Report **R-24-07** December 2024



# Baseline Forsmark – Geology

# Updating of existing site descriptive models

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ISSN 1402-3091 SKB R-24-07 ID 2044064 December 2024

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This report is published on www.skb.se

# Abstract

In the near future, the Swedish Nuclear Fuel and Waste Management Company (SKB) intends to launch two repository projects at the Forsmark site in northern Uppland, a deep geological repository (DGR) for spent nuclear fuel (HLW) and an expansion of the existing final repository for low- and intermediate-level waste (LMLW, SFR). Before commencing surface contract works and underground construction, SKB has compiled an integrated description of the current natural conditions of the geosphere and biosphere at Forsmark, known as the Baseline Forsmark. This description is primarily based on extensive site descriptive models (SDM) developed over a decade ago, supplemented by additional information and insights from subsequent investigation campaigns.

This report outlines the geological baseline conditions in the Forsmark area, aiming to provide a foundation for baseline modelling in other geoscientific disciplines and for detailed repository design. The report focuses on the updates of the deterministic geological models for SDM-Site and SDM-PSU that was carried out using data obtained after 2010. It also presents the fundamental concepts and assumptions for modelling, along with condensed descriptions of the geometric models of Baseline Forsmark. Additionally, the report addresses sources of uncertainties and their potential magnitudes, offering recommendations for downstream users.

Although the geological models of Baseline Forsmark are based on the established structural concepts of the original site descriptive models and follow similar modelling methodologies, there has been a progressive refinement of both concepts and models to meet the needs of downstream users. The major components of the model changes and additions up to the release of Baseline Forsmark include:

- All modelled deformation zones of SDM-Site and SDM-PSU has been merged into a single master version, named DMS (*Deterministically Modelled Structures*) Forsmark, encompassing all deterministically modelled deformation zones regardless of size.
- The DMS version has been expanded beyond the SDM-Site regional volume to cover the extent of the future sub-catchment area at Forsmark site.
- The spatial understanding of sheet joints has gradually improved, enabling very localised deterministic modelling of individual sheet joints and further subdivision of the shallow fracture domain FFM02 of SDM-Site, based on a marked contrast in the occurrence of sheet joints with observable apertures.
- Local revision of deformation zone geometries of the DMS have been in two areas: near the planned accesses and operational area of the repository for spent nuclear fuel, and within the volume of the planned extension of the SFR facility.
- The truncation pattern of deformation zones located northeast of the SFR facility has been reassessed to eliminate artificial blind ends of previously modelled zones of SDM-PSU.

An appendix of the report provides an extensive update of the property tables for deformation zones included in the site descriptive models, along with property tables for 14 new deformation zones. In addition to previously published descriptions, these property tables offer revised presentations of fracture characteristics and extended confidence estimates, in line with the proposed approach of Hermanson and Petersson (2022).

# Sammanfattning

Inom kort avser Svensk Kärnbränslehantering (SKB) att påbörja byggnationen av två förvarsprojekt i området kring Forsmark i norra Uppland, ett djupt geologiskt förvar (DGR) för använt kärnbränsle (HLW) och en utbyggnad av befintligt slutförvar för låg- och medelaktivt avfall (LMLW, SFR). Innan mer omfattande entreprenadarbeten påbörjas har SKB låtit sammanställa en integrerad beskrivning av de nuvarande naturförhållandena för geosfären och biosfären i Forsmark, vilken benämns Baseline Forsmark. Denna beskrivning är främst baserad på omfattande platsbeskrivande modeller (SDM) utvecklade för över ett decennium sedan, som sedan kompletterats med ytterligare information och insikter från efterföljande underökningskampanjer.

Denna rapport beskriver de geologiska baseline-förhållandena i Forsmarksområdet, i syfte att ge underlag för baseline-modellering inom andra geovetenskapliga discipliner och för detaljprojektering. Rapporten fokuserar i huvudsak på uppdateringen av de deterministiska geologiska modellerna för SDM-Site och SDM-PSU som gjorts baserat på data som erhållits efter 2010. Den presenterar också de grundläggande koncepten och antagandena för modellering, tillsammans med översiktliga beskrivningar av de geometriska modellerna i Baseline Forsmark. Dessutom tar rapporten upp källor till osäkerheter, deras potentiella omfattning, och ger rekommendationer för avnämare.

Även om de geologiska modellerna i Baseline Forsmark i grunden är baserade på etablerade strukturella koncept som tillämpats i de ursprungliga platsbeskrivande modellerna och följer liknande modelleringsmetodik, har det skett en progressiv förfining av både koncept och modeller för att möta behoven hos avnämare. De huvudsakliga ändringarna och tilläggen i modellerna fram till Baseline Forsmark inkluderar följande:

- Alla modellerade deformationszoner i SDM-Site och SDM-PSU har slagits samman till en samlad modellversion, kallad DMS (*Deterministically Modelled Structures*) Forsmark, som omfattar alla deterministiskt modellerade deformationszoner oavsett storlek.
- DMS har utökats bortom den regionala volymen för SDM-Site för att täcka hela det framtida delavrinningsområdet för Forsmarksområdet.
- Kunskapen kring bankningssprickor har gradvis förbättrats, vilket möjliggjort mycket lokal, deterministisk modellering av individuella bankningssprickor, samt en uppdelning av den grunda sprickdomänen FFM02 i SDM-Site, baserat på kontraster i förekomsten av bankningssprickor med observerbar apertur.
- Lokal revidering av deformationszonens geometrier i DMS har gjorts i två områden: nära de planerade tillfarterna och driftområdet till slutförvaret för använt kärnbränsle, och inom volymen för den planerade utbyggnaden av SFR.
- Trunkeringsmönstret för deformationszoner nordost om SFR har omprövats för att eliminera artificiella slut för tidigare modellerade zoner i SDM-PSU.

En bilaga till rapporten ger en omfattande uppdatering av egenskapstabellerna för de deformationszoner som ingår i de platsbeskrivande modellerna, tillsammans med egenskapstabeller för 14 nya deformationszoner. Utöver tidigare publicerade beskrivningar ger dessa egenskapstabeller reviderade presentationer av sprickegenskaper och utökade konfidensbeskrivningar, i linje med föreslagen metodik i Hermanson och Petersson (2022).

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# 1 Introduction

#### 1.1 Background

In 2011, SKB applied for a permit to build a deep geological repository (DGR) for spent nuclear fuel (HLW) at the Forsmark site. After review of the application by the Swedish Radiation Safety Authority (SSM), the Swedish Government approved the application in January 2022. In 2014, SKB submitted a license application to expand the existing final repository for low- and intermediate-level waste (LMLW, SFR) in Forsmark to also include disposal of waste from decommissioning of Swedish nuclear facilities. The Swedish Government granted permit for the expansion in December 2021.

The applications have been preceded by extensive site characterisation from several years of surfacebased investigations and the use of a wealth of materials from the construction of both the nuclear power plants and the SFR facility. An integrating component in the characterisation work within the repository projects was the development of site descriptive models (SDM) that constitute descriptions of the site and its regional setting. The models address the current state of knowledge regarding the geosphere and the biosphere as well as the ongoing natural processes that affect their long-term evolution. The models associated with the two repository projects are referred to as SDM-Site (for the repository for spent nuclear fuel; SKB 2008a) and SDM-PSU (for SFR; SKB 2013). The overall strategy of the site descriptive modelling has been to develop discipline-specific models through interpretation and analyses of quality-assured primary data and to integrate these models into a unified site description. In this context, the geological models are fundamental components that provide the geometrical framework and geological basis for all discipline-specific modelling.

Since the compilation of the site descriptive models more than a decade ago, new data have become available from several investigation campaigns, while there has been a progressive refinement of geological concepts and models to meet the needs of downstream users. In 2017, all modelled deformation zones of the two site descriptive models were merged into one master version to include all deterministically modelled deformation zones regardless of their size. Three years later, the master model version was expanded to cover the future sub-catchment area at Forsmark site. In addition, the spatial understanding of sheet joints has gradually improved over time to allow local modelling of individual sheet joints and a further subdivision of the fracture domain model of SDM-Site.

The updated geological models described herein constitute elements of a baseline model, developed to describe the integrated understanding of geology, rock mechanics, hydrogeology, hydrogeochemistry, bedrock transport properties, and the surface system at the Forsmark site, prior to the construction of the two repositories (HLW and LMLW). The Baseline Forsmark model will serve as a starting point for future versions of the site descriptions, developed from a growing amount of subsurface data that will be acquired during the construction of the two repositories at Forsmark. The baseline modelling includes all available data in the SKB databases Sicada and SDE up to and including December 2023.

### 1.2 Scope and objective

The original purpose of the Baseline Forsmark was to provide a compilation of the current natural conditions at the site prior to the expansion of the SFR facility and the construction of the planned repository for spent nuclear fuel; a compilation that makes use of the knowledge and understanding described in previous site descriptive models, along with insights earned during the following investigation campaigns. The task was later extended to establish a basis that fulfils the needs for the safety assessment hydro-SÄK. Furthermore, the work serves as useful preparatory work for the coming update of the present site descriptive models SDM-Site and SDM-PSU into SDM Forsmark 2026. The specific aims of the geological work of Baseline Forsmark are as follows:

- To provide an updated interpretation of the geological conditions based on information acquired after the previous SDM reports to be used by all other geoscientific disciplines.
- Evaluation of established concepts and existing geometric models in the light of new data that emerged after 2010 for the Forsmark site.

- Updating of the deterministic models for geology of SDM-Site and SDM-PSU by considering new data obtained after 2010. A basic approach has been that all geometric revision requires new data; geometries solely based on older site investigation data remain fixed.
- Description of the sources of uncertainties and their potential magnitudes, with recommendations to downstream users.
- Application of the newly developed methodology for deterministic modelling by Hermanson and Petersson (2022) wherever possible. Since data from underground construction have not yet been acquired, application has been largely limited to aspects concerning confidence estimates and the introduction of object-based modelling.

The focus of the Baseline Forsmark report for geology is the model updates carried out after completion of Forsmark version 2.3 (Stephens and Simeonov 2015) and SFR version 1.0 (Curtis et al. 2011). The report also includes presentations of the fundamental concepts and assumptions for modelling, as well as condensed descriptions of the geometric models of Baseline Forsmark version 1.0. For details regarding the development of previous model versions and related analyses of underlying data, the reader is referred to Stephens et al. (2007, 2008b), Curits et al. (2011) and Stephens and Simeonov (2015).

## 1.3 Geological framework

Forsmark is situated in northern Uppland, in a part of the Fennoscandian Shield that was formed between 1.89 and 1.85 billion years ago during the Svecokarelian orogeny (Stephens et al. 2009). The bedrock in this orogen is dominated by Precambrian igneous rocks that were variably affected by complex ductile strain and metamorphism at predominantly mid-crustal levels. Structurally, the Forsmark area is characterised by large-scale, ductile high-strain belts, striking WNW–ESE or NW–SE and showing evidence of a dextral strike-slip component of movement (Stephens et al. 2008a). These belts define an anastomosing network, enveloping less deformed tectonic lenses (Figure 1-1). The volume proposed as the repository for spent nuclear fuel is located in the northwesternmost part of one of these lenses, the so-called Forsmark tectonic lens, where gneissic granite that formed at 1.87 Ga (Hermansson et al. 2008), pegmatite and amphibolite comprise the dominant rock types.

The final repository for low- and intermediate-level radioactive waste (SFR) is situated within the high-strain belt that forms the northeastern margin to the Forsmark tectonic lens (see Figure 1-1). The rock types and temporal relationship in the rock volume surrounding SFR are virtually identical to that of the rocks in the tectonic lens, but they are generally affected by a much higher degree of ductile strain. The predominant rock components in the SFR area consist of a heterogeneous package of mainly felsic to intermediate metavolcanic rocks intercalated with gneissic granite intruded by younger igneous suites comprising granite, pegmatitic granite and pegmatite.

The high-strain belts surrounding the tectonic lens show a distinct tectonic foliation, defined by intense planar grain-shape fabric or banding, dipping sub-vertically or steeply to the southwest; a mineral stretching lineation plunging moderately to the southeast is also present. Inside the tectonic lens, the tectonic foliation is less intense, and the fabric is dominated by the mineral stretching lineation and folds that plunge moderately to shallow towards the southeast.

Thus, the framework of the tectonic lens was initially developed under amphibolite-facies metamorphic conditions, at 1.87–1.86 Ga (Hermansson et al., 2008), whereas the timing of the later folding is less tightly constrained. Low-grade ductile deformation under dextral transpression continued within the shear belts to around 1.8 Ga, with the development of discrete, WNW–ESE to NW–SE striking deformation zones, such as the regionally important Singö, Örskär, Eckarfjärden and Forsmark shear zones. Ductile-brittle or brittle deformation prevailed at 1.8–1.7 Ga, with the subsequent establishment of sub-greenschist metamorphic conditions and sole brittle deformation at around 1.7 Ga (Söderlund et al. 2009).

As the effects of orogenic activity waned and shifted to a progressively more far-field realm during and after the Mesoproterozoic, the effects of loading and unloading, involving deposition and denudation of sedimentary or glacial material, started to play a more significant role. Far-field effects of the 1.1–0.9 Ga Sveconorwegian orogeny in southwestern Sweden have been recognised in the bedrock at Forsmark, both by brittle reactivation (Sandström and Tullborg 2007) and the development of a foreland sedimentary basin that covered central Sweden (Larsson et al. 1999). Following erosion

established a sub-Cambrian peneplain that has been identified over a large part of southern Sweden, including the Forsmark area (Lidmar-Bergström 1996). The peneplain represents a relatively flat topographic surface with a gentle dip towards the east. The deposition of a sedimentary sequence, including oil-shales, covered the peneplain during the Palaeozoic and were probably not removed until after the Early Jurassic (Cederbom 2001; Larson et al. 1999; Söderlund et al. 2008). This resulted in burial and sedimentary loading followed by uplift and re-exhumation of the ancient sub-Cambrian unconformity.

Several cycles of glacial loading, removal of ice sheets and subsequent renewed exhumation of the same unconformity, with deposition of glacial and post-glacial sediment prevailed during the ongoing Quaternary (Sohlenius and Hedenström 2008). Indeed, the current ground surface, the maximum height of which in the Forsmark area is approximately +25 m above current sea level, corresponds more or less to the sub-Cambrian unconformity. Plate motion related to mid-Atlantic ridge push, in combination with glacial isostatic rebound following removal of the latest Weichselian ice sheet and crustal unloading, are the two geological processes that constrain current strain conditions in the crust in northern Europe (Muir Wood 1993, 1995).

The orientation and magnitude of the current stress field at Forsmark have been constrained by indirect observations of drill core and borehole damage (core disking and borehole breakouts, respectively) along with stress measurements (Glamheden et al. 2007; Martin 2007). Both horizontal stress components are larger than the vertical stress component and the bedrock at the proposed repository depth is currently affected by a thrust regime with horizontal compression in a NW–SE direction.



*Figure 1-1.* Tectonic lens at Forsmark and areas affected by strong ductile deformation along the coastal deformation belt in northern Uppland. Modified after Stephens et al. (2007).

# 2 Geological models and model volumes of Baseline Forsmark

#### 2.1 Model overview

The integrated geological understanding of the Forsmark site is manifested by a series of deterministic models. Each model has a specific volume populated by a selection of three-dimensional geometries of geological objects with supplemental descriptions of their geological nature in property tables. Object types and volumes of all deterministic geological models included in Baseline Forsmark version 1.0 are listed in Table 2-1. The areal coverage of the models is presented in Figure 2-1.

The geological models of Baseline Forsmark are stored in the SKB model database SKBMod at the location *Forsmark/kärnbränsleförvaret/Projekt Kärnbränsleförvaret/Berggrundsgeologi/3D Modell*.

 Table 2-1. Summary of all deterministic geological models included in Baseline Forsmark

 version 1.0.

Model	Object types	Volume
DMS	Deformation zones + deterministically modelled sheet joints	Future sub-catchment area + SDM-site regional model volume/area
RFM reg	Rock domains	SDM-Site regional model volume/area
RFM loc	Rock domains	SDM-Site local model volume/area
RFR loc	Rock domains	SDM-PSU local model volume/area
FFM	Fracture domains	SDM-Site local model volume/area

The current Baseline models rely heavily on the site descriptive models of SDM-Site (SKB 2008a) and SDM-PSU (2013), which were developed in several stages during the period 2002 to 2011. The geological basis for SDM-Site was models of deformation zones, rock domains and fracture domains of the Forsmark stage 2.2 modelling (Olofsson et al. 2007, Stephens et al. 2007), whereas geological models of the project SDM-PSU included deformation zones and rock domains presented by Curtis et al. (2011). The Forsmark stage 2.2 deterministic models for deformation zones has subsequently been updated to model version 2.3 (Stephens and Simeonov 2015), after taking account of the SDM-PSU deformation zone model of regional extent. Model version 2.3 was later revised on the basis of data from preparatory investigations conducted in shallow boreholes drilled in proximity of the planned accesses and operational area of the final repository (2011–2012). The revision included a minor deformation zone and slight geometrical adjustments of a few deformation zones (see Follin 2019).

Geometrical geological models were developed for two different volumes, termed regional and local, for each of the site descriptive models (i.e. SDM-Site and SDM-PSU). The model volumes have guided the selection of a minimum surface length for steeply dipping deformation zones. Thus, for SDM-Site, only deformation zones with inferred lengths at the ground surface of 3000 m or more are included in the regional volume model. For the local volume model of SDM-Site, limit was set at structures with trace lengths at the ground surface at 1000 m or more. Where the available high-resolution, surface magnetic data permitted, some minor zones that are shorter than 1000 m have been modelled deterministically and assigned properties, but these were not included in the local geometrical model of SDM-Site. Since sizes of gently dipping zones are difficult to estimate, and since these zones are significant from a hydrogeological point of view, it was decided to include all the identified gently dipping zones in both the local and regional models of SDM-Site. The resolution of the SDM-PSU regional model corresponds to the local model of SDM-Site, containing all modelled deformation zones with surface trace lengths of  $\geq 1000$  m or more, whereas the local SDM-PSU model contains all inferred deformation zones with trace lengths of  $\geq 300$  m or more.

The areal extent of the regional and local volumes described above is illustrated in Figure 2-1 and the geological models developed for each volume are listed in Table 2-2 along with the minimum trace length at the ground surface for steeply dipping deformation zones.



*Figure 2-1.* The areal coverage of the deterministic geological models included in Baseline Forsmark relative to the models of SDM-Site and SDM-PSU (see Table 2-1 and Table 2-2 for further details).

or obm-one and obm-r oo along with the bounding size for sleeping depining deforma		
Model and object types	Volumes/Areas	Trace length of deformation zones
SDM-Site		
Deformation zones	Regional and local	$\geq$ 3000 and $\geq$ 1000 m, respectively
Rock domains	Regional and local	-

Table 2-2. Volumes and object types populating the various deterministic geological model	S
of SDM-Site and SDM-PSU along with the bounding size for steeply dipping deformation zo	nes.

Rock domains	Regional and local	-
Fracture domains	Local	-
SDM-PSU		
Deformation zones	Regional and local	$\geq$ 1000 and $\geq$ 300 m, respectively
Rock domains	Local	-

# 2.2 DMS Baseline Forsmark

At the request of downstream users and especially the hydrogeologists, a master version of the deformation zone model has been developed by merging the individual deformation models listed in Table 2-3. This master version is named DMS (*Deterministically Modelled Structures*) and includes all deterministically modelled deformation zones in the Forsmark area, regardless of size. To attain consistency of the basic geometrical modelling principles, the merging entailed adjustments with regards to termination depth, extent, and thickness for some deformation zones, especially those of SDM-PSU.

The major changes and additions to the DMS model up to the release of Baseline Forsmark version 1.0 can be summarised as follows with further details in Chapter 5:

- Adjusted object geometries as an effect of the upgrading of SKB's modelling tool for geological visualization and modelling, RVS (*Rock Visualization System*).
- Revision of deformation zone geometries based on borehole data acquired from the preparatory investigations conducted after 2010 in proximity of the planned accesses and operational area of the final repository and the volume of the planned extension of the SFR facility.
- Addition of deterministically modelled sheet joints in shallow bedrock volumes with closely spaced boreholes.
- Extension and addition of regional deformation zones outside the SDM-Site regional volume to cover the extent of the future sub-catchment area.
- Reassessment of the truncation pattern of deformation zones northeast of the SFR facility to eliminate artificial blind ends of previously modelled zones.
- Introduction of confidence estimates for deformation zones in accordance with the proposed approach of Hermanson and Petersson (2022).

Baseline Forsmark version 1.0 have been preceded by three releases of the DMS model (Table 2-4); all three releases are strictly geometrical updates, without associated revision of property tables. Each release version includes two types of visualisations:

- Surface (hydrology) shows the origin surface of all structures.
- Volume (geology) shows the bounding surfaces of all structures.

An additional, interim delivery of geometries for deterministically modelled sheet joints was produced to support the DFN modelling group (see Table 2-4).

ID <sup>1</sup>	Model	Bounding size	Reference report
1492880	DZ modell regional PLU v2.3 Forsmark	≥ 3000 m	Stephens and Simeonov (2015)
1492438	DZ modell lokal PLU v2.3 Forsmark	≥1000 m	Stephens and Simeonov (2015)
1492088	Regional deformation zone model v.22 PLU v.22 Forsmark <sup>2</sup>	< 1000 m	Stephens et al. (2007)
2004361	489019_FPS_Forsmark	< 1000 m	Follin (2019)
1579543	SFR REG DZ v 1.0	≥ 1 000 m	Curtis et al. (2011)
1579539	SFR LOC DZ v 1.0	≥ 300 m	Curtis et al. (2011)

Table 2-3. Deformation zone models integrated into DMS Forsmark.

<sup>1</sup> ID in SKBMod.

<sup>2</sup> Minor deformation zones.

DMS version	Details
2018_1	Geometries (obj-exports) and notes (SKBMod 2047742)
2018_2	Geometries RVS v6 (SKBMod 1705366), geometries as stl- and dgn-exports, summary tables and notes (SKBMod 2047745)
Deterministic sheet joints	Geometries as stl-exports (SKBMod 2047747)
2020_1	Geometries as dgn-exports (SKBMod 1896141, 1896142) and summary tables (SKBMod 1896144)

Table 2-4. DMS model versions preceding the release of DMS Baseline Forsmark v1.0.

## 2.3 RFM and RFR Baseline Forsmark

Baseline Forsmark comprises all three rock domain models developed during SDM-Site and SDM-PSU (see Table 2-5). Details on modelling methodology, assumptions and geological character of these models are presented in Stephens et al. (2007) and Curtis et al. (2011).

The rock domain models form a nestled system where the local volumes are sub-models within the regional model volume. Thus, rock domain boundaries of the regional model volume have identical geometrical representations in the local volumes. The difference between the volumes lies in a division of some regionally defined domains in the local volumes to support the work of downstream users and repository design. The division and equivalent naming of the domains are summarised in Table 2-6.

Table 2-5. Versions of the rock domain model that precede the release of RFM and RFR Baseline Forsmark v1.0.

Baseline Forsmark v 1.0	Preceding model	Project
RFM regional	RD modell regional PLU v.2.3, Forsmark (SKBMod 1492880)	SDM-Site
RFM local	RD modell lokal PLU v.2.3, Forsmark (SKBMod 1492607)	SDM-Site
RFR local	SFR_RD_LOC-v1.0_SWEREF99 (SKBmod 1989500)	SDM-PSU

Table 2-6. All regional rock domains which are divided and/or renamed in the local volumes
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Rock domain in regional volume	Corresponding rock domain(s) in local volume
RFM029R	RFM local – RFM029 and RFM045
RFM021	RFR local – RFR01, RFR02 and RFR03
RFM033	RFR local – RFR04

None of the data acquired after the completion of SDM-Site and SDM-PSU have entailed revision of the rock domain geometry from a geological point of view. However, with the release of Baseline Forsmark version 1.0 virtually all domains have been subjected to slight geometrical adjustments. The changes can be summarized as follows with further details in Chapter 6:

- Modelled surfaces were optimised using as sparse grid as possible in order to decrease the workload for the solid modelling engine in the RVS modelling tool.
- To avoid problems along the edges of the modelling volume, modelled surfaces were extrapolated to ensure full intersection.
- Adjustment of the intersections between domain boundaries and the inferred top surface (i.e. the bedrock surface) to increase the agreement with the rock type distribution of the bedrock map on the ground surface.

# 2.4 FFM Baseline Forsmark

The basis for FFM Baseline Forsmark is the fracture domains of SDM-Site, developed during the modelling stage 2.2. Details on modelling methodology, assumptions and geological character of this model are presented in Olofsson et al. (2007) and Stephens et al. (2007). Up to the release of the FFM Baseline Forsmark version 1.0 there has been one intermediate update of the fracture domain model, which included the following major changes:

- Representation of deformation zones as single, infinitely thin surfaces ("origin surfaces") instead of volumes defined by the bounding zone surfaces.
- Division of the rather shallow FFM02 into two subdomains, based on a marked contrast in the occurrence of sub-horizontal fractures (i.e. sheet joints) with observable aperture.

Additional changes introduced by the release of FFM Baseline Forsmark version 1.0 comprise:

- Changed object geometries as an effect of the upgrading of the RVS modelling software.
- Revision of the boundary between FFM01 and FFM02, based on borehole data acquired from the preparatory investigations conducted after 2010 in proximity of the planned accesses and operational area of the final repository.

Details regarding the various changes made to the fracture domain model posterior to the SDM-Site version are presented in Chapter 7. The two versions of the fracture domain model that precede the release of FFM Baseline Forsmark version 1.0 are listed in Table 2-7.

Table 2-7. Versions of the fracture domain model that precede the release of FFM Baseline Forsmark v1.0.

Fracture domain model	Details	
Fracure domain FM 2.3	The SDM-Site stage 2.2 in RVS v6 format (SKBMod 1705617)	
FD_2.3_separated FFM02_SWEREF99	Geometries – stl-exports (SKBMod 2047747) and dgn-export (SKBMod 1898920)	

### 2.5 Model volumes

154392

6697772

Table 2-8 presents the coordinates that define the modelling volumes inherited from SDM-Site and SDM-PSU after conversion to SWEREF 99 1800 and RH2000. Motivation for the selection of these volumes is provided by SKB (2006, p. 23–24) and Curtis et al. (2011, p. 18–19).

The volume of DMS Baseline Forsmark version 1.0 has been defined laterally by combining the SDM-site regional model area with the extent of the future sub-catchment area (cf. Earon 2022), including a peripheral buffer of 200 m around the sub-catchment area (Figure 2-2). The vertical extent of the volume is identical to that of the SDM-site regional model volume with an elevation from +100 down to -2100 (RH2000).

Volume SDM-Site regional SDM-Site local SDM-PSU local Elevation\* +100 to -2100 +100 to -1 100 +100 to -300 Coordinates Easting Northing Easting Northing Easting Northing 165346 6708020 160542 6701092 162150 6700602 North 172861 6699987 163121 6698333 162738 6699974 East South 161 907 6689740 160783 6696148 162212 6699482

158 204

 Table 2-8. Coordinates and elevations defining relevant SDM-Site and SDM-PSU model volumes.

 SWEREF 99 1800 and RH2000.

\* Note that there is a 18 cm difference between elevations expressed in RH2000 and RHB70 used in SDM-Site and SDM-PSU.

6698906

161 625

6700110

West



*Figure 2-2. Extent of the future sub-catchment area of Forsmark and SDM-Site regional model area relative to the DMS Baseline Forsmark.* 

# 2.6 Bedrock surface

The bedrock surface used as model top surface is identical in all deterministic geological models of Baseline Forsmark version 1.0. It is based on the regolith depth model presented in Petrone et al. (2020). The surface denoted SDEADM.SVE\_FM\_GEO\_20235 covers the defined sub-catchment area and corresponds to the lower limit of the till layer. The extraction method is presented by Earon (2022).

The surface that covers the sub-catchment area consists of a 20 m grid with a 20 m vertical point reduction introduced by RVS. To achieve surface coverage in the parts of the DMS model that are outside the sub-catchment area (i.e. the Forsmark regional model area protruding the sub-catchment area and a peripheral buffer of 200 m; Figure 2-2), a linear interpolation to elevation = 0 (RH2000) along the surface boundaries (Easting = 152940 and 178060, Northing = 6687940 and 6713060) has been applied. The result of the approach is illustrated in Figure 2-3.

The consequence of the reduction is that the surface mesh is disconnected from the original fix points along boreholes. Thus, the surface can deviate from the registered rock surface along a borehole by several meters. Another consequence is that some of the modelled/visualised sheet joints occur above the surface mesh, especially along the inlet channel to the nuclear power station.

All deformation zones and domains inferred to reach the ground surface have been truncated at the bedrock top surface. Since some modelled/visualised sheet joints occur above the modelled mesh, it was decided to leave all sheet joints untruncated.



Figure 2-3. The model top boundary used in all deterministic models of Baseline Forsmark version 1.0. The surface is based on the regolith depth model of Petrone et al. (2020) with a linear interpolation to elevation = 0 along the surface boundaries to achieve surface coverage in the DMS model area outside the sub-catchment area, where the latter is marked by a red line.

# 2.7 Bedrock block model

With the purpose to identify and characterise Phanerozoic faulting of the Precambrian basement, Grigull et al. (2019) have developed a bedrock block model for a  $112 \times 112$  km area which covers considerable parts of Uppland and Gästrikland, along with the future sub-catchment area of Forsmark (Figure 2-4). The modelling approach is an improvement of the methodology developed by Beckholmen and Tirén (2010a, b) for topographical data. The method builds on the assumption that the original relative relief of the sub-Cambrian peneplain in the model area was less than 20 m (Rudberg 1960, Olvmo 2010).

Based on a digital elevation model (DEM) achieved by combining LiDAR and bathymetric data, block boundaries were defined by interpretation of lineaments along topographic lows. Subtraction of the sedimentary cover from the DEM, yielded a bedrock elevation model that corresponds approximately to the faulted and glacially eroded sub-Cambrian peneplain. The topographic gradient was then removed from the bedrock elevation model and maximum elevation values were calculated for each rock block as indications of relative movement across the block boundaries. Further details are presented by Grigull et al. (2019).

The ArcGIS model is archived in SKBMod at the location Forsmark/kärnbränsleförvaret/Projekt Kärnbränsleförvaret/Berggrundsgeologi/2D Modell.



*Figure 2-4.* Rock block model (blue lines) of Grigull et al. (2019) relative to the DMS model area. Background map is the combined DEM, which represents the relief of both the bedrock surface and the Quaternary cover sediments.

# 3 Data acquired after 2010

#### 3.1 Boreholes

The most recent geological models of SDM-Site, with the subsequent update of the deformation zone model to version 2.3, were developed by using data from ca 18000 m of cored boreholes with a maximum depth of ca 1000 m, and complementary data from ca 6500 m of percussion drilled boreholes down to ca 300 m depth. References to acquisition data reports and analysis of these data can be found in the series of geological modelling reports produced during the site descriptive modelling (SKB 2004, 2005, Olofsson et al. 2007, Stephens et al. 2007, 2008b, Stephens and Simeonov 2015). The borehole data used to develop the geological models of SDM-PSU comprise ca 7000 m of cored boreholes and ca 600 m of percussion drilled boreholes from the rock mass in proximity to the existing SFR facility and the volume for the planned SFR extension. Details regarding these data are provided by Curtis et al. (2011).

After conclusion of the investigations for SDM-Site and SDM-PSU, SKB has undertaken four separate drilling campaigns at Forsmark. Data from these drillings have provided essential input to the geological modelling work of Baseline Forsmark. The drilling campaigns can be summarised as follows:

- 2011–2012. Preparatory investigations of the shallow bedrock in proximity of the planned accesses and operational area of the final repository in the Söderviken area. The drilling activities included eleven cored boreholes, KFM13–KFM23, and three percussion-drilled boreholes, HFM39–HFM41, with individual lengths between 60 and 150 m. An evaluation of the borehole data focusing on the comparison with data from other boreholes located farther from the planned accesses are presented by Follin (2019).
- 2016. A ca 550 m long, subvertical borehole, KFM24, was drilled near the potential skip shaft of the planned repository with the main purpose to validate current geoscientific models and provide data for the access volume at depth. KFM24 is designed as a telescopic borehole, with ca 36 m of percussion drilling followed by core drilling to the full borehole length.
- 2018. The drilling included three cored boreholes, KFM25–KFM27, in proximity to the nuclear power plant (reactor Forsmark 1), two percussion drilled boreholes, HFM42 and HFM43, close to the planned accesses of the final repository and four percussion drilled boreholes, HFM44–HFM47, in the Stora Asphällan area (see Figure 3-2). All nine boreholes are steeply inclined (> 75°) with individual lengths of ca 100 m for the cored boreholes and ca 200 for the percussion drilled boreholes. KFM25–KFM27 were drilled with the aim to monitor the ground water level and the potential for subsidence along sub-horizontal fractures (e.g. sheet joints) with aperture and sediment fillings, whereas HFM42 was drilled for seismic monitoring and HFM43–HFM47 were drilled to perform hydraulic testing, including flow logging and water sampling.
- 2020. Four cored boreholes, KFR117–KFR120, and one telescopic borehole, KFR121, were drilled from the pier close to the SFR facility with an aim to investigate the possible existence of sub-horizontal fractures of hydraulic importance in the volume for the planned SFR extension. KFR117–KFR120 are steeply inclined (> 80°) with individual lengths of ca 176 m, whereas KFR121 has an inclination of ca 52° at the starting point with percussion drilling to ca 40 m length followed by core drilling to ca 362 m length.

Location of drill sites and borehole projection at the ground surface relative to the coastline, the Forsmark nuclear power plant and the SFR facility are presented in Figure 3-1 and Figure 3-2. Technical data concerning the drilling activities, including the coordinates of the drill sites, total length, length to inferred rock surface, bearing and inclination of the boreholes are presented in Appendix 1.

Data acquired from the standard SKB logging programmes of the boreholes include borehole TV-logging with the borehole image processing system BIPS (KFM13–KFM23 and HFM39–HFM41) and OP-TV (KFM24–KFM27, KFR117–KFR121 and HFM42–HFM47), geophysical logging and interpretation (KFM24 and KFR117–KFR121), hydraulic logging and geological logging of the drill cores (rock type, alteration phenomena and both ductile and brittle structures). Data from these programmes provide input to the integrated geological and geophysical single-hole interpretation discussed further in Section 4.1. Relevant data acquisition reports for the borehole investigations are listed in Appendix 2.



**Figure 3-1.** Location of the cored boreholes KFM13–KFM27, the percussion drilled boreholes HFM39–HFM43, excavated trenches AFM001392–AFM001394 and the lines LFM001020–LFM001025 for ground penetrating radar (GPR) and seismic measurements in proximity of the planned accesses and operational area of the final repository in the Söderviken area.



*Figure 3-2.* Location of the cored boreholes KFR117–KFR121 and the percussion drilled boreholes HFM44–HFM47 in the SFR area.

## 3.2 Trenches in the access area of the planned repository for spent nuclear fuel

During the subsequent preparatory investigations for the planned accesses and operational area of the final repository, SKB excavated two trenches in the Söderviken area, AFM001393 and AFM001394, to enable investigations of the regolith and the bedrock surface. Excavation of a third trench, AFM001392, had to be terminated before the bedrock surface was reached due to great regolith depths in combination with high inflow of groundwater. The locations of the trenches are presented in Figure 3-1.

The geological documentation of the two trenches can be summarised as follows:

**AFM001393:** Trenched outcrop of ca 26 m length excavated to investigate the nature of lineament MFM2168G with NNW–SSE trend. Deformation zone ZFMNNW1205B has been modelled along MFM2168G to transect this outcrop. The zone is manifested as two parallel, subvertical fault zones of 0.6–0.8 m width, separated by a 1.3 m thick slice of intact bedrock (Figure 3-3). Detailed fracture mapping of the outcrop was undertaken in accordance with the SKB method description 132.003e, "*Method description for detailed fracture mapping of rock outcrops*".



*Figure 3-3.* View towards NNW of the fault zones inferred to represent ZFMNNW1205B. Note the slice of intact bedrock between the faults. Width of view approximately 4.5 m. From Peterson et al. (2010).

**AFM001394:** Excavated to acquire information of the rock mass properties and estimate soil depth at the planned start position of the repository ramp. Two trenched outcrops, each of ca 20 m length, arranged almost perpendicular towards each other, with one branch trending NNW–SSE and the other NE–SW. The geological documentation included a detailed fracture mapping in accordance with the SKB method description 132.003e, along with a detailed documentation of minor fracture zones and possible glacial tectonics. Investigations with ground penetrating radar (GPR) revealed extensive sub-horizontal fractures. Exposure of a more than 4 m high, almost vertical bedrock surface emphasizes that local variations in bedrock topography largely exceed indications by the ground surface topography.

Data acquisition reports for the outcrops AFM001393 and AFM001394 are listed in Table 3-1.

Investigation	SKBdoc ID	Reference
Bedrock mapping	1338506	Petersson et al. (2015)
Detailed fracture mapping	1338599	Curtis et al. (2015)
Regolith mapping and GPR	1327863	Gustafsson and Hedman (2012)

Table 3-1.	acquisition	reports for	the outcrou	os AFM001393	and AFM001394.
	acquisition	reports for		J3 AI 1000 1 3 3 3	

## 3.3 Remote fracture mapping of islets and coastal outcrops

Remote fracture mapping based on photogrammetric models from drone imagery of ten islets and coastal outcrops at Forsmark and northwestern Gräsö was undertaken by Bakker et al.<sup>1</sup> during 2022–2023. The purpose of the mapping project was partly to provide input for DFN-modelling, and partly to test a new method for remote fracture mapping. The mapping was carried out using the Rock Characterisation System RoCS, a digital system developed by SKB for geological mapping of underground openings (tunnels, shafts and niches, etc.) based on photogrammetric 3D models.

<sup>&</sup>lt;sup>1</sup> Bakker A, Gåling J, Holmberg J, Andersson M. Remote fracture mapping of ten outcrops in the Forsmark archipelago using RoCS. Methodology and results. Svensk Kärnbränslehantering AB. (In prep.)

All distinguished fractures with trace lengths of  $\geq 1$  m were digitised and described in terms of orientation, confidence in dip, trace length, termination and form. None of the islets and coastal outcrops were revisited subsequent to the mapping for verification by field control.

In general, the islets and outcrops show similar patterns with two predominant orientation sets of vertical to steeply dipping fractures striking NE–SW and NW–SE<sup>1</sup>. The latter typically follows the ductile structural trend revealed by tectonic banding and rock type boundaries. In addition to the dominant sets, other potential fracture sets of various relative intensities are visible in some outcrops. Subordinate sets of E–W and N–S striking fractures are defined in two of the most peripheral outcrops, where the ductile structures strike in N–S direction<sup>1</sup>.

# 3.4 Outcrop observations in the sub-catchment area outside the regional model area

To provide geological support for the modelling of regional deformation zones within the future sub-catchment area situated outside the SDM-Site regional volume, a field survey was undertaken during 2020–2021 to examine the geological significance of lineaments interpreted by Isaksson and Johansson (2020) and characterise recognized deformation zones by structural analysis. For some outcrops of structural interest, drone photogrammetry was implemented. The survey was accomplished as a master's thesis by Bakker (2021). These data were not acquired according to the SKB QA system and were consequently not stored in the SKB database Sicada.

Where the exposure allowed, at least one outcrop was visited along each interpreted lineament; the majority are completely covered by water and regolith. In total 52 outcrops were visited, though the correspondence to deformation zones of inferred regional extent was only verified for five of the interpreted lineaments. Most of the remaining lineaments were attributed to ductile bedrock structures. Regardless of whether there are indications of significant deformation or not, a brief geological description has been compiled by Bakker (2021) for 33 of the visited outcrops.

The five verified deformation zones are found along the coast of central Gräsö and at the mainland, west of Öregrund. They are all steeply dipping and three of them strike NNW–SSE, whereas the other two strike NW–SE and E–W to ENE–WSW. All exhibit mylonitic fabric, which suggests an initial development under low-grade ductile deformational conditions with subsequent brittle reactivation.

Seven additional steeply dipping deformation zones were discovered in well-exposed coastal outcrops of central Gräsö and the Öregrund area (Figure 3-4). Despite of their proximity to the interpreted lineaments (see Figure 3-4), as a direct consequence of the predefined survey areas, there are no obvious connections, considering orientation, thickness and deformational character. Four of them strike E–W to ENE–WSW and three strike NNW–SSE. All seven are brittle deformation zones with inferred thicknesses in the range between 0.5 and 40 m. None of the geophysical or elevation data give convincing support for more extensive lateral continuations of these structures.

Outcrop locations in the southeastern part of the future sub-catchment are presented in Figure 3-4.

In early 2021, additional fieldwork was undertaken by the modelling team to investigate the geological significance of E–W trending lineaments at northern Gräsö. Geological information was acquired from almost 50 outcrops along three interpreted lineaments MFM3513, MFM3514 and MFM3518 from Isaksson and Johansson (2020) with associated splays. Notes from the fieldwork are presented in Appendix 3.

<sup>&</sup>lt;sup>1</sup> Bakker A, Gåling J, Holmberg J, Andersson M. Remote fracture mapping of ten outcrops in the Forsmark archipelago using RoCS. Methodology and results. Svensk Kärnbränslehantering AB. (In prep.)



**Figure 3-4.** Locations of outcrops visited by Bakker 2020–2021 in the south-eastern part of the DMS model area to examine the geological significance of lineaments interpreted by Isaksson and Johansson (2020). Outcrops that verify lineaments as deformation zones are coloured turquoise, whereas observations of deformation zones without obvious connection to interpreted lineaments are yellow. Outcrops where no deformation zones have been recognized are represented by black dots.

# 3.5 Refraction seismics and GPR data

A campaign to acquire seismic and GPR data was accomplished in 2011, during preparatory investigations of the uppermost part of the bedrock in the Söderviken area. GPR measurements were carried out along six parallel lines, LFM001020–LFM001025, with a total length of 1.2 km (Figure 3-1). Complementary seismic data were acquired along two of these lines, LFM001021 and LFM001023, to obtain information on the near surface conditions by refraction seismic interpretation. However, close spacing between the receivers (2 m) and sources (6 m) also allows the data to be processed as reflection seismic data. The results of the GPR and refraction seismic survey are presented by Mattsson (2013), whereas the reflection seismic interpretation is presented in a separate report by Juhlin (2016).

Both methods have previously turned out to be less efficient for the identification of deformation zones and individual fractures at Forsmark (cf. Stephens et al. 2007). Plausible explanations for this are, for example, the high proportion of sealed fractures and sealed fracture networks along several zones, their inhomogeneous character and a fractured near-surface bedrock with narrow depressions.

# 4 Evaluation and interpretation of geological and geophysical data

# 4.1 The significance and usage of geological data from different sources

# 4.1.1 Borehole data – identification of rock units and possible deformation zones

The geological mapping and the supportive geophysical data from the boreholes completed after conclusion of the investigations for SDM-Site and SDM-PSU provide the key input to the geological modelling work of Baseline Forsmark. For some issues, such as identification and modelling of sheet joints (see Section 4.3.3), data from older boreholes have also been used after renewed evaluation. The inherently restricted quality of the data from the percussion boreholes, as discussed in SKB (2005), remains. For this reason, focus in the current model is on the cored borehole data, as in earlier model versions. Data from the percussion boreholes have primarily been used as support in the deterministic modelling work. An exception is the identification and modelling of sheet joints, where input is mainly provided by borehole imagery and information from percussion and cored boreholes has therefore been treated equally.

The terminology and procedures used in the acquisition of fracture data follows those summarised in Appendix 1 of Hermanson and Petersson (2022). Revision of the mapping methodology has occurred successively during the course of the different investigation campaigns at Forsmark, where more significant changes include:

- The term "sealed fracture network" with the purpose to handle highly fractured sections of the borehole was introduced after the mapping of boreholes KFM01A, KFM02A, KFM03A and KFM03B.
- A method to measure the orientation of ductile linear fabric was introduced 2006, but systematic measurements were not available until after Forsmark stage 2.2. However, the method is afflicted with significant uncertainties and therefore all these linear borehole data have been omitted from the Baseline modelling.
- Ambiguities concerning the recognition of fracture apertures in percussion boreholes, have as a precaution entailed registration of aperture for all fractures. Consistent application of this has been made for all percussion boreholes mapped after 2010, which include HFM39–HFM47.
- The term "fault rock" was introduced based on a simplified classification of Braaten et al. (2004) with the purpose of a more consistent documentation of deformational features such as breccia, cataclasite and mylonite. So far only used in the mapping of boreholes KFR117–KFR121.

The modelling efforts of the SDM-Site accentuated the need for a more rigorous treatment of uncertainties in borehole orientation data, which involve uncertainties in the geological mapping, the geometric position of boreholes in 3D space and the orientation of the borehole images. Based on this, SKB carried out a critical review to identify potential errors and to quantify uncertainties in the orientation of geological entities in boreholes (Munier and Stigsson 2007). Important consequences of this review include:

- Omission of all fractures not visible in the borehole image from the analyses of orientation data in the modelling work.
- Revisions in orientation data due to imprecisions of the BIPS-image orientation. The work includes
  virtually all cored and percussion boreholes from the site investigations at Forsmark and was completed in two steps: 22 prioritized (cored) boreholes revised during 2006–2007 (Döse et al. 2008)
  and 38 additional boreholes (mainly percussion drilled boreholes and cored boreholes in proximity
  to SFR) revised during 2017–2018 (Samuelsson and Winell 2022). Following the revisions, all
  structural orientation data in the Sicada database were recalculated and provided with numerical
  estimates of uncertainty.

- A reassessment of the analyses carried out in the deterministic modelling of rock domains and deformation zones during Forsmark stage 2.2, based on the revised orientation data (cf. Stephens et al. 2007).
- A geometrical update of all deformation zones during the modelling of Forsmark version 2.3, based on the revised deviation measurements and the resulting adjustments made with the position of boreholes in 3D space, following the delivery of Forsmark stage 2.2 (Stephens and Simeonov 2015). This did not include the minor deformation zones of Forsmark stage 2.2 (cf. Table 2-3).

A revision to match the adjusted borehole positions that included all modelled object geometries of Baseline Forsmark version 1.0, was carried out during the required model conversions after the upgrading of the RVS modelling tool in 2019 (see Sections 5.4.3, 6.2 and 7.4). However, there are still uncertainties in the spatial position of boreholes in all three dimensions, with a general increase towards depth (Munier and Stigsson 2007). The estimated uncertainty of borehole intersections with modelled objects does not exceed ca 30 m in the horizontal plane. In most cases, the uncertainty is less than 10 m in the horizontal plane and less than 6 m in the vertical dimension. These uncertainties are approximately of the same order of magnitude as the uncertainty in the position of lineaments defined by magnetic minima using airborne magnetic data and for seismic reflectors; all these uncertainties are considered relatively minor in character (Stephens and Simeonov 2015).

None of the orientation data acquired from boreholes drilled after conclusion of the investigations for SDM-Site and SDM-PSU, have been subject to revision due to imprecisions of the borehole image orientation. The underlying arguments for this are an introduction of new routines for BIPS-logging (applied to KFM13–KFM23 and HFM39–HFM41) and, a few years later, the implementation of a new, fully automatic borehole orientation system, OP-TV (used in KFM24–KFM27, HFM42–HFM47 and KFR117–KFR121). In this context, it is emphasized that the deterministic modelling work in geology has only used the orientation of geological structures in boreholes (e.g. fractures) as a support in the correlation of a large-scale geological or geophysical feature (e.g. a low magnetic lineament at the ground surface); not to define the orientation of the modelled zones (see Section 5.3.2).

#### Single-hole interpretation – 1D-model

The geological mapping and the supportive geophysical data have provided the input to single-hole interpretations, which is a 1D-model of a single borehole, that in turn forms a key link between the sub-surface data and 3D-modelling. A description of the procedures adopted during the various stages of the single-hole interpretation work is provided by for example Stephens et al. (2007) and Curtis et al. (2011). The method updates proposed by Hermanson and Petersson (2022) have not yet been applied in practice. The results of the interpretations for the boreholes completed after 2010 are presented in four separate data reports, one for each drilling campaign:

- KFM13–KFM23 and HFM39–HFM41 (Appendix C<sup>2</sup>),
- KFM24 (Dahlin et al. 2017),
- KFM25-KFM27 and HFM42-HFM47 (Rauséus and Petersson 2020),
- KFR117-KFR121 (Winell and Samuelsson 2022).

The single-hole interpretation adopted by SKB is carried out independently for each borehole in two stages (Stage 1 and 2 in Table 4-1). During the first stage of the single-hole interpretation, rock units and possible deformation zones in each borehole are identified and described by analysis of base data and inspection of drill cores. Furthermore, the interpretation of each geological feature is assigned a level of confidence. The second stage of the single-hole interpretation work involves a more detailed description of the characteristics of the possible deformation zones that are recognised with high confidence, with a special focus on kinematic data. Necessary information to accomplish the second stage interpretation was only available for boreholes completed during the site investigations that preceded the SDM-Site (cf. Nordgulen and Saintot 2006, 2008; Saintot and Nordgulen 2007). The remaining boreholes at Forsmark, including the HFR and KFR boreholes situated in proximity to the SFR, and the boreholes completed after 2010 (KFM13–KFM27 and HFM39–HFM47), have only been

<sup>&</sup>lt;sup>2</sup> SKBdoc 1332706 ver 1.0 (Internal document, in swedish.)

subjected to the first stage of the single-hole interpretation, with identification and description of rock units and possible deformation zones. It should be noted that division into rock units was never done for boreholes KFM13–KFM23 and HFM39–HFM41.

Rock units are primarily characterized based on the composition, grain size and the inferred relative age of the dominant rock type. In some cases, rock units have been defined with guidance from, for example, the frequency of open and partly open fractures outside possible deformation zones, the degree of ductile deformation or the occurrence of the alteration referred to as albitization (see Section 4.2.2). Rock units extend over the total length in each borehole and, for this reason, include the borehole intervals where possible deformation zones have been recognised. The possible deformation zones identified at Forsmark are basically brittle in character, with subordinate low-grade ductile components along NW to WNW striking zones of more regional extent. Brittle deformation zones have been defined in the single-hole interpretation work primarily with guidance from the geological and geophysical data sets fracture frequency, rock alteration and focused resistivity. Other features, which have assisted in their identification, include the occurrence of low radar amplitude anomalies in the borehole radar data, low magnetic susceptibility and the occurrence of caliper anomalies.

Two additional varieties of the single-hole interpretation were implemented during the modelling work of SDM-Site and SDM-PSU, the extended single-hole interpretation (ESHI) and the simplified singlehole interpretation. The ESHI was introduced 2006 as a reassessment of existing data and drill cores in order to identify possible additional deformation zones below the resolution threshold applied during the preceding stages of the site investigation programme. The details and outcome of the ESHI are presented by Fox and Hermanson (2006). Data for these new minor zones, as well as some adjustments that emerged at the stage 2.2 modelling work to the boundaries of possible deformation zones identified in the original single-hole interpretation, are both stored in the Sicada database under a separate activity identification number, GE302. The simplified single-hole interpretation was introduced during the modelling that preceded SDM-PSU, with the purpose to enable incorporation of relevant information from older boreholes, completed during the construction of SFR, in the modelling work. This data deficiency prevented full application of the established process for single-hole interpretation, and the identification of possible deformation zones and rock units was based on direct visual inspection of the drill cores, rock code translations and the lithological overview mapping. Further details are given in Petersson et al. (2011) and results of the simplified interpretation is stored in the Sicada database under a separate activity identification number, GE299.

All available data from single-hole interpretations of boreholes at Forsmark have been of equal importance in the reappraisal process. A summary of the available data types from single-hole interpretations, which were the key components of the current model version, is presented in Table 4-1.

Type of interpretation for each borehole	Stage 1	Stage 2
Extended single-hole interpretation (GE302)		
KFM01A–KFM01D, KFM02A, KFM02B, KFM03A, KFM03B, KFM04A, KFM05A, KFM06A–KFM06C, KFM07A–KFM07C, KFM08A–KFM08C, KFM09A, KFM09B, KFM10A	х	Х
HFM01–HFM32, HFM38	Х	-
Single-hole interpretation (GE300)		
KFM08D, KFM11A, KFM12A	Х	Х
HFM33–HFM37, HFM39–HFM41*, HFM42–HFM47, HFR101, HFR102, HFR105, HFR106, KFM13–KFM23*, KFM24–KFM27, KFR101, KFR102A, KFR102B, KFR103–KFR106, KFR117–KFR121	Х	-
Simplified single-hole interpretation (GE299)		
KFR01–KFR05, KFR08–KFR14, KFR19, KFR20, KFR27, KFR31, KFR32, KFR34–KFR38, KFR51, KFR52, KFR54, KFR55, KFR57, KFR61–KFR72, KFR89, KFR7A–KFR7C	Х	_

Table 4-1. Available data types from single-hole interpretations completed at boreholes in the Forsmark area.

\* No rock units for boreholes KFM13-KFM23 and HFM39-HFM41.

The major significance of data acquired from single-hole interpretations of boreholes completed after 2010 has been a confirmation of previous concepts and existing geological models. New data that contributed to the actual revision of, and additions to, the deterministic modelling and the characterisation of modelled deformation zones are limited to the following boreholes (see Section 5.4.4 and Appendix 7):

- KFM13 and KFM21: Geometrical modelling and assignment of properties for ZFMNNW1205B, as well as revised geometry and updating of geological properties for ZFMNNW1205A.
- KFM19 and KFM24: Revised geometry and updating of geological properties for ZFMENE1061A.
- KFM23: Revised geometry and updating of geological properties for ZFMENE2120.
- KFM26, KFM27 and HFM41: Revised geometry and updating of geological properties for ZFMENE2248.
- KFR118: Updating of geological properties for ZFMENE3115.
- KFR121: Revised geometries for ZFMWNW0835 and ZFMWNW8042, as well as updating of geological properties for ZFMWNW0835, ZFMWNW3262 and ZFMWNW8042.

All deterministic modelling of sheet joints is restricted to bedrock volumes where the borehole density allows reasonable confidence in interpolation (see Section 5.3.6), which basically means in proximity to the SFR facility and the planned accesses and operational area of the final repository. The primary input to this work is information from the boreholes concluded after 2010, but also older boreholes situated at drill site 7 and 8. Data from these boreholes are also the main basis for revision of the fracture domain model, including the division of FFM02 into two subdomains (see Section 7.5) and modification of the boundary between FFM02 and FFM01 (see Section 7.6).

#### 4.1.2 Surface data from trenches and outcrops

The special studies concerned with the assembly of surface bedrock data after 2010 include:

- Bedrock mapping of trenches in the access area of the planned repository for spent nuclear fuel (Section 3.2); data provided in Sicada delivery SKBdata\_24\_020.
- Remote fracture mapping of islets and coastal outcrops (Section 3.3); data provided in Sicada delivery SKBdata\_24\_020.
- Outcrop observations in the sub-catchment area outside the regional model area (Section 3.4).

These data provide primarily support to the current site understanding by verification of established concepts and existing geological models. Only a small portion of the data have contributed directly to the deterministic modelling and the characterisation of modelled features. More specifically, data from the following trenches and outcrops have been of significance for the deformation zone modelling carried out after SDM-Site and SDM-PSU:

- AFM001393: Characterisation of lineament MFM2168G as well as modelling and assignment of properties for ZFMNNW1205B.
- ABR20002–ABR20005, ABR20007, ABR20008, ABR200020, ABR200021, ABR200034 (codes according to the thesis of Bakker 2021): Characterisation of lineament MFM3511 as well as modelling and assignment of properties for ZFMNW3511.

The outcrop observations by Bakker (2021) have proved the existence of additional deformation zones, but they are either outside the model boundary of DMS Baseline Forsmark (Figure 3-4) or inferred to be smaller than the minimum ground surface length for representation by deterministic modelling (see Section 5.4.5). However, uncertainties regarding the nature of most lineaments interpreted by Isaksson and Johansson (2020), and the field verification of those, remain and possible correlations with deformation zones cannot be ruled out solely from the work of Bakker (2021). Only three E–W trending lineaments at northern Gräsö have been rejected as surface expressions of regional deformation zones; a decision based on outcrop data from a dedicated field effort by the modelling team in early 2021 (see Section 3.4), which provide alternative explanations, including the trend of ductile bedrock structures and locally anthropogenic features such as power lines and roads.

The data from the remote fracture mapping of islets and coastal outcrops (Section 3.3) became available after the delivery of the deterministic geological models. Given the confidence level in geological data acquired by remote techniques, the application has been limited to support the evaluation of fracture statistics of borehole data.

The surface bedrock data acquired after 2010 have not provided incentive to update the bedrock geological map at the scale 1:10000 that covers the mainland and the archipelago area at the Forsmark site (Bedrock geological map, Forsmark, version 1.2); nor to extend the map further to cover remaining parts of the future sub-catchment area. None of the surface data affect the current knowledge regarding the potential for metallic mineralisations and industrial mineral deposits (cf. Lindroos et al. 2004).

# 4.2 Comparison with geological data acquired before 2011

#### 4.2.1 Rock type

The character and distribution of the rock types in the Forsmark area have previously been described in numerous reports (e.g. SKB 2005, 2008a; Stephens et al. 2005, 2007; Söderbäck 2008). Outcrop mapping during the initial site investigations enabled distinction of four major rock groups (Groups A to D), categorised based on their relative age relationships. An overview of the deformational character, composition, grain-size and relative age of individual rock types within the four groups is presented in Table 4-2. It should be emphasized that only a few of these rocks can be distinguished solely by their compositional character. Ocular distinction relies mainly on a combination of several properties, where the importance of texture and grain-size often outweigh mineralogical composition.

Table 4-2. Major groups of rock types at the Forsmark site after Stephens et al. (2005). SKB rock codes that distinguish individual rock types of each group are shown in brackets.

Rock groups	Rock types			
All rocks are affected by brittle deformation. The fractures generally cut the boundaries between the different rock types. The boundaries are predominantly not fractured.				
Rocks in Grou	p D are affected only partly by ductile deformation and metamorphism.			
Group D	<ul> <li>Fine- to medium-grained granite and aplite (111058). Pegmatitic granite and pegmatite (101061).</li> <li>Variable age relationships with respect to Group C. Occur as dykes and minor bodies that are commonly discordant and, locally, strongly discordant to ductile deformation in older rocks.</li> </ul>			
Rocks in Grou	p C are affected by penetrative ductile deformation under lower amphibolite-facies metamorphic conditions.			
Group C	• Fine- to medium-grained granodiorite, tonalite and subordinate granite (101051). Occur as lenses (boudins) and dykes in Groups A and B. Intruded after some ductile deformation in the rocks belonging to Groups A and B with weakly discordant contacts to ductile deformation in these older rocks.			
Rocks in Grou	ps A and B are affected by penetrative ductile deformation under amphibolite-facies metamorphic conditions.			
Group B	<ul> <li>Biotite-bearing granite (to granodiorite) (101057) and aplitic granite (101058), both with amphibolite (102017) as dykes and irregular inclusions. Local albitization (104) of granitic rocks.</li> <li>Tonalite to granodiorite (101054) with amphibolite (102017) enclaves. Granodiorite (101056).</li> <li>Ultramafic rock (101004). Gabbro, diorite and quartz diorite (101033).</li> </ul>			
Group A	<ul> <li>Volcanic rock (103076), calc-silicate rock (108019) and subordinate sedimentary rocks (106001).</li> <li>Iron oxide mineralization (109014) and sulphide mineralization, possibly epigenetic (109010).</li> </ul>			

Since the site investigations that preceded SDM-Site and SDM-PSU, new data on modal mineralogy and rock type distribution have been acquired from several cored boreholes. All these complementary data motivate primarily a comparison between the different data sets, but also updates regarding the mineralogical composition of the dominant rock types and quantitative estimates of the proportions of rock types in different rock domains.

The cored boreholes that succeed 2010 are located in two main areas: the northeastern part of RFM029 and the pier close to the SFR facility. Both areas were in focus of the previous site investigations, which thereby permits comparison with extensive borehole data from the immediate proximity. The assessment is therefore restricted to the rock domains RFM029, RFR01 and RFR02. The proportion

of different rock types along the cored boreholes completed after 2010 and during the site investigations is presented separately for each domains in Figure 4-1 by merging the data sets rock type (> 1 m borehole length) and rock occurrence (< 1 m borehole length) in the Sicada delivery SKBdata\_22\_065 and SKBdata\_23\_022. The working procedure has involved the removal of a short interval of rock type for each inserted rock occurrence. The following features of this compilation merit attention:

- The proportion of rock type for RFM029 show a general agreement between boreholes completed during the site investigations and after 2010, with a strong dominance of medium-grained meta-granite to granodiorite (101057). However, subordinate rock types are consistently less abundant in the borehole data acquired after 2010. This is due to variability in distribution of sub-ordinate rock types within rock domain RFM029.
- The borehole data acquired after 2010 from RFR01 show an anomalously high content of fineto medium-grained granite (111058) relative to the data from older boreholes. Virtually all of this 111058 occurs along one borehole, KFR118. The rock type is generally more abundant in RFR02, with significant occurrences along boreholes situated further north (e.g. KFR04, KFR08 and KFR37) and the rock caverns of the SFR facility. Although significant local variability is to be expected, the quantity of 111058 along KFR118 provides incentive for a future revision of the boundary between RFR01 and RFR02.
- For RFR02, the proportion of rock types in the borehole data acquired after 2010 and equivalent data from SDM-PSU differs substantially, with an increase of pegmatitic granite and pegmatite (101061) at the expanse of felsic to intermediate metavolcanics (103076) and fine- to medium-grained granite (111058). Heterogeneity in the rock type distribution has been a primary criterion for distinction of this rock domain (see Curtis et al. 2011) and local variability is to be expected.

Quantitative estimates of the proportions of rock types in different rock domains with sufficient data is presented in Section 6.4.



**Figure 4-1.** Histograms illustrating the quantitative estimates of the proportions of different rocks for the three rock domains RFM029, RFR01 and RFR02 by a separation of borehole data acquired after 2010 (new) and the previous site investigations (SDM-Site and SDM-PSU). The compilation is based on geological data from cored borehole sections (Sicada delivery SKBdata\_22\_065 and SKBdata\_23\_022). All calculations take account of rock types and rock occurrences greater than and less than 1 m in borehole length, respectively.

Modal, whole-rock geochemical and petrophysical analyses of samples of different rock types, from both outcrops at the ground surface and from boreholes, have been acquired during the site investigations that preceded the SDM-Site. In model version 1.2, these properties were determined for each rock type based on the analyses from the regional SDM-Site volume (SKB 2005). As more data became available, the estimates on the mineral composition and petrophysical properties were revised in model stage 2.2 with focus on analytical data from the local SDM-Site volume (Stephens et al. 2007; SKB 2008b). A final summary of the available data on modal mineral composition, whole-rock geochemistry, redox properties and porosity of different rock types in the Forsmark regional model volume was presented by Sandström and Stephens (2009). Corresponding analysis during the site investigations that preceded the SDM-PSU, was limited to the petrophysical parameters silicate density and magnetic susceptibility (Curtis et al. 2011); modal analysis of rock type composition was never acquired within the framework of SDM-PSU.

All modal data that have been produced after 2010 are for drill core samples of medium-grained metagranite to granodiorite (101057) and metagranodiorite (101056). One third of them has been acquired from samples affected by oxidation, which include all samples obtained in proximity to the SFR facility. After omission of these samples and duplicate analyses, twelve analyses of unaltered rock remain. In addition, there are modal data from the previous site investigation (SDM-Site) that were never used in the estimates, primarily from studies of thermal properties (Adl-Zarrabi 2004a, 2004b, 2006), but also some from the laboratory investigations of transport properties (Gustavsson 2006). These additional analyses have formed the basis for an upgrading of the mineralogical compositions presented by Stephens et al. (2007), by application of the following principles:

- Omission of samples affected by rock alteration (oxidation, albitization and quartz dissolution).
- Selection of a single analysis for thin-sections that have been analysed repeatedly (i.e. duplicate analyses).
- A minimum distance of 1 m of borehole length between individual samples; if closer, the sample with the lowest borehole length shall be omitted.
- Estimates of mineralogical compositions for 101051 and 101057 have been calculated by solely using analyses from the local SDM-Site volume. For the remaining rock types, where there are no or few samples from the local SDM-Site volume (i.e., 111058, 101061, 101058, 101056, 101054, 101033, 102017, 101004 and 103076), estimates have been calculated by using analyses from the regional model volume of SDM-Site.

A summary of the mineralogical composition of the different rock types at the Forsmark site is presented in Table 4-3. Estimates for 101057, 101056, 101054 and 103076 have been recalculated from the values presented by Stephens et al. (2007) according to the following revisions:

- 101057 addition of 14 new analyses from Adl-Zarrabi (2004a, 2004b), Gustavsson (2006) and Petersson and Eliasson (2023).
- 101056 addition of four new analyses from Adl-Zarrabi (2004b, 2006) and Petersson and Eliasson (2024).
- 101054 addition of one new analysis from Gustavsson (2006).
- 103076 two of the analyses used in the estimates presented by Stephens et al. (2007) could not be found in either Sicada or in any data report. With the addition of one new analysis from Adl-Zarrabi (2006), the current values in Table 4-3 is based on 16 instead of 17 analyses.

SKB code	No of samples	Quartz Min–max Mean ± std [vol.%]	K-feldspar Min–max Mean ± std [vol.%]	Plagioclase Min–max Mean ± std [vol.%]	Biotite* Min–max Mean ± std [vol.%]	Hornblende Min–max Mean ± std [vol.%]
Group D						
111058	5	25.4–42.8 32.4 ± 6.4	22.6–37.8 29.6 ± 5.6	22.0–46.2 33.0 ± 9.3	1.4–5.2 3.4 ± 1.4	-
101061	5	29.2–38.1 34.0 ± 3.7	19.2–45.0 31.3 ± 9.5	20.6–39.0 31.4 ± 7.4	0.7–5.2 2.2 ± 1.8	-
Group C						
101051	17	19.2–35.4 28.4 ± 4.1	1.4–32.4 11.8 ± 9.8	29.4–67.0 47.7 ± 9.8	3.4–14.4 8.4 ± 3.2	0–5.0 0.8 ± 1.4
Group B						
101058	6	30.8–44.4 37.4 ± 4.9	23.0–47.0 31.7 ± 8.6	18.8–31.2 26.4 ± 4.3	0.7–7.4 3.6 ± 3.0	-
101057	39	24.2–46.4 36.3 ± 5.0	12.6–36.0 22.2 ± 5.4	24.8–47.4 34.5 ± 4.8	3.6–11.6 5.8 ± 2.0	0–1.6 0.2 ± 0.4
101056	13	15.6–44.4 28.8 ± 8.1	6.3–16.6 11.4 ± 3.3	28.8–52.0 45.0 ± 6.7	6.4–12.4 9.2 ± 1.7	0–16.2 3.9 ± 5.7
101054	24	13.6–45.4 23.3 ± 7.4	0–11.4 5.1 ± 3.3	37.6–61.4 49.1 ± 5.3	2.6–15.8 10.5 ± 3.1	0–19.4 9.5 ± 6.2
101033	11	0–24.6 8.3 ± 7.7	In 2 samples	40.4–64.6 51.3 ± 7.0	0–15.2 8.4 ± 5.0	10.6–50.6 29.0 ± 11.8
102017	4	0–6.4 2.6 ± 2.9	In 1 sample	39.2–53.0 46.3 ± 6.4	In 1 sample	40.6–55.6 45.0 ± 7.2
101004	2	Quartz, K-feldspar and plagioclase feldspar are absent. 46.6–61.2 % pyroxene, 9.6–31.0 % hornblende (actinolite) and 0–35.2 % olivine (serpentine).				
Group A						
103076	16	5.2–39.2 28.0 ± 9.2	0–17.0 4.3 ± 5.2	29.2–58 47.3 ± 7.7	0–26.0 13.0 ± 8.5	0–35.6 No estimate

Table 4-3. Modal composition of the different rock types at the Forsmark site. SKB rock codes that distinguish individual rock types are defined in Table 4-2.

\* Includes chlorite developed by retrograde alteration of biotite.

The values for all other rock types in Table 4-3 are identical to those listed by Stephens et al. (2007). However, a notable difference is that all values for biotite have been changed to include chlorite, which developed by retrograde alteration of biotite. A summary of all analyses used in the calculations is provided in Appendix 4.

In general, the new values for 101057, 101056, 101054 and 103076 are very close to those estimated previously by Stephens et al. (2007), with mean and standard deviations within 1 vol.% of the original values. However, there are two features that deserve further attention: the range for K-feldspar in 103076, which has increased from 0-12.6 to 0-17.0 vol.%, and the content of hornblende in 101057, which occurs in accessory amounts (< 1.6 vol.%) in approximately one third of the analyses. Other accessory phases in the granitoids of Group B and C (not included in Table 4-3) are epidote (< 3.6 vol.%), titanite (< 1.8 vol.%) and magnetite (1.2 vol.%), with a few grains of muscovite, allanite, apatite prehnite/ pumpellyite, zircon, calcite and sulphides (primarily pyrite).

Following feedback from the transport modelling team, an attempt has been made to illustrate the variability of rock-forming minerals of particular importance for the thermal, mechanical and transport properties of the intact rock. The basic approach, as confirmed by data from Forsmark (SKB 2008a and references therein), is that the content of quartz has a critical impact on the thermal conductivity, whereas the content of biotite together with secondary chlorite may influence both the radionuclide sorption and the compressive strength.

Figure 4-2 illustrates the variability in the content of biotite (including chlorite) versus quartz for the different rock types at the Forsmark site. Data for the two rock types that dominates strongly within RFM029 and RFM045 (101057 and 101058, see Section 6.4) show largely overlapping ranges, with very similar quartz content and conspicuously lower biotite content in 101058. Some of the Group B granitic rocks, particularly in RFM045 where 101058 is a major component, have been affected by the alteration referred to as albitization (see Section 4.2.2). This alteration tends to raise the quartz content slightly and decrease the biotite content significantly. However, no such altered samples are included in the data set presented in Figure 4-2.

The petrophysical data acquired after the completion of SDM-Site are limited to the following data:

- Investigations preceding SDM-PSU: Analysis of density and magnetic susceptibility for samples from five boreholes: KFR04, KFR05, KFR20, KFR101 and KFR106 (Mattsson 2009, Mattsson and Keisu 2009, 2010).
- KFR24: Analysis of density, porosity, magnetic susceptibility and electric resistivity for 35 samples.



*Figure 4-2.* Variability in the content of biotite (including chlorite) and quartz for the different rock types at the Forsmark site. SKB rock codes that distinguish individual rock types are defined in Table 4-2. Encircled fields include all analyses of 101057 and 101058, the dominant rock types in RFM029 and RFM045, respectively. The diagram is based on modal analyses presented in Appendix 4 (Sicada delivery SKBdata\_23\_036\_02).

A comparison between the new data for KFM24, the SFR boreholes and the petrophysical properties presented by Stephens et al. (2007) for different rock types at Forsmark is presented in Figure 4-3. Electric resistivity has been omitted, as the base frequencies differ between the new and old measurements. Also, natural exposure rate (natural gamma radiation) has been excluded, as no such data has been produced since 2005. The diagrams include only samples unaffected by rock alteration. The following features are noticeable in the diagrams of Figure 4-3:

- Samples from KFM24 show a systematically lower porosity than the samples from site investigations that preceded SDM-Site (Figure 4-3a). This consistent bias is inferred to be of analytical nature, rather than reflecting the actual porosity of the rock mass. Including these data in the two data sets should therefore be avoided.
- By visual inspection, the parameter density in Figure 4-3b, shows no difference between the data sets from KFM24, SDM-Site and the SFR boreholes. This confirms an excellent consistency between the field and borehole assessment of the rock type and the analytical data. The density range for 102017 and 103076 reflect significant compositional variability within the two groups.
- The parameter magnetic susceptibility in Figure 4-3c shows a general agreement between the data sets from KFM24, SDM-Site and the SFR boreholes. However, a feature that merit attention is the anomalously high magnetic susceptibility of the SFR samples, with a geometric mean of 0.0035 SI, whereas the values for the amphibolites in the Forsmark tectonic lens are consistently low, in the range 0.00051–0.00086 SI. This can be explained, at least partly, by a high content of magnetite in the amphibolite of the SFR area (cf. Curtis et al. 2011).

Following discussions with colleagues of other disciplines in the modelling group, two questions were recognised concerning the homogeneity of the dominant metagranite-granodiorite (101057) at Forsmark:

- Compositional and textural differences between the tectonic lens and the rock mass in proximity to the SFR facility.
- Scale-dependent variability versus analytical uncertainties related to the point-counting method.



**Figure 4-3.** A variety of classical box and whisker diagrams comparing the petrophysical properties for different rock types at Forsmark by separation of samples from KFM24, SDM-Site and SFR boreholes. (a) Porosity, (b) density and (c) magnetic susceptibility. The whisker is defined by the range (min-max), the box by the standard deviation and the thick line by the mean (arithmetic for porosity and density, geometric for magnetic susceptibility). Data for SDM-Site are presented in Table 4-3 in Stephens et al. (2007), whereas data for KFM24 and SFR boreholes were extracted from Sicada delivery SKBdata\_23\_036.

A summary of the major differences between the metagranite-granodiorite (101057) of the tectonic lens and the rock mass around SFR is listed below. Since the only available thin-sections from the SFR volume are affected by oxidation (see Section 4.2.2), this comparison has been solely based on ocular inspection during the borehole mapping, aided by a magnifying lens.

- The typical texture of elongated monomineralic domains that characterise 101057 within the tectonic lens are less distinct in the rock mass in vicinity to the SFR (Figure 4-4).
- The grain-size is generally smaller in vicinity to the SFR than within the tectonic lens. An isolated example of a highly reminiscent variety within the lens occurs in the upper part of KFM05A (cf. Petersson et al. 2004b).
- Intensely deformed varieties of 101057 show strong similarities with the metavolcanic rocks of felsic to intermediate composition (103076), though the content of ferromagnesian phases is typically lower in 101057.
- The density is generally higher in the SFR varieties of 101057, with an arithmetic mean of ca 2 700 kg/m<sup>3</sup>, which indicates a prevailing granodioritic composition with subordinate, granitic varieties.
- The occurrence of muscovite is a pervasive feature in parts of the rock mass in vicinity to the SFR, whereas the presence of muscovite within the tectonic lens is strictly limited to deformation zones. It is inferred that the muscovitization in proximity to the SFR has an origin that pre-dates the brittle deformation of the region.

The compositional variability of 101057 is significant, with standard deviations of 5–6 vol.% for the main salic minerals and approximately 2 vol.% for biotite (Table 4-3). Comparison between samples from the surface and the borehole, along individual boreholes and within a few metres of a borehole reveals similar variations at all scales. Even duplicate analyses completed by two different persons independently of the same thin-section yielded variations of such an extent that they outmatch the modal variability among samples from different localities (e.g. the modal analyses of KFM01A 109.66, KFM06A 636.34 and KFM08C 750.32; Petersson and Eliasson 2023, Petersson et al. 2004a, 2005). The mineralogy of 101057 would not provide difficulties in the distinction between the different components, especially not the ferromagnesian phases, considering the experience of all the analysing persons. An explanation for this discrepancy of the duplicate analyses, previously provided by Petersson and Eliasson 2023, is the mounting of the thin-sections in the point-counting stage in combination with the textural character of the rock type. The counted area does not cover the entire thin-section and an infinite ability to adjust the position of the area makes it problematic for two different persons to repeat the setup. The characteristic incipient gneissosity of 101057, with stretched monomineralic domains of quartz/feldspars and trails of ferromagnesian minerals, gives a heterogeneity at centimetre-scale that cannot always be captured by the limited point-counting area. Thus, the heterogeneity at centimetrescale prevent quantification of more large-scale variations in the composition of 101057 solely based on modal data. However, whole-rock geochemistry and documentation from the geological borehole/ outcrop mapping both provide evidence for the actual existence of more large-scale variations. The systematics of possible spatial anomalies and scale-dependent differences within the lens remains to be resolved. Considering the large number of analyses available, the calculated values presented in Table 4-3 are nevertheless judged to reflect the actual variations within the lens as such with high confidence.



*Figure 4-4. Examples of drill cores from the north-western central part of the tectonic lens (KFM01A) and the rock mass close to the SFR facility (KFR120), which illustrate the textural character of 101057.* 

#### 4.2.2 Rock alteration

The significance of rock alteration at the Forsmark site, in particular the relationship between alteration and deformation zones, has previously been summarised by Stephens et al. (2007). A more detailed characterisation of the three most conspicuous alteration types, referred to as oxidation, albitization and quartz dissolution, has been provided by Petersson et al. (2012). Considering the additional data acquired at Forsmark after 2010 and discussions with other modelling disciplines, it was deemed necessary to focus on the following aspects in the presentation and evaluation of data:

- Clarifications regarding nomenclature.
- Guidelines for mapping of alteration intensity.
- Description of subordinately occurring alteration types.
- Comparison between borehole data acquired after 2010 and during the previous site investigations (SDM-Site and SDM-PSU).
- Quantitative estimates of the proportions of alterations in different rock domains (presented in Section 6.4).
- The relative change in quartz content for rock types affected by oxidation, albitization and sericitization.

The nomenclature of the rock alterations in this report may differ from the established nomenclature in some earlier SKB-reports; possibly due to perceived shortcomings of the nomenclature, which not always reflect the actual changes an alteration has given rise to. To avoid future misunderstandings, Table 4-4 provides a summary that includes the current nomenclature, SKB code, basis for identification, alternative names and a brief description. The compilation is based on information presented by Möller et al. (2003), Petersson et al. (2005, 2012), Stephens et al. (2007) and Sandström et al. (2010).

Table 4-4. Naming, SKB code, primary basis for identification and a brief description of the three most conspicuous alteration types at Forsmark, referred to as oxidation, albitization and quartz dissolution.

Alteration type	SKB code	Total length* [m]	Primary basis for identification	Alternative names		
Oxidation	706	3 5 3 5	Red-staining	Hematite dissemination, red-staining		
Oxidation commonly occurs as a wall-rock alteration along fractures and is characterized by the development of a reddish colour due to hematite dissemination within feldspar grains, along grain boundaries and in microfractures, rather than by a significant oxidation (Sandström et al. 2010). Associated mineralogical changes include mainly saussuritization of plagioclase, chloritization of biotite and conversion of magnetite into martite.						
Albitization	104	1674	Bleaching or whitening	Epitonalite, whitened alteration		
Albitization occurs extensively, but it is pronounced along contacts to amphibolite. The primary protoliths are metamor- phosed, medium-grained or aplitic granites (101057 and 101058). The altered rocks show a marked decrease in K-feldspar and an increase in quartz relative to the unaltered equivalents, resulting in an epitonalitic composition. Plagioclase is meta- morphic in character and generally richer in albite than in the unaltered rocks. It is inferred that albitization was triggered by the input of basic or intermediate melts into the crust during igneous activity close to the peak of regional metamorphism at 1.87–1.86 Ga (Petersson et al. 2012). Thus, the albitization lacks connection to brittle deformation.						
Quartz dissolution	700	151	Vugs replacing quartz giving the rock a sponge-like appearance	Vuggy rock, episyenite, desilicification		
Quartz dissolution, which resulted in the formation of episyenite, are mainly located along fracture zones. The guartz						

dissolution process was also accompanied by pervasive albitization. Most of the vugs left after the removal of quartz are, to a variable extent, refilled by hydrothermal assemblages, including quartz, albite, K-feldspar, hematite, chlorite and calcite.

\* Total length refers to the total borehole length affected by the alteration type.

Most alteration types distinguished at Forsmark are characterised by microscopic or sub-microscopic alteration assemblages, often in combination with chemical changes of feldspars, which to the unaided eye is only revealed by colour changes. Intensity estimates for some alteration types, such as oxidation and albitization, relies hence heavily on colour. Such an approach is of course rather crude, as the colour intensity not just reflect the alteration degree but also depends on the actual content of the affected mineral phase (e.g. feldspar). Another issue is the ability to capture the various aspects of an alteration type. Oxidation for example, is without exception accompanied by chloritization of biotite
and sericitization/saussuritization of plagioclase. However, the degree of chloritization and/or sericitization/saussuritization do not necessarily follow the hematite dissemination of feldspars, which gives the reddish discolouration. Despite the apparent weakness of the current intensity approach, it is considered to provide a general measure of the alteration intensity. To facilitate evaluation of intensity data for downstream users Table 4-5 present guidelines for intensity mapping of oxidation, albitization and quartz dissolution.

Intensity	Oxidation	Albitization		Quartz dissolution			
Faint		Faint bleaching with preserved texture and structure	as (s)	_*			
Weak		Distinct bleach- ing with slightly blurred grain boundaries – texture affected		_*			
Medium		Intense bleaching with obliteration of the original texture		Incomplete dissolution of quartz or partly refilled vugs			
Strong		Whitening with a distinct decrease of mafic minerals – protolith texture and structure are obliterated		Total dissolution – no quartz observed and significant porosity			

Table 4-5.	Guidelines for intensity mapping of the three most conspicuous alteration types at
Forsmark	- oxidation, albitization and quartz dissolution.

\* Faint and weak intensities are currently not applicable for quartz dissolution. However, approximately half of the total borehole length registered as quartz dissolution in the mappings completed until today (SKBdata\_22\_065) has been assigned faint to weak intensities. With the current guidelines, all these intervals would be assigned a medium intensity.

In addition to the three alteration types described above there are a number of subordinate alterations in the area, most of them with a preference to certain deformation zones or rock types. A compilation of the general occurrence and character of these alteration types are given in Table 4-6.

Table 4-6. General occurrence and character of subordinate alteration types identified along cored boreholes at Forsmark. Calculated lengths and proportions are based on delivery SKBdata\_22\_065.

Type (SKB-code)	Total length* [m]	Occurrence and character
Argillization (72)	66	Dissemination of clay minerals. About 80 % occurs along intersections with modelled deformation zones.
Carbonatization (712)	6	Calcite dissemination along intervals of $\leq$ 1 m in length. About 80 % occurs along intersections with modelled deformation zones.
Chloritization (701)	143	Typically affecting mafic rocks and about 65 % occurs along sections with amphibolites and metamorphic diorite, quartz diroite and gabbro. About 55 % occurs along intersections with modelled deformation zones.
Epidotization (702)	128	Locally associated with fracture networks sealed by epidote or with other alterations (e.g. chloritization and silicification). Includes subordinate intervals of inferred prehnitization. About 75 % occurs along intersections with modelled deformation zones, mainly in KFM11A and KFM12A along inferred intersections with with the Singö deformation belt (ZFMWNW0001, ZFMWNW0813 and ZFMWNW3259) and the Forsmark deformation zone (ZFMWNW0004).
Laumontization (721)	49	Typically associated with fracture networks sealed by laumontite. About 80 $\%$ occurs along intersections with modelled deformation zones.
Saussuritization (713)	33	Microscopic assemblage of epidote, sericite and albite formed by alteration of plagioclase. Gives the affected rock a dark greenish tint. A majority (> 19 m) is recognized along the inferred intersection between KFM12A and the Forsmark deformation zone (ZFMWNW0004). Identification is assigned a low degree of confidence.
Sericitization (714)	387	Generally muscovitization developed during low-grade metamorphism; lacks direct connection to brittle deformation, even if approximately 30 % of the length interval occurs in KFM11A at the inferred intersection with the Singö deformation belt (ZFMWNW0001, ZFMWNW0813 and ZFMWNW3259). Almost 60 % occurs in the cored boreholes in proximity to the SFR facility, where it primarily has affected metamorphic granite–granodiorite (101057).
Silicification (71)	28	The vast majority (> 21 m) occurs at 314–337 m length along KFM12A, typically in intimate association with epidotization. The interval coincides with the inferred intersection of the Forsmark deformation zone (ZFMWNW0004).
Steatitization (716)	12	Virtually all (> 10 m) are talc-rich intervals at 510–550 m length along KFM11A – the inferred intersection with the Singö deformation zone (ZFMWNW0001).

\* Total length refers to the total borehole length affected by the alteration type.

To assess whether the borehole data acquired after 2010 on rock alteration are in accordance with the conceptual judgements of SDM-Site and SDM-PSU, a comparison has been performed based on spatial proximity. Considering the locations of the cored boreholes drilled after 2010, it seemed appropriate to limit the comparison to the following three rock domains, RFM029, RFR01 and RFR02, which also were the focus of the previous site investigations. Since several alteration types are strongly related to brittle deformation, the comparison has been further extended to a separation in alteration inside and outside modelled deformation zones. A summary of selected aspects of this comparison is visualised in Figure 4-5. In general, there is a consistency between data acquired after 2010 (denoted "new" in Figure 4-5) and the previous site investigations. However, there are a number of features in the figure that deserve further attention:

- The occurrence of albitization, sericitization and chloritization have no apparent connection with deformation zones.
- The occurrence of sericitization is virtually limited to the RFR domains, enclosing the SFR facility. This is also in accordance with modal analysis of thin sections from KFR121 within RFR02, which yielded muscovite contents of 2–3.5 vol.% (Petersson and Eliasson 2023, 2024), whereas samples from RFM029 contain only traces (< 1 vol.%) of muscovite/sericite Petersson et al. (2004a, 2005).
- Oxidation is consistently more abundant within than outside deformation zones. An exception is the borehole data for RFR01 acquired after 2010, where the bedrock within zones lack oxidation. An explanation is that the data are limited to a single intersection between KFR118 and ZFMENE3115 in combination with the typical non-pervasive character of alterations along deformation zones (cf. Stephens et al. 2007).

In RFM029 and RFR02, albitization is slightly more abundant in borehole data acquired after 2010 than in data from previous site investigations. About 60 % of the albitised sections along the new boreholes within RFM029 occur in one borehole, KFM27, which is situated close to the boundary of the marginal domain RFM032. Occurrences of syn-metamorphic albitization in the northwesternmost part of RM029, close to reactor 1 and 2 of the nuclear power plant and RFM032, was previously noted in older boreholes by Stephens et al. (2007, pp. A14-31). Since the main criterion for separation between RFM029 and RFM032 is the intensity of ductile deformation, and not the presence of albitization, model changes are not considered necessary. The albitization along the new boreholes within RFR02 is mainly found along KFR121, where most albitization is of faint intensity and typically occurs adjacent to amphibolite. Thus, neither does this call for conceptual changes.



**Figure 4-5.** Histograms illustrating the quantitative estimates of rock alteration (a) outside and (b) inside target intercepts of modelled deformation zones for the three rock domains RFM029 RFR01 and RFR02 by a separation of borehole data acquired after 2010 (new) and the previous site investigations (SDM-Site and SDM-PSU). "Other alterations" include argillization, carbonatization, epidotization, laumontization, quartz dissolution, saussuritization, silicification and steatitization. The compilation is based on geological data from cored borehole sections (Sicada delivery SKBdata\_22\_065). Total borehole lengths outside and inside modelled deformation zones of each rock domain, including both altered and unaltered sections are presented in brackets. Note the scale difference between the histograms outside and inside target intercepts of modelled deformation zones. Note also that different alteration types can overlap and the total proportion of altered rock is hence lower than the sum of individual alteration types.

An issue of special interest, because of its impact on the bedrock thermal properties, is how the alteration effects the quartz content, since this mineral shows a thermal conductivity two- to threetimes higher than that in other, common rock-forming minerals (Horai, 1971). The subject is mainly relevant when it comes to the more abundant alteration types that are not limited to deformation zones: oxidation, albitization and sericitization. However, an assessment of this, based on modal mineral analyses, suffers from two major difficulties, the lack of data for the alteration types of interest and the inhomogeneous quartz content of the unaffected metamorphic granite-granodiorite (101057 and 101058), as discussed in Section 4.2.1. A compilation of available modal data for rock samples affected by oxidation and albitization are summarised in Table 4-7. There are currently no data for serizitised samples specifically, but four of the oxidised samples from KFR121 show an incipient formation of muscovite (Petersson and Eliasson 2023, 2024), that is too insignificant to allow detection during the geological mapping of the borehole.

The quartz content of the oxidized samples does not differ significantly from the contents of the unaltered equivalents (i.e., metamorphic granite to granodiorite, 101057), with a mean  $\pm$  standard deviation of  $36.3 \pm 5.8$  vol.% (see Table 4-3). However, the spread in the sample set is considerable. The apparent stability of quartz during oxidation is supported by various petrographic studies of granites in southern Sweden (Eliasson 1993) and metamorphic granite-granodiorite at Forsmark (Sandström and Tullborg 2006; Petersson and Eliasson 2023, 2024). The studies further show that the content remains unaffected regardless of the oxidation intensity.

The mineralogical changes attributed to the syn-metamorphic albitization at Forsmark has been analysed by Petersson et al. (2005, 2012). Their conclusion is that the albitization was accompanied by a slight silicification. The enrichment of quartz is reflected in the high but variable modal quartz content, with an average of 40 vol.% in the albitized samples and 35 vol.% in the unaltered equivalents, in combination with a slightly increased whole-rock silica concentration, where the average SiO<sub>2</sub> content in the albitized samples exceeds that of the unaltered, metamorphosed granitic rocks by 3.1 wt.% (cf. Petersson et al. 2012).

 Table 4-7. Modal content of quartz in metamorphic granite to granodiorite (101057 and 101058)

 affected by oxidation and albitization of medium to strong intensity.

Alteration	No of samples	Min–max [vol.%]	Mean ± std [vol.%]	References
Oxidation	11	19.8–41.7	35.5 ± 6.3	Sandström and Tullborg (2006), Petersson and Eliasson (2023, 2024)
Albitization	12	34.4–50.0	$40.0 \pm 5.7$	Stephens et al. (2003, 2005), Petersson et al. (2005)

### 4.2.3 Ductile deformation

The Forsmark site has been affected by varying degrees of penetrative ductile deformation, followed by complex folding of the bedrock on different scales. This ductile strain developed at mid-crustal depths at amphibolite-facies metamorphic conditions. Later ductile strain occurred predominantly along more discrete deformation zones in the high-strain belts around the tectonic lenses (Stephens et al. 2007).

Thorough analysis and evaluation of structural data acquired during the preceding site investigations, including the bedrock mapping at the ground surface, the geological mapping of boreholes and laboratory measurements of the anisotropy of magnetic susceptibility (AMS), have previously been presented by SKB (2005), Stephens et al. (2007) and Curtis et al. (2011). Additional data archived at Forsmark after 2010 are largely restricted to tectonic foliation measured during the borehole mapping but include infrequent measurements of linear grain-shape fabric, veining and minor ductile and ductile-brittle shear zones. The only additional structural data from the ground surface are measurements of tectonic foliation in the trenches AFM001393 and AFM001394 (cf. Section 3.2).

These new data have been analysed in relation to the structural concepts of the SDM-Site and the SDM-PSU, with a major sheath fold present inside the tectonic lens and intense tectonic banding along its flanks (cf. Section 6.1). Conceptually, the bedrock with cored boreholes KFM13–KFM27 are situated close to the hinge of the major synform, which at the current level of erosion plunges to the southeast and SSE. Integrated surface and borehole data for ductile structures from the local model

volume indicate a fold axis that plunges  $170^{\circ}/55^{\circ}$  (Stephens et al. 2007). This is also consistent with the girdle distribution pattern established on a stereographic projection from orientations of rock contacts to amphibolites measured in cored boreholes ( $158^{\circ}/43^{\circ}$ ); a relationship that signify that intrusion of the amphibolite dyke-like bodies occurred prior to the folding.

A stereographic presentation of the orientation data for ductile planar structures (primarily tectonic foliation) as well as contacts to amphibolites from the 15 boreholes KFM13–KFM27 display a similar, but less pronounced, girdle distribution pattern with a pole that plunges 173°/34° (Figure 4-6a). This is also supported by measurements of tectonic foliation in the two trenches and in excellent agreement with the orientation of the modelled major synform inside the tectonic lens. Thus, no model revision is considered necessary.

The corresponding structural concept proposed by Curtis et al. (2011) for the bedrock in proximity to the SFR facility is that the intense ductile structures generally follow the regional trend of the WNW–ESE striking high-strain belt, combined with major folding. Although confirmed by a crude, but yet distinguishable girdle pattern, with a best-fit pole at 110°/24°, the data scatter is considerable. The latter is to some extent inferred to rheological differences of an often very heterogeneous lithology. Another contributory cause might be that a fine-scale folding imparts variability in the planar fabric (cf. Curtis et al. 2011).

A stereographic presentation of the orientation data for ductile planar structures (primarily tectonic foliation) as well as contacts to amphibolites from the five boreholes KFR117–KFR121 yield a distribution along a broad girdle with an orientation of the best-fit pole at 107°/17° (Figure 4-6b). The data distribution strongly resembles the pattern that emerged from the site investigation data, which hence provides further support for the structural concept inferred by Curtis et al. (2011).



**Figure 4-6.** Orientation of planar ductile structures and amphibolite contacts in cored boreholes completed after 2010 at Forsmark. KFM13–KFM27 situated in the north-western central part of the tectonic lens, and KFR117–KFR121 situated in close proximity to the SFR facility. An estimation of the degree of point, girdle or random distribution pattern (Vollmer fabric index, PGR) in the raw data is provided for each data set. The pole to each planar structure is plotted on the lower hemisphere of an equal-area stereographic projection. No Terzaghi correction has been applied. Only one contact (the upper) for each amphibolite occurrence has been included in the plots.

### 4.2.4 Brittle deformation and fracture statistics for cored boreholes

### Fracture orientation

Presentation of fracture orientation data in the modelling reports of SDM-Site and SDM-PSU (Stephens et al. 2007; Curtis et al. 2011), has consistently been based on a distinction between fractures outside and inside deformation zones. To facilitate comparison, this approach has also been adopted in the current analysis, by separation of fractures along possible deformation zones and target intercepts of modelled deformation zones (see Section 5.3.4) from fractures outside the zones. The fracture orientation along each modelled deformation zone, where borehole intercepts are available, is presented in Appendix 7. The assessment of fracture data outside zones follows generally the spatial considerations applied to other geological properties in Section 4.2, with a restriction to the rock domains RFM029, RFR01 and RFR02. However, since most new fracture data for RFM029 are derived from rather shallow boreholes (KFM13–KFM23 and KFM25–KFM27), the orientation analysis has been further refined by a distinction between fractures within fracture domains FFM01 and FFM02.

Available information on brittle deformation for cored boreholes include the following data sets:

- Fracture (Sicada table *p\_fract\_core* division into open, partly open and sealed based on aperture; for the criteria see Figure A1-2 in Hermanson and Petersson 2022).
- Crush (Sicada table *p\_fract\_crush* predominant fracture orientations provided by Strike3/Dip3 and Strike4/Dip4).
- Sealed network (Sicada table *p\_fract\_sealed\_nw* predominant fracture orientations provided by Strike3/Dip3 and Strike4/Dip4).
- Fault rocks, including breccia, cataclasite and brittle-ductile shear zone (Sicada table *p\_fault\_rock* for KFR117–KFR121 and *p\_rock\_struct\_feat* for all other boreholes. Predominant structural orientations for *p\_fault\_rock* is provided by Strike3/Dip3 and Strike4/Dip4).

The orientation of brittle structures recorded in cored boreholes completed after 2010 and during the site investigations is presented as contoured pole data in a number of stereograms in Figure 4-7 through to Figure 4-10. Since the uncertainty in orientation is significantly higher for fractures not visible in the BIPS and OPTV imagery, such fractures have been excluded from the analysis.

A similar comparison between fracture orientation data from the cored boreholes KFM13–KFM24 completed during the preparatory investigations and the cored boreholes KFM01A–KFM10A from the site investigations that preceded SDM-Site has previously been presented by Follin (2019), with the purpose to distinguish possible anomalies in the rock mass of the planned repository accesses. The data sets of the current analysis differ from this previous comparison by the inclusion of both additional boreholes (KFM25–KFM27) and a broader spectrum of brittle structures.

In general, the fracture orientation data acquired outside deformation zones along the cored boreholes completed after 2010 and during the site investigations show similar patterns both in FFM02 (Figure 4-7) and FFM01 (Figure 4-8), with two dominant sets: a vertical to steeply dipping set that strike approximately NE and a subhorizontal set (dips  $< 20^{\circ}$ ). The relative concentration of open (and partly open) fractures is significantly higher in the subhorizontal set, whereas the NE-striking set is dominated by sealed fractures. A noticeable difference between the data acquired after 2010 and during the site investigations is the occurrence of vertical to steeply dipping fractures that strike NW to NNW (Figure 4-7 and Figure 4-8). These fractures are predominantly sealed, and clear concentrations of the set is largely restricted to the older boreholes, completed prior to 2010. A viable explanation for the difference is the bias in the borehole geometry; the boreholes completed after 2010 are mainly shallow (< 100 m) with steep plunges (cf. Appendix 1), whereas several of the more extensive, older boreholes reach deeper in the rock mass and have favourable directions for intersections with fractures of the NW- to NNW-striking set (e.g. KFM06C, KFM07A, KFM08C and KFM09A). The orientation patterns for crushes and sealed networks resemble the predominant intensities for open and sealed fractures, respectively, with subhorizontal orientations for crushes and variable, but mostly subhorizontal and NE-striking orientations, for sealed networks (Figure 4-7 and Figure 4-8). A majority of the tectonic breccias and brittle-ductile shear zones in FFM02 and FFM01 are vertical to steeply dipping with strikes to NE.



**Figure 4-7.** Orientation of brittle structures (individual fractures, fractures within crushes and sealed networks, as well as fault rocks) outside deformation zones in fracture domain FFM02 by a separation of borehole data acquired after 2010 (new) and the previous site investigations (SDM-Site). Plots for individual fractures utilize a lower hemisphere, equal area projection, with a Terzaghi correction of the Kamb contouring. Poles for crushes and sealed networks are calculated as means of Strike3/Dip3 and Strike4/Dip4.



**Figure 4-8.** Orientation of brittle structures (individual fractures, fractures within crushes and sealed networks, as well as fault rocks) outside deformation zones in fracture domain FFM01 by a separation of borehole data acquired after 2010 (new) and the previous site investigations (SDM-Site). Plots for individual fractures utilize a lower hemisphere, equal area projection, with a Terzaghi correction of the Kamb contouring. Poles for crushes and sealed networks are calculated as means of Strike3/Dip3 and Strike4/Dip4.

A comparison between fracture orientation data acquired from the SFR boreholes KFR117–KFR121 and boreholes completed before SDM-PSU shows virtually identical patterns for the rock domains RFR01 and RFR02 outside deformation zones (Figure 4-9 and Figure 4-10). Open fractures are predominantly subhorizontal (dips  $< 20^{\circ}$ ), while sealed fractures are distributed among two vertically to steeply dipping orientation sets that strike NW to NNW and NE, where the latter is more clearly defined in data from the older boreholes. There is also a subordinate, moderately dipping orientation set with an E–W strike, which is populated by both sealed and open fractures.



**Figure 4-9.** Orientation of brittle structures (individual fractures, fractures within crushes and sealed networks, as well as fault rocks) outside deformation zones in rock domain RFR01 by a separation of borehole data acquired after 2010 (new) and the previous site investigations (SDM-PSU). Plots for individual fractures utilize a lower hemisphere, equal area projection, with a Terzaghi correction of the Kamb contouring. Poles for crushes, sealed networks, breccias and cataclasites are calculated as means of Strike3/Dip3 and Strike4/Dip4.



Figure 4-10. Orientation of brittle structures (individual fractures, fractures within crushes and sealed networks, as well as fault rocks) outside deformation zones in rock domain RFR02 by a separation of borehole data acquired after 2010 (new) and the previous site investigations (SDM-PSU). Plots for individual fractures utilize a lower hemisphere, equal area projection, with a Terzaghi correction of the Kamb contouring. Poles for crushes and sealed networks are calculated as means of Strike3/Dip3 and Strike4/Dip4.

The orientations of fractures inside modelled deformation zones (presented in Appendix 7) are strongly reminiscent of the orientation of fractures outside possible deformation zones. As a rule, the predominant fracture orientation set inside a zone is approximately coincident with the overall orientation of the zone. However, a characteristic feature is the frequent occurrence of additional, subordinate sets along many of the deformation zones, with a noteworthy proportion of gently dipping fractures. It is inferred that the different sets of fractures, including both steeply and gently dipping fractures, are genetically related and formed close in time during the geological history (cf. Stephens et al. 2007).

### Fracture frequency (intensity)

A key component of the geological modelling work is the variability in fracture frequency (referred to as intensity or  $P_{10}$ ). Table 4-8 presents an overview of the fracture data from the cored boreholes completed in Forsmark after 2010. The frequencies of open fractures (single open and partly open fractures) and sealed fractures are presented as  $P_{10}$  based on (1) all registered fractures, (2) fractures visible in the borehole image, and (3) fractures visible in the borehole image with Terzaghi corrections. In addition to individual fractures, this table includes data for highly fractured borehole sections, including the percentage of crushes, sealed fracture networks and fault rocks.

More than 80 % of the fractures are generally visible in the borehole image and in most boreholes more than 90 %. Terzaghi correction increases the frequencies for open fractures by approximately 50-250 % and sealed fractures by 35-150 %. The increase is least in boreholes with inclinations of about -52 to  $-65^{\circ}$ , demonstrating that vertical to steeply dipping fractures are highly underestimated in the more steeply inclined boreholes.

The Terzaghi corrected frequency of open fractures for the shallow cored boreholes within RFM029 (KFM13–KFM23 and KFM25–KFM27) ranges between 2.3 and 9.6 fractures per metre. The deep borehole KFM24, on the other hand, exhibits a considerably lower frequency at 1.4 fractures per metre, which is comparable with the frequencies for several of the deep boreholes from the site investigations (see Table 3-11 of Stephens et al. 2007, but note that they are uncorrected). The observed borehole distribution of open fractures is inferred to reflect the influence of the near-surface fracture domain FFM02.

The SFR boreholes KFR117–KFR121 show similar Terzaghi corrected frequencies, ranging between 4.4 and 9.1 open fractures per metre. By contrast, these boreholes have significantly higher frequencies of partly open fractures, sealed fractures (both individual fractures and networks), and fault rocks (mainly breccia) than the boreholes inside the tectonic lens. Thus, the proportion of open to sealed fractures is generally lower in the SFR boreholes compared with the boreholes within the lens.

The intersection of deformation zones significantly affects the fracture intensity encountered along a given borehole. To accurately characterize background fracturing outside the deformation zones, it is necessary to remove intervals of possible deformation zones from the fracture intensity statistics. Table 4-9 presents revised frequencies after the removal of fractures within these intervals. Although the removal consistently yields lower intensities of open fractures along the boreholes in question, the decreases are rather limited, with a maximum drop of 25 % and in some boreholes small (< 5 %) increases. Most significantly, the occurrence of sealed fracture networks and breccias (fault rock) decreases with the removal of possible deformation zones. This change can be attributed to the fact that vertical to steeply dipping deformation zones at Forsmark are defined by elevated intensities of especially sealed fractures and sealed fracture networks.

Cored boreholes	P <sub>10</sub> – Open + partly open fractures			P <sub>10</sub> – Sealed fractures			Fault		Sealed
	All fractures	Visible in BIPS	Visible in BIPS, Terzaghi	All fractures	Visible in BIPS	Visible in BIPS, Terzaghi	rock [%]	Crush [%]	<b>NW</b> [%]
KFM13*	1.8	1.5	2.3	1.9	1.5	2.1	0.05	0.19	0.81
KFM14	1.7	1.5	4.7	0.8	0.4	1.1	0.00	0.00	0.00
KFM15*	2.4	2.0	6.1	2.9	2.3	4.5	0.00	0.84	0.00
KFM16	3.0	2.7	4.6	2.6	2.1	3.0	0.00	0.00	0.63
KFM17	2.6	2.1	6.6	3.5	3.3	7.1	0.00	0.23	0.74
KFM18	2.0	1.7	4.5	1.5	1.2	2.4	0.00	0.38	0.00
KFM19*	2.8	2.4	4.0	3.8	3.2	4.4	0.05	0.02	2.75
KFM20*	3.2	2.7	7.2	2.9	2.7	4.5	0.00	0.68	3.14
KFM21*	3.7	3.1	7.6	3.4	2.6	5.4	0.01	0.39	0.69
KFM22	4.1	3.0	9.6	1.9	1.5	3.6	0.00	0.49	0.00
KFM23*	4.1	3.5	9.4	2.9	2.5	4.9	0.05	0.46	0.00
KFM24	0.6	0.6	1.4	1.0	0.9	1.7	0.03	0.00	0.00
KFM25	1.9	1.9	6.4	2.2	2.0	4.1	0.00	0.02	0.00
KFM26	2.2	2.2	7.7	3.3	3.2	7.1	0.00	0.29	0.40
KFM27*	4.4	4.3	12.4	5.7	5.6	11.3	0.00	0.76	3.75
KFR117	3.7	3.6	8.5	4.4	4.3	7.1	1.44	0.08	0.49
KFR118*	4.4	4.4	9.1	5.4	5.3	8.1	0.50	0.10	13.34
KFR119*	2.3	2.2	5.3	2.9	2.8	4.3	0.47	0.00	6.19
KFR120*	3.7	3.5	8.7	6.4	6.1	10.4	0.23	0.11	12.92
KFR121*	3.1	2.9	4.4	5.6	5.3	7.3	0.22	0.39	17.64

 Table 4-8. Frequency statistics of brittle structures in cored boreholes completed in Forsmark after 2010. Numbers are based on delivery SKBdata\_22\_065.

\* Borehole that intersects possible deformation zones identified in the SHI.

Table 4-9. Frequency statistics of brittle structures outside deformation zones in cored boreholes completed in Forsmark after 2010. Numbers are based on delivery SKBdata\_22\_065 with removal of data from intervals of possible deformation zones (defined by Sicada table p\_shi).

	P <sub>10</sub> – Open + partly open fractures			P <sub>10</sub> – Sealed fractures			Fault		Sealed
Cored boreholes	All fractures	Visible in BIPS	Visible in BIPS, Terzaghi	All fractures	Visible in BIPS	Visible in BIPS, Terzaghi	rock [%]	Crush [%]	NW [%]
KFM13*	1.5	1.3	2.0	1.6	1.3	1.6	0.05	0.19	0.45
KFM14	1.7	1.5	4.7	0.8	0.4	1.1	0.00	0.00	0.00
KFM15*	2.1	1.6	5.1	2.4	2.0	3.6	0.00	0.54	0.00
KFM16	3.2	2.8	4.8	2.7	2.2	3.2	0.00	0.00	0.63
KFM17	2.6	2.1	6.6	3.5	3.3	7.1	0.00	0.23	0.74
KFM18	2.0	1.7	4.5	1.5	1.2	2.4	0.00	0.38	0.00
KFM19*	Entire borehole inside deformation zone ZFMENE1061A								
KFM20*	3.2	2.7	7.3	3.0	2.7	4.6	0.00	0.68	3.14
KFM21*	3.0	2.5	6.5	2.2	1.8	3.8	0.01	0.00	0.69
KFM22	4.1	3.0	9.6	1.9	1.5	3.6	0.00	0.49	0.00
KFM23*	3.4	2.9	8.1	2.1	1.9	3.4	0.05	0.04	0.00
KFM24	0.6	0.6	1.4	1.0	0.9	1.7	0.03	0.00	0.00
KFM25	1.9	1.9	6.4	2.2	2.0	4.1	0.00	0.02	0.00
KFM26	2.2	2.2	7.7	3.3	3.2	7.1	0.00	0.29	0.40
KFM27*	3.1	3.1	9.2	3.6	3.6	6.9	0.00	0.03	0.00
KFR117	3.7	3.6	8.5	4.4	4.3	7.1	1.44	0.08	0.49
KFR118*	4.3	4.3	9.5	5.5	5.4	8.5	0.17	0.10	6.65
KFR119*	2.2	2.1	5.3	2.6	2.6	4.0	0.04	0.00	3.58
KFR120*	3.6	3.4	8.9	5.1	4.8	9.2	0.09	0.11	7.28
KFR121*	2.3	2.2	3.4	6.1	5.7	7.7	0.00	0.00	6.24

\* Borehole that intersects possible deformation zones identified in the SHI.

The variation relative to depth for different types of fractures recorded in cored boreholes completed after 2010 and during the site investigations is presented in Figure 4-11 and Figure 4-12, as average Terzaghi corrected fracture frequencies (intensities, P<sub>10 corrected</sub>) over 10 m elevation intervals. Only fractures recorded outside sections identified as deformation zones have been included in the analysis. It should also be noted that the plots exclude the contribution from crushes and sealed networks. Follin (2019) presented a similar analysis, based on a comparison between data from the cored boreholes KFM13–KFM24 completed during the preparatory investigations and the older boreholes KFM01A–KFM10A. However, the current analysis is based on slightly different data sets and include additional boreholes from both the planned access area (KFM25–KFM27) and the pier above SFR.

The analysis is further supported by moving-average and cumulative-frequency plots for each of the cored boreholes; plots for boreholes used in Forsmark model stage 2.2 and 2.3 are presented by Stephens et al. (2007, 2008b), whereas corresponding plots for the more recent boreholes KFM13 to KFM23 and KFM25 to KFM27 are found in Appendix 6 of the current report. Such plots are one of the tools used in the single-hole interpretation work, as an aid in the identification of possible deformation zones (see Section 4.1.1). It has also formed the basis for the establishment of the fracture domain concept at the site (cf. Olofsson et al. 2007).

Starting the assessment with the frequency data for older cored boreholes within FFM01 and FFM02 (i.e. boreholes that were used in the SDM-Site, Figure 4-11), the following principal features have been recognised:

- The Terzaghi corrected frequency of sealed fractures is largely constant down to an approximate elevation of -800 m, with a tendency of higher frequencies in the upper part of the bedrock. The frequency decreases radically below -800 m, partly due to the scarcity of boreholes reaching greater depths.
- An anomalously high Terzaghi corrected frequency of open and partly open fractures in the upper part of the bedrock relative to the lower part. The frequencies of open (including partly open) and sealed fractures are essentially the same in the upper part of the bedrock, with a strong dominance of sealed fractures in the lower part down to approximately -1 000 m elevation.
- In the northwestern part of the Forsmark lens, the boundary between bedrock with an anomalously high frequency of open and partly open fractures (upper part), and bedrock with a strong dominance of sealed fractures (lower part), does not occur at the same elevation in the boreholes. The boundary varies between -30 to -40 m (e.g. drill site 8) and ca -200 m elevation (e.g. drill site 1).

The Terzaghi corrected fracture frequency for borehole data acquired after 2010 (i.e. KFM13–KFM27) is more variable but the overall distribution resembles that of the previous boreholes within FFM01 and FFM02 (Figure 4-11), with an anomalously high frequency of especially open and partly open fractures in the uppermost 100 m of the bedrock. The data set is strongly influenced by the deficiency of deep boreholes; only KFM24, of the totally 15 boreholes, reaches below –100 m elevation, and none of the new boreholes provide data below –550 m elevation.

A similar comparison between the Terzaghi corrected frequency data acquired from the SFR boreholes KFR117–KFR121 and boreholes completed within RFR01 and RFR02 before SDM-PSU, shows a contrasting distribution, with constant high Terzaghi corrected frequencies for both open and sealed fractures in the upper 300 m of the bedrock (Figure 4-12). Anomalously high Terzaghi corrected frequencies of sealed fractures, reaching > 15 fractures per metre, occur at the following depth ranges in the two data sets:

- Approximately 85–165 m depth in the cored boreholes of SDM-PSU.
- Approximately 195–215 m depth in the cored boreholes KFR117–KFR121.

It should be noted that of the boreholes in the new data set, only KFR121 reaches below -171 m elevation, and the anomalously high frequency of sealed fractures can be attributed to an interval of felsic to intermediate metavolcanic rock (103076) that occurs at 252–274 m borehole length along the borehole. These fractures are predominantly steeply dipping that strike NW–SE (i.e. parallel with ductile structural trend in the SFR area). In contrast, the more extensive depth range of anomalously high frequency in the boreholes that preceded SDM-PSU can neither be correlated with a specific lithological feature nor a particular fracture orientation set.

There are several possible combined explanations for the contrasting distributions between the frequency data acquired from the SFR boreholes and the boreholes within the Forsmark lens (i.e. FFM01 and FFM02), primarily relating to the differences in lithology, the intensity of the ductile deformation and the past and present stress conditions. An example is the horizontal to subhorizontal fractures (i.e. sheet joints) that occur in the shallow parts of the bedrock. These structures do occur in the SFR volume but show conspicuous concentrations inside the lens (FFM02), where the formation conditions are inferred to be more optimal, with a more isotropic bedrock (i.e. higher degree of lithologic homogeneity and less intense ductile fabric) in combination with significantly higher differential rock stresses (cf. Glamheden et al. 2007; SKB 2013).



**Figure 4-11.** Average Terzaghi corrected fracture frequencies ( $P_{10 \text{ corrected}}$ ) of sealed and open (plus partly open) fractures over 10 m elevation intervals in fracture domain FFM01 and FFM02, outside borehole sections identified as deformation zones. The data excludes contribution from sealed networks and crushes. The uncertainty of fracture intensity increases towards depth and only one borehole completed after 2010 (KFM24) reaches deeper than -100 m elevation (see Appendices 1and 6).



**Figure 4-12.** Average Terzaghi corrected fracture frequencies ( $P_{10 \text{ corrected}}$ ) of sealed and open (plus partly open) fractures over 10 m elevation intervals in the SFR rock domains RFR01 and RFR02, outside borehole sections identified as deformation zones. The data excludes contribution from sealed networks and crushes. The uncertainty of fracture intensity increases towards depth and only one borehole completed after 2010 (KFR121) reaches deeper than -171 m elevation (see Appendices 1 and 6).

### Fracture mineralogy

Several detailed studies of mineral coatings and fillings in fractures were carried out during the site investigations that preceded SDM-Site. The primary basis for all these studies is drill cores acquired from within the tectonic lens; information from outcrops and excavations is sparse and of low confidence due to disturbance by surficial weathering and/or erosional processes (cf. SKB 2005). Initially, the focus involved mineral identification, verification of mapping results and the establishment of mineral paragenesis and relative age relationships. An overview that integrates the results of this work has been presented by Sandström et al. (2008). In addition, a number of complementary studies were carried out to shed light on the following aspects:

- Quantitative amount of different minerals along selected fractures (Eklund and Mattsson 2009; Löfgren and Sidborn 2010).
- Nature and origin of fractures lacking visible mineralisation, i.e. fractures mapped with no detectable mineral and/or classified as non-mineralised in Sicada (Claesson Liljedahl et al. 2011).
- Brittle tectono-thermal evolution in the Forsmark area, as recorded by <sup>40</sup>Ar/<sup>39</sup>Ar geochronology, stable isotopes, rare earth elements and fluid inclusions of fracture minerals (Sandström and Tullborg 2009; Sandström et al. 2009).

Subsequent studies of fracture mineralogy within the investigation programme for the extension of SFR are more limited. With primary focus on borehole sections sampled for groundwater chemistry and redox potential (Eh) (Sandström and Tullborg 2011), identification of uranium phases present in the fractures (Sandström et al. 2011), the occurrence of iron hydroxide in bedrock fractures and the quantitative redox capacity provided by the fracture minerals (Sandström et al. 2014). Together with data from the geological borehole logging (summarised by Curtis et al. 2011), these studies strongly

indicate that there are no major differences between the fracture mineralogy in the SFR area and the adjacent tectonic lens (Stephens et al. 2007; Sandström et al. 2008); an overview of the predominant fracture minerals in the two volumes is presented in Figure 4-13. Thus, the major events of fracture mineralisation that have been distinguished based on, for example, cross-cutting relations, stable isotopes and geochronology for fractures within the tectonic lens, are valid also for the SFR area. The current interpretation of fracture mineral generations is summarized below in decreasing relative age of formation:

*Generation 1 (oldest)* – Mainly epidote, chlorite and quartz in, preferably, steep WNW–ESE to NW–SE striking fractures and, more rarely, gently dipping fractures. Wall rock alteration and red staining by disseminations of hematite. Inferred formation at about 200–300 °C, during the Proterozoic between 1.8 and 1.1 Ga. More specifically, it is suggested that precipitation occurred close to 1.8–1.7 Ga, during the waning stages of the Svecokarelian orogeny, at conditions close to the ductile-brittle transition.

*Generation 2* – Dominated by hematite-stained adularia and laumontite, together with albite, prehnite, calcite and chlorite; all preferentially precipitated along steep ENE–WSW to NNE–SSW and NNW–SSE striking fractures. Wall rock alteration and red staining by dissemination of hematite. Inferred formation at about 150–250 °C and  $^{40}$ Ar/ $^{39}$ Ar ages of adularia in breccias indicate, at the very least, precipitation as a response to far-field effects from the Sveconorwegian orogeny, around 1.1–1.0 Ga. Both reactivation of older structures and formation of new fractures and breccias are inferred during this period. After precipitation of the generation 2 minerals a period with some dissolution of fracture minerals occurred, of which the age and cause is uncertain.

**Generation 3** – Primarily quartz, calcite and pyrite with minor occurrences of, for example, asphaltite (black, highly viscous to solid hydrocarbons), analcime, corrensite, galena, adularia and fluorite. Preferential precipitation in steep ENE–WSW to NNE–SSW striking fractures and subhorizontal to gently dipping fractures. Inferred formation at about 60–190 °C (mainly < 100 °C) during several episodes in the Palaeozoic through significant reactivation of older fractures. <sup>40</sup>Ar/<sup>39</sup>Ar ages of adularia indicate that the main stage of precipitation was between 460–277 Ma. Fluids emanating from an organic-rich sedimentary sequence overlying the basement during this period and mixing with a deep brine, is suggested to have promoted the precipitation. Further, it is suggested that the episodes are far-field effects from the Caledonian orogeny and/or elevated hydrostatic pressure due to the overburden of the Caledonian foreland basin.

*Generation 4 (youngest)* – Predominantly clay minerals and thin precipitates of calcite in open fractures in the upper part of the bedrock; minor occurrences of pyrite and goethite are also found. The generation is mostly found in sub-horizontal to gently dipping fractures, but also in steep NNE, ENE and NW striking fractures. Precipitation has probably occurred at low temperatures (< 50 °C) during a prolonged period, possibly since the late Palaeozoic until present, by groundwater circulation.

The new data acquired from drill core logging after 2010 provide satisfactory support to the established concept of paragenesis and relative age relationships among the fracture minerals. Thus, instead of comparing data from new and old boreholes, the remaining part of this section address the following aspects of the fracture mineralogy at Forsmark:

- Bias in the fracture mineral data collected during the routine logging of drill cores.
- Fractures lacking visible mineralisation.
- Variation of fracture mineralogy with depth.
- Mineralogy of fractures within possible deformation zones.
- Differences between the fracture mineralogy along drill cores within the tectonic lens and the SFR area.

To maintain consistency in the fracture mineralogy data collected during the routine logging, SKB has engaged a very limited number of mapping geologists with extensive knowledge of the Forsmark site. Nevertheless, feedback from the follow-up mineralogical work and increased experience, in combination with inevitable personnel changes, have had an impact on the data acquired during the course of the investigation programmes. The primary source of bias is that certain minerals are more challenging to distinguish/identify than other. A comparison with follow-up mineralogical work indicates that the occurrence of, for example, adularia, albite and analcime is underestimated. In many fractures, their presence is likely to be masked by other, more easily detectable minerals, including chlorite, red staining hematite and calcite; the latter revealed by the reaction with diluted hydrochloric acid. Detailed mineralogical studies have, on the other hand, shown that iron hydroxide, and to some extent clay minerals, have an overestimated occurrence. The minerals most often mistaken for iron hydroxide are iron-rich mixed layer clay, uranium-minerals and hematite-stained adularia and albite (cf. Sandström et al. 2014). Inferred clay minerals in some fractures are actually clay-fraction mud from the drilling process, though it is also likely that some clay is lost during the drilling and core recovery process, even though triple-tube barrel was used exclusively during the investigations. It should be noted that different clay minerals are not distinguished during the routine logging. Follow-up mineralogical analysis show that corrensite is a common clay mineral. Other clay minerals include illite, smectite and a mixed layer clay that is composed of illite and smectite.

Fractures without any visible minerals make up several percent of the total amount of fractures stored in the Sicada database. These are predominantly, but not exclusively sub-horizontal or gently dipping (Sandström et al. 2008) and their distribution decreases significantly with depth (cf. fracture domain FFM01 and FFM02 in Figure 4-13). Since the existence of these fractures could be taken to imply that fracturing is an ongoing process, SKB initiated a dedicated study to further clarify their nature and origin (Claesson Liljedahl et al. 2011). In this study a subset of 99 fractures was selected from Forsmark to reflect various depths and fracture domains; virtually all are interpreted as waterbearing (PFL) fractures, outside inferred deformation zones. Investigation of the fracture surfaces, including detailed visual inspection and SEM-EDS analysis, revealed that the vast majority of these fractures were actually coated by minerals or that they were drill-induced fractures. Nevertheless, Claesson Liljedahl et al. (2011) conclude that five of the fractures in this study were non-mineralised. Groundwater flow was detected in three of them and all are subhorizontal (dips <  $20^{\circ}$ ) and occur at depth above -250 m.

Several processes that may have contributed to the origin of these non-mineralised fractures are discussed by Stephens et al. (2007) and Claesson Liljedahl et al. (2011): (1) drilling and subsequent handling of the core; (2) mechanical flushing and/or chemical dissolution of fracture coating; (3) fracturing due to ice segregation; (4) borehole intersection with fracture fronts; (5) tension induced sheet jointing (see Section 5.1.2); and (6) reactivation/opening of fractures/micro-fractures and/or non-connected, partly sealed, parts of a fracture plane. Of these, it is concluded that 2 is the least likely processes and 6 the most likely process, possibly in combination with other suggested processes. Tension induced sheet jointing (5) is also a viable mechanism to explain the existence of these fractures. Based on the knowledge of fracture mineral generations in Forsmark, it is suggested by Claesson Liljedahl et al. (2011) that the opening of these fractures is not older than Late Palaeozoic. Furthermore, it cannot be excluded that at least some of these fractures were opened up during the Quaternary glaciations or during the post-glacial Holocene period.

The variation in the occurrence of different fracture minerals with depth has been addressed by Stephens et al. (2007), while a more focused analysis of the variation of minerals along open fractures, in the upper 100 m of the bedrock, has been presented by Sandström et al. (2008). Common minerals such as chlorite and calcite, which belong to different parageneses, as well as the minerals that belong to generation 1 and 2 (e.g. epidote, adularia, laumontite, prehnite and red staining by dissemination of hematite) show no distinctive variation with depth. Their frequency of occurrence generally follows the variation in the frequency of occurrence of fractures. By contrast, the younger minerals asphaltite and goethite (generation 3 and 4) are restricted entirely to the uppermost part of the bedrock. In some boreholes, pyrite and to some extent clay minerals (generation 3 and 4), show a similar concentration in the upper part of the bedrock. Restricted occurrence of clay minerals along fractures at greater depth within and along the margins the tectonic lens is typically related to distinctive peaks in the fracture frequency, which are inferred to represent deformation zones (cf. Stephens et al. 2007 and Figure 4-13).

Since the current ground surface more or less coincides with the sub-Cambrian peneplain, the correlation with depth may have been established several hundred million years ago. The shallow distribution of asphaltite in combination with a confirmed organic origin, indicate formation by fluids emanating from the organic-rich Alum Shale of Cambrian to earliest Ordovician age that covered the crystalline bedrock at Forsmark during the earlier part of the Phanerozoic. Pyrite, precipitated during the same event, has remained in the fractures, indicating prevailing reducing conditions. However, an absence of pyrite in water conductive fractures in the uppermost 10–30 m of the bedrock in the SFR area, indicates limited intrusion of oxygenated waters during some period(s) (Sandström et al. 2011; 2014).



**Figure 4-13.** Occurrence of predominant fracture minerals (represented by Min1 in Sicada table  $p_fract_core$ ) in drill cores acquired (a-c) outside deformation zones in FFM01, FFM02 and RFR01+RFR02, and (d) inside deformation zones (all zones regardless of domain, size and orientation). The histograms include all fracture data from cored boreholes, regardless of whether the fractures are visible in the borehole images or not. The category "non-mineralized" includes both fractures where Min1 is left blank, and fractures where the code "no detectable minerals" has been used. The percentage of each mineral within open (and partly open) fractures and sealed fractures, respectively, is given above the bars.

The identification and significance of different fracture minerals along possible deformation zones in the single-hole interpretations have previously been provided by Stephens et al. (2007). A summary of the fracture mineralogy along deformation zones is presented in Figure 4-13, whereas corresponding histograms for individual zones included in Baseline version 1.0 are presented in the property tables of Appendix 7. The key aspects addressed by Stephens et al. (2007) can be summarised as follows:

- The occurrence of similar minerals and wall-rock alterations along different fracture orientation sets within a single deformation zone provides support to the assumption that different sets are genetically related.
- Minerals from more than one generation can be present along a single fracture, suggesting a history of repeated zone reactivation. In this context, it needs to be emphasized that the temperature along the zones, with their hot hydrothermal fluids, can be higher than that in the surrounding bedrock.
- Minerals of older generations may have been affected by subsequent hydrothermal events along a zone; older minerals may have been replaced by the precipitation of a younger generation of minerals. Care must therefore be taken in the interpretation of contrasting mineral parageneses along zones, both during the establishment of a conceptual model for deformation zones and the correlation between zones in different boreholes.
- There is a clear concentration of gently dipping fractures without visible minerals along possible deformation zones in boreholes KFM02A and KFM03A, which are inferred to intersect the significant family of gently dipping zones beneath Bolundsfjärden (i.e., ZFMA2, ZFMA3 and ZFMF1, see Chapter 5).

As mentioned above, there are no indications of major differences between the fracture mineralogy in the SFR area and the adjacent tectonic lens. However, minor differences, some of which may be of significance for the understanding of past and present groundwater-mineral interaction, have been identified:

- Data from the drill core logging show that muscovite/sericite and illite are common fracture coatings in the SFR area, whereas there are very few (less than 50) observations along boreholes located south of the Singö deformation zone. The minerals are preferentially found in foliation parallel fractures (Figure 4-14) along borehole sections affected by sericitization, which in turn is inferred to have developed during low-grade metamorphism (see Table 4-6). The interpretation is that a significant proportion of these fractures represent breaks along weaknesses induced by an abundance of muscovite/sericite with preferred orientation (personal communication with Eva Samuelsson 2020). Muscovite in such fractures is part of the wall-rock and lack consequently direct connection with brittle deformation history.
- The set of moderately dipping fractures with an E–W strike that occur in the SFR area, is mainly filled/coated by minerals of generation 2 (i.e. hematite-stained adularia, laumontite, calcite and chlorite, together with red staining of wall rocks). The set is clearly distinguished by plotting fractures filled by, for example, laumontite on a stereographic projection (Figure 4-14).
- The relative abundance of different clay minerals; in the SFR area a mixed layer clay consisting of smectite-illite dominates, together with illite in the water conductive fractures. In contrast, corrensite predominates the clay minerals within the tectonic lens. There are also indications that the amounts of clay minerals are greater in the SFR drill cores compared with those from the tectonic lens (Sandström and Tullborg 2011).
- Uranium minerals have been detected in 20 % of the analysed samples from the SFR drill cores (Sandström et al. 2011). During the site investigations that preceded the SDM-Site Forsmark site investigation, only one uranium mineral (altered pitchblende) was identified in more than 200 sampled fractures along boreholes within the tectonic lens (Sandström and Tullborg 2005). The locally high content of uranium in the Group D rocks (cf. Stephens et al. 2007), in combination with the abundance of these rocks in the SFR area (see Figure 4-1) suggests that pegmatitic granite, pegmatite (101061) and associated fine- to medium-grained granite (111058) is probably a source for this type of fracture coating.
- REE-carbonates have been identified in many of the SFR drill core samples; no REE-carbonates have been identified within the tectonic lens (Sandström et al. 2011). The difference can possibly be explained by the contrasting lithology, with abundant pegmatitic and fine-grained granite in the SFR area.
- Barite is more common in the SFR drill cores; a few occurrences of a Sr-rich barite have also been identified (solid solution barite-celestine series) (Sandström et al. 2011).



**Figure 4-14.** Orientation of fractures with illite or muscovite (left) and laumontite (right), outside deformation zones in boreholes completed in the SFR area after 2010 (KFR117–KFR121). The pole to each planar structure is plotted on the lower hemisphere of an equal-area stereographic projection. No Terzaghi correction has been applied. Fractures with illite or muscovite are distributed along a broad girdle with an orientation of the best-fit pole at 118°/25°, which strongly resembles the pattern that emerged from planar ductile structures and amphibolite contacts in these boreholes (cf. Figure 4-6 and Curtis et al. 2011). As a key mineral of generation 2, laumontite has been selected to illustrate the moderately dipping orientation set with an E–W strike that occur in the SFR area.

# 4.3 Sheet joints

### 4.3.1 Nomenclature

Integration work with hydrogeologists and DFN-modellers recognised the need for a common terminology associated with sheet joints. The term is used to describe tensile fractures (i.e. joints) developed essentially parallel to the topographic surface and divide the shallow part of the bedrock into thin layers with an increased spacing towards depth.

In 2019, SKB decided to use the term "sheet joint" instead of "sheeting joint", which is more widely invoked in the literature. The following nomenclature, along with the Swedish translation, is strongly recommended:

- **Sheet joints** (*Swedish: Bankningssprickor*): Fractures that bound sheet-like rock layers or plates. They exhibit generally the key kinematic qualities of joints and the term "sheet fractures" should be avoided.
- Sheets (Swedish: Bankar): The thin rock layers or plates.
- Sheeting (Swedish: Bankning): The process of development.

Avoid the ambiguous term "sheet structure" as it is unclear whether it refers to the sheets themselves or the joints between the sheets.

# 4.3.2 Observations at Forsmark site

With a rather flat topography in combination with local regolith filled depressions, observations of sheet joints in the Forsmark area are primarily limited to boreholes and the rock excavations made during the construction of the nuclear power plants. A documentation of the fracture character in the shallow rock mass in proximity to the nuclear power plants, with special focus on reactor block 3, is provided by Carlsson (1979). The study also presents details regarding the fracture distribution along an approximately 500 m continuous section of the inlet channel (Figure 4-15), located just north of the planned accesses and operational area of the repository for spent nuclear fuel. The maximum shaft height documented by Carlsson (1979) during the excavations is approximately 20 m.



*Figure 4-15.* Fracture distribution and the occurrence of sediment fillings in a 500 m long section along the northwestern shaft of the inlet channel. 1. Gneiss granite, 2. Pegmatite, 3. Greenstone, 4. Crush zone, 5. Sediment-filled fracture, 6. Fracture partly filled with sediment, 7. Fracture without sediment filling. From Carlsson (1979).

Carlsson (1979) states that shallow horizontal to sub-horizontal fractures (i.e. what we here denote sheet joints) occur, more or less, throughout the construction area where the main rock type consists of gneiss granitic rock (equivalent to 101057, medium-grained metamorphic granodiorite-granite according to SKBs current nomenclature), but are lacking in areas with paragneiss (inferred to be equivalent with 103076, felsic to intermediate metavolcanics rock or intensely deformed rocks according to SKBs current nomenclature). However, core drilling in the shallow bedrock in proximity of the planned accesses and operational area of the final repository for spent nuclear fuel has revealed a considerable spatial variability in the occurrence horizontal to sub-horizontal fractures; as shown by KFM08B and KFM14, there are shallow rock volumes where these fractures are significantly more sparse than for example along the inlet channel.

Reported trace lengths for shallow horizontal to sub-horizontal fractures observed along shafts range up to a maximum length of 176 m (along the inlet channel, cf. Figure 4-15), though most of them are less than 100 m. Furthermore, Carlsson (1979) proposes that the most extensive horizontal to sub-horizontal fractures occur in the uppermost part of the rock mass, down to about 3 m beneath the rock surface, a conclusion that might be attributed to the limited height of the shafts. Along the outlet tunnel to reactor 3, horizontal and sub-horizontal fractures with a trace length of 60 m have been observed at a level of approximately 35 m below the rock surface. (cf. Carlsson 1979, p. 40).

A significant proportion of the inferred sheet joints displays conspicuous apertures and many of them are filled with glacial sediment (Figure 4-16) with a grain-size distribution corresponding to sandy silt or clayey silt. Inferred sheet joints filled with glacial sediments have also been reported from drill site 5 (Leijon 2005) and 7 (Forssberg et al. 2007). The largest aperture in the Forsmark area has been described by Carlsson (1979) with a sediment-filled joint along the inlet channel that amounts to 820 mm (Figure 4-17). The aperture is highly variable along most sheet joints, in one case from a few millimetres up to 190 mm within a horizontal distance of about 2 m (Carlsson 1979).



*Figure 4-16.* Shaft wall along a water reservoir during the foundation of the nuclear power plant. A sediment-filled sheet joint with an aperture of approximately 0.5 m runs along the shaft. Photography by G. Hansson.



*Figure 4-17.* Shaft wall along the inlet channel with several sediment-filled sheet joints. The uppermost joint has a maximum aperture of 820 mm. Length of the levelling staff is 4 m. From Carlsson (1979). Photography by G. Hansson.

Carlsson (1979) concludes that horizontal to sub-horizontal fractures with distinct apertures, typically ranging up to 2 dm, are frequent in the uppermost 5 m of the rock mass. Boreholes from the subsequent site investigation confirm this pattern for substantial areas in the northern part of the Forsmark tectonic lens. Inferred sheet joints with apertures at 110–280 mm have been identified in five of the boreholes within the planned accesses and operation area of the repository for spent nuclear fuel. All of them occur in the uppermost 5 m of the rock mass, but in contrast to the joints observed at excavations none of them appears to be filled with unconsolidated material (Figure 4-18). Below that depth, joint apertures generally decrease, though intensely sheeted intervals with discernible apertures, occasionally up to tens of millimetres, are still frequent down to approximately -25 to -30 m in the northwestern part of the tectonic lens. The occurrence at greater depth is more sporadic. However, the distribution of inferred sheet joints with discernible aperture is rather heterogeneous and strikingly few in some boreholes, such as KFM14 and HFM41.

Sedimentary fillings are limited to the uppermost part of the rock mass, with the deepest observation 13 m below the rock surface (shaft walls at reactor block 3; Carlsson 1979). None of the boreholes drilled during the site investigations retain traces of sediment-filling, possibly due to an actual lack of sediments along the joints, but more likely as an effect of the drilling process, where the infilling has been worn or flushed away, although triple-tube barrel was used exclusively during entire site investigations. Accordingly, Carlsson (1979) noted that the sediment-filling frequently was flushed out of such joints during the drillings made in connection with the power plant foundation work.



**Figure 4-18.** BIPS images along sections of three boreholes KFM17, KFM20 and KFM23, in planned accesses and operational area of the repository. KFM17: Inferred sheet joint with an aperture of 125 mm at a level of -2.6 m (6.3 m borehole length). KFM23: Inferred sheet joint with an aperture of 280 mm at a level of -2.9 m (5.4 m borehole length). KFM20: Crushed interval with several fractures (some inferred sheet joints) with apertures of 15–30 mm between -3.8 and -6.3 m level (5.9–9.1 m borehole length). Distance between individual tick marks is 20 mm.

For the superficial horizontal to sub-horizontal fractures, Carlsson (1979) concludes that there are no obvious differences in orientation, length, spacing, aperture, filling material and roughness that can be related to the direction of the shaft walls. Moreover, the superficial horizontal to sub-horizontal fractures occur independently of all forms of discontinuities and cut as a rule across steeply dipping fractures, crush and fracture zones, dykes or other occurrences of amphibolite and pegmatite. All steeply dipping fractures in the shaft walls are intersected by the horizontal to sub-horizontal fractures (Figure 4-19). An assessment of the terminations of horizontal to sub-horizontal fractures conducted by Carlsson (1979) shows the following five types:

- Rock surface. Usually, the shallowest, sediment-filled fractures.
- Vertical to steeply dipping fractures (Figure 4-20a), but the horizontal to sub-horizontal fractures typically intersect the steeply dipping fractures.
- Branching into another horizontal to sub-horizontal fracture (Figure 4-20b).
- Crush or fracture zone.
- Rock mass, where the fracture gradually dies out (Figure 4-20c).



*Figure 4-19.* Shaft wall at reactor block 3, which displays a vertically dipping fracture zone (oriented 040°/90°) intersected by a set of sheet joints. Length of the levelling staff is 4 m. From Carlsson (1979). Photography by G. Hansson.

Carlsson (1979) has not recognised any spatial differences in the termination mode; most or all types of terminations are represented in each individual shaft. The vast majority of the shallowest horizontal to sub-horizontal fractures terminate against the bedrock surface, whereas the deeper fractures in most cases fade out in the rock mass. Sediment-filled fractures observed in the shaft walls intersect lithological contacts without displacement. However, uplifted and slightly rotated blocks, separated from the underlying bedrock by sub-horizontal fractures, are reported by Leijon (2005) from drill site 5.

# 4.3.3 Criteria for identification of sheet joints in boreholes

Sheet joints can be significant pathways to hydraulic modelling. The issue is to identify those sheet joints that are large enough to qualify for deterministic modelling. Information from the construction of the nuclear power plants in Forsmark (Carlsson 1979), suggests that aperture is the only reliable proxy for recognition of sheet joints with lateral size of several tens of meters or more. Based on this, sheet joints in Forsmark can be identified by using the following criteria for fractures and crushes in boreholes:

- 1. Dip of  $\leq 30^{\circ}$ .
- 2. Distinct aperture, i.e.  $\geq 1$  mm.
- 3. No noticeable slip/displacement.
- 4. No noticeable fracture coating or wall rock alteration.

Identification of sheet joints is not part of the regular core mapping procedure. Available mapping records may support the identification, but the final decision on whether a fracture is classified as a sheet joint, developed by extensional failure, requires a reassessment of the borehole image obtained by BIPS or OPTV.

Examples of typical sheet joints that fulfils the criteria are presented in Figure 4-21.



*Figure 4-20.* Shaft walls showing examples of terminations for sheet joints. a) Termination against a steeply dipping fracture. b) Branching into another sheet joint. c) Dead end in the rock mass. From Carlsson (1979). Photography by G. Hansson.



*Figure 4-21.* BIPS images showing examples of sheet joints with distinct aperture in two boreholes (KFM18 and KFM15) drilled in the planned accesses and operational area of the repository.

# 4.4 Complementary lineament interpretation

The complementary lineament interpretation work has been the primary basis for the following two modelling tasks:

- Extension and addition of regional deformation zones outside the SDM-Site regional volume for full coverage of the future sub-catchment area (Isaksson and Johansson 2020).
- Reassessment of the truncation pattern of deformation zones northeast of the SFR facility to eliminate artificial blind ends of previously modelled zones (cf. Curtis et al. 2011).

### 4.4.1 The DMS Baseline Forsmark area

At the request of downstream users and especially the hydrogeologists, the deformation zone model for Forsmark was expanded to include the future sub-catchment area, within the Site Descriptive Model – Safety Assessment Report (SDM-SAR) area. The DMS Baseline Forsmark area consists of a combination of the SDM-Site regional model area and the delineated future sub-catchment area (see Figure 4-22 and Section 2.5).

Identification of topographic and airborne geophysical lineaments has been carried out during the site investigations at Forsmark (Isaksson 2003; Isaksson et al. 2004, 2006a, 2006b, 2007; Korhonen et al. 2004; Isaksson and Keisu 2005; Johansson 2005). The lineaments have mainly been identified as magnetic lows. In several cases, lineaments have been verified by excavations and by drilling as representing deformation zones in the bedrock, whereas others have alternative geological explanations (Johansson and Isaksson 2006). Thus, an interpretation of lineaments, forming the base for further deformation zone modelling, was carried out within a delimited work area including the DMS Baseline Forsmark area (Figure 4-22).



**Figure 4-22.** Topographic location map showing the lineament interpretation work area (blue polygon) in relation to the area of DMS Baseline Forsmark (black line). The red polygon shows the supplementary area for the reassessment of the truncation pattern of deformation zones around the SFR facility. The SFR regional model area is presented as a yellow box. Revised from Isaksson and Johansson (2020).

The minimum trace length at the ground surface for modelling of deformation zones outside the SDM-Site regional volume was set to 5 km (see Section 5.4.5). To be in accordance with previous work, the lineament interpretation thereof has a minimum trace length at the ground surface of approximately 3 km. Lineaments were determined by identification and outlining vectors using visualization of the various magnetic, VLF (very low frequency) and elevation datasets.

#### Available data

The area of interest is covered by low-altitude airborne geophysical surveys, predominantly generated by the Geological Survey of Sweden (SGU) as part of their standard mapping activities. Surveys have also been carried out by the Geological Survey of Norway (NGU) on behalf of SKB and by Boliden AB for exploration purposes. Table 4-10 presents the various surveys performed in the area and their respective survey parameters. Figure 4-23 illustrates the areal coverage for datasets that have been used for this lineament interpretation work.

VLF data have been available mainly through the SGU surveys. From 1998, SGU also provide VLF apparent electrical resistivity calculated according to a method by Becken and Pedersen (2003). The resistivity data constitute a new data set compared to previous work in the Forsmark/Östhammar region. However, this data is only available in the northern part of the work area (Figure 4-23).



*Figure 4-23.* Available data coverages for the lineament interpretation work area. Revised from Isaksson and Johansson (2020).

DEM data from the work area consist of the Land-survey GSD, grid 50+, covering the whole work area and a special  $20 \times 20$  m grid provided by SKB. The latter is a mosaic of detailed land-based  $1 \times 1$  m grid elevation data and bathymetric data from the sea (Figure 4-24).



*Figure 4-24.* Digital elevation data, GSD, grid 50+, Lantmäteriet<sup>TM</sup>, covering the whole work area and an inset 20 m grid provided by SKB. The latter is a mosaic of detailed land-based elevation data and bathymetric data from the Sea. Figure revised from Isaksson and Johansson (2020).

Survey area	Forsmark (power plant)	13I SV, NV Österlövsta	12I Östhammar	13I Österlövsta	Forsmark SDM-Site
Contractor	SGU	Boliden	SGU	SGU	NGU
Flight year	1977	1979	1982	1998	2002
Survey direction	35°	0°, S–N	90°, E–W	90°, E–W	0°, S–N
Line spacing	200 m	Ca 150 m	200 m	200 m	50 m
Grid cell size	40 m	40 m	40 m	40 m	10 m
Ground clearance	ca 30 m	ca 30 m	ca 30 m	ca 60 m	ca 45 m
Reference	(Bergman et al. 1999)	(Bergman et al. 1999)	(Bergman et al. 1999)	(Bergman et al. 1999)	(Stephens et al. 2007)

Table 4-10. Survey parameters for airborne geophysical surveys in the study area. All surveys have been carried out in the Swedish grid RT90, 2.5 gon W, 0: −15.

#### Processing

The magnetic data has been interpolated to regular 40 and 10 m grids (Stephens et al. 2007, 2008b; Isaksson and Johansson 2020). For data enhancement and to facilitate identification and mapping of geological structures, bedrock magnetic patterns and lineaments, a package of transformations and filters have been applied to the interpolated magnetic grids. For the magnetic field, a colour RGB-composite of processed data layers, is presented in Figure 4-25.

For the 1982 VLF data, the total field is interpolated to a  $40 \times 200$  m grid and for the 1998 VLF data, the resistivity is interpolated to a  $40 \times 40$  m grid. To enhance the resistivity data from 1998, a so called "Peaker"-functions has been applied according to Persson and Daniels (2002).

The DEM grid data has been enhanced by gradient calculations and other regular grid data or image enhancement algorithms.

#### Interpretation

Interpretation of lineaments has been carried out in accordance with the methodology and strategy previously used in the Forsmark site modelling. The methodology for interpretation and documentation of lineaments has previously been well described by Isaksson and Keisu (2005). From experiences during the site descriptive modelling Forsmark version 2.1, lineaments identified in topographic data showed major uncertainties, with the ground surface inconclusive in expressing the bedrock morphology. Electromagnetic methods such as active and passive (VLF) EM exhibited similar uncertainties, due to large topographic dependence and the proximity to coastal marine saltwater. Both topography and electromagnetic data also have poor spatial resolution and reproduction in the area covered by oceans and lakes, while airborne and ground magnetic data provide a more uniform basis for assessment. In short, it is assumed that magnetic data is considered a more reliable source for identifying deformation zones from mainly low magnetic lineaments (cf. SKB 2006; Stephens et al. 2007).

For the DMS Baseline Forsmark area, some specific conditions apply. The lineament interpretation was carried out to enable modelling of deformation zones with a minimum ground surface trace length of 5 km, up to the boundary of the future sub-catchment area. This also includes an extension of all previously modelled zones that are truncated along the boundary for the SDM-Site regional area. This regardless of whether the ground surface trace length of the zone exceed 5 km or not. Thus, there should be no artificial truncation of a lineament between the SDM-Site regional area and the surrounding sub-catchment area. However, in accordance with previous similar interpretations, the lineaments in this work have a minimum ground surface trace length of 3 km. Lineaments shorter than 3 km may, in exceptional cases, be included in the case where they constitute a termination of a longer lineament or if they, for a short distance, constitute an alternate or parallel route to the main lineament.

The methodology included identification, description and documentation of the spatial occurrence of lineaments primarily in magnetic data. Topographic and airborne geophysical VLF data were used as a backing for the identification, for descriptions and for support of tracking location and propagation of a magnetic lineament. In exceptional cases, a topographic or VLF lineament may be included if it is suspected to correspond to a gently dipping zone.



*Figure 4-25.* Airborne magnetic anomaly field from "Förstudie Tierp" and an inset map with magnetic total field from NGU Forsmark 2002. Red-green-blue (RGB) colour composite of reduction to the pole (in red) and horizontal derivative (in green and blue). Revised from Isaksson and Johansson (2020).

The identified magnetic lineaments were graded in low, medium, and high uncertainty mainly with respect to the clarity in which they appear but also through judgement regarding the specific geological and geophysical character of the lineament (e.g. Isaksson and Keisu 2005). In this work, two major groups of magnetic lineaments were distinguished by their magnetic nature:

- Magnetic minima, discordant to geological and geophysical trends.
- Magnetic minima connection, concordant to geological and geophysical trends.

A third group of lineaments typically distinguished as "magnetic maxima with dyke-like character" (Stephens et al. 2007), were not identified in this work.

The lineaments were described with attribute data in a table with the same content that was used in previous work (SKB 2006). Notable is attributes such as character, uncertainty, length, and mean orientation, as well as from which data-type a lineament has been identified. A weight attribute considered the degree of uncertainty and the number of methods in which a lineament has been identified. The weight attribute assessment yields an indication of the confidence of a lineament, which is also exemplified by the lineament visualisation in Figure 4-26.

The initially identified magnetic lineament segments (i.e. method specific/co-ordinated lineaments, Figure 4-26), were subsequently linked together into linked lineaments. At this stage, linked lineaments from previous work (Forsmark stage 2.2; Stephens et al. 2007), were also included, Figure 4-27. The identity and naming followed the previous nomenclature with the prefix plus its serial number. Lineaments that connect/link to previously interpreted lineaments of Forsmark stage 2.2 were given the same identity.

From this work, in total 96 linked lineaments was generated, to compare with 44 linked lineaments in the previous Forsmark stage 2.2 (Stephens et al. 2007). Fifty of the lineaments being completely new along their full extension. Twenty-six of the previously linked lineaments have not been affected by this work and are hence keeping their previous identity and extent. Twenty of the previously identified lineaments were extended outside the SDM-Site regional model area and was in some cases also modified within the SDM-Site regional area. For the latter, earlier identities were retained. Of all linked lineaments, 24 are classified as regional (length > 10 km) and 72 as local major (1–10 km in length).

Both the method-specific/co-ordinated lineaments and linked lineaments identified and outlined in this work was delivered to the SKB databases, along with the original and processed data (delivery SKBdata\_22\_093\_2). Further details, data and results of the work is presented in Isaksson and Johansson (2020).



*Figure 4-26.* Method specific lineaments identified and outlined in this work. Revised from Isaksson and Johansson (2020).



*Figure 4-27.* Linked lineaments identified and outlined in this work. Revised from Isaksson and Johansson (2020).

# 4.4.2 The area northeast of the SFR facility

In the deformation zone model for SDM-PSU, a few lineaments with artificial truncation occur at the regional model boundary (see Curtis et al. 2011). Thus, a supplementary lineament interpretation was carried out in the area around and adjacent to the SFR facility (Figure 4-22) as a basis for handling deformation zones modelled with artificial terminations. Basically, these discrepancies mostly occur in the near shore sea area, where detailed ground geophysical magnetometry data is lacking.

### Available data and processing

As mentioned in Section 4.4.1 (sub-section Interpretation), magnetic data in general is considered a more reliable source for identifying deformation zones from mainly low magnetic anomalies. However, specifically in the area around the SFR facility, the various magnetic data are disturbed by the Fennoscandia DC power cable, (cf. Figure 4-25). In this work, a single flightline from the NGU airborne magnetic survey (2002), parallel (~ south–north) to the DC power cable and about 1.4 km towards east, was also recognized with an additional and probable line error (Figure 4-28).



*Figure 4-28.* The lineament reassessment area around the SFR facility and the SDM-PSU regional model, with the near shore, Sea bedrock surface model (Petrone et. al. 2020).

With this as background, it was decided to utilize bedrock surface data from a regolith depth model (RDM), presented by Petrone et.al. (2020), as a complement (see Section 2.6). This RDM model visualises the present spatial distribution of the regolith, as well as a model of the surface of the bedrock (Figure 4-29). In the absence of reliable magnetic data in this area, the bedrock model was used to support lineament interpretation. The bedrock surface DEM,  $20 \times 20$  m grid data, was enhanced by calculations of gradients and other regular image and grid enhancement algorithms.



Figure 4-29. Reassessment lineaments around the SFR area and the SDM-PSU regional model, within the network of linked lineaments presented in Figure 4-27 (cf. Isaksson and Johansson 2020). For legend text contents to DMS Baseline Forsmark, see Figure 4-27. For layout and clarity reasons, lineaments are not included within the SDM-PSU regional model area.
#### Interpretation

The supplementary lineament interpretation in connection with the SFR area was carried out under the following conditions, in general like the procedures described in Section 4.4.1 (sub-section Interpretation):

- Decisions on structural relationships between, and linking of, individual lineaments rely largely on the tectonic concepts adopted for development of deformation zones in Forsmark (see Section 5.1.1).
- A minimum lineament length of approximately 300 m was applied. Shorter lineaments were allowed to be included in the case where they constitute a termination of a longer lineament or if they, for a short distance, constitute an alternative or parallel route to the main lineament.
- Focus on the area north and northeast of the SDM-PSU regional area, which did not exclude additions and adjustments within the adjacent outside areas defined by the red polygon in Figure 4-22.
- Addition of new lineaments and adjustments of existing lineaments if required.
- Regional lineaments from the DMS Baseline Forsmark area, as outlined and described in Section 4.4.1, were not adjusted (Figure 4-29).
- At the boundary to SDM-PSU regional area, lineaments in the reassessment area were adjusted and adapted to the lineaments within the SDM-PSU regional area.
- Basis for interpretation was primarily the inferred rock surface below the seabed, bathymetric, refraction seismic and, high-resolution ground and airborne magnetometry data. The latter described in Section 4.4.1.
- Lineament identity according to Section 4.4.1 (sub-section Interpretation). New lineaments were named with consecutive numbers starting with "MFM3550".

From this work, in total 93 linked lineaments was generated or revised; 42 of the lineaments were completely new along their full extension (Figure 4-29). Of all linked lineaments, 43 were classified as local major (1–10 km in length), 50 as local minor (< 1 km) and none as regional (length > 10 km).

Both the method-specific/co-ordinated lineaments and linked lineaments identified and outlined in this work were delivered to the SKB databases, along with the basic and processed data (delivery SKBdata\_22\_093\_2).

## 4.4.3 Geological significance

Low magnetic lineaments may represent different geological features. The assumption that they are expressions of steeply dipping fracture zones relies on the frequent association with bedrock oxidation, characterised by martitization of magnetite and development of hematite dissemination within feldspars (cf. Table 4-4). The alteration type is commonly coincident with decreased magnetic susceptibility, which in turn gives rise to a minima in the magnetic total field.

During the site investigations that preceded SDM-Site, extensive efforts were taken to investigate the nature of low magnetic lineaments of different character and orientation (cf. SKB 2006; Stephens et al. 2007). Observations both along zone intersections in boreholes and trenched outcrops excavated across interpreted lineaments, provide undisputed support to the use of low magnetic lineaments in the identification of steeply dipping fracture zones. Although the majority of the excavations across low magnetic lineaments inside the Forsmark tectonic lens show that they represent steeply dipping zones, there are exceptions. Based on previous conclusions presented in various modelling reports (e.g. SKB 2006; Stephens et al. 2007), the geological significance of the low magnetic lineaments in Forsmark can be summarised as follows:

• Lineaments defined by discordant magnetic minima primarily represent steeply dipping zones. However, the lineament model does not always match the inferred structural concepts, which means that the extent of steeply dipping zones can deviate locally from the lineament pattern. Furthermore, excavations show that dykes that are composed of Group D granite and pegmatite have magnetic signatures that are similar to those observed along fracture zones, which therefore, introduces some element of uncertainty in the interpretation of such lineaments.

- The high-resolution data indicates that the strike-slip displacement along the steeply dipping fracture zones is minor.
- Inside the Forsmark tectonic lens, lineaments classified as magnetic minima connections are inferred to be related primarily to lithological contrasts that are aligned parallel to the ductile tectonic foliation in the bedrock (Stephens et al. 2007). However, the occurrence of minor fracture zones along the tectonic foliation cannot be excluded as a contributory factor.
- Along the margins or in the ductile high-strain belts outside the tectonic lens, where all structures are concordant, it is generally impossible to distinguish magnetic minima connections that are simply related to lithological contrasts from those that are related to deformation zones with an initial ductile development. The uncertainty in the interpretation of such lineaments is significant, especially regarding their length (see Section 8.2).
- Areas with low magnetic intensity and with low relief can be related to intersections of discordant, low magnetic lineaments. Areas of diffuse magnetic patterns may indicate a deeper bedrock source and/or the presence of fractured and altered surface rock.

Furthermore, a field effort was undertaken by the modelling team in early 2021 to investigate the geological significance of E–W trending lineaments at northern Gräsö. Outcrops along three interpreted lineaments MFM3513, MFM3514 and MFM3518 of Isaksson and Johansson (2020) with associated splays were visited (cf. Figure 3-4). At this scale, segments of the lineaments are largely defined by regolith-filled, topographic depressions, with some support from VLF data. However, the degree of bedrock exposure in some areas along the lineaments would definitely be sufficient to reveal the existence of regional deformation zones, especially the low-grade ductile components typically associated with such zones. None of the outcrops show structures with obvious relation to deformation zones of regional extent. Instead, the lineaments are attributed to the trend of penetrative ductile deformation and local anthropogenic features such as power lines and roads.

# 4.5 Seismic processing

The seismic data acquired along LFM001021 and LFM001023 indicate a frequently occurring, 2-3 m thick, transition zone between the bedrock and the Quaternary cover material, with velocities  $\leq 4\,000$  m/s (Mattsson 2013). Considering the known distribution of sheet joints at Forsmark, with the highest frequencies down to about 3 m beneath the rock surface (cf. Carlsson 1979), it is inferred that this low velocity layer is a result of fractured near-surface bedrock, locally in combination with the presence of till.

Several minor sections of low rock velocity, including one 10 m section, has been identified by Mattsson (2013) as possible minor fracture zones. However, a comparison with magnetic minima and modelled deformation zones shows poor correlation. Both ZFMNNW1205A and ZFMNNW1205B intersects LFM001021, but no associated low velocity anomalies can be distinguished. The only possible match is between ZFMNNW1205A and one of the minor low velocity sections along LFM001023. The limited correlation rate is in accordance with the outcome of a previous study presented by Isaksson (2007) on the correlation between the refraction seismic data, low magnetic lineaments and deformation zones of Forsmark, model stage 2.2.

Low velocity anomalies that do not match low magnetic lineaments and/or modelled zones may represent the following features:

- Unidentified fracture zones, preferentially minor zones or/and zones without associated wall rock oxidation.
- Narrow depressions in the bedrock surface filled with Quaternary cover material.
- Local variabilities in the vertical extent of the more intensely fractured layer of near-surface bedrock (see Figure 4-30).



*Figure 4-30.* Examples from shaft walls along the inlet channel that illustrate the local variability in the fracture intensity in the near-surface bedrock. The distance between the two localities is ca 20 m. Length of the levelling staff is 4 m. From Carlsson (1979). Photography by G. Hansson.

As previously summarised by Stephens et al. (2007), the refraction seismic data acquired at Forsmark can identify low velocity anomalies in brittle deformation zones, which contain sections of open fractures or crushed bedrock that are 5 m or wider. The method is less efficient for the identification of brittle deformation zones defined by sealed fractures and sealed fracture networks. Another problem is the often inhomogeneous character of deformation zones, as well as the large number of low velocity anomalies without direct relation to geologically verified fracture zones.

The GPR data along the six lines LFM001020–LFM001025 have generally poor signal penetration. Thus, the measurements provide very limited complementary information regarding the near-surface bedrock conditions (cf. Mattsson 2013).

Based on reflection seismic processing of the refraction seismic data acquired from LFM001021 and LFM001023, Juhlin (2016) has identified a sub-horizontal reflection (G8) at about 60 m depth that can be traced under much of the survey area. Since no boreholes penetrate the reflecting interface, it has not been possible to give a definite answer to the cause of the reflection. A conceivable possibility is that the reflector represents the transition from the more fractured bedrock of FFM02 to the underlying, more intact FFM01. Significantly higher apparent velocities on the farthest offset data support this suggestion (Juhlin (2016). However, borehole data acquired in the proximity to the G8 reflection show that the boundary between the domains is shallow in this part of the lens and lies at about 25–40 m depth (cf. Section 7.6). Other potential sources to the G8 reflection are lithological changes, a gently dipping fracture zone or a concentration of deep-seated sheet joints. An interpretation where the G8 reflection represent a northwestern continuation of deformation zone ZFM1203 can be rejected, both due to differences in depth and the lack of geological indications along boreholes situated northwest of ZFMENE0159A (cf. Section 5.4.4). Thus, drilling of the reflector in locations where it is most clearly observed on the seismic data is essential to determine its origin.

# 5 Deterministic model for structures (DMS)

# 5.1 Conceptual model

## 5.1.1 Deformation zones

Structural observations with bearing on character of deformation in combination with the truncation pattern of lineaments and previous modelling work, indicate that four distinctive sets of deformation zones are present at the Forsmark site. A conceptual model for the formation and reactivation of the different sets of deformation zones has successively grown in confidence as progressively more data have been available (SKB 2005, 2006; Juhlin and Stephens 2006; Stephens et al. 2007). A key component in this work was the use of low-temperature geochronological data that provided insights in the exhumation and cooling history, the relative time relationships and absolute age determinations of fracture minerals. For an overview and evaluation of these data, the reader is referred to Söderbäck (2008). No new information from subsequent analytical work contradicts the conceptual understanding that was presented earlier, and the model was consequently adopted both for the deformation zone modelling of SDM-PSU and Baseline Forsmark.

The conceptual fundaments of the model can be summarised as follows:

- The spatial distribution and geometric relationships between the deformation zones have largely been steered by the pronounced ductile anisotropy in the bedrock, with contrasting crustal segments of the tectonic lenses surrounded by broader high-strain belts.
- All four sets of deformation zones have been formed in the same tectonic regime and the geometric relationships between the different sets are consistent with their formation in a strike-slip tectonic regime.
- The oldest discrete structures in the area are the steeply dipping, WNW–ENE and NW–SE striking zones (e.g. Singö deformation zone) with an initial development in the ductile regime.
- Brittle multiphase reactivation of different sets of deformation zones in response to changes in the stress situation during the subsequent tectonic evolution.
- Reactivation with local shear failure and dip-slip normal displacement in connection with loading and unloading cycles around and after ca 1.45 Ga.

The current model for the Proterozoic (post-1.85 Ga) tectonic evolution at Forsmark is illustrated schematically in Figure 5-1 as a strike-slip fault system. The structural hierarchy reflects a variation in both the regional significance and relative timing of formation of these structures. Regionally important, WNW striking deformation zones (Forsmark, Singö and Örskär), and the NW splays from these zones (e.g. Eckarfjärden deformation zone), are ranked as first and second order R-Riedel structures, respectively. It is proposed that these structures formed by dextral strike-slip displacement in response to bulk crustal shortening in a N–S to NNW–SSE direction, during the latter part of the Svecokarelian orogeny (stage 1 and 2 in Figure 5-1). The activation of some steeply dipping NNW striking structures with sinistral strike-slip displacement is also inferred to have occurred at this stage in the tectonic evolution. Steeply dipping ENE to NNE striking structures are inferred to be initiated as third order antithetic Riedel structures with sinistral strike-slip displacement (stage 2 in Figure 5-1). In the same system, gently SE- and S-dipping structures are developed as fourth order structures as thrust faults sandwiched between the first and second order structures. By this, a framework for truncation of zones has been established.

All the four sets of deformation zones underwent significant reactivation during younger transpressional tectonic events, involving bulk crustal shortening in both NE–SW (possibly Gothian) and WNW–ESE (Sveconorwegian) directions. Documented sinistral strike-slip displacement along the WNW–ENE and NW–SE striking zones can be ascribed to these changed stress regimes. It is further suggested that a conjugate relationship between steeply dipping ENE striking structures and NNE to N–S striking structures, with sinistral and dextral strike-slip displacements, respectively, are related to these episodes, as well as dextral horizontal movement along the steeply dipping NE striking structures (stage 3 and 4 in Figure 5-1). During these reactivations, gently dipping zones were subjected to reverse dip-slip or strike-slip compressive deformation. According to the tectonic model, it can be expected that the gently

dipping zones in the southeastern part of the Forsmark lens follow boudinaged layers of amphibolite (see Section 5.5) and both truncate against the steeply dipping ENE to NNE striking structures and are displaced by them.



**Figure 5-1.** Two-dimensional illustrations of the Proterozoic (post-1.85 Ga) tectonic evolution at Forsmark, with the inferred maximum principal paleostress ( $\sigma$ 1) (Saintot et al. 2011) shown in grey. Transpressive deformation with a regional NNW–SSE  $\sigma_1$  axis, combined with clockwise stress deviation inside the Forsmark tectonic lens between the Eckarfjärden and Singö DZ with a more NNE–SSW direction for the  $\sigma_1$  axis (blue symbols), resulted in dextral strike-slip along regionally significant WNW–ESE and NW–SE deformation zones during the waning stages of the Svecokarelian orogenesis (stages 1 and 2). Younger transpressional tectonic events with NE–SW and nearly E–W  $\sigma_1$  axes at 1.7–1.6 and 1.1–0.9 Ga (stage 3 and 4) resulted, for example, in sinistral reactivation along the WNW–ESE and NW–SE zones. The size of the arrows indicates an inferred variable degree of activity along the zones. Modified after Stephens et al. (2015).

Around and after c. 1.45 Ga, loading and unloading cycles related to the deposition and denudation, respectively, of sedimentary rocks or glacial material have provided a significant impact on the geodynamic evolution in the Forsmark area. Based on kinematic data, it is suggested that the loading of sediments is related temporally with the reactivation of steeply dipping zones in the form of minor shear failure and dip-slip normal displacement. By contrast, unloading resulted in the reactivation of especially gently dipping structures, in the form of extensional failure and the development of dilatational joints. These loading and unloading cycles also invoked the driving mechanisms behind the formation of sheet joints, which is further discussed in Section 5.1.2. Sedimentary loading, besides tectonic events, was also a process of inferred significance for the build-up of high rock stress, a feature that presently characterises the northwestern part of the Forsmark tectonic lens down to ca 500 m depth (SKB 2008a).

Another relevant aspect to the deterministic modelling is the complex architecture of individual deformation zones. The current concept of brittle deformation zones (i.e. fracture zones) makes use of the generally accepted division of zones into undeformed host rock, transition or damage zone, and fault core (cf. summary in Hermanson and Petersson 2022 based on Munier et al. 2003), as well as the site-specific characterisation by the single-hole interpretation (Figure 5-2). At Forsmark, parts defined as transition or damage zones can range in thickness from a few metres up to several tens of metres. Relative to the unaffected host rock, these parts generally exhibit higher fracture frequencies and a more conspicuous hydrothermal alteration. The latter is defined by red-staining (see Section 4.2.2) due to sub-microscopic hematite dissemination of the minerals along the wall rock adjacent to fractures. Both sealed and open fractures usually increase in abundance inside the damage zones. In addition, damage zones can enclose segments of bedrock reminiscent of the unaffected host rock outside the actual deformation zone.

Based on the zone characterisation completed during the second stage of the single-hole interpretation (only available for boreholes from the site investigations that preceded the SDM-Site, see Section 4.1.1), fault cores have been recognised in approximately 50 % of the possible deformation zones identified with high confidence (SKB 2008a). These fault cores are typically intensely fractured with the occurrence of especially sealed fractures in complex networks, in combination with rock alteration. Cohesive breccia or cataclasite are also frequent along some fault cores. The thickness of the fault core ranges from a few centimetres up to a few metres. None of the studied zones contain fault gouge.



*Figure 5-2.* Schematic illustration of a brittle deformation zone, showing various segments of undeformed host rock, damage zone, and fault core. Modified after Munier et al. (2003) and Hermanson and Petersson (2022).

## 5.1.2 Sheet joints

Sheet joints are evidently tensile structures thought to develop parallel to the two greatest principal compressive stresses in the rock mass. Perhaps the most widely invoked explanation for the origin of sheet joints is pressure release due to erosion of overburden (e.g. Thornbury 1954). This hypothesis is, however, inconsistent with some crucial field observations reported in the literature (e.g. Holzhausen 1989; Twidale 1973), and has consequently been abandoned during recent years by several workers in favour of an alternative mechanism involving compression parallel to a convex bedrock surface (Twidale et al. 1996; Martel 2011, 2017).

The basic principles of the mechanism are provided by Martel (2011, 2017), with a starting point in the variation of tensile stress normal to the ground surface (T) as a function of depth (z). Under the prime influence of gravitational stresses, this function has a straight, negative slope (Figure 5-3a, dashed curve). Other quantities with bearing on the function are the compressive stress parallel to the ground surface and the surface shape. Strong compressive stresses parallel to the ground surface in combination with a convex surface curvature can yield a positive slope (Figure 5-3a, solid curve), with a resulting tensile stress normal to the surface at shallow depths.

The next step to illustrate the essential physics of the mechanism, is by a thin element bounded by a convex, traction-free upper surface, which can be considered as a "skin" of a bedrock outcrop (Figure 5-3b). Compressive stresses acting parallel to the convex surface yield a net outward radial force on the element. If this overcomes the inwardly directed net force of gravity and the tensile strength of the material at the base, the element is brought into disequilibrium and would separate from its substrate.

Martel (2011, 2017) has expressed this by a re-formulation of the static equilibrium equations for a traction-free surface in a curvilinear reference frame, with two contributions from curvature-stress products and a contribution from gravity (see Figure 5-3c):

$$\left. \frac{\partial T}{\partial z} \right|_{z=0} = \phi = \sigma_{11}k_1 + \sigma_{22}k_2 - \rho g \cos\beta$$
(5-1)

 $\varphi$  = slope in Figure 5-3a

 $k_1$  and  $k_2$  = the most positive and least positive curvature, respectively, at a point on the surface

 $\sigma_{11}$  and  $\sigma_{22}$  = stresses parallel to the surface in the directions of  $k_1$  and  $k_2$ , respectively

- $\rho$  = density of the bedrock
- g = gravitational acceleration
- $\beta$  = slope of the surface (cf. Figure 5-3b)



**Figure 5-3.** A series of figures from Martel (2011) to illustrate the mechanism of sheet jointing. (a) Curves showing the tension normal to a traction-free surface (T) as a function of normal depth (z) below the ground surface. The solid curve has a positive slope ( $\varphi > 0$ ) in the shallow depths, whereas the dashed curve has a linear negative slope with progressively more compressive stresses with depth. (b) Cross-section showing compressive stresses (unlabelled bold arrows) parallel to a thin concave element of a traction-free surface with a tensile stress (T) at the base of the element. R = radius of surface curvature. (c) Curvilinear local reference frame with its origin at the surface of a convex body, with axes aligned along directions of the principal curvatures.

Where the sum of the two stress-curvature products exceeds the negative contribution from gravity,  $\varphi$  will be positive and a resulting tensile stress arises perpendicular to the surface at shallow depths; a necessary criterion for the formation of sheet joints.

An important aspect of this equation is that the penetration depth of the curvature-induced tension is fully dependent on  $k_1$  and  $k_2$  with principal radii of R = 1/|k| (cf. Figure 5-3b). The consequence is that the penetration depth increase as the surface curvature decreases. Thus, sheet joints beneath broad, gently curved surfaces would extend to greater depths than those beneath small highly curved bumps (Martel 2011).

An additional positive contribution to the driving pressure gradient is water pressure, which expands and deepens the regions where sheet joints can develop substantially.

Rock type properties, in terms of unconfined compressive strength and density, are also decisive for the development of sheet joints, which explains frequent reports from massive rocks, such as granites, with an ability to sustain high compressive stresses. Accordingly, sheet joints are conspicuously absent in intensely fractured rocks (e.g. Jahns 1943) and weak rocks such as shales, which fail in shear under large differential stresses (e.g. Nygård et al. 2006).

Since the mechanism of Martel (2011, 2017) fails to account for the formation of sheet joints in non-convex bedrock morphologies, Ziegler (2013) argues for an alternative approach with formation as extensional fractures in an anisotropic, compressive stress field, analogue to longitudal (axial) splitting. Accordingly, the joint onset is dependent on the crack initiation threshold and the development into a macroscopic sheet joint requires a maximum/minimum principal stress ratio ( $\sigma_H/\sigma_v$ ) that exceeds approximately 10 (Ziegler 2013). The mechanism finds primary support in joint surface morphologies (fractographic markings), laboratory experiments and the in situ stress state with high in situ compressive stresses in the shallow rock mass. A problem is that the crack initiation threshold for the competent, often granitic rocks, in which sheet joints tend to occur, generally is far too high (approximately 30–60 % of the uniaxial compressive strength, e.g. Martin 1997) to allow the initial joint formation. Thus, either the sheet joint propagation depends on pre-existing microcracks or a process such as stress corrosion (cf. Ziegler 2013 and references therein) that might allow crack initiation at a lower differential stress.

According to the formation mechanism proposed by Martel (2011; 2017), the key parameters responsible for sheet joints are:

- large surface-parallel compressive stresses, typically several MPa or greater, and
- a convex topographic bedrock surface with the ability to deflect the near-surface stresses.

The current stress magnitudes yielded by the proposed stress model for the shallow rock mass in Forsmark (Glamheden et al. 2007) are largely equivalent with the high compressive surface-parallel stresses in most sheeted rock masses (cf. Martel 2017), especially in FFM02. The conditions appear less favourable in FFM03, with considerably lower stress magnitudes in addition to stress-release through a package of gently dipping fracture zones (i.e., ZFMA4–A7, ZFMB1 and ZFM866) is to be expected (see Figure 5-4).



*Figure 5-4.* Distribution of maximum horizontal stress models along a NW–SE striking profile in the northwestern part of the tectonic lens. Blue shades represent reduced stress magnitudes caused by stress release in FFM02 and FFM03 compared with the "normal" stress magnitudes shaded green. From SKB (2008a).

The second parameter of significance is the curvature of the bedrock surface. The current bedrock topography of Forsmark combined with a low-gradient shoreline do not appear to possess sufficient curvature to account for the systematic appearance of sheet joints described in Section 4.3. However, turning to the recent tectonic history of the Forsmark area, loading and unloading cycles in connection with burial/denudation of sedimentary rocks and glaciations/deglaciations have provided a profound impact on the stress situation in the near-surface realm, which in turn influence the potential to develop sheet joints. In addition to stress build-up, such loading tends to produce an elastic upward bending of the lithosphere peripheral to the sedimentary basin or glaciated area. The phenomenon is known as flexural or peripheral forebulge and could produce an uplift that amounts to 3–4 % of the maximum depression, independent of the mantle rheology (e.g. Brotchie and Silvester 1969; Crampton and Allen 1995). The wavelength of such forebulges may range up to several hundreds of kilometres, whilst the amplitude is estimated to a maximum of several hundred meters. During the emplacement, the sedimentary or glacial load creates a radial crustal extension within the upper crust of the uplifted forebulge (Figure 5-5a); an unfavourable situation for the development of sheet joints. A collapse and simultaneous migration of the maximum forebulge during the phase of isostatic rebound, as the displaced mantle flows back into the area beneath the former load, give however rise to compression in the forebulge region (Figure 5-5b). The flexural stresses imposed by such a rebound may typically match or even exceed the magnitude of the prevailing tectonic stress field (e.g. Stein et al. 1989), with an inferred net horizontal compression of sufficient magnitude to promote formation or propagation of sheet joints.

With several loading-unloading cycles, it seems plausible that the majority of the sheet joints occurred as soon as the stress situation permit their development, perhaps already in connection with the exhumation of the sub-Cambrian peneplain or some Palaeozoic loading-unloading event, such as the sedimentary erosion of the foreland associated with the Caledonides (cf. Cederbom et al. 2000). Most of these sheet joints, inferred to have formed in response to early loading-unloading cycles, were hence already present at the time of the Late Cenozoic glaciations-deglaciations. As such they are available for reactivation and possibly glacially induced hydraulic jacking (cf. Hall et al. 2019), which is implied by the frequent occurrence of compacted sediment fillings and re-deposited pollen with pre-Holocene signature in the more surficial sheet joints at the Forsmark site (e.g. Carlsson 1979; Leijon 2005).

The general lack of mineral coating, filling or wall rock alteration in the sheet joints provide a scanty input to these speculations, since the deficiency can be attributed to near-surface processes of dissolution during the last c. 500 million years, as well as a recent origin during the Quaternary. However, there are actually a few inferred sheet joints that evidently have mineral coatings and/or wall rock alteration such as reddening (Figure 5-6). This suggests that at least some sheet joints have been attributed to hydrothermal activity and consequently were formed in response to or predate a major burial by sedimentary rocks, presumably during the Palaeozoic. Interestingly, Lidmar-Bergström (1997) proposes that sheet joints in the Jungfrun granite, in southeastern Sweden, are of Cambrian age or older, based on findings of sandstone infillings by Mattsson (1962).



*Figure 5-5.* Schematic illustration of flexural stress field in the lithosphere during the (a) loading and (b) unloading in connection with burial and removal of sedimentary rocks or ice sheets. Redrawn from Shaw (2012).



**Figure 5-6.** BIPS image showing a swarm of inferred sheet joints at 12.3–12.7 m length in percussion borehole HFM42. The character is typical for dilatational joints formed by extensional failure. Distinct reddening reveals hydrothermal oxidation along all joints. The main fracture swarm is located at ca 10 m below the bedrock surface.

The local spatial variability in the occurrence of sheet joints, as shown in the northwestern part of the Forsmark tectonic lens, can primarily be attributed to heterogeneities in tensile strength of the material (lithology, ductile fabric, etc.) in combination with the shallow stress conditions, where the latter is highly dependent of the shape of the bedrock surface. Another contributing factor may be differential glacial erosion.

# 5.2 Definition and naming of modelled objects

Definitions of the terms deformation zone and sheet joint are provided by Hermanson and Petersson (2022), with further details in Munier et al. (2003) and Stephens et al. (2007).

Deterministically modelled deformation zones and sheet joints are identified as ZFM and JFM, respectively, where Z = zone, J = joint and FM = Forsmark site. The abbreviations are followed by two to six letters or digits according to the following principles:

- Sheet joints a three-digit serial number starting at 001 (e.g. JFM004).
- Gently dipping (≤ 45°) deformation zones those based on inferred seismic reflectors inherit the
  name of the reflector (e.g. ZFMA3), whereas the remaining gently dipping zones are labelled by
  three to four digits (e.g. ZFM871). Zones divided into two separate segments (east and west), due
  to limitations of the RVS modelling tool, are denoted by the suffixes -e and -w (e.g. ZFMA6-e).
- Moderately dipping (> 45° to < 70°) deformation zones currently no such zones in the Baseline model.
- Vertical to steeply dipping (≥ 70°) deformation zones Two to three letters providing information about the strike of the zone, followed by four digits, typically inherited from the name of the primary lineament upon which the zone is based (e.g. ZFMNNW0999). Association between primary zones and subordinate splays and subsections are denoted by the suffixes A (primary zone), B and C (subordinate zones).

The letters that give information about the strike of vertical to steeply dipping zones are strictly applied according to the nomenclature introduced by Stephens et al. (2007) to name fracture clusters along deformation zones, but do not follow the right-hand-rule convention. Applied acronyms with corresponding strike values are as follows:

EW	085–095° and 265–275°
WNW	095–125° and 275–305°
NW	125–145° and 305–325°
NNW	145–175° and 325–355°
NS	175–185° and 355–005°
NNE	185–215° and 005–035°
NE	215–235° and 035–055°
ENE	235–265° and 055–085°

# 5.3 Methodology and assumptions

## 5.3.1 Heterogeneous zone resolution throughout the model volume

Before merging, the resolution of modelled deformation zones was different in the local and regional model volumes. Each volume contained all modelled deformation zones down to a certain size, based on the measured lineament trace length on the ground surface. Following the principle that a zone is represented by one geometry regardless of the model volume, the regional zones were identical in both the local and regional model volumes.

By merging, all modelled deformation zones are included in one single volume regardless of size. However, such a representation must be used with caution since it mixes sub-volumes of different data density within a single model boundary; heterogeneity in data density does not allow for deterministic modelling of small-size zones throughout the model volume. This in turn can have major implications to modelling of hydraulic connectivity or transport within the rock mass, as well as the rock stress modelling. In the current version of the Baseline Forsmark model, such uncertainties in the deterministic heterogeneity are addressed by alternative representations using stochastic DFN models (cf. Hartley et al. 2024).

## 5.3.2 Interpolation and extrapolation of zones

The low magnetic lineaments provide the starting point for the identification of steeply dipping (>  $70^{\circ}$ ) or vertical deformation zones at the ground surface. More uncertain, topographic lineaments based on depressions in the ground surface have been used locally in the areas where the magnetic data are of poorer quality, for example in the vicinity of the nuclear power plant (SKB 2005). The zone projection towards depth is achieved by matching the lineament to possible deformation zones identified along boreholes in the single-hole interpretation. The matching process is largely geometrical, but correlation is further supported by the overall geological character in the borehole, in particular the analysis of the orientation of fractures and brittle-ductile structures along the zone. Thus, the structural orientation in each zone is used as guidance to link a particular borehole section to a suitably oriented lineament. For modelled zones that intersect the SFR facility, the matching between lineaments and borehole data have been broadened to involve available geological information from the tunnels. Although scarce, outcrop data have also been considered in the modelling of a few zones.

Guidance for the truncation pattern along the strike direction of these zones, are provided by the lineament model in combination with conceptual understanding. Thus, generally the length of steeply dipping zones at the ground surface is represented by the length of the corresponding lineament. However, the overall continuity of the lineaments has been continually reviewed during the modelling

and the background data re-examined. Alternative alignments and extents for individual lineaments have been considered, often driven by geological information from boreholes or tunnel mapping and some have been implemented after a joint review by both the geologists and geophysicists.

The strike of steeply dipping zones is assumed to be determined by the trend of the matching lineaments, whereas the dip of the zones is determined by matching of lineaments to particular borehole and tunnel intervals. Strike and dip are denoted as the average angles along the entire extent of a zone. Deformation zones that are observed only at the ground surface and lack information on their sub-surface extents from boreholes and tunnels intersections and geometry, are generally estimated by comparison with the dip of zones that intersect one or more boreholes and show a similar strike. However, in the SDM-PSU these zones are assumed to be vertical.

Termination of zones at depth is made according to the following principles:

- The termination depth is equal to the trace length of the deformation zone at the ground surface (elevation = 0), if the length is less than 2 100 m.
- Zones with trace lengths exceeding 2100 m terminate at the base of the model volume (i.e. -2100).
- The extent of subordinate splays and subsections (i.e. B and C) is controlled by the termination depth of the main deformation zone (i.e. A; see examples in Figure 5-7).
- Rounding is based on the ground surface trace lengths, where trace length > 1000 m is rounded to the nearest 50 m elevation, and trace length < 1000 m is rounded to the nearest 10 m elevation.
- Departure from the principles of termination depth is allowed where a shorter zone is used for truncation of a longer zone; then the termination depth of the shorter zone has been increased to match the truncated zone.

Gently dipping deformation zones (<  $45^{\circ}$ ) have been detected by an integration of more distinct seismic reflectors and possible deformation zones identified along boreholes in the single-hole interpretation. As for the steeply dipping and vertical zones, the matching of a reflector to a possible deformation zone follows the same analytical procedure with guidance from especially fracture orientation data along the zone. The orientation of the gently dipping zones is provided by the inferred orientation of the corresponding seismic reflector and not the orientation of the fractures inside the zone.

In accordance with the conceptual understanding of the site, the modelled extent of the gently dipping zones has been constrained by the lateral extent of the supporting investigation evidence with an assumed truncation, both along their strike and dip, against the nearest regional or major deformation zone with steep to vertical dip. This approach has also steered the splay relationship between the gently dipping zones (Figure 5-8). However, there are some exceptions, as illustrated in Figure 5-8.



**Figure 5-7.** Examples of splays and subsections of deformation zones (red - B and C) where the termination depth is controlled by that of the main deformation zone (light red - A). View towards the northwest. Trace lengths at ground surface for ZFMENE1061A and ZFMNE0808A are 1 200 and 4 077 m, respectively.



**Figure 5-8.** Illustration of the splay relationship between some of the major gently dipping zones of the site where ZFM866, ZFMB1 and ZFMF1 are truncated against ZFMA3, whereas ZFMA2 and ZFMA8 are truncated against ZFMA3 and ZFMF1. View towards the ENE. Trace lengths at ground surface for ZFMA2 and ZFMA3 are 4031 and 3196 m, respectively.

# 5.3.3 Zone length

Similar to lineaments, deformation zone length is related to the scale of assessment and the elevation of measurement. Thus, length estimates only give a rough indication of deformation zone size.

The entity refers to a projection of the overall traceable zone length along the ground surface to elevation = 0 (RH2000). Zones that fail to reach the ground surface have hence no length indication. Estimated lengths take account of the continuation of a zone outside the model volume of DMS Baseline Forsmark.

## 5.3.4 Zone thickness

Brittle deformation zones (i.e. fracture zones) may in reality have very complex architecture with various segments of damage zone, fault core and parts virtually unaffected by the brittle deformation within the zone (see Section 5.1.1). As illustrated in the conceptual sketch of Figure 5-9, both the zone thickness and the proportions of the various segments may vary considerably along a zone, and consequently from one borehole to another. However, zones are modelled with constant thickness to include the internal variability, without distinction between damage zone, fault core and more unaffected parts (cf. Figure 5-9). This is because of the inability to interpolate structural details and variability over the distance of adjacent borehole (or tunnel) intersections. If ductile deformation is present along the zone, this is also included in the thickness estimate. However, the occurrence of intense ductile is largely limited to deformation zones of regional extent along the margins of the tectonic lens and the volume in proximity to the SFR facility.

Modelled zone thickness is primarily estimated based on borehole intersections, as supporting tunnels and outcrop observations are scarce. Where more than one borehole intersection exists, the thickness has either been defined as a mean value of the estimated thicknesses in all intersecting boreholes or by the estimated thickness in one or more borehole intercepts, judged to be most reliable. By this approach, parts of an inferred zone intercept along a borehole can occur outside the modelled zone boundaries and vice versa (Figure 5-9).



*Figure 5-9.* Simplified illustration of a brittle deformation zone divided into three different segments: fault rock (e.g. Cane et al. 1996), damage zone (e.g. Gudmundsson et al. 2001) and parts virtually unaffected by the brittle deformation along the zone. Red dashed lines outline modelled zone with constant thickness. Note the variable character and thickness of the zone along the two borehole intersections (BH1 and BH2). Redrawn after Cane et al. 1996 and Stephens et al. 2007.

Two specific borehole related terms are quoted in the deformation zone descriptions and accompanying property tables (Appendix 7), *target intercept* and *geometrical intercept*:

- A target intercept is the interpreted position of a deformation zone along a borehole essentially based on anomalously high fracture frequency (both open and sealed fractures) in combination with the existence of brittle-ductile deformation and hydrothermal rock alteration. In general, target intercepts conform to the intercepts of possible deformation zone identified during the geological SHI (see Figure 5-10), in certain cases with adjustments based on complimentary information. A target intercept is described by an upper and lower borehole length (sec\_up/sec\_low).
- A geometrical intercept is the intersection between a modelled zone and an individual borehole as they are modelled with the RVS modelling tool (see Figure 5-10). The intercept is described by an upper and lower borehole length (sec\_up/sec\_low) provided by the intersection of the bounding surfaces of the modelled zone.

Technically, deformation zones are modelled by fitting of a single origin surface to interpreted lineaments/reflectors and target intercepts along boreholes. Volumetric geometries or thicknesses to capture the target intercepts are achieved by perpendicular transposition of clones to the origin surface (Figure 5-10). For most deformation zones the origin surface is located centrally between the bounding surfaces with equal thickness values on each side. However, for the deformation zones of SDM-Site, the origin surfaces were modelled to reflect the inferred position of the zone core. Several of the zones inherited from SDM-Site (about one third of all zones in the Baseline version) have therefore origin surfaces with asymmetrical positions between the bounding surfaces (Figure 5-10).

Difficulties arise in the deformation zones where thickness data from boreholes, tunnels and outcrops are lacking. With support from the literature and a foregoing discussion of the serious limitation of the approach, Stephens et al. (2007) solved this by introducing a thickness-length correlation chart based on deformation zones where both thicknesses and lengths are "known". Since the length of gently dipping zones is highly uncertain, only vertical and steeply dipping deformation zones were included in the thickness-length correlation chart. The thicknesses of gently dipping zones that lack supportive geological and geophysical data were estimated simply by a comparison with the thickness of appropriate high confidence, gently dipping zones (see Stephens et al. 2007).



**Figure 5-10.** Detail of the origin and bounding surfaces (brownish red and grey, respectively) of deformation zone ZFMNW0003 relative to possible deformation zones (PDZ1, red) identified along the intersecting boreholes HFM11 and HFM12. The origin surface has been modelled with an asymmetric position relative to the bounding surfaces to reflect the inferred zone core. Inset – enlargement to illustrate the terms target and geometrical intercept.

With reservations for high degrees of uncertainties, the power law function  $T = 0.2L^{0.6}$  yielded by the thickness-length correlation chart presented in Figure 5-11 has been used to estimate the following two parameters for vertical and steeply dipping deformation zones of SDM-Site, where direct geological information was lacking:

- The thickness of deformation zones where only the ground surface length is known form associated lineaments. Calculated thicknesses are rounded off to the nearest 5 m.
- The possible range in thickness that might be expected along each deformation zone.

Although the function was established already during the Forsmark stage 2.2 modelling work (SDM-Site), it was subsequently applied to deformation zones of Forsmark version 2.3 (Stephens and Simeonov 2015) and all zones that were added or remodelled after the merging of SDM-Site and SDM-PSU. The basic arguments for this are:

- A reluctance to change of thicknesses of zones modelled during preceding stages where the underlying data for the specific zone remain unchanged.
- Consistency in the thickness estimate regardless of the stage during which the zones were modelled.
- Subsequent addition of zones (mainly local minor zones from the SFR area) and changes in thicknesses and lengths for zones of Forsmark stage 2.2 (cf. Figure 5-11), have rather limited effect on the power law function.

Regression analysis made by Curtis et al. (2011) to investigate possible zone thickness-length relationships of SDM-PSU revealed an inability at describing the aggregate data by a single relationship with any real statistical power. Therefore, an alternative approach has been applied to deformation zones of SDM-PSU without supporting geological information, where the assigned thickness is 1 % of the zone's trace length at the ground surface, rounded off to the nearest 5 m.



*Figure 5-11.* Power law correlation diagram between thickness and length at ground surface of deterministic deformation zones, based on model stage 2.2 data from Stephens et al. (2007). Corresponding data for the Baseline model are shaded; these are uncoupled to the power law regression.

In general, the possible range in thickness that can be predicted along each steeply dipping zone is estimated on the basis of five different length classes, as presented in Table 5-1. The maximum variability in thickness along each zone is defined by the thinnest and thickest zones within each length class. This means that virtually all steeply dipping zones within a specific length class have the same range in thickness. However, there are exceptions, which include the majority of the zones inherited from SDM-PSU. Thickness spans for these zones are instead based on a general assessment of available borehole and tunnel data for a particular zone.

Table 5-1. The length classes used to define possible thickness spans for the majority of deformation zones included in SDM Baseline Forsmark version 1.0.

Length [m]	Estimated thickness span [m]
< 500	2–30
500-1000	2–43
1000-3000	3–50
3000-10000	15–64
> 10000	50–200

## 5.3.5 Assignment of geological properties

The geological properties assigned to each deformation zone are given in Table 5-2. These are identical to those presented in the deformation zone property tables provided by Stephens et al. (2007), Curtis et al. (2011) and Stephens and Simeonov (2015) for SDM-Site and SDM-PSU. Except for an increased occurrence of borehole intersections along some deformation zones in proximity to the planned access volume of the final repository and immediately southeast of the SFR facility, the geological properties have been assigned using the same type of data as for SDM-Site and SDM-PSU.

Property	Comment						
Deformation style	Brittle, brittle-ductile or ductile, including the possible presence of fault rocks (e.g. cohesive breccia and mylonite).						
Sense of displacement	Described in terms of slip direction (e.g. normal, reverse, sinistral and dextral).						
Alteration	Type and degree of alteration.						
Fracture character	Main fracture character, including fracture types (open, sealed, crushes, sealed networks, etc). Due to the intrinsic limitations of the data on fractures from percussion boreholes, such data are generally only used when data on fractures from cored boreholes are lacking.						
Orientation	Strike/dip, right-hand-rule method. Based on evaluation of Terzaghi-corrected fracture stereograms. Only fractures visible in BIPS are included. Open/partly open and sealed fractures are differentiated. Clustering has been analysed by the definition of soft sectors (see Appendix 15 in Stephens et al. 2007 for further details).						
Frequency	Terzaghi-corrected P10 fracture frequencies. Open and sealed fracture frequencies are presented separately. Includes crushes and sealed networks, where the fracture frequency is calculated on the basis of the piece length of the rock fragments inside the structure. A direct count of fractures has not been made.						
Filling	Mineral coating or filling are specified for open/partly open and sealed fractures. In data from older SFR boreholes, this information differentiates between 'broken' or 'unbroken', in accordance with the limitations of the mapping technique applied at that time.						

 Table 5-2. Properties assigned to deterministic deformation zones of the Baseline Forsmark model.

Each geological property is assigned a property confidence level based on a three-level scale. Where geological data from borehole, tunnel or surface investigations are available, the properties of the zones are relatively well-constrained and, in many cases, a property is assigned a high level of confidence. However, properties are most commonly derived from a restricted number of borehole intersections and, only in a few cases, from tunnel investigations, surface outcrops or a single surface excavation. Thus, the estimated properties need to be treated with care when extrapolating to the bedrock beyond borehole and tunnel intersections. For that reason, some geological properties have been assigned a medium or low level of confidence, even if geological data from borehole, tunnel or surface investigations are present. The adjustment from a high to a lower level of confidence, for a particular geological property, includes:

- Medium level of confidence to the estimates of fracture character (orientation, frequency, and filling) in virtually all deformation zones, since these data emanate from a restricted number of borehole intersections.
- Low level of confidence to the assessment of the style of deformation and fracture frequency in zones intersected solely by percussion boreholes, due to insufficient data quality.
- Low or medium level of confidence to the estimates of the sense of displacement along zones, when shear striae data emanate from a restricted number of borehole intersections; less than nine measurements from one or more boreholes = low level of confidence, higher quantity of shear striae data from one or more boreholes = medium level of confidence.

Where geological data are lacking, general information about deformation style and alteration has been obtained by comparison with zones of similar orientation and size. Such estimates are assigned a low to medium level of confidence. No information regarding fracture character and sense of displacement is given for these zones.

# 5.3.6 Strategy for modelling of sheet joints

The dilatational nature of the sheet joints has significant implications for both the identification and modelling approaches. One issue is to identify individual joints of such extent that they allow deterministic modelling. Information from the construction of the nuclear power plants in Forsmark (Carlsson 1979), suggests that aperture is the only reliable proxy for recognition of sheet joints with lateral size of several tens of meters or more. Provided that there is an absence of sealing sediments, aperture is also the only geological parameter with the ability to suggest whether a joint may be of importance as flow path. Based on this, it was decided to focus the modelling work on sub-horizontal joints with distinct aperture. Once sheet joints with distinct apertures have been selected, questions regarding the deterministic modelling approach remains; is it possible to single out a specific joint in several boreholes or might the spatial distribution be handled volumetrically, by a domain concept? Contrary to structures developed by shear failure, sheet joints lack kinematic support for interpolation. Also, the possibility of extrapolation and the mode of termination differ from those of shear structures. Briefly speaking, sheet joints are less predictable than shear structures with increasing distance from the observation points. With a reasonable confidence in the validity of interpolation, individual sheet joints can therefore only be modelled deterministically in rock volumes where observation points are closely situated. The consequence of this is that some parts of the rock mass, with few or no observation points remains undescribed, which would be a violation of the "space filling" principles, which states that the geometrical model needs to be described at all points (Munier et al. 2003). A possible approach is to describe volumes with too few observation points to allow reliable deterministic modelling by coupled stochastic simulations. By using this approach, deterministic representations of individual sheet joints will serve as input to the stochastic modelling (cf. Hermanson and Petersson 2022).

Based on the argumentation in the preceding paragraph, it was decided to provide deterministic representations of individual sheet joints with distinct aperture, in those cases where available data permit modelling of acceptable confidence. This modelling principle relies primarily on assumptions established by Hermanson and Petersson (2022) for modelling of sheet joints based on observations from the excavation for the inlet channel to the nuclear power plants (Carlsson 1979) and details in the literature on sheet joints. Concerning orientation and extent, the following two assumptions are used to steer the modelling procedure:

- Due to the long-wave, flat topography of the bedrock surface in Forsmark, all sheet joints are inferred to be horizontal to sub-horizontal (dips ≤ 3°).
- The largest individual sheet joints can have dimensions of a few hundred meters laterally (i.e. the approximate size of the longest joint trace mapped by Carlsson along the inlet channel).

In accordance with these assumptions, the following approach has been used:

- To allow interpolation, observation points must be located at approximately the same elevation,  $\pm 1$  m.
- Whether an observation point is of hydraulic significance or not is irrelevant for interpolation.
- The aperture of individual observation points is irrelevant for the size (horizontal extent).
- A modelled surface must be based on three or more observation points.
- Surfaces are modelled by constant thickness with a minimum of 0.1 m.
- Interpolation based on geological observations is limited to a horizontal distance of 100 m, which is the approximate radius of the longest joint trace along the inlet channel (cf. Carlsson 1979). Additional interpolation up to 150 m is possible with support from hydraulic responses.

Analysing the borehole data, it became obvious that the modelling of individual sheet joints is incapable of describing the systematic distribution of sheet joints with aperture in the near-surface realm. Instead, it was decided to handle this by a further subdivision of FFM02 by introducing a horizontal boundary between an upper and a lower slab (see Section 7.5).

Thus, the deterministic representation of individual sheet joints at the Forsmark site is based on the mapping along the inlet channel by Carlsson (1979) and interpolation observation points in boreholes. Joints that fail to fulfil the criteria for individual representation are omitted (e.g. three or more observation points and observations separated by a horizontal distance of  $\leq 100$  m), irrespective of their actual extent.

Based on their dilatational nature, the termination mode of sheet joints differs to that of the shearinduced deformation zones. Sheet joints are expected to cross both steep geological structures and lithological boundaries, though they are assumed to interact with gently dipping deformation zones. Terminations can also occur due to a decreasing stiffness of the rock mass. However, the vast majority fade out without any obvious structural or lithological explanation. This has implications for the distance of confident extrapolation and individual sheet joints are extended to a horizontal distance that corresponds to 1/3 of the maximum distance between nearby observations. Additional details of the method used during extrapolation are provided by Hermanson and Petersson (2022).

# 5.4 Adjustments to deformation zones after merging the models

## 5.4.1 Naming

Extensions and shortenings along the strike of several deformation zones inherited from SDM-Site and SDM-PSU zones have affected their strike direction. These changes are typically limited to a few degrees, with a maximum of 6°. However, strictly applying the acronyms that give information about the strike of vertical to steeply dipping zones (cf. Section 5.2), requires revised naming for twelve of the modelled zones. For some of these zones, the discrepancy between the acronym and the actual strike dates back to the time before the models were merged. The zones with revised naming are listed in Table 5-3.

Original zone name (SDM-Site and SDM-PSU)	Zone name in Baseline Forsmark version 1.0
ZFMENE0810	ZFMNE0810
ZFMEW0137	ZFMWNW0137
ZFMEW1156	ZFMWNW1156
ZFMNNE2308	ZFMNE2308
ZFMNNE2309	ZFMNE2309
ZFMNNE3266	ZFMNE3266
ZFMNW0806	ZFMNNW0806
ZFMWNW0016	ZFMNW0016
ZFMWNW0036	ZFMNW0036
ZFMWNW0851	ZFMNW0851
ZFMWNW0974	ZFMNW0974
ZFMWNW8043	ZFMNW8043

Table 5-3. Deformation zones with revised naming due to changed strike or a less strict application of the acronyms for strike in previous model versions.

## 5.4.2 Geometric adjustments due to mering the models

#### Deformation zone doublets and thickness

Several deformation zones occurred in both SDM-Site and SDM-PSU. The majority are steeply dipping, NW- to WNW-striking zones, belonging to the deformation belts of Singö (i.e. ZFMWNW0001 with splays) and ZFMNW0805A. During the upgrading of Forsmark stage 2.2 to version 2.3, all deformation zones in the SDM-PSU regional model volume have been integrated (cf. Stephens and Simeonov 2015). It was consequently decided to select the geometric representations from the Forsmark version 2.3 as input to the Baseline model where there are doublets in the two models. However, three zone representations (ZFM871, ZFMENE3115 and ZFMNW0805A) from SDM-PSU replace those with the same name in the SDM-site.

Although the regional SDM-PSU model and the local model of Forsmark version 2.3 have identical size limits for deformation zones (see Section 2.1), the modelled thickness differs slightly between the two models for some of the zone doublets. The choice of zone geometry has affected the thickness for three zones ZFMNNE0725, ZFMNNE2308 and ZFMWNW0001, which all are adopted from Forsmark version 2.3. In addition, the thickness of the SFR-zone ZFMENE3115 has been reduced from 28 to 10 m, based on the following text from the zone's property table in Curtis et al. (2011): *"It should be noted that the modelled zone thickness of 28 m is based on KFR102A DZ3. An alternative interpretation of DZ3 is that it represents more than one zone, and this would result in a reduction of ZFMENE3115 thickness to around 10 m."* 

In connection with merging the models, changes were also made to ZFMNNE2312, a local minor deformation zone in proximity to the access volume of the planned repository for spent nuclear fuel (see Section 5.4.4). The thickness was reduced from 43 m to 19 m by using SHI DZ2 (the second possible deformation zone from the start of the borehole) of KFM08C and ignoring the data from percussion borehole HFM38.

#### Termination depth

During the merging process, individual deformation zones underwent a reassessment of the termination depth with strict application of the principles presented in Section 5.3.2. Departure from the principles of termination depth is allowed where a zone truncates a slightly deeper zone. On this basis, the termination depth has been extrapolated to a lower elevation for five deformation zones: ZFMENE3115, ZFMENE3135, ZFMNE3137, ZFMNNW0101 and ZFMNNW0404.

Application of the principles has resulted in changed cut-off depth for a total of 50 zones: 23 in SDM-Site, 21 in SDM-PSU and six minor zones with surface trace length < 1000 m in Forsmark stage 2.2. The revised termination is typically within 200 m of the original depths, although additional extrapolation of zones that were originally terminated against the base of the local model volume of SDM-Site can reach significantly larger depths, in one case (ZFMENE0401A) to the base of the regional model volume.

#### Extension, truncation and removal of deformation zones

ZFMNNE3130 of SDM-PSU is a medium confidence deformation zone, based on a single magnetic lineament. It was not modelled in SDM-Site and was consequently omitted from the merged model.

Extrapolation beyond the regional volume boundary of SDM-PSU has resulted in considerable changes in the lengths along the ground surface for two of the deformation zones, ZFMENE8034 and ZFMWNW1035. In addition, there are a few zones of SDM-PSU that have been subjected to minor changes, in the order of tenths of meters, in their ground surface trace lengths. The reason is primarily the use of truncating deformation zones from SDM-Site in favour of those in SDM-PSU. Another explanation is the abovementioned removal of ZFMNNE3130, which has given rise to blind ends for three deformation zones, ZFMWNW3267, ZFMWNW3268 and ZFMNNE1034.

## 5.4.3 Upgrading of the RVS modelling tool

SDM-Site and SDM-PSU were merged in the modelling tool RVS v6. Before the release of DMS 2020\_1 (see Table 2-4) the model was converted to RVS v7, which was introduced during the autumn of 2019. The RVS v7 allows for full application of object-based deterministic modelling, introduced by Hermanson and Petersson (2022) to meet the foreseen complexity beyond the Baseline modelling work. Through the conversion, each modelled geological object (deformation zone and sheet joint) is stored with its specified geometry and position in the RVS central object library. The Baseline geological model is an assemblage of all these objects in their final form, extracted from the central object library for downstream usage.

RVS v7 provides several additional advantages over RVS v6, of which the most important items are:

- Introduction of active constraints, which means that a zone that is cut against another is automatically adapted to the new geometry of the cutting zone if this is remodelled.
- Ability to acquire volumetric representations of geological objects without the previous timeconsuming step of block modelling.

Since the introduction of RVS, there have been problems where unevenly distributed data has caused the geometry engine to generate meshes with strongly elongated triangles. However, with RVS v7 there is a change for the better, resulting in softer surface geometries and smoother folds. This change influences clearly the object geometries, not in the fix points along borehole, tunnel and ground surface intersections, but in inter- and extrapolated parts of the object surfaces. For deformation zones based solely on lineaments, the deviation is insignificant, reaching a few decimetres. However, the deviations for zones with subsurface borehole or tunnel intersections can locally amount to tens of meters in volumes without fix points, as illustrated for ZFMNNW1209 and ZFMNNE2273 in Figure 5-12. Even if the object geometries have changed significantly *between* the fix points, it needs to be emphasized that the new representations by RVS v7 are "as true as" the representations by v6.



*Figure 5-12. Examples of geometric changes due to the conversion from RVS v6 to RVS v7. Origin surfaces for ZFMNNW1209 and ZFMNNE2273 in RVS v6 (grey) and v7 (pale red).* 

Another change is the technique to truncate deformation zones. In RVS v6, the volume of a truncated zone ends against the origin surface of another zone, but in v7 the volume ends at the bounding surface of the truncating zone (Figure 5-13). As a consequence, it is possible that borehole intercepts actually used for modelling of a specific zone (attached to the origin surface as points), fall outside the bounding surfaces of the same zone (Figure 5-14). However, the intercept is still contributing as an input to the geometry of the zone.

# 5.4.4 Revision based on data acquired after 2010

#### The access volume of the planned repository for spent nuclear fuel

Data from excavation trench AFM001393 and borehole investigations conducted in KFM13–KFM27 and HFM39–HFM47 have provided information that require updated geometries for several of the deformation zones in the vicinity to the planned accesses of the final repository and the nuclear power plant (reactor Forsmark 1 and 2). Deformation zones with revised geometries relative to Forsmark version 2.3 are illustrated in Figure 5-15 and a summary of the geometrical changes are presented in Table 5-4. ZFMNNE2312 is also included among the revised zones, even if the geometrical changes were not justified by new data.



*Figure 5-13.* The truncation of ZFM1189 (grey) against ZFMA3 (red). RVS v6: Truncation against the origin surface of ZFMA3. RVS v7: Truncation against the bounding surface of ZFMA3.



**Figure 5-14.** The truncation of ZFMNNW0999 against ZFMNW0805A (not shown) illustrating the extent of he origin surface (red) and the volumetric zone representation (grey) relative to three boreholes. Two of the boreholes (KFR08 and KFR7A) intersect the origin surface, but all occur outside the grey volume.



Figure 5-15. Top view of the relationship between modelled deformation zones in the vicinity to the planned accesses of the final repository and the nuclear power plant. Deformation zones with revised geometries based on data acquired after 2010 are pale red, whereas ZFMNNE2312, which has been changed by ignoring the data from percussion borehole HFM38, are red.

Table 5-4. Summary of the geometrical differences between deformation zones of Forsmark version 2.3 and the DMS Baseline Forsmark version 1.0 in the vicinity of the access volume of the planned repository for spent nuclear fuel.

Zone ID	Forsmark v	ersion 2.3		DMS Baseline Forsmark version 1.0				
	Strike [°]		Thickness [m]	Strike [°]	Dip [°]	Thickness [m]		
ZFMENE1061A	56	81	48	58	82	48		
ZFMENE2120	237	82	12	238	79	10		
ZFMENE2248	234	80	37	236	80	36		
ZFMNNE2312	202	84	43	208	87	19		
ZFMNNW1205A	159	78	15	161	77	5		
ZFMNNW1205B	-	-	-	155	79	4		

The modelling approach used to achieve the preferred geometries for the six zones are described briefly below.

*ZFMENE1061A* – Based on single-hole interpretations (Dahlin et al. 2017) it is inferred that the zone geometry must be adjusted to avoid intersection with KFM24 and HFM40 but include the entire KFM19. However, intercepts of the two original boreholes (i.e. KFM08A and KFM08C) shall, as far as possible, remain unchanged. Furthermore, the zone thickness, as defined by the intercept with KFM08A, shall be left unadjusted at 48 m. To achieve the preferred geometry, the following changes were implemented:

- A slight modification of low magnetic lineament MFM2054G0 in proximity to HFM40.
- The fix point of the deformation zone core in KFM08A was moved from 277 to 282 m borehole length (see Figure 5-16). The target intercept of the zone boundaries remains at 244–315 m.
- A fix point for the zone plane was added in the lowermost end of KFM08C at 947 m length.
- A fix point for the zone plane was added at 700 m length along a fictitious extrapolation of KFM24.

ZFMENE2120 – Adjustment of ZFMENE2120 based on an intersection with KFM23 and a decrease of the thickness from 12 to 10 m.

*ZFMENE2248* – Revised geometry based on the drillings down to approximately 200 m depth north of the inlet channel, in proximity to reactor block 1 and 2. The single-hole interpretations of Dahlin et al. (2017) and Rauséus and Petersson (2020) indicate that the southwestern part of the zone geometry must be adjusted to avoid intersection with KFM26 and HFM41 but include PDZ1 (30–92 m borehole length) of KFM27. However, the intercept of the original borehole, KFM08A shall remain unchanged to include PDZ5 between 775–843 m borehole length. Both KFM27 PDZ1 and KFM08A PDZ5 were assigned a medium confidence level. The preferred geometry of ZFMENE2248 was achieved by the following changes:

- The inferred southwestern continuation of low magnetic lineament MFM2248G, in the disturbed area around the nuclear power plant, has been modified by moving the trace line slightly southward, closer to the ground surface trace of ZFMENE1061A.
- The thickness of the zone was decreased by 1 m from 37 to 36 m.

*ZFMNNW1205A* – A renaming ZFMNNW1205, and an accompanying geometrical adjustment based on intersections with KFM13 and KFM23. The thickness of the zone was decreased by 10 m from 15 to 5 m. For additional details, see Follin (2019).

*ZFMNNW1205B* – An inferred splay to ZFMNNW1205A added by Follin (2019). The surface manifestation is the magnetic lineament MFM2168G and data from excavation trench AFM001393. The zone is modelled to intersect KFM08B, KFM13 and KFM21.

With the additional drillings in the vicinity to the planned accesses of the final repository, an issue of further examination is whether the gently dipping ZFM1203 continues north of its current truncation against ZFMENE0159A. However, comprehensive data review provides no geological indications to support a continuation of ZFM1203 on the northwestern side of ZFMENE0159A.



*Figure 5-16.* Simplified log of brittle deformation features along SHI PDZ1 in KFM08A, showing the target intercept of ZFMENE1061A (pale red interval at 244–315 m length) and the location of the zone plane fix point (blue = original at 277 m, red = adjusted at 282 m) within the inferred core. Modified from Nordgulen and Saintot (2006).

#### The rock volume southeast of SFR

The drillings of KFR117–KFR121, immediately southeast of the SFR facility, have yielded data for geometrical adjustments of two deformation zones ZFMWNW0835 and ZFMWNW8042. Two additional zones (ZFMENE3115 and ZFMWNW3262) intersected by the boreholes have been left geometrically unmodified, as their borehole intersections are in accordance with the results from the SHI (cf. Winell and Samuelsson, 2022). Deformation zones with revised geometries relative to SFR version 1.0 are illustrated in Figure 5-17 and a summary of the geometrical changes are presented in Table 5-5. Note that ZFMENE3115 is included among the revised zones, due to the thickness reduction introduced during the merging of Forsmark version 2.3 and SFR version 1.0 (see Section 5.4.2).

The adjustment of ZFMWNW0835 is based on an intersection with SHI DZ3 (the third possible deformation zone from the start of the borehole) along KFR121 (cf. Winell and Samuelsson, 2022). The judgement is that this intersection provides a better estimate of the zone properties than the only other intersecting borehole, KFR27, which is situated close to the northern end of the zone and runs subparallel with the zone. Based on this the thickness has been reduced from 21 to 10 m (Table 5-5).



*Figure 5-17.* Top view of the relationship between modelled deformation zones in the rock volume situated southeast of the SFR facility. Deformation zones with revised geometries based on data acquired after 2010 are pale red, whereas ZFMENE3115, which has been changed during the merging of models are red.

The dip and thickness of ZFMWNW8042 has been revised to obtain full intersection with the inferred zone core of SHI PDZ4 along KFR121, located at 289.8–303.1 m borehole length (cf. Winell and Samuelsson, 2022). An effect of the changed dip direction is a truncation against ZFMWNW0835.

Table 5-5. Summary of the geometrical differences between deformation zones of SFR version	1.0
and the DMS Baseline Forsmark version 1.0 in the volume southeast of the SFR facility.	

Zone ID	SFR versi	on 1.0		DMS Baseline Forsmark version 1.0				
	Strike [°]	Dip [°]	Dip Thickness °] [m]		Strike Dip [°] [°]			
ZFMENE3115	236	84	28	238	84	10		
ZFMWNW0835	118	88	21	120	88	10		
ZFMWNW8042	116	89	5	298	88	8		

# 5.4.5 Extension of regional deformation zones into the sub-catchment area

A selection of the lineaments interpreted by Isaksson and Johansson (2020) was investigated as part of a geological field study by Bakker (2021) to verify whether they correspond to actual deformation zones (see Section 3.4). The study focuses on the well-exposed outcrops along coastal areas of central Gräsö and west of Öregrund. Additional information regarding potential deformation zones at Gräsö are presented by Svenonius (1887) and Bergman et al. (1998).

All lineaments inferred to represent deformation zones with a minimum ground surface trace length of 5 km (in practice down to about 4 km) have been modelled in the Baseline Forsmark sub-catchment area, outside the SDM-Site regional model volume. This also includes an extension of all previously modelled zones that are truncated along the boundary of the SDM-Site regional model volume; this is regardless of whether the ground surface trace length exceeds 5 km or not. Thus, artificial truncation of deformation zones along the SDM-Site regional model volume has not been allowed.

Similar to the SDM-Site, the bedrock in the Baseline Forsmark sub-catchment area is characterised structurally by ductile high-strain belts (striking WNW–ESE or NW–SE) that define an anastomosing network enveloping the less deformed tectonic lenses. As part of the same tectonic domain, it seems reasonable to expand the conceptual model of Stephens et al. (2007) to the entire sub-catchment area by proposing that the composite ductile and brittle, steeply dipping WNW and NW zones formed in response to transpressive deformation. This resulted in dextral strike-slip displacement and an R-Riedel shear relationship between regionally significant WNW and NW zones as presented in Figure 5-18. The framework is given by the regionally significant Forsmark, Singö and Örskär deformation zones. The development of steeply dipping NNW structures with sinistral strike-slip displacement is also inferred to have occurred later in the tectonic evolution. The strong anisotropy in the bedrock, related to older ductile deformation under higher-grade metamorphic conditions, is a critical factor that controls the location and orientation of these older deformation zones.



**Figure 5-18.** The large-scale tectonic framework of the DMS Baseline Forsmark model area (red line) showing the concept where regionally significant WNW and NW zones evolved by dextral strike-slip displacement in response to transpressive deformation. Note that Örskär DZ (ZFMWNW3509) is not included in the model area.

Accepting this, an approach identical to that of Stephens et al. (2007) was used to estimate orientation and thickness for zones that lack borehole intersections:

- The strike of a zone is assumed to be determined by the trend of the matching lineament.
- The dip of the zone is estimated by comparison with the dip of high confidence zones that intersect one or more boreholes and show a similar strike. In general, this means 80° for the sub-set referred to as ENE (NE) and NNE and 90° for all other sub-sets referred to as WNW, NW, NNW and EW.
- The thickness of the zone has been calculated with the help of the length-thickness correlation diagram presented in Figure 5-11, according to the power law function  $T = 0.2 L^{0.6}$ , rounded to the nearest 5 m. Note that the changed trace lengths along the ground surface for some of the existing deformation zones (ZFMNNE0828, ZFMNW0016, ZFMNW0036, ZFMWNW0023 and ZFMWNW0836) resulted in thickness changes.

In total 15 of the existing deformation zones have been extended beyond the SDM-Site regional model volume and eleven new deformation zones have been added within the Baseline Forsmark sub-catchment area. Geological support for the actual existence of the newly added zones is only provided for two of them, ZFMNW3511 and ZFM3519 (Bakker 2021). Three rather well-defined lineaments on the northern part of Gräsö were omitted as possible deformation zones based on field control (MFM3513, MFM3514 and MFM3518), see Section 3.4. It shall be emphasized that there is currently no deterministic approach to handle the possible existence of gently dipping zones; such zones inferred to occur throughout the sub-catchment area, but deterministic modelling requires drillings and seismic data for identification.

# 5.4.6 Reassessment of the deformation zone truncation pattern northeast of SFR

In the SDM-PSU deformation zone model there are six deformation zones with blind ends (ZFMNNE3264, ZFMNNE3265, ZFMNNE3266, ZFMNNW0999, ZFMNNW3113 and ZFMNS3154) immediately northeast of deformation zone ZFMNW0805A (Figure 5-19). The truncation is apparently artificial, but the reason is somewhat ambiguous. The most obvious reason is the resolution of the magnetic data, which is the primary basis for the lineament interpretation. In addition, there are disturbances in the magnetic total field data due to the Fenno-Skan HVDC (high voltage, direct current) cable, which prevent confident identification of lineaments at the appropriate scale in the area north of ZFMNNW0999, ZFMNNW3113 and ZFMNS3154 (Figure 5-19).

With deficiencies in the magnetic data, it was decided to do a reassessment of the lineament interpretation in the area between ZFMNW0805A and ZFMNW0806. The primary basis for this work was the inferred bedrock surface (lower surface of layer Z5, generated from the regolith depth model), with varying support from the magnetic data. For details regarding the interpretation, see Section 4.4). Several new lineaments were added during the work and the reassessment showed the need to adjust some of the magnetic lineaments from previous interpretations. These adjustments included the lineaments used as surface traces for the blind end zones ZFMNNW0999, ZFMNNW3113 and ZFMNS3154, which based on bedrock topography were extended further to the north into the magnetically disturbed area.

The lineaments used as surface traces for ZFMNNE3264, ZFMNNE3265 and ZFMNNE3266 in SDM-PSU bend in a northeastward direction immediately outside the area covered by the high-resolution ground magnetic data (Figure 5-19). With further analysis, it appears that the northeast striking parts of these lineaments are all magnetic minima connections, and the interpretation is that they have a lithological origin.

To achieve natural terminations of these zones after modification, two deformation zones were added (ZFMNW0997 and ZFMWNW3571) based on lineaments from the renewed interpretation (Figure 5-20). The current conceptual thinking is that the six modified zones were formed as second order synthetic and antithetic Riedels due to dextral strike-slip displacement along ZFMNW0805A and ZFMNW0997 (Figure 5-21). Truncation against ZFMNW0997 has led to an elongation of the three northern zones (ZFMNNW0999, ZFMNNW3113 and ZFMNS3154) and a shortening of the three southern zones (ZFMNNE3264, ZFMNNE3265 and ZFMNNE3266). This in turn has affected the orientations and thicknesses of the zones, which in the absence of geological data are based on the length-thickness correlation (Figure 5-11); consequently, ZFMNNE3266 has been renamed to ZFMNE3266.



Figure 5-19. Ground surface trace lines of modelled deformation zones in SDM-PSU overlain on a combined magnetic map, which illustrates the extent of the high-resolution ground magnetic survey (land and sea) relative to the NS-directed helicopter survey (red, turquoise and black layer). SDM-PSU local and regional model areas a marked in red and blue, respectively.



Figure 5-20. Extract from DMS Baseline Forsmark version 1.0 illustrating the changes in the deformation zones pattern relative to SFR version 1.0, immediately northeast of ZFM0805A. Zones with changed geometries are red with their former geometry shown in blue (blue arrows show original ends). New zones are shown in green and the previous, unchanged zones are grey. Oblique view towards the north.



*Figure 5-21.* Conceptual model of the tectonic origin for the deformation zones with former artificial blind ends northeast of the SFR facility. Zone colours are as in Figure 5-20.

# 5.5 Geometric model and object properties

One hundred fifty-nine deformation zones have been modelled deterministically in the DMS Baseline Forsmark version 1.0. Of these, 135 are vertical and steeply dipping ( $\geq 70^{\circ}$ ) structures, which all except one (ZFMNNW1204) intersect the ground surface. The remaining zones are gently dipping ( $\leq 45^{\circ}$ ) zones and 14 of these also intersect the ground surface. Based on orientation, the modelled zones can be divided into three main sets:

- Vertical and steeply dipping fracture zones with sub-sets referred to as ENE (NE) and NNE (72 zones).
- Vertical and steeply dipping deformation zones with sub-sets referred to as WNW and NW (47 zones).
- Gently dipping fracture zones with dips to the south and SE (24 zones).

In addition, there are 16 vertical and steeply dipping deformation zones that belong to the sub-sets referred to as NNW and EW. A division based on trace length along the ground surface (Figure 5-22) shows that the proportion of vertical and steeply dipping zones in the WNW and NW sub-sets increases significantly with trace length, from 10 % of the zones that are shorter than 1000 m to about 60 % of the zones whose length exceeds 3000 m. This correlation between specific orientation and trace length is strongly related to the spatial distribution of zones, and consequently to the tectonic anisotropy of the high-strain belt in which the Forsmark area is located. In accordance with the current understanding, vertical and steeply dipping zones of the WNW and NW sub-sets are largely restricted to the margins of and to the high-strain areas outside the Forsmark tectonic lens, whereas the fracture zones of the other sub-sets mainly have developed in volumes of less intense strain, as second order structures, in response to displacements along these more extensive zones.



*Figure 5-22.* Orientation of deformation zones in DMS Baseline Forsmark version 1.0. Vertical and steeply dipping deformation zones with ground surface trace lengths (a) less than 1000 m (including ZFMNNW1204), (b) 1000–3000 m and (c) exceeding 3000 m. (d) Gently dipping zones. The orientations of zones in the stereographic projections (equal-area, lower hemisphere) are shown as contours with no Terzaghi correction.

The distribution of data for modelling is a crucial consideration when covering zones with specific orientations and trace lengths. This inherent bias becomes more significant due to the merging of models that have varying minimum zone lengths and the extension of the model volume to encompass the future sub-catchment area. Using the current methodology, modelling of vertical to steeply dipping zones of local extent requires access to high-resolution ground magnetic data, while modelling of gently dipping zones relies on reflection seismics. Such data are limited to the local model volumes of SDM-Site and SDM-PSU. The heterogeneous distribution of deterministically modelled structures that is related to the lack of data needs to be handled by stochastic methods (cf. Selroos et al. 2022).

The bias related to the spatial lack of data and hence the lower cut-off lengths applied in the various model volumes is also reflected in a logarithmic trace length frequency plot (Figure 5-23). Artificially induced trace length bias is visible where the slope coincides with the lower cut-off lengths of SDM-Site and SDM-SFR (i.e., 1000 and 3000 m, see Table 2-2 and Table 2-3) and the sub-catchment area outside the SDM-Site regional model volume (i.e., 5000 m, see Section 5.4.5).



**Figure 5-23.** Distribution of surface trace length of vertical and steeply dipping deformation zones in DMS Baseline Forsmark version 1.0. Estimated trace lengths include continuations outside the inferred sub-catchment area. Splays or attached branches, which are modelled to belong to a particular zone and strike more or less parallel to the zone (e.g. ZFMENE0401B that is a branch related to ZFMENE0401A), are not included in the data set.

Most of the vertical and steeply dipping zones in the WNW and NW sub-sets follow the general structural trend defined by rock contacts and the ductile planar grain-shape fabric. The subordinate set of vertical and steeply dipping fracture zones referred to as NNW also follows the ductile bedrock fabric. Vertical or steeply dipping zones in the other sub-sets are concentrated in three areas: the Forsmark tectonic lens, the SFR area and centrally in Öregrundsgrepen (see Figure 5-18). Inside the tectonic lens, where the ductile fabric is folded and more variable in orientation (cf. Stephens et al. 2007), the bedrock is intersected exclusively by vertical or steeply dipping zones of the ENE (NE) and NNE sub-sets. The zones are typically distributed in clusters.

The majority of gently dipping deformation zones are situated in the southeastern, central part of the tectonic lens, where several zones appear to splay off each other in an integrated mesh (Figure 5-8). In particular, ZFMA2 defines the hanging-wall of the volume that has been identified as potentially suitable for the excavation of a repository. Conceptually Stephens et al. (2007) proposes that these gently dipping zones mainly follow arrays of amphibolite boudins. For this reason, the more frequent occurrence of gently dipping zones in this part of the tectonic lens is related to the gentler, southeast dip of the amphibolite occurrences, the tectonic foliation and the mineral stretching lineation (see orientation data from KFM03A presented in Figure 5-6 of Stephens et al. 2007). Gently dipping zones are also inferred to occur outside the tectonic lens and the rock volume close to the SFR facility, but with a lack of drillings and seismic data it has not been possible to identify them.

Deterministic modelling of local minor deformation zones, with trace lengths at the ground surface shorter than 1 000 m, is limited to the local model volumes of SDM-Site and SDM-PSU. The zones have been identified primarily along boreholes as SHI deformation zones, which were correlated with lineaments recognised in the interpretation of the high-resolution ground magnetic data. One minor zone (ZFMNNW1204) has been modelled entirely based on borehole data.

An atypical feature among the deterministically modelled structures is ZFM1189. It represents a fractured alteration pipe of vuggy, quartz-deficient rock referred to as episyenite, sandwiched between the gently dipping zones ZFMA2 and ZFMA3 at drill site 2. An assessment of surface seismic, VSP

(vertical seismic profile) and borehole radar data indicates that the episyenite pipe and associated fracture zones in KFM02A (borehole interval 240–310 m, including DZ4 and DZ5) has a steep orientation and trends more or less parallel with the borehole KFM02A.

The properties of deformation zones included in the merged deterministic models have been compiled into property tables, presented in the following reports:

- Forsmark version 2.3 (trace lengths > 1000 m) Stephens and Simeonov (2015)
- Forsmark stage 2.2 (trace lengths < 1000 m) Stephens et al. (2007)
- SFR version 1.0 Curtis et al. (2011)

Property tables which also gives hydraulic and engineering characteristics for deformation zones within and in close proximity to the volume of the planned repository for spent nuclear fuel (SKB 2008a, 2009) and the SFR facility (SKB 2013) have also been presented.

Property tables for the current versions of the deformation zones included in DMS Baseline Forsmark version 1.0 are stored in SKBmod (cf. Section 2.2). A summary of some key aspects of the three dominant orientation sets of deformation zones at Forsmark is presented in Table 5-6. Further details of the various sub-sets are given by Stephens et al. (2007, 2015) and Curtis et al. (2011). Hydrothermal alteration along brittle deformation zones at Forsmark are described in more detail in Sandström et al. (2008) and Petersson et al. (2012), whereas kinematic data for the zones are presented in Saintot et al. (2011).

Di <b>p</b>	Vertical and steeply dipping	Vertical and steeply dipping	Gently dipping			
Strike	WNW and NW	ENE (NE) and NNE	-			
Deformation style	Both ductile and brittle. High frequency of especially sealed fractures and sealed fracture networks.	Only brittle. High frequency of especially sealed fractures.	Only brittle. High frequency of especially open fractures.			
Fault core	Mylonite, protomylonite, cataclastic rock and cohesive breccia in structures of regional size.	Highly elevated fracture frequency with sealed networks, locally cohesive breccia and cataclasite.	Highly elevated fracture frequency with sealed networks or non-cohesive rock, cohesive breccia and cataclasite.			
Alteration	Hematite dissemination, locally quartz dissolution, development of muscovite- and talc-rich rocks.	Hematite dissemination, locally quartz dissolution.	Hematite dissemination, locally quartz dissolution.			
Fracture orientation	Vertical to steep dips, striking NW–SE, NE–SW and NNE–SSW. Also gently dipping to sub-horizontal fractures.	Vertical to steep dips, striking ENE–WSW (dominant) to NNE–SSW (subordinate). Also gently dipping to sub- horizontal fractures.	Gently dipping to sub-horizontal and vertical to steeply dipping that strike ENE–WSW to NNE–SSW.			
Fracture filling	Calcite, chlorite, adularia and hematite. Clay minerals, laumontite, quartz, prehnite, pyrite and epidote are locally present.	Calcite, chlorite, laumontite, adularia and hematite. Pyrite quartz, clay minerals, prehnite and epidote are locally present.	Calcite, chlorite, adularia, hematite and fractures with no apparent mineral coating. Clay minerals, laumontite, pyrite, prehnite, asphaltite and epidote are locally present.			
Sense of displacement	Strike-slip displacement with both dextral and sinistral sense of shear.	Strike-slip displacement with both sinistral and dextral sense of shear.	Reverse sense of shear.			

Table 5-6. Summary of the geological properties of the three dominant orientation sets of deformation zones at Forsmark. Slightly modified from Stephens et al. (2015).

# 5.6 Unassigned possible deformation zones identified in the SHI

Less than one third of the possible deformation zones (PDZ's) identified during the SHI lack correlation with any of the modelled deformation zones. This group of PDZ's are denoted "unassigned deformation zones". In total, there are 97 unassigned deformation zones distributed among 11 percussion and 49 cored boreholes. Relative to the modelled PDZ's, the unassigned deformation zones typically occur along rather short borehole intervals and a considerable proportion of them were defined with a low or medium confidence level during the SHI work (Figure 5-24). Although uncertainty remains related to the nature of the unassigned zones, especially in terms of size and orientation, it is judged from these features that they predominantly represent intersections with minor zones (see Section 8.4), too small to allow deterministic representation.

The possible orientation of the unassigned deformation zones has been evaluated by analysis of orientations for fractures, sealed networks, crushes and fault rocks along the defined zone interval. All fractures not visible in BIPS were eliminated from this analysis due to larger uncertainty in orientation. The general distribution pattern on an equal-area stereographic projection for the structural data in each zone is used as a guideline for the orientation of the unassigned zones. However, the data set for about one third of the unassigned deformation zones is too limited or shows too much scatter to allow orientation estimates. For the remaining 66 unassigned zones, a predominant structural orientation has been estimated, but some of them include also distinct subordinate sets. The estimated general orientations among the unassigned deformation zones, based on the predominant structural set, are illustrated in Figure 5-25.



*Figure 5-24. Histogram showing the relative distribution of confidence levels for modelled and unassigned PDZ's in the Forsmark baseline model version 1.0.* 



*Figure 5-25. Histogram showing the relative distribution of estimated general orientations for unassigned PDZ's in the Forsmark baseline model version 1.0.* 

A considerable proportion of the unassigned zones is inferred to be gently dipping. Except for two, they are all situated in the uppermost 150 m of the rock mass, which strongly suggest that they primarily represent intersections with swarms of sheet joints. The estimated orientations of vertical to steeply dipping unassigned zones is in line with the orientations of the modelled zones, with the two main sets that strike ENE (NE) to NNE and WNW to NW.

# 5.7 Quantification of confidence for deformation zones

A new approach to quantify confidence for deterministically modelled deformation zones is presented by Hermanson and Petersson (2022). Although the approach focuses on subsurface modelling of structures only identified in underground openings and boreholes, it was proposed that the methodology can be applicable to already established deformation zones of the DMS Baseline Forsmark, where zone geometries primarily are derived from lineaments and seismic reflectors in combination with data from boreholes. However, the usefulness of the approach remains to be verified by further investigations of deformation zones included in the DMS Baseline Forsmark.

The basic principle of the approach comprises four categories, each divided into two subcategories and with the purpose to reflect various modelling decisions that affect the object geometry. Each subcategory is assigned a confidence estimate according to the scale 1-3 (low, medium, high). A total relative confidence for a zone is then achieved by summing the confidence estimates for each individual subcategory, which hence ranges between 8 and 24.

Following the proposed methodology, confidence estimates for each deformation zone in DMS Baseline Forsmark version 1.0 are presented in the property tables of Appendix 7. This work was completed after the delivery of the 3D model version 1.0 to visualise the assembled confidence estimate for each zone by means of colour coding. An upgraded 3D model version 1.1 was released in late 2023 (see Chapter 9). In this model, the confidence range (8–24) is declared by an RGB colour scheme programmed in the RVS modelling tool (Table 5-7). Note that gently dipping zones separated into two parts to facilitate geometric modelling in RVS (ZFMA6, ZFMB5 and ZFMB23) are treated as unbroken surfaces and are consequently assigned identical confidence levels.

Full implementation of the methodology outlined by Hermanson and Petersson (2022) to the already established deformation zones included in the DMS Baseline turned out to require both some further development and additional clarification of the principles. The adjustments and complements used during the work of confidence assignment are captured and summarized in Table 5-8.

Color code	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
R	255	255	255	255	255	255	255	255	255	234	213	191	170	149	127	106	84
G	0	31	63	95	127	159	191	223	255	240	224	209	193	177	162	146	130
В	0	0	0	0	0	0	0	0	0	6	13	19	26	33	39	46	53

Table 5-7. RGB colour scheme programmed in the RVS modelling tool to visualise the total relative confidence estimate for deformation zones.

#### Interpretation

#### Data source

No deviations from or additions to the guidelines presented by Hermanson and Peterson (2022); the confidence level has been based on the source with the highest degree of confidence.

#### Results of interpretation

The confidence level has been based on the interpretation with the best quality of the source data, with the following amendments to the methodology of Hermanson and Peterson (2022):

Lineaments – Each interpreted lineament has been given an uncertainty ranging from 1 to 3, where 1 = low, 2 = medium and 3 = high (see e.g. Isaksson and Johansson 2020). These values have been directly adopted as confidence levels. Uncertainties given with decimal precision have been rounded to the nearest integer.

Where a deformation zone is modelled based on multiple lineaments, average values have been used.

Boreholes – Only borehole intersections defined as target intercepts (see Section 5.3.4) have been considered as observation points. Thus, intersections with absence of supporting geological indications/evidence, and boreholes where no SHI has been completed, have been omitted.

#### Information density

#### Number of observation points

Implementation of the guidelines presented by Hermanson and Petersson (2022), with the clarification that observations along boreholes are limited to target intercepts (see the subcategory data source above).

#### Distribution of observation points

Large distance between points and/or two observation points or less will result in low confidence according to Hermanson and Petersson (2022). However, the meaning of "large distance" in this subcategory is not further defined by Hermanson and Petersson (2022). Regional scale deformation zone may have a lateral extent of several kilometres in length, while local deformation zones may have a lateral extent less than 1 000 m. Therefore, the term "large distance" has a different weight on regional deformation zones and those of more local extent. Henceforth, the notion of "large distance" has been neglected within the subcategory-distribution of observation points in the current work. Lineaments that comprise several segments has been considered as a continued observation point. Examples of the confidence assignment for this subcategory are illustrated in Figure 5-26.

#### Interpolation

#### Geometry

The trend of lineaments and the conceptual understanding of the deformation, in combination with the structural trend obtained by analysis of the orientation patterns of the natural fractures along boreholes and tunnels (where available) has been regarded as the key parameter in this category.

#### Geological indicators

No deviations from or additions to the guidelines presented by Hermanson and Peterson (2022).

#### Extrapolation/Truncation – Vertical and steeply dipping deformation zones

#### Strike direction

Since a lineament is considered an observation point, there is a high confidence in the assumption that a modelled zone continues along the lineament. Thus, a modelled zone within confinement of an interpreted lineament has been given a high confidence in the subcategory extrapolation in strike direction. If a zone is extrapolated further, beyond the lineament, the conceptual understanding of the deformation and the pattern of surrounding lineaments/zones have been considered; such zones have been assigned a medium confidence.

#### Dip direction

Zones with trace lengths exceeding 2100 m at the ground surface terminate at the base of the model volume (see Section 5.3.2). These deformation zones have automatically been assigned a high confidence level for extrapolation in the dip direction, extending an equal distance to their ground surface trace length.

Deformation zones with trace lenghts less than 2100 m at the ground surface are extended to a depth that is approximately the same as its trace length at the surface. In such case, the uncertainty remains from the point of the lowest geological observation (borehole, tunnel) to the base of the model volume; Such zones with target intercepts along boreholes have been given a medium confidence in the dip direction.

Deformation zones based solely on lineaments and with a surface trace length less than 2100 m have been assigned a low confidence level in the dip direction.

#### Extrapolation/Truncation – Gently dipping deformation zones

#### Strike and dip direction

Quantifying the confidence for the extrapolation of the gently dipping zones involves firm understanding of the proposed structural concepts, limitations and assumptions of the underlying data. In this regard, the general approach has been as follows (Figure 5-27):

- Low confidence Zones that have been terminated prior to truncation against other modelled zones (i.e. zones with dead ends). No geometrical control by tunnels/boreholes outside the modelled extent of the zone.
- Medium confidence Inferred truncation against vertical to steeply dipping zones in agreement with the conceptual understanding of the deformation.
- High confidence Strong geometrical control by observation along tunnels/boreholes/outcrops outside the modelled extent of the zone, in combination with inferred truncation against vertical to steeply dipping zones, in agreement with the conceptual understanding of the deformation.


**Figure 5-26.** Simplified examples of the distribution of observation points along the deformation zones. Grey rectangles represent deformation zones, brown line represents lineaments and a black dots represent geological observation points. Modified after Hermanson and Petersson (2022). Regardless of the distance, the distribution pattern of the observation points forms the basis for confidence assignment. A) A single lineament. B) A lineament and a single observation point. C) A lineament and two observation points. D) A lineament and three clustered observation points. E) A lineament and three observation points that are equally distributed along the entire horizontal length of the modelled deformation zone. F) Three observation points that are equally distributed along the entire horizontal length of the modelled deformation zone. No lineament.



**Figure 5-27.** The general principles of confidence assignment for extrapolation/truncation of gently dipping deformation zones; exemplification with ZFMA3 (light red). The existence of the zone is based on observations along HFM04, KFM02A, KFM02B and KFM03A (white points), in combination with a number of seismic reflectors (blue). Observations are limited to the area encircled by the white dashed line and parts beyond this line are the results of extrapolation. Oblique view towards north. Three hypothetical varieties of extrapolation are illustrated: 1) High confidence, where three fictitious boreholes (red points) that lack indication of the zone's existence give a strong geometrical control for extrapolation in the direction of strike (A and B) and dip (C) to the approximate position of the red dashed line. 2) Low confidence, where the lack of geometrical control by observations or concepts limits the extrapolation to the grey dashed line (according to the methodology of Hermanson and Petersson (2022) a distance equivalent to 1/3 of the maximum distance between observation intercepts). 3) Medium confidence, with truncation against surrounding vertical to steeply dipping zones in agreement with the current conceptual understanding of the deformation.

## 5.8 Deterministic sheet joints

The geometric representation of deterministically modelled sheet joints includes the following two main components:

- Three-dimensional visualisations of sheet joints along the inlet channel to the nuclear power plants, based on the mapping of joint traces made by Carlsson (1979).
- Geometries of individual sheet joints modelled based on interpolation between observation points in boreholes.

All representations are restricted to the SFR area and an area of approximately 0.5 km<sup>2</sup> in proximity of the planned accesses and operation area of the final repository, where the borehole density allows reasonable confidence in interpolation. Additional sheet joints of significant extent are inferred to exist in the Forsmark area (cf. Bono et al. 2010), but available borehole data do not allow confident deterministic modelling. In total eleven individual sheet joints have been modelled based on borehole observation points, distributed among the following three subareas illustrated in Figure 5-28:

- 1. The planned accesses and operational area of the repository, including drill site 8.
- 2. Drill site 7, including HFM43.
- 3. The drill sites of KFR117–120 in the SFR area.

A summary of the basic geometrical properties for each of these sheet joints are presented in Table 5-9.

The 39 most extensive sheet joints along the inlet channel are represented by horizontal discs with diameters provided by the trace length of each joint in the profile. Except for two of the discs (JFM003 and JFM015), they are all named JFM001, with a suffix from 1 to 38 (e.g. JFM001\_23). The joint traces are typically undulating, and the discs are placed at the level of the trace line centre, relative to a reference level established from photographs of the channel length-section. Individual fractures range up to a maximum diameter of 176 m, but most are less than 100 m. The largest disc, named JFM003, has been extended to include an observation point in KFM19 at 7.5 m borehole length (level -3.8 m), located at the southeastern part of the of the inlet channel. An additional disc (JFM001\_16, renamed to JFM015), has been extended to include an observation point in KFM25 at 6.6 m borehole length (level -3.9 m). While the channel length-section is restricted to 500 m, the discs provide valuable insights into the potential extent and size distribution of sheet joints within the uppermost eight meters of the bedrock.



*Figure 5-28.* Top view of the three subareas with deterministically modelled sheet joints (red) together with a visualization of the sheet joints documented by Carlsson (1979) along the inlet channel (green). Water is shaded and horizontal borehole projections marked by thin black lines.

ID	Z [−m]	Strike [°]	Dip [°]	Max diameter [m]	Thickness [m]	No of observation points	Comments
Subarea 1							
JFM004	2–7	284	0.1	237	0.1	10	-
JFM005	15–17	148	1.1	177	0.1	4	-
JFM006	17–18	342	0.6	149	0.2	4	-
JFM007	20–21	298	0.7	248	0.1	5	Splay to JFM008
JFM008	22–24	023	0.2	219	0.1	6	Splay to JFM007
JFM009	50–51	169	0.3	215	0.1	5	-
Subarea 2							
JFM010	5–8	323	0.4	161	0.1	4	-
JFM011	19–20	157	1.6	69	0.1	3	-
JFM012	35–37	284	1.4	78	0.1	3	_
JFM014	151–153	340	0.9	220	0.1	3	-
Subarea 3							
JFM016	8–9	279	0.3	176	0.1	4	-

Table 5-9. Geometry of sheet joints with aperture, modelled based on borehole observation points in the Forsmark area.

#### 5.8.1 Subarea 1

For deterministic modelling, this subarea serves as the most dependable foundation, where a sequence of six distinct sheet joints has been identified down to an elevation of approximately -50 m (Figure 5-29). The most well-defined joints occur immediately beneath the bedrock surface and at approximately -20 to -24 m elevation. The latter coincides with the lowermost part of FFM02U and includes two sheet joints (JFM007 and JFM008), which are inferred to splay into each other. The joint immediately beneath the bedrock surface (JFM004) follows largely the elevation of the bedrock surface (Figure 5-30). Two joints of more subordinate size have been defined at -15 to -18 m elevation (JFM005 and JFM006); a close spatial relationship as splays is also inferred for these two joints.

The sheet joints of subarea 1 lies between the steeply dipping deformation zones ZFMENE0159A and ZFMENE1061A and has been modelled to crosscut three subordinate deformation zones (ZFMNNW1205A, ZFMNNW1205B and ZFMENE2120) with trace lengths at the ground surface of less than 400 m (Figure 5-15). No mutual dependencies are inferred to exist between the sheet joints and the deformation zones.



*Figure 5-29.* Oblique side view towards southeast showing the sequence of deterministically modelled sheet joints in subarea 1 relative to the three subordinate deformation zones ZFMNNW1205A, ZFMNNW1205B and ZFMENE2120.



**Figure 5-30.** Histogram showing the inferred borehole elevations for the bedrock surface (grey staples) relative to the uppermost sheet joints (filled circles with intersecting line) modelled in each subarea. Intersecting boreholes without BIPS- or OPTV-images at the section of interest are omitted from the diagram.

#### 5.8.2 Subarea 2

The sequence of deterministically modelled sheet joints in subarea 2 includes four individual joints, all based on 3–4 observation points along boreholes (Figure 5-31). The two uppermost joints (JFM010 and JFM011) occur at approximately the same level as the most well-defined joints in subarea 1. Similar to the shallowest joints in subarea 1, JFM010 undulates parallel with and immediately beneath the bedrock surface (Figure 5-30). The lowermost joint (JFM014) is defined at a depth (–150 m) with few equivalents in the scientific literature (e.g. Jahns 1943; Twidale 1973) and alternative interpretations, where the fractured intersections represent separated structures, cannot be ruled out. However, all the observation points fulfil the sheet joint criteria listed in section "criteria for identification of sheet joints" and none of them appears to differ from inferred sheet joints at more shallow depths.



*Figure 5-31. Oblique side view towards northeast showing the stack of deterministically modelled sheet joints in subarea 2 relative to the three deformation zones ZFMENE0159A, ZFMENE0159B and ZFM1203.* 

#### 5.8.3 Subarea 3

One sheet joint (JFM016) has been modelled deterministically in subarea 3. The joint is based on four observation points and occurs immediately beneath the bedrock surface (Figure 5-30). The joint has been modelled to intersect three steeply dipping deformation zones (ZFMENE3115, ZFMNE3112 and ZFMWNW0835), without mutual dependencies.

#### 5.8.4 Shallow bedrock aquifer (SBA) structures

The modelled joint JFM016 is situated immediately south of SFR, in close proximity to the rock volume where Curtis et al. (2009, 2011) defined three horizontal to sub-horizontal structures, H1+H3, H5 and H6, based on fracture observations in boreholes and indications of hydraulic connections. These structures were inferred to occur at approximately -25, -110 and -130 m elevation, respectively. All of them were included as so-called shallow bedrock aquifer (SBA) structures in the hydrogeological model of SDM-PSU (Section 7.4.3 in SKB 2013), with further details in Öhman and Follin (2010).

H1+H3 corresponds to SBA7 of Öhman and Follin (2010) and was originally introduced by Carlsson et al. (1985) as two separate structures H1 and H3 of more limited extent above the silo in SFR (Figure 5-32). Their existence is based on sections with increased fracture frequency and local occurrence of clay minerals along eleven boreholes from the construction of SFR. Curtis et al. (2011) concluded that H1+H3 is the same type of structure as the sheet joints that occur in the shallow rock mass of the northwestern part of the tectonic lens. The modelled surface has a lateral extent of  $250 \times 400$  m (Figure 5-32), which is almost twice as large as the longest trace length Carlsson (1979) registered along the inlet channel.

Although there is no substantial argument to reject the structure, it has been omitted from DMS Baseline Forsmark version 1.0 based on the following facts:

- Lateral distances of more than 100 m between some of the borehole observations.
- None of the boreholes have been filmed by BIPS or OPTV and it is therefore not possible to verify whether the fractures are horizontal to sub-horizontal and exhibit substantial aperture.

H5 and H6 have been modelled by Curtis et al. (2011) as possible sheet joints for further assessment and consideration by the hydrogeology modelling team. Support for interpolation is provided by an increased frequency of horizontal or sub-horizontal fracturing with a certain amount of hydraulic connection as indicated by testing in and between various boreholes.



*Figure 5-32. a) a) Plan view of H1+H3. b) Representation of H1 and H3 as represented in the earlier model by Carlsson et al. (1985). From Curtis et al. (2011).* 

H5 is based on fracture observations in nine boreholes together with a radar reflector, which runs subparallel with KFR105. All boreholes are filmed with BIPS and a reassessment has been made of the character of the inferred intercepts. Four of the boreholes (HFM102, KFR101, KFR103 and KFR106) show sub-horizontal fractures and crushes with significant apertures, whereas the geological indications in the other five boreholes are more questionable or completely absent, as in HFR106 and KFR102B. For example, the crushed section in HFM105 is situated at -104 m, whilst the inferred intercepts in the other boreholes (e.g. KFR101, KFR103 and KFR106) occur between -143 and -145 m, a difference of approximately 40 m. All five boreholes drilled from the pier during 2020 (KFR117–KFR121) have theoretical intercepts with H5, but only KFR117 exhibit a crushed section with significant aperture at the same elevation (-142 m) as the observations in KFR101, KFR103 and KFR103, which is the closest of the three boreholes, exceeds 290 m. Moreover, there are no observations in boreholes situated between KFR117 and KFR103.

Thus, there is no geological support for a continuous structure of the extent that the modelled geometry of H5 indicates, with a lateral size of  $650 \times 1000$  m (Figure 5-33a). A plausible interpretation is that the inferred surface involves several structures of more limited extent. It is geometrically possible to join the observed joints/crushes in KFR101, KFR103 and KFR106 into one continuous, horizontal plane, but the distance between the intercepts exceeds 200 m for KFR101 and KFR103, and more than 300 m for KFR103 and KFR106. Considering the size of the documented sheet joints along the inlet channel (cf. Carlsson 1979), such an interpolation seems highly uncertain. Furthermore, observations of a corresponding structure are lacking in HFM106, which is located between KFR103 and KFR106.

H6 is modelled to occur at an approximate elevation of -110 m with an extent of  $100 \times 200$  m (Figure 5-33b). The geological input to the surface is limited to fracture observation along two boreholes, KFR27 and KFR102B. Both boreholes are filmed with BIPS, which allows for a reassessment of the fracture character along the inferred intercepts. Several sub-horizontal fractures with distinct apertures occur on the level of interest (-118.5 m) in KFR102B, but the indications in KFR27 are less obvious. The same applies to KFR120, which has a theoretical intersection with H6. A reasonable conclusion is that H6 is also more limited in its extent.

The overall picture is that these structures are considerably more limited in their lateral extent than what is modelled geometrically. The hydraulic connection that the boreholes exhibit is rather a result of a more complex fracture network of steeply dipping structures that enable hydraulic contact between a number of smaller horizontal and sub-horizontal structures located at different levels in the rock mass.



*Figure 5-33. Plan view of a) H5 and b) H6 as delivered by Curtis et al. (2011) for further evaluation by hydrogeological modelling.* 

# 6 Rock domain models

#### 6.1 Conceptual model

Forsmark is situated in a major deformation belt of the Fennoscandian Shield, which extends several tens of kilometres in WNW–ESE to NW–SE direction along the coast of northern Uppland. This high-strain belt was developed under amphibolite-facies metamorphic conditions and includes intervening lens-shaped volumes where the bedrock is folded and, in general, affected by less intense ductile strain. The Forsmark tectonic lens represents one such volume, with a size of ca 25 km length and up to ca 4 km in width, from the nuclear power plant in the northwest to Öregrund in the southeast (Figure 1-1). Regionally important, discrete deformation zones of retrograde character, such as the Singö, Eckar-fjärden and Forsmark deformation zones, form an anastomosing network outside the tectonic lenses. Borehole data support the conceptual model that the lens is a major geological structure that can be traced from the surface to at least ca 1000 m depth.

Folding of an older ductile fabric and a generally lower degree of ductile strain are inferred to be present inside the Forsmark tectonic lens. By contrast, the surrounding rocks are inferred to be affected by a higher degree of ductile strain and a conspicuous WNW to NW structural trend. The ductile structures at the site are characteristic of regions where variable degrees of ductile strain, folding and stretching are intimately related during strong, progressive, non-coaxial deformation. This structural anisotropy, with crustal segments of contrasting ductile strain, has important implications for an understanding of the spatial distribution of younger deformation zones and for uncertainties in the modelling of such zones (see Section 5.5).

Compressive deformation in the Forsmark region was absorbed initially by dextral strike-slip shear along the high-strain segments of the deformation belt, combined with shortening across these segments expressed by grain-shape fabric development. As the ductile strain progressed, these structures were folded at different scales. The transpressive deformation was accompanied by continuous extrusion of material in a southeasterly direction. Folding developed initially with a normal cylindrical shape, but, to variable extent, the folds were progressively drawn out in the stretching direction into tubular-shaped sheath folds. A major sheath fold is inferred to be present inside the Forsmark tectonic lens (Figure 6-1).

The bedrock inside the Forsmark tectonic lens is relatively homogeneous and is dominated by medium-grained, equigranular granite. Between 1.87 and 1.86 Ga, both this granite and the surrounding rocks were affected by penetrative ductile deformation at mid-crustal depths under high-temperature metamorphic conditions (Söderbäck 2008). Amphibolite and fine- to medium-grained granitoid intruded syn-tectonically as dykes and minor bodies during this time interval and, locally, at least the amphibolites gave rise to alteration (albitization) in the older granitic rocks. Ductile deformation with folding continued to affect the younger intrusive rocks, including amphibolite, under lower metamorphic conditions, prior to 1.85 Ga (Hermansson et al. 2008). Subsequently, until at least 1.8 Ga, the ductile strain continued to affect the bedrock, predominantly along the margins of the tectonic lens along discrete zones (Söderbäck 2008).

The conceptual model, which involves a tectonic lens and marginal domains with their different styles of ductile deformation, has provided a firm basis for the modelling of rock domains in the Forsmark area. In the modelling procedure, all the isolated bodies of metamorphosed intrusive rocks have been treated as major constrictional, rod-like structures that extend at depth sub-parallel to the mineral stretching lineation. A body of metatonalite (RFM017) that is situated in the southeastern part of the tectonic lens (Figure 6-5) is inferred to be a mega-xenolith inside the metagranite. The geochronological data by Hermansson et al. (2008) support this concept. A younger granite body (RFM022) that is situated in the archipelago northeast of the tectonic lens, has been treated conceptually as a laccolith. It shows a broad extension at the surface, but a rapidly decreasing extension at depth. This geological feature has not been drilled and remains as an unconfirmed concept.

Relative to the adjacent Forsmark tectonic lens, rocks inside the SFR central block were affected by a generally higher degree of ductile strain and a well-defined WNW–ESE to NW–SE structural trend. The most strongly deformed rocks in the area consist of a heterogeneous package of mainly felsic to intermediate metavolcanic rock intercalated with metagranodiorite (to granite) and minor amphibolite. All these rocks display moderate to strong foliation, locally along with banding and gneissosity. These rocks have been intruded by considerable amounts of younger granite and pegmatitic granite, which locally form bodies of significant volume, within which the older rocks occur as xenoliths. The rheological heterogeneity of the rock mass in the SFR area has resulted in irregular folding at all scales (cf. Curtis et al. 2011). A structural concept, with the development of major sheath folds, similar to that of the Forsmark tectonic lens, is therefore not fully applicable in the SFR area. Due to this structural uncertainty, the use of borehole and tunnel intercepts marking gross compositional changes, as well as the magnetic anomaly signature have been the primary input to the modelling work, instead of structural measurements. However, projections of the rock domain boundaries were modelled to avoid conflict with the general ductile structural trend, oriented roughly NW–SE.



Figure 6-1. Conceptual model for the development of major, sheath folding inside the Forsmark tectonic lens, with fold axes sub-parallel to the mineral stretching lineation. Redrawn after figure in Stephens et al. (2007).

## 6.2 Upgrading of the RVS modelling tool

When the rock domain models were created in an earlier version of RVS, most rock boundary surfaces were created outside RVS and imported as ready-made geometries terminated against the modelling volume boundaries. When importing such objects into RVS v7 the object's edges coincides with the modelling volume boundary. This is unfavourable as rounding errors will create very long and very narrow triangles near the edges, which cannot be handled by the solid modelling engine. Also, imported geometries cannot be remodelled or otherwise updated using RVS tools, which is a serious limitation for further revision. Since the RVS modelling tools have been upgraded to make it possible to create the desired geometries, all objects were re-created using the RVS modelling tools.

To avoid problems along the edges, the modelled surfaces were extrapolated to reach outside the modelling volume (see Figure 6-2). The surfaces were also optimised using as sparse grid as possible, without simplifying the objects too much, to decrease the workload for the solid modelling engine.

This means that the rock boundary surfaces after the move to RVS v7 were not identical to previous versions of the model, but the overall appearance and geometry follows the original surfaces fairly close. All borehole intersections were kept unchanged.



*Figure 6-2.* The modelled rock boundary surface RUB18\_12-29. On the top is the *entire* surface modelled in RVS v6 as it is cut by the modelling volume boundary. In the bottom the *visible* part of the surface modelled in RVS v7 is shown in green and its *entirety* is shown in purple. The upper part of the surface does not extend above the modelling boundary, but above the topographic surface.

#### 6.3 Adjustment of domain boundaries along the top surface

When evaluating the imported surfaces against the outcrop map and the interpreted rock boundaries on the ground surface, a known systematic error in the original modelling of the surfaces was discovered. When the surfaces were modelled in the original model, all rock domain traces on the surface, plotted in 2D at z = 0, were lifted 27 m vertically to ensure that all rock domain boundaries would extend above the topography. They were then modelled from that position, down through the modelling volume with the evaluated inclination. The reason for that was due to lack of function in RVS, at the time for modelling, for draping the 2D rock boundaries on topographic a surface. For boundaries with a non-vertical inclination this meant that the modelled surface intersected the top surface with a non-negligible displacement from the original interpretation (Figure 6-3).

To rectify this, the upper profile of several rock domain boundaries was adjusted or moved to make the intersection follow the interpreted rock boundaries as closely as possible. Boundary surfaces without borehole intersections below surface were moved, keeping the shape of the surfaces intact, meaning that these surfaces were moved through the entire volume, see Figure 6-3a. However, for boundary surfaces with borehole intersections below ground, these intersections had to be kept unchanged. So, for these surfaces only the uppermost profile was changed, meaning that these surfaces will have a slightly altered geometry above the uppermost borehole intersection, but will be more or less unaltered below this intersection, see Figure 6-3b.



**Figure 6-3.** (a and b) Cross-sections perpendicular to a rock domain trace on the ground surface plotted on a plane at z = 0 is shown as a filled blue circle. The same trace lifted 27 m vertically is shown as a filled red circle, and the boundary surface modelled from this position as a red line. The intersection between the modelled boundary surface and the topography is shown as an unfilled red circle. The desired position of this intersection is shown as an unfilled green circle. To achieve the anticipated intersection boundary surfaces with no observation point below ground (a) were moved in their entirety to make the intersection with the topography fit with the position projected on the z = 0 plane (left). For boundary surfaces with borehole intersections below ground (b), the uppermost part was adjusted, but the boundary surface was unchanged below the uppermost borehole intersection. (c) Top view of a rock domain trace in blue, the intersection between the topography and the modelled rock boundary surface from the RVS v6 model in red and the intersection between the topography and the adjusted rock boundary surface from the RVS v7 model in green.

# 6.4 Division into rock domains, geometries and property assignment

The three rock domain models of Baseline Forsmark form a nestled system where RFM and RFR local are sub-models within volume of the RFM regional model. The number of domains in each model volume and the division of some regionally defined domains in the local model volumes are listed in Table 6-1. The inferred relationship between the domains of the local volumes and regional model volumes is illustrated in Figure 6-4.



*Figure 6-4.* Two-dimensional representation of the distribution of rock domains included in Baseline Forsmark version 1.0 at the ground surface. Domains immediately outside the local model volumes (RFM and RFR) are in paler colours. The different colours represent the dominant rock type in each domain.

Data acquired after conclusion of the investigations for SDM-Site and SDM-PSU have provided satisfactory support to the previously established rock domain models. Thus, none of the new data have prescribed revision of the domain boundaries. However, the new borehole data set have resulted in minor adjustments to the properties of rock domains compared with the three models developed during SDM-Site and SDM-PSU.

Table 6-1. The number of rock domains in each of the three model volumes included in Baseline Forsmark version 1.0, along with information about the division of two regionally defined domains in the local models.

Model volume	Number of domains	Comments on division
RFM regional	38	-
RFM local	14	RFM029R of the regional volume divided into RFM029 and RFM045
RFR local	4	RFM021 divided into three sub-domains: RFR01–RFR03 RFM033 = RFR04

In the RFM models, the identification of rock domains was initiated at the surface with a subsequent correlation with geological data along especially cored boreholes from the SHI. Due to the lack of outcrops in the SFR area, the initial recognition of the RFR domains has been based on the geological tunnel mapping of the SFR facility and SHI results of cored boreholes, which were correlated with interpretations of high-resolution ground magnetic data (see Curtis et al. 2011). Rock domains were established based on two distinct types of rock units (cf. Stephens et al. 2007):

- Composition and, to some extent, the grain size of the dominant rock type.
- Degree of bedrock homogeneity in combination with the style and degree of ductile deformation.

The principles for the identification of rock units are largely the same both for the surface mapping and the SHI of boreholes, with the advantage to permit correlation between the different data sets. The division into rock domains makes use of all the combinations in the two types of rock units. For example, separate domains can be defined based solely on an anomalous degree of ductile strain even if other properties of the bedrock are similar.

The Forsmark tectonic lens is represented by a limited number of rock domains (RFM029, RFM045, RFM044, RFM032, RFM034, RFM020 and RFM017), of which the volumetrically most important is RFM029. Domains situated immediately outside the tectonic lens are stretched along the southwestern (RFM026, RFM025, RFM018 and RFM012) and northeastern (RFM043, RFM021 and RFM016) limbs of the synform that is part of the inferred major sheath fold. All these marginal domains dip steeply towards the southwest, following the trend of the coastal deformation belt. The geometry of the synform is constrained by the boundary between rock domain RFM029 and the marginal domains RFM032 and RFM044 (Figure 6-5). Ductile structures in outcrops and boreholes situated in this volume prove that the synform plunges moderately to steeply (55–60°) to the southeast. Domain RFM045 has a constricted rod-like geometry steered by the proximity to the hinge of the synform (Figure 6-5). Rock domain RFM034 is located structurally beneath the two folded marginal domains, RFM032 and RFM044.





In general, linear (L) ductile mineral fabrics, including folding, dominate over planar (S) equivalents (LS-tectonites) in the domains that belong to the tectonic lens. They are inferred to be affected by a lower degree of ductile strain relative to the domains outside the tectonic lens even if the intensity of tectonic foliation increases somewhat towards the margins of the lens. However, the rocks in domains RFM032 and RFM044 are more strongly deformed and inferred to be folded by the major synform.

The rock volume with the RFR domains is situated in domains RFM021 and RFM033 (Figure 6-4), where the former is inferred to be part of the coastal deformational belt and composed predominantly of felsic metavolcanic rocks with abundant pegmatite and pegmatitic granite. Domains RFR01–RFR03 are sub-domains of RFM21, whereas RFR04 is equal to RFM033. The concept for modelling of the two domains RFR01 and RFR03 has involved irregular folding of compositionally heterogeneous rock volumes dominated by pegmatitic granite.

Quantitative estimates of the proportions of different rock types and alteration types are presented in Figure 6-6 and Figure 6-7 for the domains RFM012, RFM044, RFM045, RFM029, RFM029R, RFR01 and RFR02. Quantitative borehole data for the other domains are either insufficient to carry out a reliable estimate (RFM032 and RFM034) or are lacking.

Granites affected by amphibolite-facies metamorphism and, to some extent also by syn-metamorphic albitization, form the dominant rock component inside the tectonic lens. The rock domains that lie outside the tectonic lens are dominated by different types of granitoids, predominantly felsic volcanic rocks and quartz-poor or quartz-deficient diorite to gabbro, all of which are affected by amphibolite-facies metamorphism. More inhomogeneous bedrock is common in domains RFM018 and RFM021, on both sides of the tectonic lens.



**Figure 6-6.** Histograms illustrating the quantitative estimates of the proportions of different rocks in rock domains RFM012, RFM029, RFM029R, RFM044, RFM045, RFR01 and RFR02. The compilation is based on geological data from cored borehole sections (Sicada delivery SKBdata\_22\_065 and SKBdata\_23\_022). All calculations take account of both rock types and rock occurrences. Rock types with codes 101057 and 101058 in domain RFM045 are more or less altered to a fine-grained, quartz-plagioclase feldspar-(biotite) rock; the alteration is referred to as albitization (code 104 in the Sicada database).

A considerable proportion of the bedrock within RFM045 is affected by syn-metamorphic albitization, whereas more extensive occurrences of sericitization (muscovitization) generally are restricted to the RFR domain.

Property tables for the current versions of the rock domains included in Baseline Forsmark version 1.0 are stored in SKBmod (cf. Section 2.3). Property tables and information regarding the modelling procedure for the previously established model versions are provided by SKB (2005, 2006), Stephens et al. (2007) and Curtis et al. (2011). More detailed descriptions of the key domains in the target volumes for the planned repositories are presented by Stephens et al. (2007) and Curtis et al. (2011).





**Figure 6-7.** Histograms illustrating the quantitative estimates of rock alteration (a) outside and (b) inside target intercepts of modelled deformation zones for the rock domains RFM012, RFM029, RFM029R, RFM044, RFM045, RFR01 and RFR02. "Other alterations" include argillization, carbonatization, epidotization, laumontization, quartz dissolution, saussuritization, silicification and steatitization. The compilation is based on geological data from cored borehole sections (Sicada delivery SKBdata\_22\_065). Total borehole lengths outside and inside modelled deformation zones of each rock domain, including both altered and unaltered sections are presented in brackets. Note the scale difference between the histograms outside and inside target intercepts of modelled deformation zones. Note also that different alteration types can overlap, and the total proportion of altered rock is hence lower than the sum of individual alteration types.

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# 7 Fracture domain model

#### 7.1 Conceptual model

During the work with the SDM-Site, a need was recognised to divide the Forsmark site into fracture domains as a prerequisite for the development of an updated model for discrete fracture networks (DFN). For this purpose, Olofsson et al. (2007) identified and described a number of fracture domains at the site by using an integrated assessment of especially hydrogeological and hydrogeochemical data to support the development of a fracture domain concept.

A systematic assessment of the variation in the frequency of particularly open and partly open fractures with depth along each borehole (cf. Olofsson et al. 2007; Stephens et al. 2007) contributed significantly to the division of the bedrock into fracture domains. The following four considerations presented by Olofsson et al. (2007) control the identification and conceptual understanding of fracture domains at the site:

- Boreholes in the northwestern and southeastern parts of the investigated volume of the tectonic lens show a marked contrast in the fracture frequency distribution patterns with depth, particularly in the frequency of open and partly open fractures. It is suggested that this feature is essentially related to the corresponding contrast in the frequency of gently dipping deformation zones between the two sub-volumes. Since such zones are far less frequent beneath the combined zones ZFMA2 and ZFMF1 (cf. Figure 5-8), which merge southeast of drill site 2, different fracture domains are anticipated above and beneath these zones.
- The fracture frequency distribution patterns with depth also show that the bedrock beneath zone ZFMA2 displays different fracture characteristics close to the surface and at depth. This feature motivates separate fracture domains at different depths beneath this zone.
- There is a significant contrast in both the degree and character of the ductile strain and, to a large extent, the compositional homogeneity in the rock domains that form the margins of the tectonic lens, compared to the rock domains inside the lens. It is suggested that this contrast motivates the inclusion of the former as separate fracture domains. This strategy is also supported by the results of the DFN model version 1.2 (La Pointe et al. 2005). Two separate fracture domains are proposed, corresponding to the combined rock domains RFM012 and RFM018 and the combined rock domains RFM032 and RFM044.
- Rock domain RFM045, inside the tectonic lens, is dominated by fine-grained, altered (albitised) granitic rock. It is judged that both the finer grain size and the somewhat higher quartz content of this rock, as compared to unaltered granitic rock, may be significant for fracture characterization. The rock domain is consequently identified as a separate fracture domain.

# 7.2 Division into fracture domains, geometries and property assignment

Based on the considerations presented in the preceding section, six separate fracture domains have been recognised within the RFM local volume (Olofsson et al. 2007). However, borehole data that allow satisfactory characterisation are only available for four of the domains – FFM01, FFM02, FFM03 and FFM06. The inferred relationship between the domains is illustrated in Figure 7-1.

Data acquired after conclusion of the investigations for SDM-Site prescribes slight modifications for one of the domains, described further in Sections 7.5 and 7.6, but the framework and overall concept remains unchanged. A brief description of the four fracture domains is presented below. Further details regarding the fracture character, modelling procedures and uncertainties for the previously established model version are provided by Olofsson et al. (2007), with summaries in Stephens et al. (2007) and SKB (2008a). Property tables for the current versions of the fracture domains included in Baseline Forsmark version 1.0 are stored in SKBmod (cf. Section 2.4).



**Figure 7-1.** (a) Top view of FFM Baseline Forsmark version 1.0 at the ground surface. Volumetric representations of deformation zones ZFMA2 and ZFMWNW0001 are shown as references; they are not part of the current version of the fracture domain model. (b) Three-dimensional model for fracture domains FFM01, FFM02 and FFM03 viewed towards the ENE. FFM06 is enclosed by FFM01 and situated beneath FFM02 and is for this reason not visible. Origin surfaces for the gently dipping zones ZFMA2 and ZFMF1 also shown in red.

**Fracture domain FFM01** is situated within rock domain RFM029. It lies beneath the gently dipping zones ZFMA2, ZFMA3 and ZFMF1 and northwest of the steeply dipping zone ZFMNE0065, at an elevation that varies from ca -40 m (large distance from ZFMA2) to ca -200 m (close to ZFMA2). Relative to the overlying fracture domain FFM02, the bedrock in this domain shows a lower frequency of open and partly open fractures. Gently dipping or sub-horizontal deformation zones are not common inside this domain, based on current available data and understanding of the site. It is suggested that local accumulation of high in situ rock stresses have occurred at one or more times during geological history, in connection with, for example, sedimentary loading processes (SKB 2006; Stephens et al. 2007).

Fracture domain FFM02 is situated close to the surface, directly above fracture domain FFM01 and FFM06. It is characterized by a complex network of gently dipping and sub-horizontal, open and partly open fractures, which, conceptually, are considered to merge into minor fracture zones. Several of the fractures are evidently extensional structures (i.e. sheet joints), developed parallel to the current ground surface and to the two greatest principal compressive stresses in the rock mass. The transition depth to the less fractured bedrock of FFM01 increase as the distance from zone ZFMA2 decreases. A viable explanation for this is provided by the numerical stress simulations of Glamheden et al. (2007), which reveals that ZFMA2 perturbs all the stresses in the rock mass above the zone, and to limited extent below the zone (Figure 7-2). This deflection of the near-surface stresses is proposed to mimic the effect of a convex topographic surface and might have the ability to induce tension. Furthermore, the numerical modelling of the current stress conditions, implies significantly higher stress magnitudes below ZFMA2 and ZFMF1 than in the hanging wall (i.e. FFM03), where release of stress has reached deeper levels relative to that in FFM02. The stress magnitudes yielded by Glamheden et al. (2007) are largely equivalent with the high compressive surface-parallel stresses in most sheeted rock masses (cf. Martel 2017), especially in FFM02. FFM03 yields considerably lower stress magnitudes, likely due to stress-release facilitated by gently dipping fracture zones (i.e. ZFMA4–A7, ZFMB1 and ZFM866). This behaviour aligns with expectations.



Figure 7-2. Principal stress tensors along NW–SE vertical section obtained from 3DEC numerical simulation to assess the impact of major deformation zones; ZFMA2, ZFMF1 and ZFMENE062A. Note the rotation of principal stress tensors above and around ZFMA2 and ZFMF1. From Glamheden et al. (2007, Figure 6-26).

**Fracture domain FFM03** is situated within rock domains RFM017 and RFM029. Structurally, the domain lies above the shallow dipping zones ZFMA2, ZFMA3 and ZFMF1. The domain is characterised by a high frequency of gently dipping fracture zones containing both open and sealed fractures. It is suggested that this sequence of gently dipping zones inhibited the build-up of rock stresses in connection with, for example sedimentary loading processes (cf. Stephens et al. 2007). The development of sheet joints is hence less conspicuous than in FFM02.

**Fracture domain FFM06** is situated within rock domain RFM045. It resembles fracture domain FFM01 in the sense that it lies beneath both zone ZFMA2 and fracture domain FFM02. It is distinguished from domain FFM01 based on lithological characteristics of the widespread occurrence of fine-grained, altered (albitized) granitic rock, with slightly higher contents of quartz compared with unaltered granitic rock.

#### 7.3 Changed representation of deformation zones

Up to Fracture domain FM version 2.3 (cf. Table 2-7), the rock volume was divided into fracture domains, comprising of the volume included in the rock domains minus the volume of rock occupied by deformation zones. Thus, all deformation zones were represented by volumes between their bounding surfaces and as such treated as separate domains in a space filling model, which is illustrated in Figure 7-3a.

Regarding the FFM Baseline Forsmark, on the other hand, it was decided to represent each deformation zone by a single, infinitely thin surface – the origin surface, which generally corresponds to the centre of the zone (Figure 7-3b). If the end-users have a need for volumetric representations of deformation zones this can easily be achieved by superposition of deformation zone boundary geometries in DMS Baseline Forsmark (Figure 7-3c).

The advantage of the latter approach, with zones as single surfaces, is that the downstream users can decide whether to include a zone or not, depending on the purpose and modelling tool. With the former approach, the downstream users were forced to handle zones as separate domains, otherwise there were gaps that required extrapolations of adjacent domains to retain the connectivity.



**Figure 7-3.** Simplified figure showing alternative representations of deformation zones in a fracture domain model. Deformation zones can be handled as (a) separate domains in a space filling model or (b) single, infinitely thin surfaces (the origin surface). In the latter case volumetric representations of deformation zones can be achieved by later superposition of the bounding zone surfaces, as illustrated in alternative c.

## 7.4 Upgrading of the RVS modelling tool

The fracture domain model that preceded the release of FFM Baseline Forsmark version 1.0 (cf. Table 2-7) was produced in RVS v6. To achieve full concordance with the revised geometries of the other deterministic geological models of Baseline Forsmark, which were introduced by the conversion to RVS v7 (see Sections 5.4.3, 6.2 and 6.3), it was also necessary to generate a new fracture domain model. The major changes that affected the geometries of the fracture domain boundaries are as follows:

- The meshing of the domain boundaries was optimised by a general point reduction. Although this change has affected the geometric details, the overall geometric appearance remains indistinguishable from the boundaries of the original model (see Section 6.2).
- Adjustments of domain boundaries to achieve a better matching between ground surface intersections and the inferred rock boundaries derived from outcrop data. Boundaries without borehole intersections retained their original geometries, but with a slight shift in the position. For boundaries with borehole intersections, only the uppermost surface profile was adjusted to limit the geometrical changes to the part above the uppermost borehole intersection (se Section 6.3).

### 7.5 The division of FFM02 into subdomains

The frequency of sub-horizontal fractures with aperture displays a marked contrast between the upper and lower part of fracture domain FFM02 along the boreholes in the planned accesses and operation area of the final repository for spent nuclear fuel. The transition from a shallow rock mass, sheeted by sub-horizontal fractures with aperture, and the underlying part of FFM02 is rather distinct at -18to -28 m elevation in most of the boreholes in proximity to the repository access volume (Figure 7-4). A similar depth-dependent trend is also revealed along other boreholes within fracture domain FFM02, especially those at drill sites 1, 5, 6 and 7. However, the feature is usually less conspicuous in these boreholes and tends to be vague to non-existent along most of the possible deformation zones identified during the single-hole interpretation process (e.g. boreholes at drill site 9 which are inferred to intersect ZFMENE1208A). The trend is also obscured by shallow level intersections of ZFMA2, where sub-horizontal fractures with significant aperture instead are attributed to ZFMA2. Thus, horizontal to sub-horizontal fractures close to ZFMA2 can be splays rather than superficial sheet joints.

Although there are local difficulties in the identification, this transition has been defined in approximately two thirds of all boreholes with images (BIPS and OP-TV images) covering the level of interest in FFM02. On this basis, fracture domain FFM02 has been divided into two subdomains:

- FFM02U (upper) A shallow rock mass sheeted by horizontal to sub-horizontal fractures with distinct aperture and, in some cases, anomalously high transmissivities. The subdomain has a rather constant thickness, mainly ranging from 17 to 27 m, unaffected by the distance to ZFMA2, and a lower boundary that dips 0.3° towards the west.
- FFM02L (lower) In principle, the underlying (remaining) part of fracture domain FFM02, down to the transition to the less fractured bedrock of FFM01 (and FFM06). The subdomain is characterised by an increasing spacing with depth between horizontal to sub-horizontal fractures with distinct aperture, relative to the shallow rock mass of FFM02U. The origin of the horizontal to sub-horizontal fractures with distinct aperture at great depth can be different than at shallow depth, with a genetic relationship to the other fracture sets in the area.

The distribution of inferred sheet joints with aperture relative to the defined boundary between the subdomains FFM02U and FFM02L are presented in Figure 7-4, as logs for boreholes in the planned accesses and operational area of the final repository and drill site 7. The extent of FFM02U and FFM02L, is shown in Figure 7-5. A similar depth-dependent contrast in the frequency of sub-horizontal fractures with aperture is also revealed along some of the boreholes outside fracture domain FFM02, such as in HFM32 in FFM03. But most of the boreholes show no such distribution pattern, even if inferred sheet joints are rather common. These observations, together with the sparse drillings outside of fracture domain FFM02 do not provide sufficient support for a deterministic extension of a shallow rock slab with frequent sheet joints beyond FFM02.



*Figure 7-4.* Borehole logs covering drill site 7, 8 and the planned accesses and operation area of the final repository down to a depth of approximately -40 m. The logs show the distribution of inferred sheet joints with aperture along individual boreholes relative to the extent of fracture domains FFM02U, FFM02L and FFM01. Inferred sheet joints are divided based on aperture and transmissivity (T).



**Figure 7-5.** Oblique view to northeast showing the relationship between fracture domains FFM02U, FFM02L and FFM03 relative to the boreholes used to define the boundary between FFM02U and FFM02L. FFM02U are transparent above FFM06 in order to display the geometry of the latter. Note that several of the boreholes are hidden by FFM02U in the current view.

It is important to emphasise again that the distribution of horizontal to sub-horizontal fractures within FFM02L is highly variable, with an increased spacing towards depth. The boreholes completed after 2010 provide very limited information to the issue, as they all are located in a part of FFM02, where the transition depth to the underlying fracture domain FFM01 is close to the minimum. Also, the fracture data in the southeastern part, where the transition depth increases to a maximum of ca 200 m, are rather sparse with mainly deep telescopic boreholes, locally affected by the gently dipping zone ZFMA2.

#### 7.6 Local revision of the boundary between FFM01 and FFM02

In the previous fracture domain FM 2.3 (cf. Table 2-7), the primary basis for the separation of fracture domain FFM02 from the underlying FFM01/FFM06 along cored boreholes is "an anomalously high frequency of open and partly open fractures" (Olofsson et al. 2007). The borehole intersection fix-points used for modelling of the boundary between the two domains are listed in Table 5-2 of Olofsson et al. (2007). However, the actual surface was achieved by Gaussian process regression with subsequent import to RVS. Olofsson et al. (2007) also present diagrams of the variation in the fracture frequency at depth for each cored borehole included at model stage 2.2 of SDM-Site. These diagrams have been designed to provide an initial assessment of significant variations in fracture frequency in the bedrock outside the influence of geological anomalies such as deformation zones. Due to the lower quality of geological data in the percussion boreholes, the lower confidence level in the single-hole interpretation and the limited length of these boreholes, data from the percussion boreholes have not been used to define fracture domains at the site.

The drilling programme conducted in the shallow part of the access volume during 2011–2012 with the drilling of KFM13 to KFM23, as well as the subsequent drilling of KFM25 to KFM27, have provided information for an updated geometry of the boundary between FFM01 and FFM02. The approach used to define the revised boundary is virtually the same as the one used by Olofsson et al. (2007), who basically relied on cumulative frequency plots of open and partly open fractures for each individual borehole. Cumulative frequency plots for the boreholes KFM13 to KFM27 and KFR117 to KFR121 are presented in Appendix 6.

Except for the increased fracturing along intervals of inferred deformation zones, two typical fracture distribution patterns can be distinguished along the boreholes:

- 1. Virtually constant frequency along the entire borehole, even if the absolute frequency differs among the boreholes. Examples: KFM14 (Figure 7-6) and KFR16.
- 2. High and often variable frequency in the uppermost 20–40 m of the rock mass, with a change into lower and more constant frequency towards depth. Examples: KFM15, KFM17, KFM18 and KFM20 (Figure 7-6). KFM13, KFM21 and KFM23 show to some extent a similar distribution pattern, but with interference from intersecting deformation zones. This change in the distribution pattern of open and partially open fractures towards depth, has been taken to represent the boundary between FFM02 and FFM01. As illustrated by KFM20 in Figure 7-6, this change occurs at an approximate elevation of −30 m, with a shift from a rather high and variable frequency of 6.2 open and partially open fractures per metre in the upper part to an average of 1.4 in the remaining, lower part of the borehole.

Only boreholes with a distinct change in the fracture distribution pattern have been used to define the fracture domain boundary. Several of the older, cored boreholes from the site investigations situated close to the access volume are of telescope type (i.e. percussion drilled upper part of the borehole), and the cored parts do normally start at approximately 60–100 m depth. Within the planned access volume, the boundary between FFM02 and FFM01 is defined at an approximate elevation of –40 m in the previous model Fracture domain FM 2.3. The depth was defined along KFM08B during an extended SHI where the boundary between the two domains was identified at 46 m borehole length (Olofsson et al. 2007). The difference in the frequency of open and partially open fractures along the borehole is not obvious and there is more of a rather high, constant distribution (Figure 7-7) reminiscent of that in KFM14 (Figure 7-6) and KFM16. However, further support has been provided by the existence of fractures with aperture and especially differences in SPR (single point resistivity) and fluid resistivity (Michael Stephens, personal communication).



*Figure 7-6.* Two typical distribution patterns for open fractures (including partly open fractures and crushes) towards depth, exemplified by KFM14 and KFM20. Fracture frequencies are shown cumulatively. Note that the diagrams are based on elevation (not borehole length).



*Figure 7-7. Cumulative frequency of open fractures (including partly open fractures and crushes) in KFM08B. Note that the diagram is based on elevation (not borehole length).* 

Based on the frequency distribution of open and partly open fractures, the boundary between FFM02 and FFM01 has been possible to identify in about half of the cored boreholes situated in or close to the shallow part of the access volume (cf. Figure 7-4). In the remaining boreholes, there are either a disturbance by intersecting deformation zones (KFM19, KFM21, KFM23 and KFM27) or a rather constant frequency distribution along the entire borehole length (KFM14 and KFM16). Defined boundary intercepts, listed in Table 7-1, have been used as targets or fix points for revision of the surface geometry in the access volume. Following the modelling approach for Fracture domain FM 2.3, it was decided to exclude data from the percussion boreholes in this work. Target borehole intercepts used for modelling of the FFM02/FFM01 boundary in Fracture domain FM 2.3 (cf. Table 5-2 of Olofsson et al. 2007) have been left unchanged. However, kriging fix points situated close to target intercepts listed in Table 7-1, have been omitted to achieve a smooth shape of the boundary geometry. With this update, the boundary between FFM02 and FFM01 has been moved upward, closer to the ground surface, by about 5 m in the volume of the added borehole fix points.

Borehole	BH length [m]	BH depth [−m]	Comment
KFM13	46	37.2	Distinct change in the frequency of open and partly open fractures close to sec_low of PDZ1
KFM14	_	-	Low, rather constant frequency of open and partly open fractures throughout the borehole
KFM15	23	19.2	Distinct change in the frequency of open and partly open fractures
KFM16	-	-	Constant frequency of open and partly open fractures
KFM17	36	32.1	Distinct change in the frequency of open and partly open fractures
KFM18	26	22.3	Distinct change in the frequency of open and partly open fractures
KFM19	_	-	Constant frequency of open and partly open fractures. The borehole is almost completely included in ZFMENE1061A
KFM20	33	29.9	Distinct change in the frequency of open and partly open fractures
KFM21	_	-	-
KFM22	42	39.0	Distinct change in the frequency of open and partly open fractures
KFM23	-	-	Difficult to define a boundary since the borehole is almost completely inside ZFMENE2120
KFM24	_	_	Percussion drilled down to 35.68 m borehole length
KFM25	28	25.2	Rather weak change in the frequency of open and partly open fractures
KFM26	_	-	Constant frequency of open and partly open fractures
KFM27	-	-	Disturbance of the fracture frequency pattern by ZFMENE2248, which occurs along the entire borehole

Table 7-1. Target intercepts along boreholes for revision of the boundary between FFM02 and FFM01. See Appendix 6 for cumulative frequency diagrams.

8

# Model validity, uncertainties and recommendations

Increased confidence and successive reduction of uncertainties in the six versions of the site descriptive models have, besides improvement of the conceptual understanding, been the main driving forces of the surface-based investigations at Forsmark. A recurring question has been whether remaining uncertainties are acceptable for the purpose of engineering design of the repository for spent nuclear fuel and post-closure safety assessment or could be further reduced by additional investigations. Assessments of uncertainties and confidence have, consequently, been essential components in all previous versions of the geological models. These include whether all data are considered and understood, identification of the main uncertainties and their causes, possible alternative models and their handling, and conceptual consistency between disciplines, which in turn forms the basis for an overall confidence statement. Remaining uncertainties at completion of SDM-Site and SDM-PSU are summarised in SKB (2008a) and SKB (2013), respectively, with a more systematic, multi-disciplinary compilation for SDM-Site in SKB (2008b). Further notes on uncertainties in the Forsmark deformation model version 2.3 are presented by Stephens and Simeonov (2015).

The overall confidence level concerning the geological evolution and the broad tectonic framework of the region is judged to be high, based on the detailed work associated with the site investigations and the associated modelling work as reported in Stephens et al. (2007) and Curtis et al. (2011). More specifically, this confidence in the deterministic models rely on a comprehensive site understanding, as a basis for well-founded modelling concepts, but also the consistency between different model versions, the wealth and quality of available data and support from other disciplines. The predictability of the occurrence and character of both deformation zones and rock domains has proven to be high (Stephens et al. 2008b) and no new deformation zones with trace lengths exceeding 3000 m at the ground surface have emerged in the proximity to the SFR facility or the local model volume of SDM-Site since model stage 2.2. However, the confidence in the deterministic modelling is naturally scale-related, with high confidence in existence for zones of regional extent and lower levels as increasingly smaller structures are considered. The predictability of the region is inferred to be strongly related to the bedrock anisotropy that was established over 1850 million years ago, when the bedrock was situated at mid-crustal depths and was affected by penetrative, ductile deformation.

Geometries of modelled objects are highly dependent on the spatial positioning of the underlying data, which mostly consist of boreholes and geophysical entities, such as seismic reflectors and low magnetic lineaments. The estimated uncertainty in the position is generally less than 10 m, with a minimum accuracy of approximately 30 m (cf. Cosma et al. 2003; Isaksson and Keisu 2005; Isaksson et al. 2006a; Munier and Stigsson 2007). The negative impact on the geometric models of these uncertainties is judged to be relatively minor in significance compared to other more interpretative factors, such as the coherence between different geological observations and their interpolation or extrapolation (see Hermanson and Petersson 2022). The intrinsic weaknesses in the modelling procedure of vertical to steeply dipping deformation zones, including the matching between lineaments and possible deformation zones identified in a single-hole interpretation, and assumptions concerning the downdip extension (see Section 5.3.2), affect the modelled zone geometries significantly. The consequence of this is that the geometric constellations of zones in the current models are non-unique, as alternative geometries cannot be excluded. This is even more striking when it comes to deterministic modelling of sheet joints, which basically requires complimentary semi-stochastic modelling to fully describe the uncertainties in occurrence and spatial extent (cf. Hermanson and Petersson 2022).

Uncertainties outside the bedrock volumes, which were the focus of the previous site investigations, are significant, but are judged to be of less importance for post-closure safety assessment and repository design. The most noticeable example of this data bias is the absence of gently dipping zones in large parts of the volume of DMS Baseline Forsmark version 1.0, where no reflection seismic data exist. Such deterministic gaps need to be addressed by the stochastic DFN modelling work.

After the compilation and revision of the deterministic geological models covered by Baseline Forsmark version 1.0, there remains several more specific uncertainties; the majority of which were identified already at the completion of SDM-Site and SDM-PSU:

- Size of gently dipping deformation zones, which are currently extended to the nearest steeply dipping zone.
- Lateral extent of vertical to steeply dipping deformation zones that are largely defined by magnetic minima connections (e.g. ZFMWNW0123).
- The truncation pattern of vertical to steeply dipping deformation zones outside areas of high-resolution magnetic measurements or in magnetically disrupted areas.
- Orientation and size of unresolved deformation zones identified in the single-hole interpretation.
- The existence and geological character of gently dipping zones beneath the final repository.
- The presence of additional deformation zones not captured in the deterministic Baseline model, such as gently dipping zones in areas that lack reflection seismics and drillings.
- Size, occurrence and frequency of sheet joints in the upper part of the crystalline bedrock.
- Size and spatial distribution of subordinate rock types, especially for anomalously thick amphibolite bodies in domain RFM045.

#### 8.1 Size of gently dipping deformation zones

The estimated size of the gently dipping zones is based on the modelling of surface seismic reflection data and intersections along boreholes, in combination with the conceptual understanding of the tectonic evolution at Forsmark (see Section 5.1.1). Current knowledge is judged satisfactory where it concerns occurrence, orientation and geological properties in the volumes covered by the site investigations. Information from boreholes in these volumes provide constraints on the along-strike and down-dip extension for a few of the zones, such as ZFM1203 (see Section 5.4.4) and ZFM871, but uncertainties remain for the vast majority.

In the adopted modelling approach, it is judged that the uncertainty is sufficiently bounded by extending gently dipping zones to the nearest steeply dipping zone, even if there are uncertainties regarding the truncation towards depth. In addition, the significance of this uncertainty has been reduced somewhat through the selection of potential volumes for both the final repository and the expansion of the SFR facility. Though the uncertainty does still influence the modelling work of other disciplines, and hence the post-closure safety assessment.

The uncertainty can be reduced through complimentary surface-based investigations, such as boreholes and seismic reflection data in a tighter network of two-dimensional profiles (cf. SKB 2008b), but the significance in the near-repository volumes of the bedrock is judged to be limited.

# 8.2 Lateral extent of deformation zones largely defined by magnetic minima connections

Lineaments referred to as magnetic minima connections are related primarily to lithological contrasts that are aligned parallel to the ductile tectonic foliation in the bedrock. However, along or close to the high-strain margins of the Forsmark tectonic lens, lineaments defined by concordant magnetic minima are typically inferred expressions of vertical to steeply dipping, WNW–ESE and NW–SE striking zones with an initial ductile development. Whether a lineament defined by magnetic minima connections represent a possible deformation zone or lithological variability is not always obvious, and the occurrence of minor deformation zones along the tectonic foliation cannot be excluded as a contributory factor to these lineaments (e.g. ZFMNNW0404, ZFMNNW1204 and ZFMNNW1205A/B). This condition introduces some element of uncertainty in the interpretation of such lineaments, especially regarding their length.

Uncertainties regarding the length for some low magnetic lineaments has also been accentuated in the model review by the Swedish Radiation Safety Authority (SSM) through the following quotation: *"SKB's high-resolution ground magnetic measurements show that several steeply dipping deformation zones can be extended, which is particularly notable for zone ZFMWNW0123 which has been extended into the edge of the western part of the preliminary depositional area"* (GLS question 137). The example is highly relevant, given the possible impact on the preliminary layout of the repository, if a zone of such size (trace length at the ground surface is ca 5 km) were to be extended towards the NNW (cf. Figure 1-3 in Fälth 2022).

In the DMS Baseline Forsmark, ZFMWNW0123 terminates against ZFMENE0060A. A continuation further NNW of ZFMENE0060A cannot be completely excluded, based on the following information:

- Borehole data indicate that ZFMWNW0123 initially was developed by low-grade ductile deformation, whereas ZFMENE0060A shows only brittle strain. Thus, ZFMWNW0123 has at least locally existed before the development of ZFMENE0060A. Nevertheless, the conceptual model with a process of multiple reactivations and successive growth does not exclude the current truncation of ZFMWNW0123.
- The available high-resolution magnetic data provide basis for additional lineaments in the continuation of ZFMWNW0123, north of ZFMENE0060A (written communication with Hans Isaksson, dated 2019-12-19, see Figure 8-1).
- The northwestern part of ZFMWNW0123 instead follows lineament MFM0123G, which continues an additional 480 m northwest of ZFMENE0060A (Figure 8-1). Another possibility is that this part of the lineament represents a splay to the current interpretation of ZFMWNW0123; data from intersecting boreholes allow for both alternatives.
- None of the existing boreholes intersect a possible NNW continuation before it reaches KFM07A (Figure 8-1).
- The modelling team visited a number of outcrops in the area in early 2020 to shed further light on a possible continuation of ZFMWNW0123, though none of the outcrops provided any decisive input to the issue.



**Figure 8-1.** High-resolution ground magnetic data relative to interpreted lineaments (thin blue and green lines) and boreholes with surface projections in the area of truncation between ZFMWNW0123 and ZFMENE0060A (solid black lines). Inferred lineaments in the northern continuation of ZFMWNW0123 are marked by dashed red lines, whereas lineament MFM0123G is marked by a blue solid line.

A possible continuation of ZFMWNW0123 can be investigated both by boreholes and trenches positioned immediately north of ZFMENE0060A. Given the depth of the regolith in some depressions (e.g. AFM001243, Cronquist et al. 2005), it is recommended that such investigations are restricted to surface-based drillings.

There is also some uncertainty about the total extent of the zone and especially its southern part, which gradually receives an approximately east–west strike before truncation towards ZFMWNW0023. The question is whether the zone has a more limited extent or follows an alternative lineament in the south. Further analysis is recommended through a reassessment of the underlying data and the inferred lineaments in the light of current tectonic concepts.

#### 8.3 The truncation pattern of vertical to steeply deformation zones

Uncertainties in the truncation patterns of vertical to steeply dipping zones are primarily of significance outside of areas covered by high-resolution ground magnetic measurements and in magnetically disturbed areas. The issue can be illustrated by Figure 8-2 from Stephens et al. (2008b), which compare the deterministic deformation zones in Forsmark stage 2.2 with modified zone traces implied by a revised interpretation of low magnetic lineaments that emerged from new high-resolution ground magnetic data (Isaksson et al. 2007). Based on this, the extent of individual lineaments, as well as the truncation pattern, is strongly dependent on the resolution of the underlying data, with a higher degree of uncertainty in areas outside of detailed ground magnetic surveys.

Although of a more local character, magnetically disturbed areas with low relief also exhibit significant uncertainties in lineament interpretation. Such disturbances occur close to man-made installations, including the Fennoscandian high-voltage DC cable, residence areas, landfill areas (e.g. the pier above the SFR facility), drill sites and water tubes. Furthermore, there are no measurements around the nuclear power plant. In these areas, the interpretations instead rely on alternative data sources (cf. SKB 2005), with strong support from the adopted tectonic concept.



**Figure 8-2.** Detail of Figure 2-3 in Stephens et al. (2008b), showing deterministic deformation zones in Forsmark stage 2.2 (Stephens et al. 2007) compared with magnetic lineaments inferred from new high-resolution ground magnetic data (light green areas) and previous lineaments (Isaksson et al. 2007). The modification implied by the new high-resolution data in the western area is for some zones significant (magenta coloured, Group 3). The local model area of SDM-Site is marked with a blue dashed line. Magnetically disturbed areas are marked with yellow. © Lantmäteriverket Gävle 2007. Consent I 2007/1092.

Available high-resolution ground magnetic data cover, by a significant margin, the areas above the potential volumes of both the final repository and the expansion of the SFR facility. In these areas, it is judged that uncertainty in the truncation pattern of vertical to steeply dipping deformation zones is limited. The uncertainty outside these areas, which largely covers the local model areas of SDM-Site and SDM-PSU, has primarily been handled by an increase of the bounding size for modelled zones (e.g. from 1 to 3 km in SDM-Site). Nevertheless, the inferred spatial relations between zones in these areas of low-resolution airborne data rely to a greater extent on the conceptual understanding. Although significantly reduced, uncertainties in the details of the zone truncation largely remains. The impact on particularly the hydrogeological modelling is obvious, but the uncertainties are judged to have limited importance for post-closure safety and repository engineering.

#### 8.4 Orientation and size of unresolved deformation zones

Possible deformation zones from the single-hole interpretation, which have not been modelled deterministically, are in this report denoted unresolved deformation zones. The confidence and possible orientation of these zones have been evaluated in Section 5.6.

Some of these zones could be transmissive and therefore of interest from a hydrogeological point of view. It is judged that these structures are either minor zones (cf. Stephens et al. 2007), branches from already modelled deformation zones or, considering the often low or medium confidence level in identification, brittle features of more local nature, such as fracture step-overs or results of small-scale rheological anomalies. Based on this, it is questionable whether these structures are sufficiently important to warrant further investigation.

Both the occurrence and geological character of the unresolved deformation zones are known. Uncertainty concerns how to link the zones with geophysical anomalies (e.g. a magnetic minimum), to establish their orientation and size. Such a link may simply not be possible using the geophysical data available at the ground surface due to limited penetration towards depth.

The lack of confidence has been handled by providing bounding estimates through stochastic modelling, on the assumption that they are minor zones (cf. Hartley et al. 2024). From the absence of geophysical anomalies, it can be concluded that all these sections correspond to zones that are less than 3 km in trace length at the ground surface, but it cannot be ruled out that some of them have surface trace lengths larger than 1 km.

## 8.5 Gently dipping zones beneath the final repository.

A main concern for the safety assessment is the existence and nature of gently dipping deformation zones beneath the final repository. This relies on the basic view that the maximum induced displacements associated with seismic reactivation of such structures in a reverse stress regime are generally significantly larger in the hanging wall than in the foot wall (see Hökmark et al. 2019). This means that the critical radii, defined as the smallest radius for any given combination of fracture orientation and distance to fault that can host a single slip exceeding the canister shear failure threshold (Munier 2006), are typically much smaller in the hanging wall.

The current available information from deep boreholes and seismic reflection processing provide support for the existence of one gently dipping zone beneath the planned repository, ZFMA1. Other gently dipping zones, such as ZFMB7 and ZFMB8, are inferred to terminate before they reach the footprint of the repository, though continuation beneath part of the repository cannot be excluded. Furthermore, since no boreholes penetrate seismic reflector A1/A0 there are uncertainties regarding the geological character of this feature. An alternative interpretation of the reflector, as provided by Stephens et al. (2007), is that it is related, wholly or partly, to compositional variations in the bedrock inside rock domain RFM032.

It is suggested that these uncertainties concerning the nature of seismic reflector A1/A0, as well as the possible existence of deformation zones with gentle dips towards the southeast beneath the planned repository, could be reduced by additional surface-based drillings in the northern to northwestern parts of rock domain RFM032.

# 8.6 Additional deformation zones not captured by the deterministic model

The main conclusions concerning the presence of undetected deformation zones at the completion of the preceding site descriptive modelling can be summarised as follows:

- Inside the repository target volume (i.e., the central part of the Forsmark local model volume), the existence of previously unknown deformation zones that are significantly longer than 3000 m is highly unlikely (Stephens et. al. 2007). This view has not been altered by the investigations conducted after 2010.
- There is a high confidence that no, previously unknown, local major (1–10 km length) or larger deformation zone exists in the SFR local model volume (Curtis et al. 2011).

The essence of these statements is that all deformation zones of critical importance for post-closure safety and the overall repository layout have been identified. However, there are no guarantees that *all* deformation zones down to the bounding size of the local models of SDM-Site and SDM-PSU (see Table 2-3) have been identified.

Outside the local volumes of SDM-Site and SDM-PSU, where the support from direct geological observations is sparser, the uncertainties are larger. This means that only a few of the lineaments have been verified as deformation zones by actual observations and that there might exist undetected deformation zones, which exceed the bounding size of the specific volume (see Table 2-3). Uncertainties are most significant for WNW–ESE to NW–SE striking zones along magnetic minima connections (see Section 8.2) and gently dipping zones, which require either boreholes or seismic reflection data for detection. Such deterministic gaps because of data deficiencies need to be stochastically addressed using DFN modelling (cf. Selroos et al. 2022). However, the usage of the DMS Baseline Forsmark without a complementary DFN model would transfer these uncertainties to the modelling work of downstream users, with significant impact on the hydrogeological and mechanical modelling.

#### 8.7 Size, occurrence and variability of sheet joints

There is considerable variation and uncertainty in the size and intensity of sheet joints in the upper part of the crystalline bedrock at Forsmark. The structures are often highly conductive and can affect the rock mass stability. Thus, the variation and uncertainty affect assessment of stability and groundwater conditions (inflows and drawdown).

Current knowledge is based on a number of percussion and cored boreholes, together with the documentation of Carlsson (1979) from the earlier construction of the nuclear power plant. The issue of sheet joints has been the focus in most of the borehole investigations conducted after 2010, and their occurrence in the immediate proximity to the planned accesses of the final repository and extension of the SFR facility is judged to be rather well-described. The information outside these areas is, on the other hand, more sporadic and the uncertainty is significant.

In SDM-Site this uncertainty was handled and quantified by assigning the upper part of the bedrock in rock domain RFM045 and the northern part of rock domain RFM029 to a separate fracture domain (FFM02), within which the fracture character was modelled stochastically (cf. SKB 2008a). This concept was further refined in the Baseline Forsmark by a local revision of the boundary between the two fracture domains FFM02 and FFM01 (see Section 7.6), and a division of fracture domain FFM02 into two subdomains, based on a marked contrast in the occurrence of inferred sheet joints with observable aperture (see Section 7.5). Baseline Forsmark also includes deterministic representations of individual sheet joints in a few limited areas, with the sole purpose to provide basis for conditional probability simulations in the DFN modelling work. By this semi-deterministic approach, it is judged that the uncertainty is sufficiently bounded in the upper part of the bedrock, in areas of planned exploitation. However, the uncertainty in the nature of these structures increase with depth, and even if inferred occurrences exist at greater depths, there are no indications concerning size. It is questionable whether this uncertainty could successfully be further reduced by additional surface-based investigations; explorations with special focus on this issue are instead advisable during the construction of the repository access.

### 8.8 Size and spatial distribution of subordinate rock types

The rock domain model of SDM-Site relies heavily on the accuracy of the bedrock geological map at the surface (two-dimensional model) and the positioning of boreholes at depth (three-dimensional model). For the two key rock domains RFM029 and RFM045 in the local model volume, the extension of domain boundaries at depth and the quantitative estimates of the proportions of different rock types are judged to be sufficiently well-defined for the basis of engineering design and post-closure safety assessment. Corresponding details are still lacking for all other rock domains, though the uncertainty is not judged to be of major significance.

The uncertainties in size and spatial distribution of subordinate rock types, on the other hand, remain for all rock domains of SDM-Site, including RFM029 and RFM045. An issue of concern for both the thermal and rock mechanical modelling is the anomalously thick amphibolite bodies in rock domain RFM045. Borehole data indicate that amphibolites thicker than 1 m are uncommon in rock domain RFM029 but are more plentiful in domain RFM045. The modelling scale and the spatial density of borehole data have not permitted a deterministic approach to this uncertainty, which is a direct result of the high degree of lithological heterogeneity. The simulations of the size and spatial distribution of subordinate rock bodies have been optimised for thermal modelling at the canister scale. For other scales, the uncertainties are greater, which means that the distributions of both larger and smaller bodies are less well described (cf. SKB 2008b). Advisable, this is handled stochastically by extending the thermal modelling to reflect additional scales.

Considering the rock domain model of SDM-PSU, geological data are virtually limited to the key domains RFR01 and RFR02. Both domains, and especially RFR02, exhibit a considerable heterogeneity in the rock type distribution compared with the domains within the Forsmark tectonic lens. Despite some spatial variability, the uncertainty in both the geometric boundary between the two domains and the quantitative estimate of the proportions of different rock types are judged to be low to moderate (cf. Curtis et al. 2011). The lack of data in the rock domains that are peripheral to the volume of interest for the extension of SFR (i.e., RFR03 and RFR04), is not judged to be of any major significance for either engineering design or post-closure safety assessment. 9

# Quality assurance, model deliveries and supporting tables

The quality assurance (QA) system of SKB provides a number of procedures and instructions to ensure that the models are:

- derived from qualified data acquired prior to a fixed date,
- correctly reviewed and approved by expert groups and responsible modellers,
- correctly delivered to, and employed by, the downstream users.

Peer-review of model changes introduced after the release of SDM-Site and SDM-PSU have been conducted by SKB's own experts. Review records are archived in SKBdoc in the folder: *Avdelningar – Enheter/Forskning och utveckling/Enhet RP/Platsmodellering/Geologi* 

Deterministic geological models included in Baseline Forsmark version 1.0 were delivered to the SKB model database SKBmod during the spring of 2022. Details for the delivery are listed in Table 9-1. All models have been approved by the person who is responsible for the geological modelling at SKB. The only models that are allowed for further use by the geology team and downstream users are the approved versions downloaded from SKBmod. The database is also used for internal deliveries.

Table 9-1. Details for the geological models and supporting tables of Baselin	e Forsmark
version 1.0 in SKBmod.	

ID*	Name	Format	Approval date
1968355	DMS Baseline Forsmark v1 Surface	Microstation DGN	2022-02-03
1968356	DMS Baseline Forsmark v1 Volumetric	Microstation DGN	2022-02-03
1981496	FFM Baseline Forsmark v1	Microstation DGN	2022-05-12
1981497	RFM loc Baseline Forsmark v1	Microstation DGN	2022-05-12
1981498	RFM reg Baseline Forsmark v1	Microstation DGN	2022-05-12
1981499	RFR loc Baseline Forsmark v1	Microstation DGN	2022-05-12
1990410	1967948 – Summary tables – geological models Baseline Forsmark v1	MS Excel 2010	2022-09-26

ID in SKBMod.

The delivery includes the file *1967948* – *Summary tables* – *geological models Baseline Forsmark v1*, which comprises supporting tables with information concerning intercepts between boreholes and modelled objects, geometries and underlying data for modelled deformation zones, as well as inferred orientations for unresolved possible deformation zones (see Section 5.6). The meaning of the data presented in these tables (spreadsheets) are described in Table 9-2 to Table 9-5.

The bedrock surface, used as top surface in all deterministic geological models of Baseline Forsmark version 1.0 (see Section 2.6), was uploaded to SKBmod in mid-November 2023 with the identity 2028629 – *Topo 40m grid Max error 20m.dgn*.

Table 9-2.	Description of data presented in the spreadsheet DZ – Geometry in the file 19	967948
– Summai	ry tables – geological models Baseline Forsmark v1, stored in SKBmod.	

Column heading	Description
ID	Name of the deformation zone
Old ID	Name of the deformation zone in Forsmark version 2.3 and SFR version 1.0
Version	Object version extracted from RVS
Strike	According to the right-hand-rule method. Extracted from RVS
Dip	Extracted from RVS
Thickness, total	The sum of "Thickness, dipdir" and "Thickness, opposite dipdir". Extracted from RVS
Thickness, dipdir	The thickness of the zone on the right hand side (in the strike direction) of the origin surface (cf. Figure 5-10). Identical to " <i>Thickness, opposite dipdir</i> " for symmetrical zones. Extracted from RVS
Tickness, opposite dipdir	The thickness of the zone on the left hand side (in the strike direction) of the origin surface (cf. Figure 5-10). Identical to " <i>Thickness, dipdii</i> " for symmetrical zones. Extracted from RVS
Constant (C) or variable (V) thickness	All zones in DMS Baseline Forsmark version 1.0 are modelled with constant thickness
Thickness based on length-thickness correlation (Y/N)	Indicates whether the zone thickness has been defined on the basis of geological information (N) or the power law function T = $0.2 L^{0.6}$ yielded by the thickness-length correlation chart presented in Figure 5-11 (Y)
Projected horizontal length	The horizontal trace length at the ground surface inside the model volume. Zones that fail to reach the ground surface have hence no length indication (see Section 5.3.3). Extracted from RVS
Total length	The entire horizontal trace length at the ground surface, including parts that occur outside the future sub-catchment area (see Section 5.3.3). Values are only provided for zones that continue outside the model boundary of the future sub-catchment area. Extracted from RVS
Max depth	The zone termination depth. Zones with " <i>Max depth</i> " of $-2100$ reach the base of the model volume. Extracted from RVS
Terminates against other objects	Modelled objects that the zone terminates against. "Topo 40m grid Max error 20m" is the bedrock surface (see Section 2.6) – all zones inferred to reach the ground surface terminates against this. "Surface Planar Cut(s)" denotes terminations made by the RVS trimming function, with no relations to other modelled objects. Extracted from RVS
Terminations caused by the zone	Other zones that terminate against the zone in question. Extracted from RVS

Table 9-3. Description of data presented in the spreadsheets *DZ* – Borehole, *FFM* – Borehole, *RFM reg* – Borehole, *RFM loc* – Borehole, *RFR* – Borehole in the file 1967948 – Summary tables – geological models Baseline Forsmark v1, stored in SKBmod.

Column heading	Description
Geometrical intercept	The intersection between a modelled zone and an individual borehole as they exist in the RVS modelling tool (see Figure 5-10). The intercept is described by an upper and lower borehole length (sec_up/sec_low) provided by the intersection of the bounding surfaces of the modelled zone. Note that the geometrical sec_up along some boreholes represent intersections with the bedrock surface used as model top surface. In such boreholes, the geometrical sec_up can deviate from the position of the rock surface registered in the SKB database Sicada by several meters; the reason is the vertical point reduction introduced by RVS (see Section 2.6), eoh = end of borehole. Extracted from RVS
Target intercept	The interpreted position of a deformation zone or domain boundary along a borehole essentially based on geological indications, often with support from geophysical information. Consequently, if there is a geometrical intercept but no target intercept, there is nothing to support the existence of the zone or domain boundary along that specific borehole. In general, the target intercept conform to the intercept of a possible deformation zone or rock unit boundary identified during the geological SHI (see Figure 5-10), in certain cases with adjustments based on complimentary information. A target intercept is described by an upper and lower borehole length (sec_up/sec_low)
Intercept defined by SHI	The position of possible deformation zones or rock units inferred to represent a specific deformation zone or domain, respectively. Note that the target intercepts can include several possible deformation zones along a borehole; in such case geometrical and target sec_up/ sec_low are identical for all included possible deformation zones. Based on data delivery SKBdata_22_065
RVS fix point	Fix point that define the intercept between a borehole and the origin surface of a modelled zone (see Figure 5-10). For deformation zones inherrited from the SDM-Site, the borehole fix points were positioned to reflect the inferred intercept of zone cores. Extracted from RVS

# Table 9-4. Description of data presented in the spreadsheets Sheet joint – Borehole in the file 1967948 – Summary tables – geological models Baseline Forsmark v1, stored in SKBmod.

Column heading	Description
Version	Object version extracted from RVS
Strike	According to the right-hand-rule method. Extracted from RVS
Dip	Extracted from RVS
Target intercept	The interpreted position of a sheet joint based on the criteria listed in Section 4.3.3. A target intercept is described by an upper and lower borehole length (sec_up/sec_low), typically defined by the aperture of the joint
RVS fix point	Fix point that define the intercept between a borehole and the origin surface of a modelled sheet joint. Extracted from RVS

# Table 9-5. Description of data presented in the spreadsheets *PDZ – unresolved* in the file 1967948 – *Summary tables – geological models Baseline Forsmark v1*, stored in SKBmod.

Column heading	Description
PDZ defined by SHI	Possible deformation zones defined in the single-hole interpretation. Each possible deformation zone is described by an upper and lower borehole length (sec_up/sec_low). Confidence level assigned in the single-hole interpretation, according to a three-level scale where 3 = high, 2 = medium and 1 = low. Based on data delivery SKBdata_22_065
Orientation	Estimated on the basis of the general distribution pattern of structural data presented on an equal-area stereographic projection (see Section 5.6). Orientations are not specified in those cases where the data set is too limited or shows too much scatter. Analysis is based on delivery SKBdata_22_065

# References

SKB's (Svensk Kärnbränslehantering AB) publications can be found at www.skb.com/publications. SKBdoc documents will be submitted upon request to document@skb.se.

**Adl-Zarrabi B, 2004a.** Forsmark site investigation. Drill hole KFM01A. Thermal properties: heat conductivity and heat capacity determined using the TPS method and mineralogical composition by modal analysis. SKB P-04-159, Svensk Kärnbränslehantering AB.

Adl-Zarrabi B, 2004b. Forsmark site investigation. Drill hole KFM04A. Thermal properties: heat conductivity and heat capacity determined using the TPS method and mineralogical composition by modal analysis. SKB P-04-199, Svensk Kärnbränslehantering AB.

Adl-Zarrabi B, 2006. Forsmark site investigation. Borehole KFM01A, KFM01C, KFM01D, KFM04A, KFM05A, KFM06A and KFM09A. Thermal properties of rocks using calorimeter and TPS method, and mineralogical composition by modal analysis. SKB P-06-233, Svensk Kärnbränslehantering AB.

**Axelsson C-L, Mærsk Hansen L, 1997.** Update of structural models at SFR nuclear waste repository, Forsmark, Sweden. SKB R-98-05, Svensk Kärnbränslehantering AB.

**Bakker A, 2021.** Geological characterisation of geophysical lineaments as part of the expanded site descriptive model around the planned repository site for high-level nuclear waste, Forsmark, Sweden. Dissertations in geology at Lund University, No. 623, 48 pp.

**Balu L, Cosma C, 2005.** Estimation of 3D positions and orientations of reflectors based on an updated interpretation of Stage 1 reflection seismic data. Preliminary site description of the Forsmark area – version 1.2. SKB R-05-39, Svensk Kärnbränslehantering AB.

**Becken M, Pedersen L B, 2003.** Transformation of VLF anomaly maps into apparent resistivity and phase. Geophysics, 68, pp 497–505. doi:10.1190/1.1567217

**Beckholmen M, Tirén S A, 2010a.** Rock-block characterization on regional to local scales for two SKB sites in Forsmark – Uppland and Laxemar – eastern Småland, southeastern Sweden. SSM report 2010:40, Swedish Radiation Safety Authority.

**Beckholmen M, Tirén S A, 2010b.** Rock-block configuration in Uppland and the Ålands-hav basin, the regional surroundings of the SKB site in Forsmark, Sea and land areas, eastern Sweden. SSM report 2010:41, Swedish Radiation Safety Authority.

Bergman S, Bergman T, Johansson R, Stephens M, Isaksson H, 1998. Förstudie Östhammar. Delprojekt jordarter, bergarter och deformationszoner. Kompletterande arbeten 1998. SKB R-98-57, Svensk Kärnbränslehantering AB.

**Bono N, Fredriksson A, Maersk Hansen L, 2010.** Sättningsanalys Forsmarks kärnkraftverk – aggregat 1. SKB P-10-48. Svensk Kärnbränslehantering AB.

**Braathen A, Osmundsen PT, Gabrielsen R H, 2004.** Dynamic development of fault rocks in a crustal-scale detachment: An example from western Norway. Tectonics 23, pp 1–21.

**Brotchie J F, Silvester R, 1969.** On crustal flexure. Journal of Geophysical Research, vol 74, pp 5240–5252.

Caine J S, Evans J P, Forster C B, 1996. Fault zone architecture and permeability structure. Geology 24 (11), 1025–1028.

**Carlsson A, 1979.** Characteristic features of a superficial rock mass in Southern central Sweden. Horizontal and sub-horizontal fractures and filling material. Striae 11.

**Carlsson A, Christiansson R, 1987.** Geology and tectonics at Forsmark, Sweden. SKB SFR 87-04, Svensk Kärnbränslehantering AB.

**Carlsson L, Carlsten S, Sigurdsson T, Winberg A, 1985.** Hydraulic modelling of the final repository for reactor waste (SFR). Compilation and conceptualization of available geological and hydrogeological data. Edition 1. SKB SFR 85-06, Svensk Kärnbränslehantering AB.

Cederbom, C, 2001. Phanerozoic, pre-Cretaceous thermotectonic events in southern Sweden revealed by fission track thermochronology. Earth and Planetary Science Letters 188, 199–209.

**Cederbom C, Larsson S Å, Tullborg E-L, Stiberg J-P, 2000.** Fission track thermochronology applied to Phanerozoic thermotectonic events in central and southern Sweden. Tectonophysics 316, 153–167.

**Christiansson R, Bolvede P, 1987.** Byggnadsgeologisk uppföljning. Slutrapport. SKB SFR 87-03, Svensk Kärnbränslehantering AB. (In Swedish.)

**Claesson L-Å, Nilsson G, 2004.** Forsmark site investigation. Drilling of the telescopic borehole KFM03A and the core drilled borehole KFM03B at drilling site DS3. SKB P-03-59, Svensk Kärnbränslehantering AB.

**Claesson L-Å, Nilsson G, 2005.** Forsmark site investigation. Drilling of the telescopic borehole KFM06A and the core drilled borehole KFM06B at drill site DS6. SKB P-05-50, Svensk Kärnbränslehantering AB.

**Claesson L-Å, Nilsson G, 2006.** Forsmark site investigation. Drilling of the telescopic borehole KFM06C at drill site DS6. SKB P-05-277, Svensk Kärnbränslehantering AB.

**Claesson L-Å, Nilsson G, Ullberg A, 2007.** Forsmark site investigation. Drilling of borehole KFM01C and the telescopic borehole KFM01D at drill site DS1. SKB P-06-173, Svensk Kärnbränslehantering AB.

**Claesson Liljedahl L, Munier R, Sandström B, Drake H, Tullborg E-L, 2011.** Assessment of fractures classified as non-mineralised in the Sicada database. SKB R-11-02, Svensk Kärnbränslehantering AB.

**Crampton S L, Allen PA, 1995.** Recognition of fore bulge unconformities associated with early stage foreland basin development. AAPG Bulltin, vol 79, pp 495–1514.

**Cosma C, Balu L, Enescu N, 2003.** Estimation of 3D positions and orientations of reflectors identified in the reflection seismic survey at the Forsmark area. SKB R-03-22, Svensk Kärnbränslehantering AB.

**Cosma C, Balu L, Enescu N, 2006.** Estimation of 3D positions and orientations of reflectors identified during the stage 2 reflection seismic survey at Forsmark Site descriptive modeling Forsmark Stage 2.1. SKB R-06-93, Svensk Kärnbränslehantering AB.

Cronquist T, Forssberg O, Mærsk Hansen L, Jonsson A, Koyi S, Leiner P, Vestgård J, Petersson J, Skogsmo G. 2005. Forsmark site investigation. Detailed fracture mapping of two trenches at Forsmark. SKB P-04-88, Svensk Kärnbränslehantering AB.

Curtis P, Petersson J, Triumf C-A, Isaksson H, 2009. Site investigation SFR. Deformation zone modelling. Model version 0.1. SKB P-09-48, Svensk Kärnbränslehantering AB.

Curtis P, Markström I, Petersson J, Triumf C-A, Isaksson H, Mattsson H, 2011. Site investigation SFR. Bedrock geology. SKB R-10-49, Svensk Kärnbränslehantering AB.

Curtis P, Runslätt E, Vestgård J, Bergkvist L, Mærsk Hansen L, Olsson A, Ergun F, 2015. SFK Byggundersökningar. Detaljerad dikeskartering i Söderviken. SKBdoc 1338599 ver 1.0, Svensk Kärnbränslehantering AB. (In Swedish.)

**Dahlin P, Petersson J, Mattsson H, 2017.** Geological single-hole interpretation of KFM24. SKB P-16-29, Svensk Kärnbränslehantering AB.

Döse C, Stråhle A, Rauséus G, Samuelsson E, Olsson O, 2008. Revision of BIPS-orientations for geological objects in boreholes from Forsmark and Laxemar. SKB P-08-37, Svensk Kärnbränslehantering AB.

**Earon R, 2022.** Watershed Analysis of SAR Model Area. Spatial analysis of overland runoff relating to Site Modelling- Forsmark area. SKBdoc 1940271 ver, 1.0 Svensk Kärnbränslehantering AB.

**Eklund S, Mattsson K-J, 2009.** Forsmark site investigation. Quantitative mapping of fracture minerals in Forsmark. SKB P-08-47, Svensk Kärnbränslehantering AB.

**Eliasson T, 1993.** Mineralogy, geochemistry and petrophysics of red coloured granite adjacent to fractures. SKB TR 93-06, Svensk Kärnbränslehantering AB.
Follin S (ed), 2019. Multidisciplinary description of the access area of the planned spent nuclear fuel repository in Forsmark prior to construction. SKB R-17-13, Svensk Kärnbränslehantering AB.

**Forssberg O, Hansen L M, Koyi S, Vestgård J, Öhman J, Petersson J, Albrecht J, Hedenström A, Gustavsson J, 2007.** Forsmark site investigation. Detailed fracture and bedrock mapping, Quaternary investigations and GPR measurements at excavated outcrop AFM001264. SKB P-05-269, Svensk Kärnbränslehantering AB

**Fox A, Hermanson J, 2006.** Identification of additional, possible minor deformation zones at Forsmark through a review of data from cored boreholes. SKB P-06-293, Svensk Kärnbränslehantering AB.

**Fälth B, 2022.** Deformation zone stability and co-seismic secondary fracture displacements at Forsmark. SKB TR-22-13, Svensk Kärnbränslehantering AB.

**Glamheden R, Fredriksson A, Röshoff K, Karlsson J, Hakami H, Christiansson R, 2007.** Rock mechanics Forsmark, Site descriptive modelling Forsmark stage 2.2. SKB R-07-31, Svensk Kärnbränslehantering AB.

Grigull S, Peterson G, Nyberg J, Öhrling C, 2019. Phanerozoic faulting of Precambrian basement in Uppland. SKB R-19-22, Svensk Kärnbränslehantering AB.

**Gustavsson E, 2006.** Forsmark site investigation. Data report from the laboratory investigations of the transport properties of the rock. Data delivery for data freeze Forsmark 2.2. SKB P-06-186, Svensk Kärnbränslehantering AB.

**Gustafsson J, Hedman P, 2012.** SFK Byggundersökningar. Jordartskartering och markradarmätningar i diken i Söderviken. SKBdoc 1327863 ver 1.0, Svensk Kärnbränslehantering AB. (In Swedish.)

Hartley L, Libby S, Bym T, Carty J, Cottrell M, Mosley K, 2024. Baseline Forsmark – A discrete fracture network (DFN) model applying grown fractures and hydromechanical (HM) coupling. SKB R-23-01, Svensk Kärnbränslehantering AB.

Hall A M, Ebert K, Goodfellow B W, Hättestrand C, Heyman J, Krabbendam M, Moon M, Stroeven A P, 2019. Past and future impact of glacial erosion in Forsmark and Uppland. Final report. SKB TR-19-07, Svensk Kärnbränslehantering AB.

**Hermanson J, Petersson J, 2022.** Methodology for deterministic geological modelling of the Forsmark site. Application to the development of the final repository for spent nuclear fuel. SKB R-20-10, Svensk Kärnbränslehantering AB.

Hermansson T, Stephens M B, Corfu F, Page L M, Andersson J, 2008. Migratory tectonic switching, western Svecofennian orogen, central Sweden: Constraints from U/Pb zircon and titanite geochronology. Precambrian Research 161, 250–278.

Holmén J G, Stigsson M, 2001. Modelling of future hydrogeological conditions at SFR. SKB R-01-02, Svensk Kärnbränslehantering AB.

Holzhausen G R, 1989. Origin of sheeting structure, 1. morphology and boundary conditions. Engineering Geology, vol 27, pp 225–278.

**Horai K, 1971.** Thermal conductivity of rock-forming minerals. Journal of Geophysical Research 76, 1278–1308.

**Hökmark H, Fälth B, Lönnqvist M, Munier R, 2019.** Earthquake simulations performed to assess the long-term safety of a KBS-3 repository. Overview and evaluation of results produced after SR-Site. SKB TR-19-19, Svensk Kärnbränslehantering AB.

**Isaksson H, 2003.** Forsmark site investigation. Interpretation of topographic lineaments 2002. SKB P-03-40, Svensk Kärnbränslehantering AB.

**Isaksson H, 2007.** Correlation between refraction seismic data, low magnetic lineaments and deformation zones (model stage 2.2). In Stephens M B and Skagius K (edits.), Geology – Background complementary studies. Forsmark modelling stage 2.2. SKB R-07-56, Svensk Kärnbränslehantering AB.

**Isaksson H, Johansson L, 2020.** Complementary lineament interpretation in the SDM-SAR drainage area at Forsmark. SKB P-20-14, Svensk Kärnbränslehantering AB.

**Isaksson H, Keisu M, 2005.** Forsmark site investigation. Interpretation of airborne geophysics and integration with topography. Stage 2 (2002–2004). An integration of bathymetry, topography, refraction seismics and airborne geophysics. SKB P-04-282, Svensk Kärnbränslehantering AB.

**Isaksson H, Thunehed H, Keisu M, 2004.** Forsmark site investigation. Interpretation of airborne geophysics and integration with topography. Stage 1 (2002). SKB P-04-29, Svensk Kärnbränslehantering AB.

**Isaksson H, Pitkänen T, Thunehed H, 2006a.** Forsmark site investigation. Ground magnetic survey and lineament interpretation in an area northwest of Bolundsfjärden. Forsmark site investigation. SKB P-06-85, Svensk Kärnbränslehantering AB.

**Isaksson H, Thunehed H, Pitkänen T, Keisu M, 2006b.** Detailed ground and marine magnetic survey and lineament interpretation in the Forsmark area – 2006. Forsmark site investigation. SKB P-06-261, Svensk Kärnbränslehantering AB.

**Isaksson H, Thunehed H, Pitkänen T, Keisu M, 2007.** Forsmark site investigation. Detailed ground magnetic survey and lineament interpretation in the Forsmark area, 2006–2007. SKB R-07-62, Svensk Kärnbränslehantering AB.

Jahns R H, 1943. Sheet structure in granites: its origin and use as a measure of glacial erosion in New England. Journal of Geology, vol 51, pp 71–98.

Johansson R, 2005. A comparison of two independent interpretations of lineaments from geophysical and topographic data at the Forsmark site. SKB R-05-23, Svensk Kärnbränslehantering AB.

**Johansson R, Isaksson H, 2006.** Forsmark site investigation. Assessment of inferred lineaments in the northwestern part of the Forsmark site investigation area. Present knowledge and recommendations for further investigations. SKB P-05-261, Svensk Kärnbränslehantering AB.

**Juhlin C, 2007.** Integrated interpretation of surface and borehole (VSP) seismic data along profiles 2 and 5, Forsmark, Sweden. In Stephens M B and Skagius K (eds.), Geology – Background complementary studies. Forsmark modelling stage 2.2. SKB R-07-56, Svensk Kärnbränslehantering AB.

**Juhlin C, 2016.** Reflection seismic processing of refraction seismic profiles 2 and 4, Forsmark, Sweden. SKBdoc 1327865 ver 1.0, Svensk Kärnbränslehantering AB.

Juhlin C, Palm H, 2005. Reflection seismic studies in the Forsmark area, 2004: Stage 2. Forsmark site investigation. SKB R-05-42, Svensk Kärnbränslehantering AB.

**Juhlin C, Stephens M B, 2006.** Gently dipping fracture zones in Paleoproterozoic metagranite, Sweden: Evidence from reflection seismic and cored borehole data and implications for the disposal of nuclear waste. Journal of Geophysical Research 111, B09302, 19 pp.

**Juhlin C, Zhang F, 2010.** Site investigation SFR. Reprocessing of reflection seismic profiles 5b and 8, Forsmark. SKB P-10-50, Svensk Kärnbränslehantering AB.

**Juhlin C, Bergman B, Palm H, 2002.** Reflection seismic studies in the Forsmark area – stage 1. SKB R-02-43, Svensk Kärnbränslehantering AB.

**Keisu M, Isaksson H, 2004.** Forsmark site investigation. Acquisition of geological information from Forsmarksverket. Information from the Vattenfall archive, Råcksta. SKB P-04-81, Svensk Kärnbränslehantering AB.

Korhonen K, Paananen M, Paulamäki S, 2004. Interpretation of lineaments from airborne geophysical and topographic data. An alternative model within version 1.2 of the Forsmark modelling project. SKB P-04-241, Svensk Kärnbränslehantering AB.

**La Pointe P, Olofsson I, Hermanson J, 2005.** Statistical model of fractures and deformation zones for Forsmark: Preliminary site description Forsmark area – version 1.2. SKB R-05-26, Svensk Kärnbränslehantering AB.

Larsson S Å, Tullborg E-L, Cederbom C, Stiberg J-P, 1999. Sveconorwegian and Caledonian foreland basins in the Baltic Shield revealed by fission-track thermochronology. Terra Nova 11, 210–215.

Leijon B (ed), 2005. Forsmark site investigation. Investigations of superficial fracturing and block displacements at drill site 5. SKB P-05-199, Svensk Kärnbränslehantering AB.

**Lidmar-Bergström K, 1996.** Long term morphotectonic evolution in Sweden. Geomorphology 16, 33–59.

Lidmar-Bergström K, 1997. A long-term perspective on glacial erosion. Earth Surface Processes and Landforms, vol 22, pp. 297–306.

**Lindroos H, Isaksson H, Thunehed H, 2004.** The potential for ore and industrial minerals in the Forsmark area. SKB R-04-18, Svensk Kärnbränslehantering AB.

**Löfgren M, Sidborn M, 2010.** Statistical analysis of results from the quantitative mapping of fracture minerals in Forsmark. Site descriptive modelling – complementary studies. SKB R-09-30, Svensk Kärnbränslehantering AB.

Martin C D, 1997. Seventeenth Canadian Geotechnical Colloquium: The effect of cohesion loss and stress path on brittle rock strength. Canadian Geotechnical Journal, vol 34, pp 698–725.

Martin, C D, 2007. Quantifying in situ stress magnitudes and orientations for Forsmark, Forsmark stage 2.2. SKB R-07-26, Svensk Kärnbränslehantering AB.

**Martel S J, 2011.** Mechanics of curved surfaces, with application to surface-parallel cracks. Geophysical Research Letters, vol 38, L20303.

Martel S J, 2017. Progress in understanding sheeting joints over the past two centuries. Journal of Structural Geology, vol 94, pp 68–86.

Mattsson A, 1962. Morphologische Studien in Südschweden und auf Bornholm über die nichtglaziale Formenwelt der Felsenskulptur. Gleerupska Universitets-Bokhandeln, Lund, 357 pp.

**Mattsson H, 2009.** Site investigation SFR. Interpretation of geophysical borehole measurements from KFR01, KFR02, KFR03, KFR04, KFR05, KFR19 and KFR20 and petrophysical measurements from KFR04, KFR05 and KFR20. SKB P-09-72, Svensk Kärnbränslehantering AB.

**Mattsson H, 2013.** SFK Byggundersökningar. Markradar och refraktionsseismiska undersökningar. SKBdoc 1318988 ver 1.0, Svensk Kärnbränslehantering AB.

**Mattsson H, Keisu K, 2009.** Site investigation SFR. Interpretation of geophysical borehole measurements and petrophysical data from KFR101, HFR101, HFR102 and HFR105. SKB P-09-02, Svensk Kärnbränslehantering AB.

**Mattsson H, Keisu K, 2010.** Site investigation SFR. Interpretation of geophysical borehole measurements and petrophysical data from KFR105, KFR106 and HFR106. SKB P-10-12, Svensk Kärnbränslehantering AB.

**Muir Wood R, 1993.** A review of the seismotectonics of Sweden. SKB TR 93-13. Svensk Kärnbränslehantering AB.

**Muir Wood R, 1995.** Reconstructing the tectonic history of Fennoscandia from its margins: The past 100 million years. SKB TR 95-36, Svensk Kärnbränslehantering AB.

Munier R, 2006. Using observations in deposition tunnels to avoid intersections with critical fractures in deposition holes. SKB R-06-54, Svensk Kärnbränslehantering AB.

Munier R, Stigsson M, 2007. Implementation of uncertainties in borehole geometries and geological orientation data in Sicada. SKB R-07-19, Svensk Kärnbränslehantering AB.

Munier R, Stenberg L, Stanfors R, Milnes A G, Hermanson J, Triumf C-A, 2003. Geological Site Descriptive Model. A strategy for the model development during site investigations. SKB R-03-07, Svensk Kärnbränslehantering AB.

**Möller C, Snäll S, Stephens M B, 2003.** Forsmark Site Investigation. Dissolution of quartz, vug formation and new grain growth associated with post-metamorphic hydrothermal alteration in KFM02A. SKB P-03-77, Svensk kärnbränslehantering AB.

**Nordgulen O, Saintot A, 2006.** The character and kinematics of deformation zones (ductile shear zones, fault zones and fracture zones) at Forsmark – report from phase 1. SKB P-06-212, Svensk Kärnbränslehantering AB.

**Nordman C, 2003.** Forsmark site investigation. Boremap mapping of percussion boreholes HFM01-03. SKB P-03-20, Svensk Kärnbränslehantering AB.

Nygård R, Gutierrez M, Bratli R K, Høeg K, 2006. Brittle-ductile transition, shear failure and leakage in shales and mudrocks. Marine Petroleum Geology, vol 23, pp 201–212.

**Olofsson I, Simeonov A, Stigsson M, Stephens M, Follin S, Nilsson A-C, Röshoff K, Lindberg U, Lanaro F, Fredriksson A, Persson L, 2007.** Site descriptive modelling Forsmark, stage 2.2. A fracture domain concept as a basis for the statistical modelling of fractures and minor deformation zones, and interdisciplinary coordination. SKB R-07-15, Svensk Kärnbränslehantering AB.

**Olvmo M, 2010.** Review of denudation processes and quantification of weathering and erosion rates at a 0.1 to 1 Ma time scale. SKB TR-09-18, Svensk Kärnbränslehantering AB.

**Persson L, Daniels J, 2002.** Utveckling av tolkningsmetoder för VLF-data. Slutrapport. SGU-rapport 2002:41.

**Petrone J, Sohlenius G, Ising J, 2020.** Baseline Forsmark – Depth and stratigraphy of regolith. SKB R-17-07, Svensk Kärnbränslehantering AB.

**Petersson J, Eliasson T, 2023.** Petrographic analysis, Forsmark, stage 2. Eight thin-sections from two cored boreholes – KFM08C and KFR121. SKBdoc 2020833 ver 1.0, Svensk Kärnbränslehantering AB.

**Petersson J, Eliasson T, 2024.** Petrographic analysis. Samples from five cored boreholes in Forsmark – KFM01A, KFM02A, KFM08C, KFM08D and KFR121. SKBdoc 1982389 ver 1.0, Svensk Kärnbränslehantering AB.

Petersson J, Berglund J, Danielsson P, Wängnerud A, Tullborg E-L, Mattsson H, Thunehed H, Isaksson H, Lindroos H, 2004a. Forsmark site investigation. Petrography, geochemistry, petrophysics and fracture mineralogy of boreholes KFM01A, KFM02A and KFM03A+B. SKB P-04-103, Svensk Kärnbränslehantering AB.

**Petersson J, Berglund J, Wängnerud A, Danielsson P, Stråhle A, 2004b.** Forsmark site investigation. Boremap mapping of telescopic drilled borehole KFM05A. SKB P-04-295, Svensk Kärnbränslehantering AB.

**Petersson J, Berglund J, Danielsson P, Skogsmo G, 2005.** Forsmark site investigation. Petrographic and geochemical characteristics of bedrock samples from boreholes KFM04A-06A, and a whitened alteration rock. SKB P-05-156, Svensk Kärnbränslehantering AB.

**Petersson J, Curtis P, Bockgård N, Mattsson H, 2011.** Site investigation SFR. Rock type coding, overview geological mapping and identification of rock units and possible deformation zones in drill cores from the construction of SFR. SKB P-10-07, Svensk Kärnbränslehantering AB.

**Petersson J, Stephens M B, Mattsson H, Möller C, 2012.** Albitization and quartz dissolution in Paleoproterozoic metagranite, central Sweden – Implications for the disposal of spent nuclear fuel in a deep geological repository. Lithos, v. 148, pp. 10–26.

**Petersson J, Kvartsberg S, Vestgård J, Andersson T, Åkerström K, 2015.** Berggrundskartering av avrymningarna AFM001393 och AFM001394 belägna vid Söderviken, Forsmark. SKBdoc 1338506 ver 1.0, Svensk Kärnbränslehantering AB. (In Swedish.)

**Rauséus G, Petersson J, 2020.** Geological single-hole interpretation of HFM42–HFM47 and KFM25–KFM27. SKB P-20-13, Svensk Kärnbränslehantering AB.

**Rudberg S, 1960.** Geology and morphology. In Sømme A (ed). A geography of Norden. Oslo: J.W. Cappelens forlag.

Saintot A, Stephens M B, Viola G, Nordgulen Ø, 2011. Brittle tectonic evolution and paleostress reconstruction in the southwestern part of the Fennoscandian Shield, Forsmark, Sweden. Tectonics, v. 30, pp. 1–36.

**Samuelsson E, Winell S, 2022.** Revision av BIPS-baserade karteringar från Forsmarksområdet. SKB P-21-29, Svensk Kärnbränslehantering AB.

**Sandström B, Stephens M B, 2009.** Mineralogy, geochemistry, porosity and redox properties of rocks from Forsmark. Compilation of data from the regional model volume for SR-Site. SKB R-09-51, Svensk Kärnbränslehantering AB.

**Sandström B, Tullborg E-L, 2005.** Forsmark site investigation. Fracture mineralogy. Results from fracture minerals and wall rock alteration in boreholes KFM01B, KFM04A, KFM05A and KFM06A. SKB P-05-197, Svensk Kärnbränslehantering AB.

**Sandström B, Tullborg E-L, 2006.** Mineralogy, geochemistry, porosity and redox capacity of altered rock adjacent to fractures. Forsmark site investigation. SKB P-06-209, Svensk Kärnbränslehantering AB.

**Sandström B, Tullborg E-L, 2007.** Paleohydrogeological events in Forsmark, central Sweden, recorded by stable isotopes in calcite and pyrite. In Water-Rock Interaction, Taylor and Francis Group, London, 773–776.

**Sandström B, Tullborg E-L, 2009.** Episodic fluid migration in the Fennoscandian Shield recorded by stable isotopes, rare earth elements and fluid inclusions in fracture minerals at Forsmark, Sweden. Chemical Geology, 266, pp 135–151.

**Sandström B, Tullborg E-L, 2011.** Site investigation SFR. Fracture mineralogy and geochemistry of borehole sections sampled for groundwater chemistry and Eh. Results from boreholes KFR01, KFR08, KFR10, KFR19, KFR7A and KFR105. SKB P-11-01, Svensk Kärnbränslehantering AB.

Sandström B, Tullborg E-L, Smellie J, MacKenzie A B, Suksi J, 2008. Fracture mineralogy of the Forsmark site. SDM-Site Forsmark. SKB R-08-102, Svensk Kärnbränslehantering AB.

**Sandström B, Tullborg E-L, Larson S Å, Page L, 2009.** Brittle tectonothermal evolution in the Forsmark area, central Fennoscandian Shield, recorded by paragenesis, orientation and <sup>40</sup>Ar/<sup>39</sup>Ar geochronology of fracture minerals. Tectonophysics, 478, pp 158–174.

Sandström B, Annersten H, Tullborg E-L, 2010. Fracture-related hydrothermal alteration of metagranitic rock and associated changes in mineralogy, geochemistry and degree of oxidation: a case study at Forsmark, central Sweden. International Journal of Earth Sciences, 99, pp 1–25.

Sandström B, Nilsson K, Tullborg E-L, 2011. Site investigation SFR. Fracture mineralogy including identification of uranium phases and hydrochemical characterisation of groundwater in borehole KFR106. SKB P-11-41, Svensk Kärnbränslehantering AB.

Sandström B, Tullborg E-L, Sidborn M, 2014. Iron hydroxide occurrences and redox capacity in bedrock fractures in the vicinity of SFR. SKB R-12-11, Svensk Kärnbränslehantering AB.

Selroos J-O, Mas Ivars D, Munier R, Hartley L, Libby S, Davy P, Darcel C, Trinchero P, 2022. Methodology for discrete fracture network modelling of the Forsmark site. Part 1 – Concepts, data and interpretation methods. SKB R-20-11, Svensk Kärnbränslehantering AB.

Shaw R P, Auton C A, Baptie B, Brocklehurst S, Dutton M, Evans D J, Field L P, Gregory S P, Henderson E, Hughes A J, Milodowski A E, Parkes D, Rees J G, Small J, Smith N, Tye A, West J M, 2012. Potential Natural Changes and Implications for a UK GDF. British Geological Survey Minerals and Waste Programme. Commissioned Report CR/12/127, 175 pp.

**SKB**, **2004.** Preliminary site description Forsmark area – version 1.1. SKB R-04-15, Svensk Kärnbränslehantering AB.

**SKB**, **2005.** Preliminary site description Forsmark area – version 1.2. SKB R-05-18, Svensk Kärnbränslehantering AB.

**SKB**, 2006. Site descriptive modelling Forsmark stage 2.1. Feedback for completion of the site investigation including input from safety assessment and repository engineering. SKB R-06-38, Svensk Kärnbränslehantering AB.

**SKB**, **2008a**. Site description of Forsmark at completion of the site investigation phase. SDM-Site Forsmark. SKB TR-08-05, Svensk Kärnbränslehantering AB.

**SKB**, **2008b.** Confidence assessment. Site descriptive modelling SDM-Site Forsmark. SKB R-08-82, Svensk Kärnbränslehantering AB.

**SKB**, **2009.** Site engineering report Forsmark. Guidelines for underground design Step D2. SKB R-08-83, Svensk Kärnbränslehantering AB.

**SKB, 2012.** SFK – byggundersökningar. Markteknisk undersökningsrapport Geoteknik, Geologi, Hydrogeologi. SKBdoc 1332706 ver 1.0, Svensk Kärnbränslehantering AB. (In Swedish.) (Internal document.)

**SKB**, 2013. Site description of the SFR area at Forsmark at completion of the site investigation phase SDM-PSU Forsmark. SKB TR-11-04, Svensk Kärnbränslehantering AB.

**Sohlenius G, Hedenström A, 2008.** Geological development during the Quaternary period. In: Söderbäck, B. (Ed.), Geological evolution, palaeoclimate and historical development of the Forsmark and Laxemar-Simpevarp areas. Site descriptive modelling SDM-Site. SKB R-08-19, Svensk Kärnbränslehantering AB.

**Stein S, Cloetingh S, Sleep N H, Wortel R, 1989.** Passive margin earthquakes, stresses and rhelogy. In: Gregersen S, Basham P W (Eds.), Earthquakes at North-Atlantic Passive Margins: Neotectonics and Postglacial Rebound. Series C: Mathematical and Physical Sciences. Kluwer Academic Publishers, pp 231–260.

**Stephens M B, Simeonov A, 2015.** Description of deformation zone model version 2.3, Forsmark. SKB R-14-28, Svensk Kärnbränslehantering AB.

**Stephens M B, Lundqvist S, Bergman T, Andersson J, Ekström M, 2003.** Forsmark site investigation. Bedrock mapping. Rock types, their petrographic and geochemical characteristics, and a structural analysis of the bedrock based on Stage 1 (2002) surface data. SKB P-03-75, Svensk Kärnbränslehantering AB.

**Stephens M B, Lundqvist S, Bergman T, Ekström M, 2005.** Forsmark site investigation. Bedrock mapping. Petrographic and geochemical characteristics of rock types based on stage 1 (2002) and stage 2 (2003) surface data. SKB P-04-87, Svensk Kärnbränslehantering AB.

Stephens M B, Fox A, La PointeP, Simeonov A, Isaksson H, Hermanson J, Öhman J, 2007. Geology Forsmark. Site descriptive modelling, Forsmark stage 2.2. SKB R-07-45, Svensk Kärnbränslehantering AB.

**Stephens M B, Bergman T, Isaksson H, Petersson J, 2008a.** Bedrock geology Forsmark. Modelling stage 2.3. Description of the bedrock geological map at the ground surface. SKB R-08-128, Svensk Kärnbränslehantering AB.

**Stephens M B, Simeonov A, Isaksson H, 2008b.** Bedrock geology Forsmark. Modelling stage 2.3. Implications for and verification of the deterministic geological models based on complementary data. SKB R-08-64, Svensk Kärnbränslehantering AB.

Stephens M B, Ripa M, Lundström I, Persson L, Bergman T, Ahl M, Wahlgren C-H, Persson P-O, Wickström L, 2009. Synthesis of the bedrock geology in the Bergslagen region, Fennoscandian Shield, south-central Sweden. SGU ser Ba 58.

Stephens M B, Follin S, Petersson J, Isaksson H, Juhlin C, Simeonov A, 2015. Review of the deterministic modelling of deformation zones and fracture domains at the site proposed for a spent nuclear fuel repository, Sweden, and consequences of structural anisotropy. Tectonophysics, v. 653, pp. 68–94.

Svenonius F, 1887. Beskrifning till kartbladen Forsmark och Björn. Sveriges geologiska undersökning, Aa 98 och 99, 42 pp.

**Söderbäck B (ed), 2008.** Geological evolution, palaeoclimate and historical development of the Forsmark and Laxemar-Simpevarp areas. Site descriptive modelling, SDM-Site. SKB R-08-19, Svensk Kärnbränslehantering AB.

**Söderlund P, Juez-Larré J, Page L M, Stuart F M, Andriessen P M, 2008.** Assessment of discrepant (U-Th)/He and apatite fission-track ages in slowly cooled Precambrian terrains: A case study from SE Sweden. (Ph.D thesis), In: Söderlund, P. (Ed.), <sup>40</sup>Ar-<sup>39</sup>Ar, AFT and (U-Th)/He thermochronologic implications for the low-temperature geological evolution in SE Sweden. Litholund Theses 16. University of Lund, Sweden (20 pp.)

**Söderlund P, Hermansson T, Page L M, Stephens M B, 2009.** Biotite and muscovite <sup>40</sup>Ar–<sup>39</sup>Ar geochronological constraints on the post-Svecofennian tectonothermal evolution, Forsmark site, central Sweden. International Journal of Earth Sciences 98, 1835–1851.

Thornbury W D, 1954. Principles of Geomorphology. Wiley, New York.

Twidale C R, 1973. On the origin of sheet jointing. Rock Mechanics, vol 5, 163–187.

**Twidale C R, Vidal Romani J R, Champell E M, Centeno J D, 1996.** Sheet fractures: response to erosional offloading or to tectonic stress? Zeitschrift für Geomorphologie Supplementband, vol 106, pp 1–24.

**Winell S, Samuelsson E, 2022.** Geological single-hole interpretation of KFR117–KFR121. SKB P-21-25, Svensk Kärnbränslehantering AB.

**Ziegler M, 2013.** Age and formation mechanism of exfoliation joints in the Aar Granites of the Central Alps (Grimsel region, Switzerland). Doctoral thesis ETH Zurich, Switzerland. 157 pp.

Öhman J, Follin S, 2010. Site investigation SFR. Hydrogeological modelling of SFR. Model version 0.2. SKB R-10-03, Svensk Kärnbränslehantering AB.

# Technical data for cored and percussion drilled boreholes completed in Forsmark after 2010

BH ID	Total length [m]	Bedrock surface <sup>2</sup> [m]	Northing	Easting	Inclination [°]	Bearing [°]
KFM13	150.21	7.20	6698803.40	160 109.53	-60.57	89.85
KFM14	60.18	5.40	6698724.07	160 197.44	-85.42	267.27
KFM15	62.30	5.20	6698768.62	160072.88	-83.62	137.90
KFM16	60.35	3.70	6698774.81	160 183.63	-59.65	323.30
KFM17	60.45	4.60	6698747.58	160096.08	-85.92	346.72
KFM18	60.46	7.90	6698746.19	160045.06	-86.70	156.48
KFM19	102.37	5.45	6698875.99	160018.61	-64.76	172.42
KFM20	60.50	1.40	6698687.89	160060.90	-85.42	339.07
KFM21	101.06	4.90	6698654.41	160168.87	-70.93	62.12
KFM22	60.26	6.95	6698917.75	160194.37	-85.50	157.58
KFM23	100.64	3.38	6698662.00	160283.10	-73.02	342.88
KFM24	550.17	3.08	6698770.32	160 182.02	-83.44	314.45
KFM25	100.72	4.90	6698868.99	159804.37	-84.27	140.00
KFM26	100.74	5.50	6698941.42	159726.47	-84.88	17.00
KFM27	100.64	5.00	6698854.47	159597.05	-74.97	322.00
KFR117	176.01	6.40	6699954.80	162141.98	-80.59	34.05
KFR118	175.48	9.30	6699934.01	162132.41	-85.59	236.00
KFR119	176.47	7.40	6699929.31	162210.71	-80.79	210.48
KFR120	176.91	9.20	6699930.77	162256.47	-79.88	37.41
KFR121	362.53	9.20	6699919.24	162420.29	-52.45	215.97
HFM39	151.20	4.90	6698775.72	160093.56	-85.82	164.64
HFM40	101.70	5.10	6698756.04	159896.74	-85.16	168.17
HFM41	101.50	4.10	6699012.09	159798.80	-84.84	175.46
HFM42	195.30	2.25	6698418.32	160094.17	-89.12	176.19
HFM43	200.00	1.44	6698537.92	160064.53	-85.21	303.79
HFM44	199.60	5.95	6699322.21	161 395.20	-83.19	255.72
HFM45	200.30	0.30	6699603.14	161 117.22	-84.98	291.20
HFM46	200.00	0.00	6699951.07	161 324.55	-85.41	108.14
HFM47	200.40	9.92	6699398.78	161 283.40	-84.42	150.00

Table A1-1. Technical borehole data (Coordinate system SWEREF99 1800)<sup>1</sup>.

<sup>1</sup> Data deliveries: SKBdata\_20\_069 and SKBdata\_22\_056.

<sup>2</sup> Length to inferred bedrock surface from top-of-casing.

# Data acquisition reports for geological and geophysical investigations completed after 2010

Data specification	Report	SKBdoc ID
Technical data in connection with drilling		
KFM13–KFM23 and HFM39–HFM41	-	1338601
KFM24	SKB P-16-32	1528493
HFM42–HFM46	SKB P-18-09	1686826
KFM25–KFM27 and HFM47	SKB P-19-25	1860464
KFR117–KFR121	SKB P-20-32	1923690
Boremap mapping		
KFM13–KFM23 and HFM39–HFM41	-	1327873, 1338831, 1338835
KFM24	SKB P-16-28	1536007
HFM42–HFM47	-	1678353*, 1909182*
KFM25–KFM27	SKB P-19-26	1865774
KFR117–KFR121	SKB P-21-24	1963160, 1988720, 1994749
Single-hole interpretation		
KFM13–KFM23 and HFM39–HFM41	-	1332706
KFM24	SKB P-16-29	1536007
KFM25–KFM27 and HFM42–HFM47	SKB P-20-13	1886598, 1898425
KFR117–KFR121	SKB P-21-25	1914790, 1994760
Surface-based data		
Geological mapping of AFM001392–AFM001394	-	1338506
Detailed fracture mapping of AFM001392–AFM001394	-	1338599
GPR and regolith mapping of AFM001392–AFM001394	-	1327863
Refraction seismics and GPR along LFM001020–LFM001025	-	1318988
Reflection seismic processing (LFM001021 and LFM001023)	-	1327865
Bedrock mapping – outcrop data in the sub-catchment area outside the regional model area	MSc thesis Bakker (2021)	-
Remote fracture mapping of islets and coastal outcrops	SKB P-23-02	1914643
Modal analysis and petrography		
KFM01A, KFM02A, KFM08C, KFM08D and KFR121	-	1982389, 2020832
KFM08C and KFR121	-	2020833

\* Preliminary, not yet approved.

#### **Appendix 3**



### Notes from the fieldwork to investigate E–W trending lineaments at northern Gräsö





Possible ancient remains



LEGEND	BRIEF DESCRIPTION AND INTERPRETATION
Topograhic minimas corresponding to inferred magnetic lineaments	Gneissic granite, locally pegmatitic. Locally heterogeneous, almost migmatitic character, but there are volumes with more homogeneous, massive granite (geyish red, equigranular and medium-grained).
1090°/45° Orientation (strike/dip) of planar ductile fabric	Well-defined gneissosity that dips from 45 to 70 degrees towards SE or SSE.
Outcrop observation, gneissic granite	The brittle tectonics is strongly controlled by the gneissocity. Considerable fracture spacing; <u>no</u> reddening, increased fracture frequency or mylonite that support the existence of a large-scale deformation zone.

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	LEGEND	BRIEF DESCRIPTION AND INTERPRETATION	
	Topograhic minimas corresponding to inferred magnetic lineaments	Pegmatitic granite and gneissic granite in the whole area.	1
	Orientation (strike/dip) of planar ductile fabric	Well-defined gneissosity that dips from 33 to 80 degrees towards SE or SSW.	
$\bigcirc$	Outcrop observation, gneissic granite	fracture frequency or mylonite that support the existence of a large-scale deformation zone.	FILLE



## Modal analyses used to estimate mineralogical composition of rock types

Estimated mineralogical compositions for unaltered rock types presented in Table 4-3 and Figure 4-2 are based on a selection originally made by Stephens et al. (2007), with complimentary data from studies of thermal properties (Adl-Zarrabi 2004a, 2004b, 2006), the laboratory investigations of transport properties (Gustavsson 2006) and petrographic studies of Petersson and Eliasson (2023, 2024).

The complete data set used in the upgrading of the compositions is listed in Table A3-1, by the use of Sicada delivery SKBdata\_23\_036\_02 (activity identification numbers GE200 and GE202).

BH or outcrop ID	Sec_up [m]	Sec_low [m]	Report*	Qtz [vol.%]	K-fsp [vol.%]	PI [vol.%]	Bt [vol.%]	Chl [vol.%]	Hbl [vol.%]
111058 Granite,	fine- to me	edium-graine	d						
PFM000530B	-	-	P-03-75	33.0	28.0	36.8	1.4	-	-
PFM000651A	-	_	P-04-87	42.8	28.4	22.0	4.0	1.2	-
PFM002210A	-	_	P-03-75	30.2	37.8	27.0	3.0	0.2	-
PFM005245A	-	_	P-04-87	25.4	22.6	46.2	4.4	-	-
KFM03A	157.40	157.45	P-04-103	30.6	31.4	33.2	0.6	2.4	-
101061 Pegmat	ite, pegma	titic granite							
PFM000198A	-	-	P-03-75	33.6	27.0	37.2	1.6	-	-
PFM000656A	-	_	P-03-75	38.1	19.2	39.0	0.3	0.4	-
PFM001163A	-	_	P-03-75	37.1	31.8	28.4	0.6	0.5	-
PFM001243B	-	_	P-04-87	29.2	33.6	31.8	5.2	-	-
KFM03B	62.32	62.36	P-04-103	31.8	45.0	20.6	0.6	1.6	-
101051 Granite,	granodio	rite and tonal	ite, metamorp	ohic, fine- t	o medium	-grained			
PFM000529A	-	-	P-03-75	22.8	3.0	57.8	11.8	0.4	-
PFM000657B	-	_	P-03-75	29.4	27.2	35.4	6.0	0.2	-
PFM000712A	-	_	P-03-75	19.2	2.2	67.0	6.4	-	2.6
PFM001161A	-	-	P-04-87	30.0	13.2	48.4	4.6	0.2	-
PFM001220A	-	_	P-03-75	27.6	15.8	50.0	4.8	-	-
PFM001246B	-	_	P-03-75	35.4	2.4	54.8	-	3.4	-
PFM002206A	-	_	P-03-75	31.6	23.0	34.4	9.8	0.2	-
PFM002213A	-	_	P-03-75	27.0	10.6	53.0	6.0	1.2	0.2
PFM002214A	-	_	P-03-75	32.6	24.0	35.0	5.8	-	-
KFM01A	242.44	242.44	P-04-103	25.0	8.0	49.0	9.0	-	5
KFM01A	521.27	521.27	P-04-103	33.4	5.6	46.4	9.4	-	1.2
KFM01A	838.06	838.06	P-06-233	31.8	16.0	44.6	5.6	-	-
KFM01A	970.35	970.35	P-04-103	28.0	32.4	29.4	8.4	0.2	-
KFM05A	686.94	686.99	P-06-233	26.6	3.2	52.4	11.0	-	1.6
KFM05A	691.78	691.82	P-05-156	24.8	6.4	53.2	11.2	0.2	0.8
KFM05A	708.40	708.45	P-06-233	28.4	1.4	56.2	12.8	-	-
KFM06A	588.64	588.68	P-06-233	30.0	6.6	44.2	14.2	0.2	0.2
101058 Granite,	metamor	ohic, aplitic							
PFM000278B	-	_	P-03-75	30.8	47	18.8	1.8	-	-
PFM001106A	-	-	P-04-87	35.2	35.6	26.0	2.0	-	-
PFM001160A	-	-	P-04-87	44.4	27.7	25.4	0.6	0.1	0.1
PFM005205B	-	-	P-04-87	41.0	26.2	29.8	2.0	-	-
KFM06A	636.34	636.37	P-05-156	34.5	30.7	27.2	6.9	0.5	-
KFM09A	443.32	443.35	P-06-233	38.4	23.0	31.2	7.4	-	-

Table A3-1. Modal analyses used to estimate mineralogical composition of the rock types at the Forsmark site.

Table A	A3-1.	Continu	ed.
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BH or outcrop ID	Sec_up [m]	Sec_low [m]	Report*	Qtz [vol.%]	K-fsp [vol.%]	PI [vol.%]	Bt [vol.%]	Chl [vol.%]	Hbl [vol.%]
101057 Granite	to geanodi	orite, meamoi	rphic, mediun	n-grained					
PFM000289A	-	_	P-03-75	36.0	30.8	27.2	5.6	-	-
PFM000319A	-	-	P-03-75	39.4	27.4	27.0	5.4	-	-
PFM000658A	-	-	P-03-75	32.6	36.0	24.8	5.4	-	-
PFM001159A	-	-	P-03-75	34.5	27.1	30.2	6.5	0.1	-
PFM001159B	-	-	P-03-75	30.2	30.0	33.8	5.0	-	-
PFM001164A	-	-	P-03-75	40.3	17.7	33.6	6.6	0.1	-
PFM001216A	-	-	P-03-75	41.8	19.6	34.2	3.8	-	0.2
PFM002207A	-	-	P-03-75	36.6	24.2	34.2	4.8	-	-
PFM002214B	-	-	P-03-75	33.0	29.0	31.8	4.6	-	-
KFM01A	103.46	103.65	P-06-186	24.2	25.1	38.1	11.6	-	0.2
KFM01A	109.66	109.66	P-04-103	34.6	22.8	37.6	4.4	-	-
KFM01A	312.20	312.50	P-06-186	38.4	21.6	30.4	7.0	-	-
KFM01A	317.79	317.79	P-04-103	45.8	12.8	34.4	5.4	-	0.4
KFM01A	231.28	231.28	P-04-159	42.2	24.0	28.6	4.8	-	0.2
KFM01A	235.23	235.23	P-04-159	40.4	19	35.6	4.0	-	0.4
KFM01A	389.68	389.68	P-04-159	37.0	17.6	36.6	8.0	-	0.2
KFM01A	477.30	477.30	P-04-103	46.0	12.6	32.0	8.8	0.4	-
KFM01A	487.10	487.50	P-06-186	26.1	22.2	40.5	8.6	0.2	-
KFM01A	494.82	494.82	P-04-159	30.8	25.8	36.2	6.2	-	0.8
KFM01A	692.02	692.02	P-04-159	37.0	16.2	39.0	6.8	-	0.8
KFM01A	698.35	698.35	P-04-159	38.6	19.4	37.6	4.2	-	-
KFM01A	705.88	705.88	P-04-103	32.2	13.2	47.4	4.2	-	-
KFM01A	908.18	908.36	P-06-186	36.2	14.2	41.3	7.3	-	-
KFM01A	947.70	947.70	P-04-103	37.8	23.2	30.8	7.2	-	-
KFM01B	397.41	397.76	P-06-209	46.4	16.6	30.3	3.6	0.5	0.2
KFM04A	186.65	186.70	P-05-156	40.4	19.8	32.8	5.2	0.2	-
KFM04A	271.40	271.44	P-05-156	29.8	21.0	42.6	5.8	-	-
KFM04A	581.05	581.10	P-04-199	32.8	29.6	36.6	4.0	-	-
KFM04A	816.76	816.81	P-04-199	34.0	18.4	42.0	5.4	-	-
KFM05A	152.66	152.70	P-05-156	39.2	21.0	35.0	3.8	0.2	-
KFM05A	272.11	272.15	P-05-156	40.8	24.4	30.6	3.4	0.2	0.2
KFM05A	299.19	299.23	P-05-156	34.4	18.6	38.2	6.8	-	0.2
KFM06A	440.13	440.60	P-06-186	39.0	29	27.0	3.4	0.4	-
KFM07A	387.47	387.87	P-06-186	30.8	20.4	36.6	11.6	-	-
KFM08C	750.32	750.44	2020833	39.0	21.2	31.3	3.0	0.9	1.6
KFM08C	751.95	752.06	2020833	34.9	20.6	39.5	3.0	1.0	-
KFM08C	837.20	837.32	2020833	35.7	24.7	33.1	4.9	-	0.8
KFM08C	839.87	840.00	2020833	36.0	22.3	35.2	3.8	0.8	1.1
KFM09A	583.00	583.03	P-06-233	30.6	28.2	32.6	6.8	0.2	-
101056 Granod	iorite, meta	morphic, med	lium-grained						
PFM000614A	_	_	P-04-87	31.2	11.0	46.8	8.8	-	1.2
PFM000650A	_	_	P-04-87	25.0	14.8	51.4	7.6	-	-
PFM000692A	_	_	P-03-75	30.0	11.6	42.6	12.4	_	_
PFM001198A	_	_	P-03-75	33.6	14.8	39.0	9.4	0.2	_
PFM001255A	_	_	P-03-75	24.4	8.6	44.4	9.2	-	13.4
PFM001580A	-	_	P-04-87	36.0	16.6	37.2	9.2	-	-
PFM005282A	_	_	P-04-87	26.8	9.8	50.8	8.8	_	_
KFM01A	477.50	477.61	1982389	38.8	6.3	46.1	8.1	0.2	_
KFM04A	108.76	108.80	P-04-199	21.4	12.8	47.4	8.6	_	9.8
KFM04A	109.05	109.09	P-04-199	27.6	11.0	48.8	8.2	_	4.4
KFM04A	117.70	117.74	P-05-156	15.6	7.2	49.6	2.2	4.2	16.2
KFM09A	719.13	719.16	P-06-233	19.0	8.2	52.0	12.4	_	5.2
KFM09A	761.89	761.92	P-06-233	44.4	15.4	28.8	5.2	4.6	_

101054 real-action problem problem         PFM000466.       -       P         P       P       P         P       P       P       P         P       Q       S       S       P         P       Q       S       S       Q       S       Q       S       Q       S       Q       S       Q       S       Q	BH or outcrop ID	Sec_up [m]	Sec_low [m]	Report*	Qtz [vol.%]	K-fsp [vol.%]	PI [vol.%]	Bt [vol.%]	Chl [vol.%]	Hbl [vol.%]
PFM000207Λ         -         -         P-0375         45.4         7.4         45.4         2.6         -         -           PFM000657Λ         -         -         P-04-87         23.0         5.8         44.4         14.8         -         9.4           PFM00073Λ         -         -         P-04-87         33.0         5.0         66.2         7.2         -         -         -           PFM00073Λ         -         -         P-04-87         33.2         9.2         48.6         6.2         -         1.8           PFM00073ΛΛ         -         -         P-04-87         12.2         48.8         13.2         -         14.6           PFM00073ΛΛ         -         -         P-04-87         25.0         2.6         5.3         15.4         -         -           PFM000157Λ         -         -         P-03-75         17.6         10.6         45.2         10.6         -         9.4         14.4           PFM00157Λ         -         -         P-03-75         17.6         10.6         45.2         10.4         0.2         12.0           PFM00157Λ         -         -         P-03-75         12.2         14	101054 Tonalite to granodiorite, metamorphic, medium-grained									
PFM000665A         -         -         P-03.75         35.6         1.6         37.6         1.5.6         0.2         4.6           PFM000571A         -         -         P-04.87         31.0         5.0         56.2         7.2         -         -           PFM000730A         -         -         P-03.75         32.2         9.2         48.6         6.2         -         1.8           PFM000730A         -         -         P-04.87         19.4         1.2         48.8         13.2         -         1.86           PFM00037A         -         -         P-04.87         25.0         2.6         5.3.4         1.5.4         -         -         -         9.4           PFM00157A         -         -         P-04.87         25.0         2.6         5.3.4         1.5.4         -	PFM000207A	-	-	P-03-75	45.4	7.4	45.4	2.6	-	-
PFM00057A         -         -         P-0487         3.0         5.8         44.4         1.4.8         -         9.4           PFM00072A         -         -         P-0375         3.2         9.2         48.6         6.2         -         1.8           PFM00073A         -         -         P-0375         3.2         9.2         6.0         6.4         9.0         -         0.8           PFM00073A         -         -         P-0375         12.2         6.0         6.4         9.0         -         1.4.6           PFM00073A         -         -         P-0487         13.6         2.2         6.0         8.1         12.2         -         1.0.0           PFM000157A         -         -         P-0487         13.6         2.8         44.8         -         9.4         1.4           PFM00157A         -         -         P-0475         1.6         1.6         6.4         -         2.8           PFM00157A         -         -         P-0375         2.4         2.8         45.6         11.2         -         1.4.0           PFM00157A         -         -         P-0475         2.4         2.8	PFM000465A	-	-	P-03-75	35.6	1.6	37.6	15.6	0.2	4.6
PFM000271A         -         -         P4047         31.0         5.0         56.2         7.2         -         -           PFM00073A         -         -         P4375         33.2         9.2         48.6         6.2         -         1.8           PFM00073A         -         -         P0375         22.2         6.0         60.4         9.0         -         0.8           PFM00037A         -         -         P0477         12.4         6.2         50.8         13.2         -         1.46           PFM00037A         -         -         P0477         25.0         2.6         53.4         15.4         -         -         -         P.44         P17         1.6         6.2         53.4         15.4         -         -         P.44         P17         1.8         61.4         6.4         -         2.8         P17         P14         <	PFM000557A	-	-	P-04-87	23.0	5.8	44.4	14.8	-	9.4
PFM000729A         -         -         P0375         332         9.2         48.6         6.2         -         1.8           PFM000730A         -         -         P0375         22.2         6.0         60.4         9.0         -         0.8           PFM000794A         -         -         P0447         12.4         48.8         13.2         -         1.45           PFM000837A         -         -         P0447         26.2         4.4         45.0         11.2         -         1.00           PFM001167A         -         -         P0475         1.6         1.6         2.8         44.8         -         9.4         1.4           PFM001167A         -         -         P0375         24.6         7.4         46.0         9.8         -         1.1.4           PFM001513A         -         -         P0375         24.6         7.4         46.0         9.8         -         1.4.0           PFM001573A         -         -         P0375         1.4         47.2         1.8         6.1         2.8         1.4.1         -         1.4.2         P         PM001573A         -         -         1.4.2         P	PFM000621A	-	-	P-04-87	31.0	5.0	56.2	7.2	-	-
PFM000730A         -         -         P0375         22.2         6.0         60.4         9.0         -         0.8           PFM000730A         -         -         P0487         12.4         48.8         13.2         -         9.8           PFM000827A         -         -         P0447         25.2         4.4         45.0         11.2         -         -         9.4           PFM000827A         -         -         P0447         25.0         2.6         53.4         15.4         -         -         -         P67001177         -         -         P0375         17.6         10.6         45.2         11.4         -         9.4         18.4           PFM001271A         -         -         P0375         27.0         1.8         61.4         6.4         -         2.8           PFM001573A         -         -         P0477         2.3         3.6         46.5         6.6         -         14.0           PFM001574A         -         -         P04.75         14.2         2.8         45.6         11.2         -         14.2           PFM001574A         -         -         P04.75         19.2         11.4	PFM000729A	-	-	P-03-75	33.2	9.2	48.6	6.2	-	1.8
PFM000778A         -         -         P04-87         19.4         1.2         48.8         13.2         -         14.6           PFM000837A         -         -         P04-87         25.0         2.6         53.4         15.4         -         -         10.0           PFM000837A         -         -         P04-87         25.0         2.6         53.4         15.4         -         -         9.4         18.4           PFM001162A         -         -         P03-75         17.6         10.6         45.2         10.6         -         9.4         18.4           PFM00153A         -         -         P03-75         27.0         18.8         61.4         6.4         -         2.8           PFM001573A         -         -         P03-75         22.0         8.0         49.2         8.4         0.2         12.0           PFM001573A         -         -         P03-75         14.4         6.2         49.0         12.8         -         14.0           PFM002177A         -         -         P03-75         19.2         11.4         47.2         12.0         -         8.6           PFM0026172A         - <t< td=""><td>PFM000730A</td><td>-</td><td>-</td><td>P-03-75</td><td>22.2</td><td>6.0</td><td>60.4</td><td>9.0</td><td>-</td><td>0.8</td></t<>	PFM000730A	-	-	P-03-75	22.2	6.0	60.4	9.0	-	0.8
PFM000794A         -         -         P03-75         19.4         6.2         50.8         13.2         -         9.8           PFM000827A         -         -         P04-87         26.2         4.4         45.0         11.2         -         10.0           PFM000137A         -         -         P04-87         25.0         2.6         53.4         15.4         -         -           PFM001157A         -         -         P03-75         17.6         10.6         45.2         10.6         -         9.4         18.4           PFM001253A         -         -         P03-75         27.0         1.8         61.4         6.4         -         2.8           PFM00157AA         -         -         P04-75         22.0         8.0         49.2         8.4         0.2         12.0           PFM00157AA         -         -         P04-75         12.2         2.8         45.6         11.2         -         14.2           PFM00157A         -         -         P04-87         19.2         11.4         47.2         12.0         -         19.4           KFM03A         239.84         239.89         P06-133         18.8	PFM000778A	-	-	P-04-87	19.4	1.2	48.8	13.2	-	14.6
PFM000827A         -         -         P-04-87         26.2         4.4         45.0         11.2         -         10.0           PFM000157A         -         -         P-04-87         25.0         2.6         53.4         15.4         -         9.4           PFM001152A         -         -         P-03-75         17.6         10.6         45.2         10.6         -         9.4           PFM001518A         -         -         P-03-75         27.0         1.8         61.4         6.4         -         2.8           PFM001518A         -         -         P-03-75         12.0         8.0         49.2         8.4         12.0         14.0           PFM001574A         -         -         P-03-75         15.4         6.2         49.0         12.8         -         14.0           PFM001574A         -         -         P-03-75         19.2         14.4         67.4         12.0         -         8.6         16.0           PFM001574A         -         -         P-04-87         19.2         14.4         47.2         12.0         -         8.6         16.0           PFM001582A         -         -         P-04-87 </td <td>PFM000794A</td> <td>-</td> <td>-</td> <td>P-03-75</td> <td>19.4</td> <td>6.2</td> <td>50.8</td> <td>13.2</td> <td>-</td> <td>9.8</td>	PFM000794A	-	-	P-03-75	19.4	6.2	50.8	13.2	-	9.8
PFM000837A – – – P-04-87 25.0 2.6 53.4 15.4 – – – PFM001162A – – – P-04-87 13.6 2.8 44.8 – 94 18.4 PFM001217A – – P-03-75 17.6 10.6 45.2 10.6 – 94 PFM001217A – – P-03-75 24.6 7.4 46.0 9.8 – 11.4 PFM001573A – – P-03-75 27.0 1.8 61.4 6.4 – 2.8 PFM001518A – – P-03-75 27.0 8.0 49.2 8.4 0.2 12.0 PFM001573A – – P-04-87 23.2 3.6 46.6 9.6 – 12.0 PFM001573A – – P-04-87 12.2 1.4 52.4 – 9.8 16.0 PFM001574A – – P-04-87 19.2 11.4 47.2 12.0 – 8.6 PFM00157A – – P-04-87 19.2 11.4 47.2 12.0 – 8.6 PFM00157A – – P-04-87 19.2 11.4 47.2 12.0 – 8.6 PFM003A 24.93 243.13 P-06-186 25.1 10.4 47.7 10.2 – 6.6 KFM03A 239.84 239.89 P-04-103 18.8 1.2 52.4 10.4 0.2 15.4 KFM03A 24.93 243.13 P-06-186 25.1 10.4 47.7 10.2 – 6.6 KFM03A 239.84 239.89 P-04-103 18.8 1.2 52.4 10.4 0.2 15.4 KFM03A 24.93 243.13 P-06-186 25.1 10.4 47.7 10.2 – 6.6 KFM03A 239.84 239.89 P-04-103 18.8 1.2 52.4 10.4 0.2 15.4 KFM03A 24.93 243.13 P-06-186 25.1 10.4 47.7 10.2 – 6.6 KFM03A 239.84 239.89 P-04-103 18.8 1.2 52.4 10.4 0.4 10.6 PFM000572A – P-04-87 3.8 – 60.0 7.6 – 25.8 PFM000782A – P-04-87 7.0 0.2 55.4 6.4 – 28.0 PFM000858A – P-04-87 7.8 – 60.6 15.0 0.2 10.6 PFM000858A – P-04-87 7.8 – 50.8 – - 42.8 PFM000178A – P-04-87 7.8 – 50.8 – - 42.8 PFM000158A – P-04-87 7.8 – 53.4 12.2 – 21.0 PFM000568A – P-04-87 7.8 – 53.4 12.2 – 24.6 PFM000568A – P-04-87 7.8 – 53.4 12.2 – 24.6 PFM00150A – P-04-87 7.8 – 53.4 12.2 – 21.0 PFM00150A – P-04-87 7.8 – 53.4 12.2 – 21.0 PFM00150A – P-04-87 7.8 – 53.4 12.2 – 21.0 PFM00150A – P-04-87 7.8 – 53.0 – – 42.8 PFM00150A – P-04-87 15.4 – 48.0 10.8 – 23.8 PFM00150A – P-04-87 15.4 – 48.0 10.8 – 23.0 PFM00150A – P-04-87 5.2 – 43.8 4.6 1.0 PFM00150A – P-04-87 5.2 – 43.8 4.6 1.0 PFM00150A – P-04-87 5.2 – 43.8 4.8 14.6 – – 42.8 PFM00150A – P-04-87 5.2 – – 10.0 PFM00152A – P-04-75 7.2 – 43.8 4.8 4.4 16.6 – – P-04-7 PFM00152A – P-04-75 33	PFM000827A	-	-	P-04-87	26.2	4.4	45.0	11.2	-	10.0
PFM001157A         -         -         P-04-87         13.6         2.8         44.8         -         9.4         18.4           PFM001217A         -         -         P-03-75         17.6         10.6         45.2         10.6         -         9.4           PFM001253A         -         -         P-03-75         27.0         1.8         61.4         6.4         -         2.8           PFM001518A         -         -         P-03-75         27.0         1.8         61.4         6.4         -         2.8           PFM001573A         -         -         P-04-87         23.2         3.6         46.6         1.2.0         -         14.0           PFM001574A         -         -         P-03-75         15.4         6.2         49.0         12.8         -         14.2           PFM001572A         -         -         P-03-75         19.2         11.4         47.2         12.0         -         8.6           PFM0002217A         -         -         P-04-87         13.8         1.2         52.4         10.4         0.2         15.4           KFM03A         239.84         239.89         P-04-103         18.8	PFM000837A	-	-	P-04-87	25.0	2.6	53.4	15.4	-	-
PFM001162A         -         -         P-03-75         17.6         10.6         45.2         10.6         -         9.4           PFM00123A         -         -         P-03-75         22.0         8.0         9.8         -         11.4           PFM00153A         -         -         P-03-75         22.0         8.0         49.2         8.4         0.2         12.0           PFM00157AA         -         -         P-03-75         54.6         24.90         12.8         -         14.0           PFM00157AA         -         -         P-03-75         54.4         2.4         4.0         -         14.0           PFM00157AA         -         -         P-03-75         12.2         1.4         47.2         1.0         -         8.6           PFM00217A         -         -         P-04-87         14.4         -         63.4         12.0         -         18.4           KFM03A         242.93         23.13         P-06-133         18.8         1.2         52.4         10.4         0.2         15.4           KFM03A         797.98         798.01         P-06-233         15.8         5.6         45.8         10.4         <	PFM001157A	-	_	P-04-87	13.6	2.8	44.8	-	9.4	18.4
PFM001217A         -         -         P-03.75         24.6         7.4         46.0         9.8         -         11.4           PFM001515A         -         -         P-03.75         27.0         1.8         61.4         6.4         -         2.8           PFM001517A         -         -         P-03.75         15.4         6.2         49.0         12.8         -         14.0           PFM00157A         -         -         P-03.75         15.4         6.2         49.0         12.8         -         14.0           PFM00157A         -         -         P-03.75         19.2         1.4         52.4         -         9.8         16.0           PFM005172A         -         -         P-04.87         19.2         1.4         47.7         10.2         -         6.6           KFM03A         242.93         243.13         P-06-186         25.1         10.4         47.7         10.2         -         6.6           KFM03A         29.84         29.89         P-04.103         8.8         1.2         52.4         10.4         0.2         15.4           KFM03A         79.98         798.01         P-06-233         15.8	PFM001162A	-	_	P-03-75	17.6	10.6	45.2	10.6	-	9.4
PFM0012S3A       -       -       P-03-75       27.0       1.8       61.4       6.4       -       2.8         PFM001518A       -       -       P-03-75       20.0       8.0       49.2       8.4       0.2       12.0         PFM00157AA       -       -       P-04-87       23.2       3.6       46.6       11.2       -       14.0         PFM00152A       -       -       P-03-75       12.4       52.4       49.0       12.8       -       14.2         PFM00217A       -       -       P-04-87       11.4       47.2       12.0       -       8.6         PFM00217A       -       -       P-04-87       11.4       47.7       10.2       -       6.6         KFM03A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       242.93       298.9       P-04-103       18.8       1.2       5.4       10.4       0.2       15.4         KFM03A       298.80       P-06-87       7.0       0.2       55.4       6.4       -       28.0         PFM000782A       -       -       P-04-87       7.0       <	PFM001217A	-	_	P-03-75	24.6	7.4	46.0	9.8	-	11.4
PFM001518A       -       -       P-03-75       20.0       8.0       49.2       8.4       0.2       12.0         PFM001573A       -       -       P-04-87       23.2       3.6       46.6       9.6       -       12.0         PFM001573A       -       -       P-03-75       15.4       6.2       49.0       12.8       -       14.0         PFM001582A       -       -       P-04-87       19.2       1.4       52.4       -       9.8       16.0         PFM0025172A       -       -       P-04-87       14.4       -       53.4       12.0       -       19.4         KFM03A       243.93       243.13       P-06-168       25.1       10.4       47.7       10.2       -       6.6         KFM03A       797.98       798.01       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6         101033 Diorite, quartz diorite and gabbro, metamorphic, medium-grained       -       22.6       45.4       5.6       45.8       10.8       0.4       16.6       15.0       0.2       10.6         PFM000825B       -       -       P-04-87       7.8       -       64.6       3.4 <t< td=""><td>PFM001253A</td><td>-</td><td>_</td><td>P-03-75</td><td>27.0</td><td>1.8</td><td>61.4</td><td>6.4</td><td>-</td><td>2.8</td></t<>	PFM001253A	-	_	P-03-75	27.0	1.8	61.4	6.4	-	2.8
PFM001573A       -       -       P-04-87       23.2       3.6       46.6       9.6       -       12.0         PFM001524A       -       -       P-03-75       15.4       6.2       49.0       12.8       -       14.2         PFM0015874A       -       -       P-03-75       19.2       1.4       52.4       -       9.8       16.0         PFM005172A       -       -       P-04-87       19.2       1.4       47.2       12.0       -       8.6         PFM005172A       -       -       P-04-87       14.4       -       53.4       12.0       -       6.6         KFM03A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       239.84       239.89       P-04-103       18.8       1.2       52.4       10.4       0.2       15.4         FM00082A       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM00082A       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000826A       -       -	PFM001518A	-	-	P-03-75	20.0	8.0	49.2	8.4	0.2	12.0
PFM001574A       -       -       P-03-75       15.4       6.2       49.0       12.8       -       14.0         PFM001582A       -       -       P-03-75       24.2       2.8       45.6       11.2       -       14.2         PFM001574A       -       -       P-04-87       19.2       1.4       52.4       -       9.8       16.0         PFM005172A       -       -       P-04-87       19.2       1.4       47.2       12.0       -       8.6         PFM003A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       229.94       798.01       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6 <b>1000372A</b> -       -       P-04-87       3.8       -       60.0       7.6       -       25.8         PFM000825A       -       -       P-04-87       3.8       -       60.0       7.6       -       28.8         PFM00085A       -       -       P-04-87       7.0       0.2       55.4       6.4       -       48.0       10.8       -       28.0	PFM001573A	-	_	P-04-87	23.2	3.6	46.6	9.6	-	12.0
PFM001582A       -       -       P-03-75       24.2       2.8       45.6       11.2       -       14.2         PFM00217A       -       -       P-04-87       19.2       1.4       52.4       -       9.8       16.0         PFM00217A       -       -       P-04-87       19.2       11.4       47.2       12.0       -       8.6         PFM005172A       -       -       P-04-87       14.4       -       53.4       12.0       -       6.6         KFM03A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       798.98       798.01       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6         10103 Diorite, quartz diorite and gabbro, metamorphic, medum-grained       P       P       25.4       6.4       -       25.8         PFM000825B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000826A       -       -       P-04-87       7.0       0.2       50.8       -       28.8         PFM001086A       -       -       P-04-87 <td>PFM001574A</td> <td>-</td> <td>_</td> <td>P-03-75</td> <td>15.4</td> <td>6.2</td> <td>49.0</td> <td>12.8</td> <td>-</td> <td>14.0</td>	PFM001574A	-	_	P-03-75	15.4	6.2	49.0	12.8	-	14.0
PFM001874A       -       -       P-04-87       19.2       1.4       52.4       -       9.8       16.0         PFM005172A       -       -       P-03-75       19.2       11.4       47.2       12.0       -       8.6         PFM005172A       -       -       P-04-87       14.4       -       53.4       12.0       -       19.4         KFM03A       239.84       239.89       P-04-103       18.8       1.2       52.4       10.4       0.2       15.4         KFM03A       239.84       239.89       P-04-103       18.8       1.2       52.4       10.4       0.2       15.4         IM033 Diorite, quartz diorite and gabbro, metamorphic, medium-grained       P       P       7.0       0.2       55.4       6.4       -       28.0         PFM000252B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000865A       -       -       P-03-75       4.0       -       46.6       15.0       0.2       10.6         PFM001204A       -       -       P-04-87       7.8       -       50.8       -       -       42.8         PFM001506A <td>PFM001582A</td> <td>-</td> <td>_</td> <td>P-03-75</td> <td>24.2</td> <td>2.8</td> <td>45.6</td> <td>11.2</td> <td>-</td> <td>14.2</td>	PFM001582A	-	_	P-03-75	24.2	2.8	45.6	11.2	-	14.2
PFM002217A       -       -       P-03-75       19.2       11.4       47.2       12.0       -       8.6         PFM005172A       -       -       P-04-87       14.4       -       53.4       12.0       -       19.4         KFM03A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       239.84       239.89       P-04-103       18.8       1.2       5.2.4       10.4       0.2       15.4         KFM03A       797.98       798.01       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6         DF0000825B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000826B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000826A       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM00086A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM0011204A       -	PFM001874A	-	_	P-04-87	19.2	1.4	52.4	-	9.8	16.0
PFM005172A       -       -       P-04-87       14.4       -       53.4       12.0       -       19.4         KFM03A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       239.84       239.89       P-04-103       18.8       1.2       52.4       10.4       0.2       15.4         KFM09A       79.98       798.01       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6         10033 Diorite, quartz diorite and gabbro, metamorphic, medium-grained       P       P       9.6       7.0       0.2       55.4       6.4       -       25.8         PFM000852B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000852A       -       -       P-04-87       7.4       -       64.6       3.4       -       28.8         PFM00158A       -       -       P-04-87       7.8       -       50.4       10.8       -       23.8         PFM001204A       -       -       P-04-87       7.8       -       54.4       12.2       -       21.0	PFM002217A	-	_	P-03-75	19.2	11.4	47.2	12.0	-	8.6
KFM03A       242.93       243.13       P-06-186       25.1       10.4       47.7       10.2       -       6.6         KFM03A       239.84       239.89       P-04-103       18.8       1.2       52.4       10.4       0.2       15.4         KFM03A       79.98       79.80       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6         IO003782A       -       -       P-04-87       3.8       -       60.0       7.6       -       25.8         PFM000852B       -       -       P-04-87       24.6       -       46.6       15.0       0.2       10.6         PFM000858A       -       -       P-04-87       24.6       -       46.6       15.0       0.2       10.6         PFM001858A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0       -       28.8         PFM00158A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001906A       -       -       P-04-87       7.8       -       52.2       14.2       -       21.0         PFM0050	PFM005172A	-	-	P-04-87	14.4	-	53.4	12.0	-	19.4
KFM03A       239.84       239.89       P-04-103       18.8       1.2       52.4       10.4       0.2       15.4         KFM09A       797.98       798.01       P-06-233       15.8       5.6       45.8       10.8       0.4       16.6         DFM000782A       -       -       P-04-87       3.8       -       60.0       7.6       -       25.8         PFM000825B       -       -       P-04-87       3.8       -       60.0       7.6       -       25.8         PFM000825A       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM00085A       -       -       P-04-87       24.6       -       40.6       15.0       0.2       10.6         PFM00158A       -       -       P-03-75       0.4       -       64.6       3.4       -       28.8         PFM001504A       -       -       P-04-87       7.8       -       50.8       -       -       42.8         PFM001906A       -       -       P-04-87       7.8       -       52.2       14.2       2.0       20.0         PFM005206A       -       - <t< td=""><td>KFM03A</td><td>242.93</td><td>243.13</td><td>P-06-186</td><td>25.1</td><td>10.4</td><td>47.7</td><td>10.2</td><td>-</td><td>6.6</td></t<>	KFM03A	242.93	243.13	P-06-186	25.1	10.4	47.7	10.2	-	6.6
KFM09A         797.98         798.01         P-06-233         15.8         5.6         45.8         10.8         0.4         16.6           101033 Diorite, quartz diorite and gabbro, metamorphic, medium-grained         PFM000782A         -         -         P-04-87         3.8         -         60.0         7.6         -         25.8           PFM000842A         -         -         P-04-87         24.6         -         46.6         15.0         0.2         10.6           PFM000858A         -         -         P-04-87         24.6         -         46.6         15.0         0.2         10.6           PFM000858A         -         -         P-03-75         4.0         -         40.4         4.0         -         50.6           PFM00158A         -         -         P-03-75         0.4         -         64.6         3.4         -         28.8           PFM01158A         -         -         P-04-87         7.8         -         54.4         12.2         -         24.6           PFM010106A         -         -         P-04-87         7.8         -         48.2         12.6         0.2         20.0           DFM001010A         -	KFM03A	239.84	239.89	P-04-103	18.8	1.2	52.4	10.4	0.2	15.4
101033 Diorite, quartz diorite and gabbro, metamorphic, medium-grained           PFM000782A         -         -         P-04-87         3.8         -         60.0         7.6         -         25.8           PFM000825B         -         -         P-04-87         7.0         0.2         55.4         6.4         -         28.0           PFM000842A         -         -         P-04-87         24.6         -         46.6         15.0         0.2         10.6           PFM000865A         -         -         P-03-75         4.0         -         40.4         4.0         -         50.6           PFM00186A         -         -         P-03-75         0.4         -         64.6         3.4         -         28.8           PFM01158A         -         -         P-04-87         7.8         -         54.4         12.2         -         24.6           PFM001579A         -         -         P-04-87         7.8         -         54.4         12.2         -         21.0           PFM001906A         -         -         P-04-87         15.8         -         48.2         12.6         0.2         20.0           102017 Amphibolite <td>KFM09A</td> <td>797.98</td> <td>798.01</td> <td>P-06-233</td> <td>15.8</td> <td>5.6</td> <td>45.8</td> <td>10.8</td> <td>0.4</td> <td>16.6</td>	KFM09A	797.98	798.01	P-06-233	15.8	5.6	45.8	10.8	0.4	16.6
PFM000782A       -       -       P-04-87       3.8       -       60.0       7.6       -       25.8         PFM000825B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM00085BA       -       -       P-04-87       24.6       -       46.6       15.0       0.2       10.6         PFM00085BA       -       -       P-03-75       4.0       -       40.4       4.0       -       50.6         PFM0015BA       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM001579A       -       -       P-04-87       7.8       -       50.8       -       -       42.8         PFM001906A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005206A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-03-75       - <td>101033 Diorite.</td> <td>guartz diori</td> <td>te and gabbr</td> <td>o. metamorpl</td> <td>hic. mediu</td> <td>m-arained</td> <td></td> <td></td> <td></td> <td></td>	101033 Diorite.	guartz diori	te and gabbr	o. metamorpl	hic. mediu	m-arained				
PFM000325B       -       -       P-04-87       7.0       0.2       55.4       6.4       -       28.0         PFM000842A       -       -       P-04-87       24.6       -       46.6       15.0       0.2       10.6         PFM000858A       -       -       P-03-75       4.0       -       40.4       4.0       -       50.6         PFM000865A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001509A       -       -       P-04-87       7.8       -       52.2       14.2       -       21.0         PFM005206A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75<	PFM000782A	_		P-04-87	3.8	_	60.0	7.6	_	25.8
PFM000842A       -       -       P-04-87       24.6       -       46.6       15.0       0.2       10.6         PFM000858A       -       -       P-03-75       4.0       -       40.4       4.0       -       50.6         PFM000865A       -       -       P-03-75       0.4       -       64.6       3.4       -       28.8         PFM001158A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001906A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005209A       -       -       P-04-87       15.8       -       42.2       12.6       0.2       20.0         12017 Amphibolite       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75 <td>PFM000825B</td> <td>_</td> <td>_</td> <td>P-04-87</td> <td>7.0</td> <td>0.2</td> <td>55.4</td> <td>6.4</td> <td>_</td> <td>28.0</td>	PFM000825B	_	_	P-04-87	7.0	0.2	55.4	6.4	_	28.0
PFM000858A       -       -       P-03-75       4.0       -       40.4       4.0       -       50.6         PFM000865A       -       -       P-03-75       0.4       -       64.6       3.4       -       28.8         PFM001158A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM001204A       -       -       P-04-87       -       -       50.8       -       -       42.8         PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001906A       -       -       P-04-87       7.8       -       52.2       14.2       -       21.0         PFM005209A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75	PFM000842A	_	_	P-04-87	24.6	_	46.6	15.0	0.2	10.6
PFM000365A       -       -       P-03-75       0.4       -       64.6       3.4       -       28.8         PFM00158A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM001204A       -       -       P-04-87       7.8       -       50.8       -       -       42.8         PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001906A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005206A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0 <b>102017 Amphibolite</b> -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156 <td>PFM000858A</td> <td>_</td> <td>_</td> <td>P-03-75</td> <td>4.0</td> <td>_</td> <td>40.4</td> <td>4.0</td> <td>_</td> <td>50.6</td>	PFM000858A	_	_	P-03-75	4.0	_	40.4	4.0	_	50.6
PFM001158A       -       -       P-04-87       2.2       -       43.8       4.6       1.0       43.0         PFM001204A       -       -       P-04-87       -       -       50.8       -       -       42.8         PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001506A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005206A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       41.0         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic       -<	PFM000865A	_	_	P-03-75	0.4	_	64.6	3.4	_	28.8
PFM001204A       -       -       P-04-87       -       -       50.8       -       -       42.8         PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001906A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005206A       -       -       P-04-87       8.8       -       52.2       14.2       -       21.0         PFM005209A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic       -       +       42.6       -       -       -       +       -       -       -       -       -       -	PFM001158A	_	_	P-04-87	2.2	_	43.8	4.6	1.0	43.0
PFM001579A       -       -       P-04-87       7.8       -       54.4       12.2       -       24.6         PFM001906A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005206A       -       -       P-04-87       8.8       -       52.2       14.2       -       21.0         PFM005209A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       -       -         PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -	PFM001204A	_	_	P-04-87	_	_	50.8	_	_	42.8
PFM001906A       -       -       P-04-87       16.4       -       48.0       10.8       -       23.8         PFM005206A       -       -       P-04-87       8.8       -       52.2       14.2       -       21.0         PFM005209A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite         PFM001010A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       -         PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352B	PFM001579A	_	_	P-04-87	7.8	_	54.4	12.2	_	24.6
PFM005206A       -       -       P-04-87       8.8       -       52.2       14.2       -       21.0         PFM005209A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite         PFM00110A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic       -       -       42.6       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic       -<	PFM001906A	_	_	P-04-87	16.4	_	48.0	10.8	_	23.8
PFM005209A       -       -       P-04-87       15.8       -       48.2       12.6       0.2       20.0         102017 Amphibolite         PFM001010A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic       P       P       9.03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM00120A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0	PFM005206A	_	_	P-04-87	8.8	_	52.2	14.2	_	21.0
102017 Amphibolite         PFM001010A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic         PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM001252A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75	PFM005209A	_	_	P-04-87	15.8	_	48.2	12.6	0.2	20.0
PFM001010A       -       -       P-04-87       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       42.6 <b>103076 Felsic to intermediate volcanic rock, metamorphic</b> PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM000352B       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001220A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -<	102017 Amerika	- 114-								
PFM001010A       -       -       P-04-67       6.4       -       42.8       9.0       -       40.6         PFM001183B       -       -       P-03-75       -       -       39.2       -       -       55.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       42.6 <b>103076 Felsic to intermediate volcanic rock, metamorphic</b> PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM001352B       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -<		ome		D 04 97	6 /		10.0	0.0		40 G
PFM001183B       -       -       P-03-75       -       -       39.2       -       -       -       53.6         KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       42.6 <b>103076 Felsic to intermediate volcanic rock, metamorphic</b> PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM00156A       -       -       P-03-75       24.8       0.8       49.8       21.2       0.4       -         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -<		-	-	P-04-87	0.4	-	42.0	9.0	-	40.0 55.0
KFM04A       737.61       737.65       P-05-156       3.0       2.0       50.0       -       -       41.0         KFM05A       356.07       365.11       P-05-156       0.8       -       53.0       -       -       42.6         103076 Felsic to intermediate volcanic rock, metamorphic       PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       - </td <td></td> <td>-</td> <td>-</td> <td>P-03-75</td> <td>-</td> <td>-</td> <td>39.Z</td> <td>-</td> <td>-</td> <td>55.6</td>		-	-	P-03-75	-	-	39.Z	-	-	55.6
103076 Felsic to intermediate volcanic rock, metamorphic         PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM000352B       -       -       P-03-75       24.8       0.8       49.8       21.2       0.4       -         PFM001156A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001236A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       - <td>KFM04A KFM05A</td> <td>356.07</td> <td>365.11</td> <td>P-05-156 P-05-156</td> <td>3.0 0.8</td> <td>2.0 —</td> <td>50.0 53.0</td> <td>_</td> <td>_</td> <td>41.0 42.6</td>	KFM04A KFM05A	356.07	365.11	P-05-156 P-05-156	3.0 0.8	2.0 —	50.0 53.0	_	_	41.0 42.6
PFM000350A       -       -       P-03-75       25.6       0.6       48.4       22.8       -       -         PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM000352B       -       -       P-03-75       24.8       0.8       49.8       21.2       0.4       -         PFM001156A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001236A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001908A       -       -       P-04-87	103076 Felsic to	intermedia	te volcanic r	ock metamo	rnhic					
PFM000352A       -       -       P-03-75       24.4       10.6       50.8       14.2       -       -         PFM000352B       -       -       P-03-75       24.8       0.8       49.8       21.2       0.4       -         PFM001156A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001236A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001908A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM000350A	_	_	P-03-75	25.6	0.6	48.4	22.8	_	_
PFM000352B       -       -       P-03-75       24.8       0.8       49.8       21.2       0.4       -         PFM001156A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001908A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM000352A	_	_	P-03-75	24.4	10.6	50.8	14.2	_	_
PFM001156A       -       -       P-03-75       33.6       1.0       52.2       -       -       10.0         PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001956A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM000352B	_	_	P-03-75	24.8	0.8	49.8	21.2	0.4	_
PFM001200A       -       -       P-03-75       32.2       12.6       29.2       9.6       0.2       1.4         PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001956A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM001156A	_	_	P-03-75	33.6	1.0	52.2	_	_	10.0
PFM001222A       -       -       P-03-75       38.4       1.6       43.4       16.6       -       -         PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001956A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM001200A	_	_	P-03-75	32.2	12.6	29.2	96	02	14
PFM001229A       -       -       P-03-75       12.8       2.2       49.4       20       -       13.8         PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001956A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM001222A	_	_	P-03-75	38.4	1.6	43.4	16.6	_	_
PFM001236A       -       -       P-03-75       27.6       0.8       48.6       22.4       -       -         PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001956A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM001222A	_	_	P-03-75	12 8	22	49.4	20	_	13.8
PFM001908A       -       -       P-04-87       30.6       4.8       50.8       12.6       -       -         PFM001956A       -       -       P-04-87       27.0       1.2       55.0       14.2       0.4	PFM001229A	_	_	P-03-75	27.6	0.8	48.6	22 4	_	_
PEM001956A = P.04.87 27.0 12 55.0 14.2 0.4	PEM001230A	_	_	P_04_87	21.0	4.8	-0.0 50.8	12.4	_	_
	PFM001956A	_	_	P-04-87	27.0	1.2	55.0	14.2	0.4	_

BH or outcrop ID	Sec_up [m]	Sec_low [m]	Report*	Qtz [vol.%]	K-fsp [vol.%]	PI [vol.%]	Bt [vol.%]	Chl [vol.%]	Hbl [vol.%]
PFM002163B	_	_	P-03-75	5.2	_	53.2	_	_	35.6
PFM002163C	-	_	P-03-75	24.2	0.8	58.0	0.2	-	15.2
PFM005217A	-	_	P-04-87	36.8	7.0	45.4	8.8	-	-
PFM005236A	-	_	P-04-87	39.2	7.2	47.0	5.6	-	-
KFM09A	786.79	786.82	P-06-233	38.0	17.0	31.2	12.6	0.8	-
KFM04A	124.56	124.60	P-05-156	28.2	0.4	44.8	25.6	0.4	_

<sup>•</sup> P-03-75 Stephens et al. (2003), P-04-87 Stephens et al. (2005), P-04-103 Petersson et al. (2004a), P-04-159 Adl-Zarrabi (2004a), P-04-199 Adl-Zarrabi (2004b), P-05-156 Petersson et al. (2005), P-06-186 Gustavsson (2006), P-06-233 Adl-Zarrabi (2006), 1982389 Petersson and Eliasson (2024), 2020833 Petersson and Eliasson (2023).

### Identified sheet joints with distinctive aperture along boreholes

Based on the criteria presented in Section 4.3.3, potential sheet joints with distinctive aperture have been identified along boreholes completed during the different drilling campaigns in Forsmark. The identification process has been based on a reassessment of the borehole image obtained by BIPS or OPTV down to an elevation of approximately –200 m (RH2000), with support from geological borehole data (Sicada delivery SKBdata\_22\_065 and SKBdata\_23\_029). Fractures identified as sheet joints are listed in Table A4-1.

The criteria for identification are as follows for fractures and crushes in boreholes:

- 1. Dip of  $\leq 30^{\circ}$ .
- 2. Distinct aperture, i.e.  $\geq 1$  mm.
- 3. No noticeable slip/displacement
- 4. No noticeable fracture coating or wall rock alteration.

It is important to emphasize that strict application of the identification criteria has only been possible with respect to orientation (dip  $< 30^{\circ}$ ) and aperture. The remaining two criteria, i.e. deficiency of discernible slip and mineral coating, have been of secondary importance, since a strict fulfilment requires verification through examination of drill cores. Another aspect is that neither slip nor mineral precipitation can be excluded as a result of later reactivation (cf. Section 5.1.2). Even if a considerable proportion of the fractures identified as sheet joints in the cored boreholes are classified as non-mineralised, the majority exhibits faint mineral coating. However, the mapping data give no information of the quantities. Frequent coatings are clay minerals, calcite, chlorite and hematite. Small quantities of all these minerals may possibly originate from the drilling activity and core handling procedures. Other minerals, such as quartz and muscovite, may be part of the wall rock (cf. Section 4.2.4).

Even if a fracture fulfils all four criteria, it is not necessarily a sheet joint sensu stricto, which has been formed by extensional failure. For example, the fractures that predominate the gently dipping deformations zones within the Forsmark tectonic lens are virtually indistinguishable from the sheet joins. Consequently, Table A4-1 includes several fractures that have been used to define the gently dipping deformations zones ZFM1203, ZFMA2, ZFMA4 and ZFMA8.

A more subtle feature to support identification is the relationship with other fractures. Typical dilatational joints often occur in swarms of parallel joints, separated by millimetres or a few centimetres.

Further, it should be noted that the quality and the resolution of the borehole image is crucial for identification of sheet joints. As a rule of thumb, images for percussion boreholes are of lower quality and resolution than those for cored boreholes, and images acquired by OPTV are generally of better quality and have significantly better resolution than those produced up to 2014 by the BIP system.

Boremap d	ata		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
<b>HFM01</b> – m	apping starts a	at 31.95 m [-2	9.39 m]		
35.447	35.447	2	10	-	Inside target intercept of ZFMA2 (PDZ1)
42.671	42.865	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
99.389	99.389	1	2	-	-
<b>HFM02</b> – m	apping starts a	at 25.40 m [-2	2.14 m]		
28.186	28.186	0	2	-	Mapped as unbroken, sealed fracture
43.330	43.519	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
44.878	44.878	1	4	-	Inside target intercept of ZFMA2 (PDZ1)
45.991	45.991	1	2	_	Inside target intercept of ZFMA2 (PDZ1)
<b>HFM03</b> – m	apping starts a	at 13.10 m [–9	.75 m]. Very p	boor image q	juality
15.493	15.788	-	-	-	Mapped as crush
21.216	21.326	-	-	-	Mapped as crush
22.566	22.566	20	-	-	-
<b>HFM04</b> – m	apping starts a	at 12.09 m [-7	.99 m]		
No identifie	d sheet joints v	vith distinctive	aperture		
<b>HFM05</b> – m	apping starts a	at 11.87 m [–3	.97 m]		
No identifie	d sheet joints v	vith distinctive	aperture		
<b>HFM06</b> – m	apping starts a	at 12.01 m [–5	.14 m]		
53.378	53.378	10	-	-	Amphibolite contact
53.573	53.573	3	-	-	-
56.943	56.943	6	-		_
<i>HFM07</i> – m	apping starts a	at 18.01 m [-1	1.96 m]		
No identifie	d sheet joints v	vith distinctive	aperture		
<b>HFM08</b> – m	apping starts a	at 18.00 m [-1	0.63 m]		
No identifie	d sheet joints v	vith distinctive	aperture		
<b>HFM09</b> – m	apping starts a	at 17.01 m [-1	0.56 m]		
19.723	19.723	0.5	1	-	Interval of several fractures at 19.723 to 19.761 m. Mapped as partly open fracture. Inside target intercept of ZFMENE0060A (PDZ1)
19.741	19.741	0.5	1	-	Mapped as partly open fracture. Inside target intercept of ZFMENE0060A (PDZ1)
19.761	19.761	0.5	1	-	Mapped as partly open fracture. Inside target intercept of ZFMENE0060A (PDZ1)
22.368	23.134	-	-	-	Mapped as crush. Inside target intercept of ZFMENE0060A (PDZ1)
25.854	27.330	-	-	-	Mapped as crush. Inside target intercept of ZFMENE0060A (PDZ1)
<b><i>HFM10</i></b> – m	apping starts a	at 11.75 m [–5	.83 m]		
26.026	26.026	0.5	2	_	-
47.567	47.567	0.5	1	-	-
<b>HFM11</b> – m	apping starts a	at 12.00 m [-1	.33 m]		
37.970	37.970	0.5	1	-	-
<b>HFM12</b> – m	apping starts a	at 14.90 m [-4	.15 m]		
No identifie	d sheet joints v	vith distinctive	aperture		

### Table A4-1. Identified sheet joints with distinctive aperture down to approximately -200 m elevation along selected boreholes.

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
HFM13-	mapping starts	at 14.91 m [-	7.00 m]		
20.319	20.349	-	-	_	Mapped as crush
162.353	162.353	19	-	-	Inside target intercept of ZFMENE0401A (PDZ1)
HFM14 –	mapping starts	at 3.05 m [-1.	45 m]		
3.422	3.809	-	-	-	Mapped as crush
7.684	7.684	1.7	8	-	Two fractures at 7.684 and 7.791 m
7.791	7.791	1.2	8	-	
21.151	21.151	36	-	-	-
25.036	25.036	12	-	-	-
49.602	49.638	_	-	-	Mapped as crush
68.113	68.113	24	-	-	Inside target intercept of ZFMA2 (PDZ1)
68.503	68.503	1	2	-	Inside target intercept of ZFMA2 (PDZ1)
71.368	71.368	15	-	-	Interval of several fractures at 71.368 to 71.465 m. Inside target intercept of ZFMA2 (PDZ1)
71.419	71.419	1	-	-	Inside target intercept of ZFMA2 (PDZ1)
71.465	71.465	0.5	-	-	Inside target intercept of ZFMA2 (PDZ1)
72.027	72.027	7	-	-	Inside target intercept of ZFMA2 (PDZ1)
72.845	72.845	0.5	2	-	Inside target intercept of ZFMA2 (PDZ1)
87.237	87.237	1	2	-	-
93.792	93.792	0.5	2	-	Inside target intercept of ZFMA2 (PDZ2)
98.644	98.780	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ2)
100.573	100.868	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ2)
101.911	101.970	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ2)
102.738	103.053	_	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ2)
HFM14B	– No borehole i	mage availabl	e		
HFM15 –	mapping starts	at 6.02 m [-0.	15 m]		
23.276	23.276	5	12	_	_
23.653	23.653	0.5	6	_	_
26.281	26.281	1	10	_	-
66.447	66.471	_	_	_	Mapped as rock occurrence
67.192	67.215	-	-	-	Mapped as rock occurrence
	mapping starts	at 12.05 m [-8	3.55 m]		
12 455	12 455	0.5	3	_	Inside target intercent of ZEMA8 (PDZ1)
10 753	19 753	0.5	1	_	Inside target intercept of ZEMA8 (PDZ1)
24.280	24.372	_	-	-	Mapped as crush. Inside target intercept
35.123	35.211	-	-	-	Mapped as crush. Inside target intercept
41.310	41.408	-	-	-	Mapped as crush. Inside target intercept of ZEMA8 (PDZ1)
59.814	60.156	_	-	-	Mapped as crush. Inside target intercept of ZEMA8 (PDZ1)
61.425	61.425	0.5	10	_	Inside target intercept of ZFMA8 (PDZ1)
69.200	69.528	-	-	-	Mapped as crush. Inside target intercept
70.358	70.529	_	_	_	Mapped as crush. Inside target intercept of ZFMA8 (PDZ1)
	mapping starts	at 8.01 m [–4	04 ml		
31.096	31.548	-	_	-	Mapped as crush

Boremap	data		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
HFM18-	mapping starts a	at 8.99 m [-2.	47 m]		
23.948	23.948	2	3	-	-
37.563	37.778	-	-	-	Mapped as crush. Inside target intercept of ZFMA4 (PDZ2)
46.706	46.897	-	-	-	Mapped as crush. Inside target intercept of ZFMA4 (PDZ2)
HFM19-	mapping starts a	at 12.23 m [-6	6.57 m]		
13.4	13.4	0.5	2	_	_
20.373	20.373	2	_	_	_
52.206	52.206	1	2	-	Interval of several fractures at 52.206 to 52.296 m
52.240	52.240	0.5	_	_	-
52.296	52.296	1	_	_	_
101.231	101.231	0.5	6	_	_
101.794	101.794	1	2	_	_
168.915	168.915	0.5	3	_	Inside target intercept of ZFMA2 (PDZ2)
170.425	170.771	-	_	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ2)
HFM20-	mapping starts a	at 12.10 m [-8	3.90 m]		
21.775	21.839	_	_	_	Mapped as crush
23.220	23.288	_	_	_	Mapped as crush
24.818	24.918	_	_	_	Mapped as crush
25.991	25.991	2	8	26.01	Crushed interval mapped as two individual fractures at 25.991 and 26.014
26.014	26.014	0.5	3	-	-
64.590	64.590	0	2	-	Mapped as unbroken, sealed fracture
78.037	78.037	0.5	2	-	-
87.474	87.474	0	1	-	Mapped as unbroken, sealed fracture
115.202	115.202	0	1	-	Interval of several fractures at 115.241 to 115.338 m. Mapped as unbroken, sealed fracture
115.241	115.241	0.5	2	-	
115.297	115.297	0	1	-	Mapped as unbroken, sealed fracture
115.338	115.338	0	1	-	Mapped as unbroken, sealed fracture
118.831	118.831	1	2	-	Crushed interval mapped as two individual fractures at 118.831 and 118.868
118.868	118.868	5	10	-	
137.431	137.431	0	6	-	Mapped as unbroken, sealed fracture
147.651	147.651	0	3	-	Mapped as unbroken, sealed fracture. Rather a crushed interval at 146.65–146.71 m
168.422	168.422	0	3	-	Interval of several fractures at 168.422 to 168.60 m. Mapped as unbroken, sealed fracture
168.498	168.498	0	1	-	Mapped as unbroken, sealed fracture
168.535	168.535	0	1	-	Mapped as unbroken, sealed fracture
168.596	168.596	0	1	-	Mapped as unbroken, sealed fracture
197.049	197.049	0	2	-	Mapped as unbroken, sealed fracture
198.433	198.433	0	1	-	Mapped as unbroken, sealed fracture
HFM21 -	mapping starts a	at 12.05 m [-6	6.06 m]		
12.564	12.564	0.5	4	JFM010	-
12.641	12.641	0.5	2	-	-
27.210	27.210	1	2	JFM011	-
48.081	48.081	0	2	JFM012	Mapped as unbroken, sealed fracture
52.764	52.764	0	2	-	Mapped as unbroken, sealed fracture
96.435	96.815	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)
99.094	99.170	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
168.589	168.589	0	2	-	Mapped as unbroken, sealed fracture
182.789	182.789	0	2	-	Mapped as unbroken, sealed fracture
184.900	184.900	0	2	-	Mapped as unbroken, sealed fracture
<b>HFM22</b> – m	apping starts	at 12.05 m [-8	3.54 m]		
28.854	28.854	0.5	-	JFM007 JFM008	-
62.228	62.273	_	_	JFM009	Mapped as crush
85.181	85.220	-	-	-	Mapped as crush
<b>HFM23</b> – m	apping starts	at 20.80 m [-´	13.14 m]		
21.175	21.175	1	5	_	_
36.395	36.395	2.5	-	_	Inside target intercept of ZFMENE1208A (PDZ1)
52.037	52.099	-	-	_	Mapped as crush
54.197	54.197	0.5	1	_	_
89.23	89.23	0.5	1	-	Inside target intercept of ZFMNNW0100 (PDZ2)
	apping starts	at 18.05 m [-1	11.57 m]		
18 430	18 439	05	1	_	Inside target intercent of ZEMW/NW0123 (PDZ1)
29.737	29.737	0.5	1	-	Two fractures at 29.737 and 29.786 m.
29 786	29 786	0.5	1	_	Inside target intercept of ZFMWNW0123 (PDZ1)
43 847	43 847	0.5	1	_	Inside target intercept of ZEMWNW0123 (PDZ2)
46 549	46 549	0.5	1	_	Inside target intercept of ZEMWNW0123 (PDZ2)
47.825	47.825	0.5	1	-	Two fractures at 47.825 and 47.845 m.
47 845	47 845	1	_	_	Inside target intercept of ZFMW/NW0123 (PDZ2)
49.412	49.412	2	-	-	Two fractures at 49.412 and 49.446 m.
49.446	49.446	1	2	_	Inside target intercept of ZFMWNW0123 (PDZ2) Inside target intercept of ZFMWNW0123 (PDZ2)
<b>HFM25</b> – m	apping starts	at 9 00 m [-3	56 ml		
No identifie	d sheet joints	with distinctive	e aperture		
<b>HFM26</b> – m	apping starts	at 12 03 m [-6	3 72 ml		
No identifie	d sheet joints	with distinctive	e aperture		
<b>HFM27</b> – m	apping starts	at 12.04 m [-8	3.52 ml		
10.024	10.067				Mannad as crush
27.793	28.491	_	_	_	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
49.399	49.553	_	-	-	Mapped as crush
50.712	50.712	1	2	-	Interval of several fractures at 50.712 to 50.746 m.
50.733	50.733	0.5	_	-	-
50.746	50.746	1.5	_	-	-
51.142	51.142	1.5	_	-	Two fractures at 51.142 and 51.162 m
51.162	51.162	1	_	-	-
54.672	54.672	0.5	1	_	_
66.058	66.058	0.5	-	_	Two fractures at 66.058 and 66.067 m
66.067	66.067	1	2	-	_
118.705	118.771	_	_	_	Mapped as crush
121.468	121.468	1	3	_	_
122.458	122.458	16	_	_	_
<b>HFM28</b> – m	apping starts	at 12.10 m [-7	7.59 m]		
112 /12	112 /12	1	2	_	
145 587	145 587	0.5	<u>د</u> 1	_	_
	10.007	0.0	1		

Boremap	data		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
HFM29 –	mapping starts	at 9.05 m [−3.	07 m]		
16.380	16.400	-	-	-	Mapped as crush
HFM30 –	mapping starts	at 18.00 m [-´	11.55 m]		
69.239	69.239	0.5	1	_	Two fractures at 69.239 and 69.288 m
69.288	69.288	0.5	1	_	_
90.981	90.981	0.5	2	_	Inside target intercept of ZFMNW0017 (PDZ1)
94.914	94.914	1	3	-	Inside target intercept of ZFMNW0017 (PDZ1)
159.346	159.405	-	-	-	Mapped as crush. Inside target intercept of ZFMNW0017 (PDZ1)
178.520	178.520	1	4	-	Inside target intercept of ZFMNW0017 (PDZ1)
190.241	190.241	0.5	1	-	Inside target intercept of ZFMNW0017 (PDZ1)
HFM31 –	mapping starts	at 9.00 m [−2.	16 m]		
20.812	20.812	0.5	1	_	_
52.927	52.927	0.5	3	_	-
69.777	69.777	2	3	_	-
83.389	83.389	0	1	-	Interval of several fractures at 83.389 to 83.530 m. Mapped as unbroken, sealed fracture
83.405	83.405	0	1	-	Mapped as unbroken, sealed fracture
83.530	83.530	0.5	1	-	-
HFM32 –	mapping starts	at 6.03 m [−4.	82 m]		
10.35	10.35	0.5	_	_	Interval of several fractures at 10.350 to 10.710 m.
10.393	10.393	0.5	_	_	_
10.438	10.438	0.5	_	_	_
10.454	10.454	0.5	_	_	_
10.511	10.511	0.5	_	_	_
10.545	10.545	0.5	_	_	-
10.572	10.572	0.5	-	-	-
10.633	10.633	0.5	-	-	-
10.644	10.644	0.5	-	-	-
10.664	10.664	0.5	-	-	-
10.680	10.680	0.5	-	-	-
10.704	10.704	0.5	-	-	-
10.710	10.710	0.5	-	-	-
15.336	15.463	-	-	-	Mapped as crush
18.087	18.229	-	-	-	Mapped as crush
27.979	27.979	_	2	_	Not registered in Boremap
HFM33 –	mapping starts	at 12.06 m [ <del>-</del> 7	7.49 m]		
77.715	77.715	0.5	2	-	-
77.957	77.957	0.5	2	-	-
79.387	79.387	0.5	2	-	-
81.065	81.065	4	-	-	-
127.079	127.079	2	-	-	-
136.537	136.537	8	-	-	
136.559	136.559	4	-	_	Two fractures at 136.537 and 136.559 m
HFM34 –	mapping starts	at 12.08 m [ <del>-</del> 7	7.68 m]		
16.463	16.463	50	-	-	-
23.186	23.186	1	-	-	-
27.857	27.857	1	-	-	-
28.581	28.581	1	2	-	-
30.953	30.953	1	-	-	-
00.013	00.013	5	-	_	

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
120.182	120.433	-	-	-	Uncertain due to poor image quality. Inside target intercept of ZFMWNW0001 (PDZ1)
<b>HFM35</b> – r	napping starts	at 12.04 m [-8	3.17 m]		
25.439	25.542	-	-	-	Mapped as crush. Inside target intercept of ZFMWNW0001 (PDZ1)
48.759	48.775	-	-	-	Mapped as crush. Inside target intercept of ZFMWNW0001 (PDZ1)
50.703	51.132	-	-	-	Mapped as crush. Inside target intercept of ZFMWNW0001 (PDZ1)
118.116	118.116	0.5	2	-	-
143.829	143.829	3	-	-	-
154.384	154.448	_	-	-	Mapped as crush
154.878	154.975	-	-	-	Mapped as crush
<b><i>HFM36</i></b> – r	napping starts	at 12.06 m [-*	1.71 m]		
27,504	27.585		_	_	Mapped as crush
32,575	32.575	0.5	1	_	Interval of several fractures at 32 575 to 32 639 m
32,614	32.614	0.5	1	_	_
32.639	32.639	0.5	1	_	_
41.464	41.464	0.5	1	_	Mapped as partly open
43.433	43.433	1	2	_	
46.367	46.367	1.5	_	_	-
47.023	47.023	0.5	6	_	-
51.373	51.462	_	_	_	Mapped as crush
51.682	51.682	4	_	_	_
56.937	56.937	1	_	_	-
59.642	59.642	1	_	_	_
<b>HFM37</b> – r	napping starts	at 9.07 m [−4.	64 m]		
16.204	16.204	2	-	-	Inside target intercept of ZFMWNW0004 (PDZ1)
16.277	16.277	1.5	-	-	Inside target intercept of ZFMWNW0004 (PDZ1)
17.108	17.108	0	2	-	Mapped as unbroken, sealed fracture. Inside target intercept of ZFMWNW0004 (PDZ1)
37.693	37.693	2	-	-	
37.727	37.727	2	-	-	Two fractures at 37.693 and 37.727 m
<b>HFM38</b> – r	napping starts	at 9.14 m [-5.	03 m]		
21.557	21.557	0.5	2	_	_
24.619	24.619	0.5	5	-	_
27.641	27.641	0.5	7	_	-
30.044	30.526	_	-	_	Mapped as crush
32.068	32.068	0.5	11	-	Mapped as partly open
33.236	33.236	0.5	4	-	_
34.498	34.498	0.5	5	-	-
37.566	37.566	0.5	10	-	-
53.193	53.193	0.5	5	-	-
185.361	185.361	0.5	2	-	-
186.808	186.808	1	2	-	-
<b><i>HFM</i>39</b> – r	napping starts	at 6.05 m [-1.	69 m]		
7 066	7 066	200	_	JFM004	_
12,201	12,201	0.5	5	_	_
16.959	16.959	0.5	5	_	_
22.514	22.720	_	_	JFM006	Crushed interval or fracture swarm. Not registered in Boremap
35.442	35,442	0.5	4	_	- '

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
52.093	52.093	0.5	1.5	-	_
57.271	57.271	0.5	2	-	-
66.261	66.261	0.5	1	-	Interval of several fractures at 66.261 to 66.771 m
66.363	66.363	0.5	1	-	-
66.379	66.379	0.5	1	-	-
66.522	66.522	0.5	1	-	-
66.579	66.579	0.5	1	-	-
66.771	66.771	0.5	1	-	-
81.23	81.23	0.5	1	_	Interval of several fractures at 81.230 to 81.737 m
81.29	81.29	0.5	1	_	_
81.331	81.331	0.5	1	_	_
81.465	81.465	0.5	1	-	_
81.517	81.517	0.5	1	_	-
81.653	81.653	0.5	1	_	-
81 737	81 737	0.5	1	_	_
97.073	97.073	0.5	1	_	Interval of several fractures at 97 073 to 97 342 m
97 254	97 254	0.5	1	_	
07 3/2	07 3/2	0.5	1	_	
107.445	107.445	0.5	1	_	Interval of several fractures at 107.445 to
					108.479 m
107.535	107.535	0.5	1	-	-
107.999	107.999	0.5	1	-	-
108.142	108.142	0.5	1	-	-
108.305	108.305	0.5	1	-	-
108.479	108.479	0.5	1	-	-
139.181	139.181	0.5	1	-	Interval of several fractures at 139.181 to 139.546 m
139.27	139.27	0.5	1	-	-
139.546	139.546	0.5	1	-	-
140.134	140.134	0.5	3	-	-
HFM40	mapping starts	at 6.26 m [−3.	.70 m]		
7.767	7.767	0.5	2	-	-
10.945	11.000	-	4	-	Not registered in Boremap
13.817	13.817	0.5	1	1	Interval of several fractures at 13.817 to 13.980 m
13.928	13.928	0.5	1	-	-
13.980	13.980	0.5	1	-	-
15.161	15.161	0.5	1	-	-
20.654	20.654	0.5	8	_	Character of a minor crush
28.474	28.474	0.5	1	_	_
29.727	29.727	0.5	12		Character of a minor crush
65.795	65.795	0.5	2	_	Two fractures at 65.795 and 65.902 m
65.902	65.902	0.5	2	_	_
HFM41	mapping starts	at 6.04 m [−2.	.38 m]		
7,755	7,755	0.5	2	_	Two fractures at 7,755 and 8,076 m
8.076	8.076	0.5	2	_	-
HFM42	mapping starts	at 6.03 m [−1.	.82 m]		
12.394	12.454	_	_	JFM010	Mapped as crush
23.227	23.227	2	_	JFM011	_
23.297	23.297	3	_	JFM011	-
24 422	24 422	4	_	_	_
40 72	40 72	0.7	_	.IFM012	Interval of several fractures at 40 720 to 41 032 m
40.798	40.798	0.7	_	JFM012	_

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
40.912	40.912	0.7	-	JFM012	_
41.001	41.001	0.7	-	JFM012	-
41.032	41.032	0.7	-	JFM012	-
88.555	88.555	20	-	-	Amphibolite contact. Inside target intercept of ZFM1203
90.503	90.503	18	-	-	Amphibolite contact. Inside target intercept of ZFM1203
96.335	96.335	10	_	-	Two fractures at 96.335 and 96.373 m. Inside target intercept of ZFM1203
96.373	96.373	15	-	-	Inside target intercept of ZFM1203
157.853	157.853	5	-	JFM014	Two fractures at 157.853 and 157.859 m
157.859	157.859	5	-	JFM014	-
<b>HFM43</b> – r	napping starts	at 6.03 m [−1.	69 m]		
14.440	14.563	-	-	-	Mapped as crush
33.201	33.383	-	-	-	Mapped as crush
40.220	40.333	-	-	-	Mapped as crush
79.104	79.104	0.7	2	-	Two fractures at 79.104 and 79.181 m
79.181	79.181	0.7	2	-	-
88.162	88.162	0.7	-	-	Interval of several fractures at 88.162 to 88.255 m
88.190	88.190	0.7	-	-	-
88.221	88.221	0.7	-	-	-
88.255	88.255	0.7	-	-	-
90.730	90.730	0.7	-	-	Two fractures at 90.730 and 90.753 m
90.753	90.753	0.7	1.5	-	-
95.239	95.363	_	_	-	Mapped as crush
106.799	106.799	40	_	-	Rather a crush
121.405	121.513	_	_	-	Mapped as crush
173.805	173.805	1	2	-	-
<b>HFM44</b> – r	napping starts	at 9.12 m [−6.	14 m]		
50.411	50.411	2	-	-	Two fractures at 50.411 and 50.428 m
50.428	50.428	2	_	-	-
73.444	73.444	40	_	-	-
113.592	113.592	2	-	-	-
<b>HFM45</b> – r	napping starts	at 6.30 m [−2.	43 m]		
14.908	15.030	_	_	-	Mapped as crush
68.758	68.758	2	-	-	_
73.008	73.008	0.7	2	-	-
122.452	122.452	4	_	-	Two fractures at 122.452 and 122.480 m
122.480	122.480	2	-	-	-
136.145	136.145	2	-	-	_
<b>HFM46</b> – r	napping starts	at 6.12 m [−4.	40 m]		
32.890	32.890	2	_	-	-
33.516	33.516	0.7	-	-	Interval of several fractures at 33.516 to 33.813 m
33.615	33.615	0.7	-	-	-
33.695	33.695	0.7	-	-	-
33.813	33.813	0.7	-	-	-
169.096	169.096	2	-	_	-
184.632	184.769	-	-	-	Mapped as crush
<b>HFM47</b> – r	napping starts	at 12.09 m [-8	3.53 m]		
No identifie	ed sheet joints	with distinctive	e aperture		

Boremap d	lata		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
HFR101 –	mapping starts	at 8.04 m [−4	.74 m]		
70.996	70.996	1	-	-	Interval of several fractures at 70.996 to 71.406 m
71.374	71.374	1	-	-	-
71.406	71.406	1	-	-	-
HFR102 -	mapping starts	at 9.04 m [-5	.22 m]		
No identifie	ed sheet joints	with distinctive	aperture		
HFR105 -	mapping starts	at 21.12 m [-	24.11 m]		
23 107	23 107	2		_	Inside target intercent of ZEMW/NW/0001 (PDZ1)
30 448	30 448	20	_	_	Inside target intercept of ZEMWNW0001 (PDZ1)
HFR106 -	mapping starts	at 9.03 m [-6	.32 m]		
39.143	39.143	6	-	-	
KFM01A –	mapping start	s at 101.00 m	[-97.20 m]		
105.295	105.295	1	-	-	Two fractures at 105.295 and 105.324 m
105.324	105.324	1	-	-	-
122.578	122.578	1	2	-	Two fractures at 122.578 and 122.591 m
122.591	122.591	1.5	-	-	-
158.599	158.599	3	-	-	-
178.394	178.394	4	-	-	-
187.749	187.749	2	-	-	Two fractures at 187.749 and 187.869 m
187.869	187.869	2	_	-	-
194.669	194.669	1	_	-	Two fractures at 194.669 and 194.673 m
194.673	194.673	1	-	-	-
KFM01B-	mapping start	s at 15.50 m [·	-11.93 m]		
16.321	16.321	1.5	_	_	Inside target intercept of ZFMA2 (PDZ1)
17.543	17.543	3	_	_	Inside target intercept of ZFMA2 (PDZ1)
18.547	18.627	_	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
20.591	20.654	_	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
21.025	21.025	25	-	-	Inside target intercept of ZFMA2 (PDZ1)
21.085	21.135	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
21.197	21.218	_	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
27.592	27.592	1	-	-	Interval of several fractures at 27.592 to 28.015 m. Inside target intercept of ZFMA2 (PDZ1)
27.641	27.641	1	-	-	Inside target intercept of ZFMA2 (PDZ1)
27.838	27.838	1.5	-	-	Inside target intercept of ZFMA2 (PDZ1)
27.872	27.872	1.5	-	-	Inside target intercept of ZFMA2 (PDZ1)
28.015	28.015	1	-	-	Inside target intercept of ZFMA2 (PDZ1)
28.316	28.316	3	-	-	Inside target intercept of ZFMA2 (PDZ1)
28.527	28.617	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
29.895	29.943	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
39.784	39.813	_	-	_	Mapped as crush. Interval of several crushes and fractures at 39.784 to 41.861 m. Inside target intercept of ZFMA2 (PDZ1)
40.574	40.623	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
40.832	40.860	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
41.015	41.077	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)

Boremap data		Revised JF	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
41.838	41.861	-	-	_	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
45.590	45.590	1	2		Interval of several fractures and crushes at 45.590 to 46.925 m. Inside target intercept of ZFMA2 (PDZ1)
45.597	45.597	0.5	2	-	Inside target intercept of ZFMA2 (PDZ1)
45.722	45.722	0.5	8	-	Inside target intercept of ZFMA2 (PDZ1)
46.210	46.210	0.5	2	-	Inside target intercept of ZFMA2 (PDZ1)
46.245	46.245	0.5	4	_	Inside target intercept of ZFMA2 (PDZ1)
46.270	46.270	0.5	2	_	Inside target intercept of ZFMA2 (PDZ1)
46.295	46.295	0.5	2	-	Inside target intercept of ZFMA2 (PDZ1)
46.487	46.487	0.5	2	_	Inside target intercept of ZFMA2 (PDZ1)
46.517	46.517	0.5	8	_	Inside target intercept of ZFMA2 (PDZ1)
46.644	46.644	0.5	2	_	Inside target intercept of ZEMA2 (PDZ1)
46.816	46.925	_	_	-	Mapped as crush. Inside target intercept of ZEMA2 (PDZ1)
47.740	47.968	_	-	-	Interval of several crushes at 47.740 to 50.517 m. Inside target intercept of ZFMA2 (PDZ1)
48 971	49 426	_	_	_	Inside target intercent of ZEMA2 (PDZ1)
49 687	50 268	_	_	_	Inside target intercept of ZEMA2 (PDZ1)
50 503	50 517	_	_	_	Inside target intercent of ZEMA2 (PDZ1)
53 562	53 562	15	_	_	Inside target intercent of ZEMA2 (PDZ1)
69.870	69 891	-	_	_	Manned as crush
79 976	79 902				Mapped as crush
00.000	70.095	-	-	-	Mapped as crush
09.000	09.903	-	-	-	Mapped as crush
92.993	92.993	2.5	-	-	
94.513	94.513	1	-	-	Two fractures at 94.513 and 94.543 m
94.543	94.543	4	_	-	-
97.085	97.104	_	-	-	
122.018	122.018	1	-	-	Two fractures at 122.018 and 122.030 m
122.030	122.030	1	-	-	-
123.796	123.796	6	-	-	-
138.755	138.772	_	-	-	Mapped as crush
KFM01C-	mapping star	ts at 11.80 m [·	–5.90 m]		
12.366	12.366	1	3	-	Two fractures at 12.366 and 12.402 m
12.402	12.402	2	6	-	
16.82	16.82	1.8	_	-	-
18.061	18.061	4	6	-	-
18.432	18.432	2.5	_	-	-
26.022	26.022	0.5	2	-	Inside target intercept of ZFMA2 (PDZ1)
34.259	34.259	2.5	4	-	Inside target intercept of ZFMA2 (PDZ1)
40.455	40.560	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
40.978	41.006	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
43.037	43.583	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)
46.144	46.144	2	3	_	Inside target intercept of ZFMA2 (PDZ1)
52.122	52.122	2	_	_	_
59.562	59.562	1.2	_	_	_
79.044	79.044	3	_	_	Inside target intercept of ZFMA2 (PDZ2)
80.999	80.999	1.5	3	_	Inside target intercept of ZFMA2 (PD72)
84.384	86.095	_	_	-	Mapped as crush. Uncertain orientation. Inside target intercept of ZFMA2 (PDZ2)
91.581	91.581	0.5	3	-	Inside target intercept of ZFMA2 (PDZ2)

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
93.010	93.010	1.5	4	_	Inside target intercept of ZFMA2 (PDZ2)
98.491	98.491	4.5	15	-	Inside target intercept of ZFMA2 (PDZ2)
105.019	105.019	1.5	_	-	-
146.230	146.230	1	2	-	-
196.184	196.184	1.5	-	-	-
KFM01D-	mapping start	s at 91.60 m [-	-71.78 m]		
106.029	106.029	1.5	-	-	Interval of several fractures at 106.029 to 106.088 m
106.053	106.053	1	_	-	-
106.088	106.088	3	_	-	-
111.161	111.161	2	_	-	-
120.901	120.901	1.5	_	-	_
121.897	121.897	2.5	_	-	_
122.355	122.355	1	_	-	Two fractures at 122.355 and 122.382 m
122.382	122.382	2	_	_	_
122.762	122.762	2	-	-	Interval of several fractures at 122.762 to 122.827 m
122.795	122.795	1	_	-	-
122.827	122.827	1	-	-	-
144.842	144.842	2	_	-	-
145.553	145.553	2	_	-	-
147.005	147.005	2	_	-	-
168.814	168.814	2	-	-	-
KFM02A -	mapping start	s at 12.00 m [-	-4.42 m]. Poo	r to very poo	r image quality down to 101.75 m
88.659	88.659	3	_	_	_
118.307	118.345	-	-	-	Mapped as crush. Inside target intercept of ZFM866 (PDZ2)
118.858	119.437	-	-	-	Mapped as crush. Inside target intercept of ZFM866 (PDZ2)
120.182	120.182	2	-	-	Inside target intercept of ZFM866 (PDZ2)
121.003	121.003	15	-	-	Inside target intercept of ZFM866 (PDZ2)
121.255	121.255	3	-	_	Interval of several fractures at 121.255 to 121.646 m. Inside target intercept of ZFM866 (PDZ2)
121.401	121.401	1	_	-	Inside target intercept of ZFM866 (PDZ2)
121.438	121.438	1	_	-	Inside target intercept of ZFM866 (PDZ2)
121.445	121.445	1	_	-	Inside target intercept of ZFM866 (PDZ2)
121.492	121.492	1	_	-	Inside target intercept of ZFM866 (PDZ2)
121.565	121.565	2	_	-	Inside target intercept of ZFM866 (PDZ2)
121.606	121.606	3	_	-	Inside target intercept of ZFM866 (PDZ2)
121.611	121.611	1	_	-	Inside target intercept of ZFM866 (PDZ2)
121.646	121.646	1	_	-	Inside target intercept of ZFM866 (PDZ2)
122.207	122.207	1	_	-	_
137.068	137.068	2	_	-	_
162.611	162.611	3	_	_	Inside target intercept of ZFMA3 (PDZ3)
163.106	163.133	-	-	-	Mapped as crush. Inside target intercept of ZFMA3 (PDZ3)
KFM02B-	· mapping start	s at 88.56 m [-	-79.59 m]. Lo	cally very po	or image quality
137,664	137,664	2		_	_
138 423	138 423	- 1	_	_	_
158.099	158.099	1	-	-	Interval of several fractures at 158.099 to 158.175 m. Inside target intercept of ZFMA3 (PDZ2)
158.144	158.144	1	_	-	Inside target intercept of ZFMA3 (PDZ2)

			Povisod	IEMyyy	Commont
	ala		Revised	JEINIXXX	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
158.149	158.149	2	-	-	Inside target intercept of ZFMA3 (PDZ2)
158.165	158.165	2	-	-	Inside target intercept of ZFMA3 (PDZ2)
158.175	158.175	1	-	-	Inside target intercept of ZFMA3 (PDZ2)
KFM03A –	mapping star	ts at 102.05 m	[-93.36 m]		
108.676	108.676	2	-	-	-
KFM03B –	mapping star	ts at 5.15 m [-	3.52 m]		
5.830	5.830	8	-	-	-
8.502	8.502	0	1	-	Two fractures at 8.502 and 8.518 m
8.518	8.518	0	1	-	-
24.668	24.668	1	_	-	Inside target intercept of ZFMA5 (PDZ1)
55.592	55.592	1.5	-	-	_
<b>KFM04A</b> – section was	mapping star	ts at 11.699 m at about 100 r	[−1.19 m]. Ve m. The fracture	ery poor imag ed interval is	ge quality down to 108.60 m. An unstable, fractured interpreted to represent a subhorizontal fracture zone.
103.686	103.686	4	-	-	-
112.564	112.564	9	-	-	Inside target intercept of ZFM1200 (PDZ1)
116.200	116.200	2	-	-	Inside target intercept of ZFM1200 (PDZ1)
181.919	181.919	2	-	-	-
192.064	192.064	4	-	-	-
193.473	193.473	2	_	-	Two fractures at 193.473 and 193.494 m
193.494	193.494	2	_	-	-
202.744	202.744	2	-	-	Interval of several fractures at 202.744 to 202.852 m. Inside target intercept of ZFMA2 (PDZ2)
202.760	202.760	5	_	-	Inside target intercept of ZFMA2 (PDZ2)
202.852	202.852	6	_	-	Inside target intercept of ZFMA2 (PDZ2)
207.058	207.058	6	_	-	Inside target intercept of ZFMA2 (PDZ2)
208.184	208.184	3	-	_	Inside target intercept of ZFMA2 (PDZ2)
232.585	232.730	_	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ3)
233.316	233.316	10	-	_	Inside target intercept of ZFMA2 (PDZ3)
233.413	233.413	4	-	_	Inside target intercept of ZFMA2 (PDZ3)
233.865	233.865	3	-	_	Inside target intercept of ZFMA2 (PDZ3)
235.525	235.525	10	-	-	Inside target intercept of ZFMA2 (PDZ3)
<i>KFM04B</i> – image qual represent a	image starts ity. An unstabl subhorizonta	at 11.70 m [-1 le, fractured se Il fracture zone	.18 m]. No ge ection was end e.	ological map countered at	ping has been carried out for this borehole. Very poor about 80 m. The fractured interval is interpreted to
62.095	62.095	_	2	_	Possible fracture
69.612	69.612	_	2	_	Possible fracture
81.107	81.107	_	-	_	Possible fracture
81,664	81 733	_	_	_	Possible crush
93,775	93 863	_	_	_	Possible crush
97.577	97.577	_	2	_	Two possible fractures at 97 577 and 97 800 m

- <i>FM05A</i> – mapping starts at 109.00 m [−88.79 m]							
109.349	-	-	-	Mapped as crush. Inside target intercept of ZFMA2 (PDZ1)			
110.079	2	-	-	Inside target intercept of ZFMA2 (PDZ1)			
110.133	10	-	-	Inside target intercept of ZFMA2 (PDZ1)			
	mapping start 109.349 110.079 110.133	mapping starts at 109.00 109.349 – 110.079 2 110.133 10	mapping starts at 109.00 m [-88.79 m] 109.349 – – 110.079 2 – 110.133 10 –	mapping starts at 109.00 m [-88.79 m] 109.349 – – – 110.079 2 – – 110.133 10 – –			

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Interval of several fractures at 110.458 to

Inside target intercept of ZFMA2 (PDZ1)

110.728 m. Inside target intercept of ZFMA2 (PDZ1)

97.800

110.458

110.517

97.800

110.458

110.517

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Table A4-1.	Continue	d.
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Boremap data			Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
110.554	110.554	1	_	_	Inside target intercept of ZFMA2 (PDZ1)
110.728	110.728	2	_	_	Inside target intercept of ZFMA2 (PDZ1)
111.485	111.485	0.5	_	_	Interval of several fractures at 111.485 to 111.803 m.
111.498	111.498	1	_	_	Inside target intercept of ZFMA2 (PDZ1)
111.532	111.532	3	_	_	Inside target intercept of ZFMA2 (PDZ1)
111.601	111.601	1	_	_	Inside target intercept of ZFMA2 (PDZ1)
111.687	111.687	1	_	_	Inside target intercept of ZFMA2 (PDZ1)
111.803	111.803	1.5	_	_	Inside target intercept of ZFMA2 (PDZ1)
112.313	112.313	2	_	-	Interval of several fractures at 112.313 to 112.374 m. Inside target intercept of ZFMA2 (PDZ1)
112.326	112.326	0.5	_	_	Inside target intercept of ZFMA2 (PDZ1)
112.349	112.349	1	_	_	Inside target intercept of ZFMA2 (PDZ1)
112.374	112.374	1	_	_	Inside target intercept of ZFMA2 (PDZ1)
112.575	112.575	2	_	_	Inside target intercept of ZFMA2 (PDZ1)
112.86	112.86	2	_	_	Inside target intercept of ZFMA2 (PDZ1)
116.489	116.489	1	_	_	Interval of several fractures at 116.489 to 116.568 m.
116.499	116,499	0.5	_	_	_
116.536	116.536	1	_	_	_
116.555	116.555	1	_	_	_
116 568	116 568	3	_	_	_
119 657	119 657	15	_	_	_
120 582	120 582	2	_	_	_
120.002	124 382	1	2	_	_
125.035	125.035	1	2	_	_
142 315	142 315	1	2	_	_
162 760	162 760	2	_	_	-
163.803	163.803	1	_	_	
	100.000		(0.00. 1.)(		
KFM06A -	<ul> <li>mapping start</li> </ul>	s at 13.11 m [·	-18.02 mJ. Ve	ry poor imag	e quality down to 100.00 m.
115.277	115.277	1.5	-	-	-
123.113	123.113	1.5	-	-	-
125.982	125.982	5	-	-	-
126.896	126.896	2	-	-	-
128.386	128.386	1	-	-	Interval of several fractures at 128.386 to 128.412 m.
128.394	128.394	1.5	-	-	-
128.412	128.412	2	-	-	-
129.321	129.321	1.5	-	-	Interval of several fractures at 129.321 to 129.423 m.
129.326	129.326	1	-	-	-
129.332	129.332	1	-	-	-
129.423	129.423	1	-	-	-
130.269	130.318	-	-	-	Mapped as crush
181.161	181.161	2	-	-	-
206.214	206.214	2.5	4	-	Inside target intercept of ZFMENE0060B (PDZ2)
220.386	220.386	1.5	-	-	Two fractures at 220.386 and 220.409 m. Inside target intercept of ZFMENE0060B (PDZ2)
220.409	220.409	3	-	-	Inside target intercept of ZFMENE0060B (PDZ2)
220.627	220.627	5	-	-	Inside target intercept of ZFMENE0060B (PDZ2)
KFM06B	- mapping start	s at 5.70 m [-	1.35 m]		
6.509	6.509	2	7	-	-
9.701	9.730	-	-	-	Mapped as crush
17.110	17.130	-	-	-	Mapped as crush
17.277	17.291	-	-	-	Mapped as crush

Boremap data			Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
18.572	18.572	3	_	_	Two fractures at 18.572 and 18.626 m.
18.626	18.626	2	-	-	-
20.757	20.757	1.5	-	-	-
21.149	21.149	7	-	-	-
34.009	34.009	1	-	-	Interval of several fractures at 34.015 to 34.256 m
34.015	34.015	3	-	-	-
34.051	34.051	1	-	-	-
34.256	34.256	1.5	-	-	-
35.303	35.303	7	-	-	-
35.558	35.558	4	-	-	-
43.470	43.470	1.5	-	-	-
45.502	45.502	1.5	-	-	-
55.269	55.388	-	-	-	Mapped as crush. Inside target intercept of ZFMA8 (PDZ1)
55.666	56.255	-	-	-	Mapped as crush. Inside target intercept of ZFMA8 (PDZ1)
61.225	61.225	1	-	-	Two fractures at 61.225 and 61.234 m. Inside target intercept of ZFMA8 (PDZ1)
61.234	61.234	2	-	-	Inside target intercept of ZFMA8 (PDZ1)
64.857	64.857	1.5	-	-	Inside target intercept of ZFMA8 (PDZ1)
KFM06C -	- mapping start	ts at 101.00 m	[-82.69 m]		
124 450	124 450	15	_	_	_
143 103	143 103	2	_	_	_
143 338	143 338	15	_	_	_
143.330	144 262	0.5	_	_	Two fractures at 144 262 and 144 278 m
144 278	144 278	4	_	_	-
145.400	145.400	2	_	_	_
154,298	154.345	_	_	_	Mapped as crush
166.544	166.544	3	_	_	Two fractures at 166.544 and 166.577 m.
166.577	166.577	3	_	_	_
168.746	168.746	1	_	_	_
172.617	172.617	2	_	_	Two fractures at 172.617 and 172.652 m.
172.652	172.652	2	_	_	_
174.082	174.082	2	_	_	-
176.48	176.48	2	_	_	-
182.245	182.245	2.5	_	_	_
205.025	205.025	1.5	-	-	-
205.335	205.335	1.5	-	-	-
214.153	214.153	2	-	-	-
217.443	217.443	3	-	-	-
236.578	236.578	1.5	-	-	-
KFM07A -	- mapping start	s at 100.40 m	[-83.14 m]		
111.253	111.253	1.5	-	-	Two fractures at 111.253 and 111.313 m. Inside target intercept of ZFM1203 (PDZ1)
111.313	111.313	1	-	_	Inside target intercept of ZFM1203 (PDZ1)
112.076	112.443	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)
116.579	116.592	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)
116.958	116.958	1.5	-	-	Inside target intercept of ZFM1203 (PDZ1)
119.330	119.330	2	-	-	Two fractures at 119.330 and 119.404 m. Inside target intercept of ZFM1203 (PDZ1)
119.404	119.404	1	-	-	Inside target intercept of ZFM1203 (PDZ1)

Table A4-1.	Continued.
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Boremap data			Revised	JFMxxx	Comment		
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]				
120.146	120.198	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)		
120.350	120.350	1	_	-	Inside target intercept of ZFM1203 (PDZ1)		
120.573	120.573	1.5	_	-	Inside target intercept of ZFM1203 (PDZ1)		
121.296	121.296	3	_	_	Inside target intercept of ZFM1203 (PDZ1)		
121.647	121.647	1	-	-	Interval of several fractures at 121.647 to 121.822 m. Inside target intercept of ZFM1203 (PDZ1)		
121.667	121.667	1	_	-	Inside target intercept of ZFM1203 (PDZ1)		
121.801	121.801	1	_	_	Inside target intercept of ZFM1203 (PDZ1)		
121.822	121.822	1	_	_	Inside target intercept of ZFM1203 (PDZ1)		
122.752	122.764	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)		
123.666	123.666	1.5	_	_	Inside target intercept of ZFM1203 (PDZ1)		
124.503	124.503	3.5	_	_	Inside target intercept of ZFM1203 (PDZ1)		
133.564	133.671	-	-	-	Mapped as crush. Inside target intercept of ZFM1203 (PDZ1)		
143.844	143.844	3			Inside target intercept of ZFM1203 (PDZ1)		
178.495	178.528	_	-	JFM014	Mapped as crush		
KFM07B	- mapping star	s at 5.19 m [-	0.69 m]				
10.018	10.018	30	35	JFM010	_		
28.081	28.081	2	3	_	_		
20.001	29 307	2	-	IEM011			
20.007	32 172	15	2	-			
44 725	44 725	6	2	_	_		
46.056	46.056	15	_	_			
40.000	40.050	1.5					
47.400	47.400	3	—	JFIVIU12	- Two frequence at 70 750 and 70 761 m		
79.75	79.75	1.5	—	-	Two fractures at 79.750 and 79.761 m.		
79.701	/9./01	0.5	-				
KFM07C	<ul> <li>mapping on ir</li> </ul>	nage starts at	98.46 m [-94	.46 m]			
144.08	144.08	1.5	_	-	-		
156.294	156.294	0.5	-	JFM014	Interval of several fractures at 156.294 to 156.386 m		
156.303	156.303	2	-	JFM014	-		
156.319	156.319	0.5	-	JFM014	-		
156.33	156.33	0.5	-	JFM014	-		
156.349	156.349	0.5	_	JFM014	-		
156.386	156.386	2	-	JFM014	-		
163.729	163.729	1.5	-	-	-		
KFM08A							
116.632	116.632	1.5	-	-	Two fractures at 116.632 and 116.845 m.		
116.845	116.845	1	_	-	-		
119.854	119.854	1.5	_	-	-		
124.353	124.353	1.5	-	-	-		
130.242	130.242	2	-	_	-		
134.973	134.973	2	_	_	_		
189.730	189.730	2	_	_	_		
193.539	193.539	1.5	_	_	-		
197.707	197.707	2	-	_	Interval of several fractures at 197.707 to 197.808 m		
197,797	197.797	4	_	_	-		
197.808	197.808	1	_	_	-		
214.187	214.187	1.5	_	_	_		

Boremap data			Revised	JFMxxx	Comment			
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]					
<i>KFM08B</i> – mapping starts at 5.72 m [−1.83 m]								
10.769	10.769	0.5	2	JFM004	-			
13.187	13.187	4	_	-	_			
16.855	16.855	2	_	-	_			
21.365	21.389	_	_	JFM005	Mapped as crush			
30.278	30.278	5	-	-				
30.955	30.989	_	_	JFM008	Mapped as crush			
33.121	33.121	2	_	-	_			
61.892	61.892	0.5	2	JFM009	Two fractures at 61.892 and 61.923 m.			
61.923	61.923	0.5	2	JFM009	_			
106.945	106.945	1	2	-	-			
<i>KFM08C</i> – mapping starts at 102.23 m [-85.7 m] No identified sheet joints with distinctive aperture								
KFM08D -	- mapping star	ts at 59 00 m [·	-45 7 ml					
82 004	82 004	0.5	2	_	_			
02.004	02.004 107.352	0.5	2	-	- Two fractures at 107 252 and 107 561 m			
107.552	107.552	0.5	2	-				
107.501	107.501	1 5	-	-	-			
109.109	109.109	1.5	-	-	-			
10.993	10.995	2	4	-	-			
120.020	125.520	2	-	-				
120.007	125.557	0.5	-	-	-			
131.090	131.090	۲ ۲	3 2	-	-			
149.779	149.779	I	2	_				
KFM09A -	<ul> <li>mapping start</li> </ul>	ts at 7.80 m [–:	2.23 m]					
9.372	9.372	3	-	-	-			
19.421	19.480	-	-	-	Mapped as crush. Inside target intercept of ZFMENE1208A (PDZ1)			
41.352	41.352	5	-	-	-			
48.682	48.682	2	-	-	-			
53.897	53.897	3	-	-	-			
67.881	67.881	1.5	-	-	-			
108.442	108.442	2	-	-	Inside target intercept of ZFMENE1208B (PDZ2)			
113.003	113.003	1.5	-	-	Inside target intercept of ZFMENE1208B (PDZ2)			
121.611	121.611	2	-	-	-			
122.355	122.355	0.5	2	-	-			
131.495	131.495	2	-	-	-			
134.155	134.155	2	-	-	-			
135.667	135.667	5	-	-	-			
149.121	149.121	0.5	1	-	Two fractures at 149.121 and 149.329 m.			
149.329	149.329	2	-	-	-			
160.076	160.115	-	-	-	Mapped as crush			
170.244	170.244	1.5	-	-	-			
<b><i>KFM09B</i></b> – mapping starts at 9.22 m [-3.08 m]								
50 012	50 012	5	_	_	_			
51 536	51 536	15	_	_	_			
61 405	61 405	1.5	_	_	Two fractures at 61 405 and 61 419 m			
01.400	01.400	1.0			Inside target intercept of ZFMENE1208B (PDZ1)			
61.419	61.419	1.5	-	-	Inside target intercept of ZFMENE1208B (PDZ1)			
62.532	62.532	2	-	-	Inside target intercept of ZFMENE1208B (PDZ1)			
64.341	64.341	1.5	-	-	Inside target intercept of ZFMENE1208B (PDZ1)			
68.775	68.775	1.5	-	-	Inside target intercept of ZFMENE1208B (PDZ1)			

Boremap data			Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
76.328	76.328	2	-	_	Two fractures at 76.328 and 76.383 m. Inside target intercept of ZFMENE1208B (PDZ1)
76.383	76.383	1.5	_	-	Inside target intercept of ZFMENE1208B (PDZ1)
77.665	77.665	2.5	-	-	Inside target intercept of ZFMENE1208B (PDZ1)
82.489	82.489	2	-	-	_
114.646	114.646	2	_	_	Inside target intercept of ZFMENE0159A (PDZ1)
117.621	117.621	2	-	_	Inside target intercept of ZFMENE0159A (PDZ1)
119.816	119.816	1.5	_	_	Inside target intercept of ZFMENE0159A (PDZ1)
147.393	147.393	2	_	_	Two fractures at 147.393 and 147.429 m.
147.429	147.429	1.5	_	_	_
165.772	165.772	1.5	_	_	_
166.841	166.841	2	_	_	_
219.364	219.364	1.5	-	-	-
KFM10A	mapping star	s at 62.92 m [·	-43.16 m]		
72.799	72.799	1.5		_	Inside target intercept of ZFMWNW0123 (PDZ1)
76.201	76.201	0.5	_	-	Two fractures at 76.201 and 76.209 m. Inside target intercept of ZEMWNW0123 (PDZ1)
76 209	76 209	15	_	_	Inside target intercept of ZEMWNW0123 (PDZ1)
85.707	85.849	-	_	-	Mapped as crush. Inside target intercept of ZEMWNW0123 (PDZ1)
87.904	87.904	2	3	-	Inside target intercept of ZFMWNW0123 (PDZ1)
KFM11A	mapping start	s at 71.50 m [·	-60.05 m]		
No analysi	s of the boreho	ole image.			
<b>KFM12A</b> –	mapping start	s at 61.40 m [·	-42.42 m]		
No analysi	s of the boreho	le image.			
<b>KFM13</b> – r	napping starts	at 8.30 m [−4.	25 m]		
11.013	11.013	7	_	JFM004	_
11.158	11.158	6	_	JFM004	-
13.639	13.639	5	15	-	-
13.910	13.973	_	-	_	Mapped as crush
14.536	14.536	1	3	_	_
15.823	15.823	1.5	_	_	_
23.110	23.110	1.5	_	JFM005	_
23.192	23.192	1.5	-	JFM005	_
23.936	23.936	2	3	_	_
27.062	27.228	_	-	JFM007	Mapped as crush
27.945	27.945	3	4	_	-
129.140	129.140	1.5	-	_	_
<b>KFM14</b> – r	napping starts	at 5.91 m [−3.	74 m]		
6.786	6.786	0.5	3	JFM004	-
18.905	18.905	2	5	JFM005	_
22.787	22.787	1	2	JFM007	_
24.165	24.165	2	6	JFM008	_
34.946	34.946	1	2	_	Several parallel fractures
46.534	46.534	1	2	_	_
46.551	46.551	1	4	_	-
53.249	53.249	1	_	JFM009	_
КFM15 – г	napping starts	at 7.48 m [-3	78 ml		
7 065	7 065	20			
7.070	COE.1	30	-		Mannad as arush
1.819	8.020	-	-	JF1VI004	mapped as crush
Boremap data		Revised	JFMxxx	Comment	
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Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
16.027	16.081	_	-	-	Mapped as crush
16.921	16.976	_	-	-	Mapped as crush
20.537	20.625	-	-	-	Mapped as crush
21.142	21.229	-	-	JFM006	Mapped as crush
KFM16-	mapping starts	at 4.42 m [−2.	13 m]		
10.090	10.090	5	-	JFM004	-
18.612	18.612	0.5	1	JFM005	Interval with several fractures at 18.612 to 18.652 m
18.615	18.615	0.5	1	JFM005	-
18.632	18.632	0.5	1	JFM005	-
18.652	18.652	1	-	JFM005	-
28.147	28.147	10	-	JFM007 JFM008	Interval with several fractures at 28.147 to 28.424 m
28.218	28.218	0.5	1	JFM007 JFM008	-
28.347	28.347	3	-	JFM007 JFM008	-
28.400	28.400	1	-	JFM007	-
28.424	28.424	1.5	-	JFM007	-
39 968	39 968	9	_	_	_
49 251	49 251	35	_	_	_
51.095	51.095	2.5	_	_	_
52.048	52.048	1.5	_	_	-
53.130	53.130	2	4	_	-
KEM17	manning starts	at 5.08 m [-2	14 ml		
6.25	6.25	125	- -	JFM004	_
12.180	12.215	_	_	_	Mapped as crush
14.954	15.060	_	_	_	Mapped as crush
23.969	23.969	10	_	JFM007	-
KFM18 –	- mapping starts	at 8.89 m [-5.	22 m]		
9.826	9.826	1	2	_	-
10.469	10.469	2.5	_	JFM004	-
10.998	10.998	1.5	_	_	-
15.573	15.573	3	7	_	Mapped as partly open
15.925	15.925	1.5	3	_	_
18.548	18.577	-	_	-	Mapped as crush
20.616	20.766		-	JFM006	Mapped as crush
21.035	21.084		_	JFM006	Mapped as crush
22.718	22.718	1	2	_	223/18
24.209	24.209	3	_	_	_
30.242	30.242	3	_	-	_
32.865	32.865	1.5	-	-	-
KFM19-	mapping starts	at 7.25 m [−3.	60 m]		
7.525	7.525	150	-	JFM003	Inside target intercept of ZFMENE1061A (PDZ1)
8.177	8.177	5.5	-	-	Inside target intercept of ZFMENE1061A (PDZ1)
15.297	15.297	3	-	-	Inside target intercept of ZFMENE1061A (PDZ1)
17.797	17.797	5.5	-	-	Inside target intercept of ZFMENE1061A (PDZ1)
19.430	19.430	2	4	-	Inside target intercept of ZFMENE1061A (PDZ1)
35.263	35.263	3	7	-	Inside target intercept of ZFMENE1061A (PDZ1)
49.490	49.490	1	2	-	Inside target intercept of ZFMENE1061A (PDZ1)

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
KFM20-	mapping starts	at 2.33 m [0.6	6 m]		
2.466	2.466	7	-	-	_
3.386	3.386	5	-	_	_
3.410	3.410	6	-	_	_
3.923	3.923	3	_	-	_
5.906	5.906	15	_	JFM004	_
5.965	5.965	1	_	JFM004	-
5.987	5.987	15	_	JFM004	-
7.503	7.610	_	_	_	Mapped as crush
8.128	8.128	20	_	_	=
9.098	9.098	30	_	_	-
11.927	11.927	1.5	_	_	-
13.947	14.022	_	_	_	Mapped as crush
14,785	14.872	_	_	_	Mapped as crush
17 512	17 512	2.5	_	_	_
18 182	18 182	5	15	_	_
18 895	18.895	15	_	_	_
18 907	18.000	1.5	_	_	_
20.054	20.195	-	_	JFM006	<ul> <li>Rather steeply dipping, but includes inferred</li> </ul>
					sheet joints
21.440	21.440	2	-	-	Two fractures
26.586	26.586	6	-	-	-
29.106	29.106	5	-	_	-
<b>KFM21</b> –	mapping starts	at 5.82 m [-2.	70 m]		
6.803	6.803	110	-	JFM004	-
7.417	7.417	4.5	-	-	-
7.447	7.447	4.5	-	-	-
8.944	8.944	3	-	-	-
10.352	10.352	4	-	-	-
10.407	10.407	2.5	-	-	-
13.183	13.183	1.5	_	-	-
21.792	22.023	-	-	-	Mapped as crush. Inside target intercept of ZFMNNW1205A (PDZ1)
23.625	23.717	_	-	JFM007	Mapped as crush. Inside target intercept
24.652	24.652	4	_	_	Interval with several fractures at 24.652 to 25.112 m.
04 705	04 705	4			Inside target intercept of ZEMININW1205A (PDZ1)
24.765	24.765	1	-	-	Inside target intercept of ZEMININW1205A (PDZ1)
24.773	24.773	1	-	-	Inside target Intercept of ZEMININW1205A (PDZ1)
24.819	24.819	0.5	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
24.834	24.834	0.5	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
24.894	24.894	0.5	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
24.986	24.986	1	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
24.994	24.994	1	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
25.106	25.106	1	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
25.112	25.112	1	-	-	Inside target intercept of ZFMNNW1205A (PDZ1)
26.994	26.994	7	15	JFM008	Inside target intercept of ZFMNNW1205A (PDZ1)
34.900	34.900	5			Interval with several fractures at 34.900 to 35.377 m
35.073	35.073	0.5	-	-	-
35.107	35.107	1.5	-	-	-
35.212	35.212	0.5	-	-	-
35.257	35.257	4	-	-	-
35.355	35.355	3	-	-	-
35.377	35.377	0.5	-	-	-

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
43.391	43.391	5	_	_	_
46.925	46.925	20	-	-	-
48.871	48.871	1.5	-	-	-
52.825	52.825	1	2	-	-
94.166	94.166	5	-	-	Inside target intercept of ZFMNNW1205B (PDZ3)
<b>KFM22</b> – r	mapping starts	at 8.40 m [-5	.44 m]		
19.254	19.254	1.5	-	-	-
20.998	20.998	6	10	-	-
40.149	40.149	2.5	-	-	-
<b>KFM23</b> – r	mapping starts	at 4.60 m [−1	.94 m]		
4.971	4.971	25	-	-	-
5.440	5.440	280	-	-	-
23.533	23.678	-		JFM007	Mapped as crush. Inside target intercept of ZFMENE2120 (PDZ1)
25.944	25.944	2	-	-	Inside target intercept of ZFMENE2120 (PDZ1)
27.068	27.119	-	-	JFM008	Mapped as crush
28.076	28.076	1.5	-	-	Inside target intercept of ZFMENE2120 (PDZ1)
29.023	29.023	1.5	-	-	Inside target intercept of ZFMENE2120 (PDZ1)
31.203	31.288	-	-	-	Mapped as crush. Inside target intercept of ZFMENE2120 (PDZ1)
38.994	38.994	1.5	-	-	-
41.914	41.914	2	-	-	-
44.479	44.479	2	-	-	-
49.030	49.030	2	-	-	-
52.307	52.307	1.5	-	-	-
54.490	54.490	1.5	-	JFM009	
60.520	60.520	2	-	-	-
63.859	63.859	1.5	-	-	-
64.958	64.958	1.5	-	-	-
67.786	67.786	0.5	-	-	Interval with several fractures at 67.786 to 67.923 m
67.793	67.793	0.5	-	-	-
67.923	67.923	0.5	-	-	-
74.891	74.891	1.5	-	-	-
75.766	75.766	3.5	-	-	-
98.629	98.629	1.5	-	-	-
<b>KFM24</b> – r	mapping starts	at 37.18 m [–:	35.71 m]		
51.848	51.848	3	-	JFM009	-
126.669	126.669	2	-	-	-
184.939	184.939	1	-	-	Very limited interval with several fractures
195.058	195.058	1	_	_	Very limited interval with several fractures
<b>KFM25</b> – r	napping starts	at 6.06 m [-3	.37 m]		
6.629	6.629	29	-	JFM015	-
7.842	7.842	4.5	-	-	-
8.420	8.420	1.5	-	-	-
19.209	19.209	3.5	-	-	-
23.83	23.83	11.5	-	-	-
33.012	33.012	0.5	-	-	Interval with several fractures at 33.012 to 33.045 m
33.023	33.023	0.5	-	-	-
33.045	33.045	0.5	-	-	-
38.300	38.300	2	-	-	- -
42.600	42.600	0.5	-	-	I wo fractures at 42.600 and 42.613 m

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
42.613	42.613	1	-	-	-
61.524	61.524	2	1	-	-
61.861	61.861	2	-	-	Two fractures at 61.861 and 61.875 m
61.875	61.875	2	-	-	-
66.535	66.553	_	-	-	Mapped as crush
73.852	73.852	0.5	-	-	Interval with several fractures at 73.852 to 73.948 m
73.884	73.884	0.5	-	-	-
73.900	73.900	0.5	-	-	-
73.948	73.948	1	-	-	-
74.004	74.004	0.5	-	-	-
<b>KFM26</b> – m	apping starts a	at 6.03 m [-3.0	)1 m]		
6.313	6.313	44.5	_	_	_
6.563	6.563	55	_	_	_
6.616	6.616	8	_	_	_
7.036	7.036	10	_	_	_
8.318	8.318	1	2	_	_
23 152	23 152	0.5	1	_	Two fractures at 23 152 and 23 165 m
23 165	23 165	1	1.5	_	_
28 539	28 539	1	1.5	_	_
35,157	35.213	_	_	_	Mapped as crush
70 108	70 108	0.5	_	_	Interval with several fractures at 70 108 to 70 127 m
70.118	70.118	0.5	_	_	_
70.127	70.127	0.5	_	_	_
85.927	85.927	1	3	_	_
87.830	87.830	1.5	_	_	_
91.833	91.833	3.5	_	_	Interval with several fractures at 91.833 to 91.901 m
91.838	91.838	2.5	_	_	-
91.901	91.901	0.5	_	_	-
94.496	94.496	1	_	_	Two fractures at 94.496 and 94.506 m
94.506	94.506	2	_	_	_
98.706	98.787	_	-	_	Mapped as crush
99.815	99.815	1	4	_	_
<b>KFM27</b> – m	apping starts a	at 9.03 m [-6.1	16 m]		
12 236	12 236	0.5	_	_	Interval with several fractures at 12 236 to 12 257 m
12.200	12.230	0.5	_	_	
12.240	12.240	0.5	_	_	_
16 741	16 741	1	8	_	Two fractures at 16 741 and 16 759 m
16 759	16 759	15	-	_	
19 526	19 561	_	_	_	Manned as crush
53 923	53 923	15	_	_	Inside target intercent of ZEMENE2248 (PDZ1)
55 090	55 090	1.0	2	_	Inside target intercept of ZEMENE2248 (PDZ1)
66 447	67 025	_	_	_	Revised length 66 81–66 87 m. Inside target
70.050	70.050	0.5			intercept of ZFMENE2248 (PDZ1)
73.052	73.052	0.5	-	-	Interval with several fractures at 73.052 to 73.218 m. Inside target intercept of ZFMENE2248 (PDZ1)
73.071	73.071	0.5	-	-	Inside target intercept of ZFMENE2248 (PDZ1)
73.218	73.218	1	-	-	Inside target intercept of ZFMENE2248 (PDZ1)
73.803	73.803	0.5	-	-	Interval with several fractures at 73.803 to 73.850 m. Inside target intercept of ZFMENE2248 (PDZ1)
73.814	73.814	0.5	-	-	Inside target intercept of ZFMENE2248 (PDZ1)
73.828	73.828	0.5	-	-	Inside target intercept of ZFMENE2248 (PDZ1)
73.850	73.850	0.5	-	-	Inside target intercept of ZFMENE2248 (PDZ1)

Boremap of	data		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
86.702	86.739	-	-	-	Mapped as crush. Inside target intercept of ZFMENE2248 (PDZ1)
87.849	87.921	_	2	-	Mapped as crush. Inside target intercept of ZFMENE2248 (PDZ1)
88.316	88.358	-	6	-	Mapped as crush. Inside target intercept of ZFMENE2248 (PDZ1)
KFM90B -	- mapping start	s at 1.60 m [-	1.95 m]		
6.211	6.211	0.5	1	JFM010	-
15.102	15.102	0.5	1	_	Interval with several fractures at 15.102 to 15.172 m
15.165	15.165	0.5	_	_	-
15.172	15.172	0.5	1	_	_
KFM90C -	- mapping start	s at 1.58 m [–2	2.16 m]		
5 847	5 847	1	_ `	_	Two fractures at 5 847 and 5 863 m
5 863	5 863	2	_	_	
14 625	14 625	2 1	_	_	Two fractures at 14,625 and 14,637 m
14.025	14.025	1	_	_	
KEM90D-	- manning start	sat 1.60 m [–	1 76 ml		
No identifi	ed sheet joints	with distinctive	e aperture		
KFM90E -	- mapping start	s at 1.59 m [-*	 1.82 ml		
5 627	5 627	0.5	1	_	_
6 247	6 247	1	-		
15 264	15 264	0.5	1	-	-
15.304	15 372	0.5	1		
15.372	15.372	0.5	1	_	
15.30	15.30	0.5	1	-	-
15.402	15.402	0.5	1	-	-
13.431	15.451	0.5	1	-	- Two fractures at 17 466 and 17 475 m
17.400	17.400	0.5	1	_	
KEM00E	monning stort				-
KFIVI90F -	- mapping start	s at 1.59 m [-2	2.01 mj		
5.762	5.762	0.5	1	_	-
<b>KFR27</b> – r	mapping starts	at 11.82 m [-8	.76 m]		
23.457	23.457	0	1	-	Mapped as unbroken, sealed fracture
23.488	23.488	0	1	-	Mapped as unbroken, sealed fracture
28.361	28.361	0.5	1	-	-
44.284	44.284	1	-	-	-
50.174	50.174	2	-	-	-
54.743	54.743	6	-	-	-
60.312	60.312	0.5	-	-	Interval with several fractures at 60.312 to 60.334 m
60.322	60.322	0.5	_	-	-
60.334	60.334	1	-	-	-
65.515	65.515	1	-	-	-
87.240	87.240	1	_	-	-
89.036	89.036	5	-	-	-
98.691	98.691	1	-	-	Two fractures at 98.691 and 98.695 m
98.695	98.695	1	-	_	_
144.052	144.052	1	-	_	Two fractures at 144.052 and 144.070 m
144.070	144.070	0.5	-	_	
189.041	189.041	1	-	_	In interval with core loss.
192.506	192.707	-	_	-	Mapped as crush

Boremap o	lata		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
KFR101 -	mapping start	s at 13.72 m [-	-8.67 m]		
16.815	16.815	1	_	_	Inside target intercept of ZFMNNW1034 (PDZ1)
19.201	19.201	1.5	-	-	Inside target intercept of ZFMNNW1034 (PDZ1)
25.291	25.291	1	-	-	Inside target intercept of ZFMNNW1034 (PDZ1)
28.385	28.385	1	-	-	Two fractures at 28.385 and 28.408 m. Inside target intercept of ZFMNNW1034 (PDZ1)
28.408	28.408	1	_	-	Inside target intercept of ZFMNNW1034 (PDZ1)
32.775	32.775	1	8	_	Inside target intercept of ZFMNNW1034 (PDZ1)
53.394	53.394	0.5	1	-	Inside target intercept of ZFMNNW1034 (PDZ1)
59.421	59.421	0.5	1	-	Inside target intercept of ZFMNNW1034 (PDZ1)
62.644	62.644	1	-	-	Inside target intercept of ZFMNNW1034 (PDZ1)
64.224	64.224	1.5	_	-	Inside target intercept of ZFMNNW1034 (PDZ1)
64.840	64.840	1	-	-	Inside target intercept of ZFMNNW1034 (PDZ1)
141.135	141.135	1	_	-	Two fractures at 141.135 and 141.139 m
141.139	141.139	1	-	-	-
180.948	181.006		-	-	-
KFR102A	<ul> <li>mapping sta</li> </ul>	rts at 71.95 m	[-62.83 m]		
100.482	100.482	0.5	1	_	Interval with several fractures at 11.482 to 100.576 m
100.504	100.504	0.5	1	_	_
100.551	100.551	0.5	1	-	_
100.576	100.576	0.5	1	_	_
144.857	144.857	1	3	-	-
147.507	147.507	0.5	1	-	-
161.787	161.787	0.5	1	-	-
188.303	188.321	-	-	-	Mapped as crush
188.766	188.766	0.5	2	-	-
200.814	200.814	1.5	3	-	-
205.892	205.892	3	-	-	-
215.920	215.920	3	-	-	Two fractures at 215.920 and 215.929 m
215.929	215.929	0.5	2	-	-
235.486	235.486	1	-	-	-
240.697	240.697	1	2	-	-
KFR102B	– mapping sta	rts at 13.95 m	[-8.70 m]		
26.420	26.420	1	_	-	-
48.620	48.620	3	_	-	Two fractures at 48.620 and 48.652 m
48.652	48.652	1	_	-	-
54.062	54.062	1	-	-	-
172.598	172.598	1	-	-	-
KFR103-	mapping start	s at 13.34 m [-	-8.28 m]		
14.049	14.049	2	12	_	_
16.343	16.343	2	10	_	_
20.384	20.384	5	-	_	_
64.003	64.003	3	_	_	-
84.579	84.579	0.5	2	-	_
85.668	85.708	_	_	-	Mapped as crush
86.609	86.740	_	_	_	Mapped as crush
164.013	164.013	1	_	_	_
180.689	180.725	-	-	-	Mapped as crush. Inside target intercept of ZFMWNW3262 (PDZ3)
181.293	181.293	0.5	1	-	Two fractures at 181.293 and 181.301 m. Inside target intercept of ZFMWNW3262 (PDZ3)

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
181.301	181.301	0.5	1	-	Inside target intercept of ZFMWNW3262 (PDZ3)
181.894	182.010	-	-	-	Mapped as crush. Inside target intercept of ZFMWNW3262 (PDZ3)
KFR104 –	mapping starts	s at 8.74 m [−4	.14 m]		
10.821	10.821	2	-	_	_
14.364	14.364	3	_	_	_
19.396	19.396	1	-	_	_
20.291	20.291	1	_	_	Interval with several fractures at 20.291 to 20.365 m
20.299	20.299	1	_	_	_
20.334	20.334	1	-	_	_
20.365	20.365	1	_	_	_
25.384	25.384	3	_	_	_
41.309	41.309	3	_	_	Inside target intercept of ZFMNE3118 (PDZ1)
49.977	49.977	0.5	1	_	Two fractures at 49.977 and 49.994 m
49.994	49.994	0.5	1	_	_
52.457	52.457	1.5	-	_	_
54.646	54.646	1.5	-	_	_
64.523	64.523	3.5	-	_	_
73.363	73.363	0.5	1	_	Interval with several fractures at 73.363 to 73.397 m
73.38	73.23	0.5	1	_	_
73.397	73.25	0.5	1	_	_
73.841	73.841	3	-	_	Two fractures at 73.841 and 73.885 m
73.885	73.885	4	_	_	-
93.515	93.515	2	_	_	-
121.558	121.558	1	_	_	_
KED105_	manning starts	s at 4 02 m [-1	07 34 ml		
No analysi	s of the boreho	ble image	07.0 <del>4</del> mj		
	manning start		22 ml		
A 700 -		s at 9.11 m [-7	.55 mj		<b>T</b>
9.736	9.736	2	-	-	I wo fractures at 9.736 and 9.750 m
9.750	9.750	0.5	-	-	-
41.239	41.239	1.5	-	-	-
50.766	50.766	1	-	-	-
60.199	60.199	0.5	1	-	-
61.884	61.884	0.5	1	-	-
61.909	61.909	0.5	1	-	
68.241	68.241	14	-	-	Inside target intercept of ZFMWNW3262 (PDZ3)
72.996	72.996	0.5	1	-	Iwo fractures at 72.996 and 73.017 m. Inside target intercept of ZFMWNW3262 (PDZ3)
73.017	73.017	1	-	-	-
85.246	85.246	2	-	-	Interval with several fractures at 85.246 to 85.397 m
85.262	85.262	0.5	-	-	-
85.308	85.308	6	-	-	-
85.37	85.37	1.5	-	-	-
85.397	85.397	1	-	-	-
100.385	100.385	5	-	-	-
100.647	100.647	1	-	_	Interval with several fractures at 100.647 to 100.753 m
100.668	100.668	1	-	-	-
100.677	100.677	3	-	-	-
100.696	100.696	2	-	-	-
100.723	100.723	1	-	-	-
100.74	100.74	1.5	_	_	_

Boremap data		Revised	JFMxxx	Comment	
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
100.753	100.753	0.5	-	-	-
117.524	117.524	2	-	-	-
126.056	126.056	1.5	_	-	-
155.944	155.944	2	-	-	Interval with one crush and several fractures at 155.944 to 156.235 m
155.969	155.969	1.5	-	-	-
155.995	155.995	6	-	-	-
156.079	156.079	1	_	-	-
156.081	156.237	_	_	_	Mapped as crush
156.235	156.235	5	-	-	-
KFR117-	- mapping starts	s at 9.00 m [-6	.45 m]		
9.482	9.482	1.5	_	_	Two fractures at 9.482 and 9.586 m.
9.586	9.586	1	_	_	-
11 074	11 074	1	_	_	_
11 737	11 775	_	_	JEM016	Mapped as crush
12 881	12 881	25	_	_	
12.001	12.001	10	_	_	Two fractures at 12 272 and 12 12 m
12.373	13.373	5	-	-	
13.412	13.412	5	-	-	-
14.260	14.260	2	—	-	-
22.932	22.932	2	_	-	- -
28.710	28.710	2.5	-	-	Two fractures at 28.710 and 13.725 m.
28.725	28.725	2.5	_	-	-
30.799	30.799	1.5	-	-	-
36.314	36.314	1	-	-	-
80.560	80.560	1	-	-	-
86.291	86.291	1	-	-	-
145.938	146.037	-	-	-	Mapped as crush
KFR118-	- mapping starts	s at 12.03 m [-	8.83 m]		
12.123	12.123	11		JFM016	-
14.165	14.266	_	_	_	Mapped as crush
16.755	16.801	_	_	_	Mapped as crush
18.420	18.451	_	_	_	Mapped as crush
21,440	21.440	3	_	_	Two fractures at 21,440 and 21,471 m.
21 471	21 471	3	_	_	_
22.083	22.083	1	_	_	Two fractures at 22 083 and 22 099 m
22.000	22.000	1	_	_	
37 /05	37 495	1	_	_	
41 520	41 520	1	_	_	Two fractures at 11 52 and 11 55 m
41.550	41.550	1 E	—	-	1wo fractures at 41.55 and 41.55 fit.
41.55	41.55	5	—	-	True free shures at 40,044 and 40,000 m
42.244	42.244	2	_	_	Two fractures at 42.244 and 42.260 m.
42.260	42.260	4	-	-	-
43.385	43.385	1.5	-	-	Two fractures at 43.385 and 43.398 m.
43.398	43.398	5	-	-	-
47.240	47.240	2	-	-	-
52.125	52.125	5.5	-	-	-
52.135	52.135	9.5	-	-	-
62.376	62.376	1	-	-	Two fractures at 62.376 and 62.389 m.
62.389	62.389	5	-	-	-
69.233	69.233	1	-	-	Two fractures at 69.233 and 69.247 m.
69.247	69.247	1	-	-	-
98.352	98.352	1	_	_	-

Boremap	data		Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
KFR119-	mapping starts	s at 9.02 m [−5	5.78 m]		
10.504	10.504	1	_	_	_
11.376	11.376	89	_	JFM016	_
11.756	11.756	6	_	JFM016	Two fractures at 11.756 and 11.781 m.
11.781	11.781	2	-	JFM016	_
22.267	22.267	1	-	_	_
31.455	31.455	1	_	_	Two fractures at 31.455 and 31.461 m.
31.461	31.461	0.5	-	_	_
34.178	34.178	1.5	-	_	_
45.615	45.615	0.5	-	_	Two fractures at 45.615 and 45.628 m.
45.628	45.628	1	-	_	_
47.180	47.180	2.5	-	_	_
69.207	69.207	2.5	_	_	-
142.183	142.183	1	_	_	-
158.942	158.942	1	-	-	-
KFR120 -	mapping starts	s at 9.02 m [-5	5.78 m]		
12.531	12.719	_	-	JFM016	Mapped as crush
15.008	15.008	2	_	-	-
15.313	15.313	6	_	_	-
20.328	20.328	1	-	-	-
27.720	27.720	1	-	-	Two fractures at 27.720 and 27.729 m.
27.729	27.729	1	-	-	-
34.448	34.448	1	_	-	-
38.165	38.165	1	_	-	Interval with several fractures at 38.165 to 38.182 m
38.176	38.176	2	-	-	-
38.182	38.182	1.5	-	-	-
39.756	39.756	2	_	-	-
41.043	41.043	1	_	-	-
43.616	43.616	1.5	_	-	Two fractures at 43.616 and 43.623 m.
43.623	43.623	2.5	-	-	-
46.788	46.788	1	_	-	-
56.576	56.576	3	_	-	Two fractures at 56.576 and 56.582 m.
56.582	56.582	2	-	-	-
60.640	60.640	1.5	-	-	-
65.265	65.265	2	-	-	-
92.879	92.879	1	-	-	Two fractures at 92.879 and 92.959 m.
92.959	92.959	2.5	-	-	
94.980	94.980	1	-	-	Two fractures at 94.980 and 95.005 m.
95.005	95.005	2.5	-	-	-
96.523	96.523	2.5	-	-	-
104.035	104.035	4	-	-	-
105.094	105.094	2	-	-	Interval with several fractures at 105.094 to 105.118 m
105.108	105.108	4	-	-	-
105.118	105.118	4	-	-	-
110.623	110.623	2	-	_	Two fractures at 110.623 and 110.640 m.
110.640	110.640	1.5	-	-	-
112.903	112.903	1.5	-	_	Two fractures at 112.903 and 112.926 m.
112.926	112.926	2	-	_	-
118.734	118.734	2.5	-	-	Two fractures at 118.734 and 118.757 m.
118.757	118.757	2	-	-	-

Boremap data			Revised	JFMxxx	Comment
Sec_up [m]	Sec_low [m]	Aperture [mm]	aperture [mm]		
KFR121 -	mapping start	s at 41.13 m [-	·29.52 m]		
41.328	41.328	4.5	-	-	-
46.384	46.384	1	-	-	-
61.905	61.905	2.5	-	-	-
68.737	68.737	1	-	-	-
97.149	97.149	1.5	-	-	Inside target intercept of ZFMWNW3262 (PDZ1)
100.494	100.494	1	-	-	-
155.451	155.451	3	-	-	-

# Cumulative fracture frequency diagrams for the cored boreholes KFM13 to KFM27 and KFR117 to KFR121

This appendix presents fracture distribution plots for the boreholes KFM13 to KFM27 and KFR117 to KFR121. These plots have been the basic input for an updated geometry of the boundary between FFM01 and FFM02 in the proximity to the repository access volume. The plots include open, partly open and sealed fractures, together with crushes and sealed network converted to individual fractures based on recorded piece lengths. Fracture frequency is illustrated cumulatively for each individual borehole. The plots are based at elevation, not borehole length. Additional information presented in the plots are:

- Intersections with possible deformation zones (PDZ) identified during single-hole interpretations; marked by hatching.
- Intersections with modelled deformation zones; target intercepts (cf. Figure 5-10) marked as shaded areas.
- The target (if defined) position of the boundary between FFM02 and FFM01; marked by solid vertical, black lines.













Elevation (-z RH2000)



SKB R-24-07

# Properties of deformation zones included in Baseline Forsmark version 1.0

# A7.1 Content and structure

The procedure of the modelling work for deterministically modelled deformation zones (DZ) is presented in series of tables below. Properties of the deformation zones from SFR version 1.0 and Forsmark version 2.3 are inherited and reconstructed as precisely as possible using the application for visualisation and interpretation (AVI) tool developed by SKB.

Deterministically modelled deformation zones are arranged in the property tables, firstly, in the order of the orientation set to which the zone belongs and, secondly, in numerical order according to ID number (ZFMxxxxxx).

The terminology used for zones orientation sets or fracture clusters in stereographic projections is inherited from Stephens et al. (2007) and presented in Table A7-1. Six sets of vertical or steeply ( $\geq 45^{\circ}$ ) dipping zones with different strike are present in the models: WNW–ESE, NW–SE, NNW-SSE abbreviated to WNW, NW and NNW respectively; and ENE–WSW, NNE–SSW and NE–SW abbreviated to ENE, NNE and NE respectively. A seventh orientation set where the dip is less than 45°, referred to as "Gently dipping", is also present. Overview of the deformation zones (DZ) included in the Baseline Forsmark version 1.0 is presented in Table A7-2.

Name of vertical or steeply (≥ 45°) dipping orientation set	Strike [°]
N	355–005
NNE	005–035
NE	035–055
ENE	055–085
E	085–095
ESE	095–125
SE	125–145
SSE	145–175
S	175–185
SSW	185–215
SW	215–235
WSW	235–265
W	265–275
WNW	275–305
NW	305–325
NNW	325–355

Table A7-1. Terminology used for vertical or steeply ( $\geq$  45) dipping orientation sets in deformation zones and fracture clusters. If the structural feature dips less than 45°, the set is referred to as "gently dipping.

Table A7-2. Summary of deformation zones in the Baseline Forsmark volume version 1.0.
Presented in the same order as they occur in the property section A7.3. CL refers to total
confidence level for the deformation zone (see explanation in Table A7-3).

DZ orientation group	Zone ID	Total CL	Page
Steep alteration pipe	ZFM1189	12	215
Sently dipping	ZFM1203	20	220
Sently dipping	ZFM866	19	226
ently dipping	ZFM871	22	230
ently dipping	ZFMA1	10	235
ently dipping	ZFMA2	21	237
ently dipping	ZFMA3	20	252
ently dipping	ZFMA4	17	258
ently dipping	ZFMA5	18	265
ently dipping	ZFMA6-e	13	269
ently dipping	ZFMA6-w	13	271
ently dipping	ZFMA7	17	274
ently dipping	ZFMA8	16	278
ently dipping	ZFMB1	13	283
ently dipping	ZFMB4	13	290
ently dipping	ZFMB5-e	11	293
ently dipping	ZFMB5-w	11	294
ently dipping	ZFMB6	11	295
ently dipping	ZFMB7	16	296
ently dipping	ZFMB8	10	301
ently dipping	ZFMB10	10	286
ently dipping	ZEMB23-e	11	288
ently dipping	ZEMB23-w	11	289
ently dipping		10	303
ently dipping	ZEME1	18	460
ently dipping	ZEM 11	10	465
ently dipping	ZFM12	10	467
ently dipping		10	469
artical or stooply dipping ENE strike		22	304
artical or stooply dipping, ENE strike	ZEMENEOOGOR	15	304
ertical of steeply dipping, ENE strike		15	309
ertical of steeply dipping, ENE strike		15	314
ertical or steeply dipping, ENE strike		20	310
ertical of steepiy dipping, ENE strike	ZEMENE0002A	20	323
ertical or steeply dipping, ENE strike	ZFMENE0062B	12	328
ertical or steeply dipping, ENE strike	ZFMENE0062C	10	330
ertical or steeply dipping, ENE strike	ZFMENE0103A	15	332
ertical or steeply dipping, ENE strike	ZFMENE0103B	11	336
ertical or steeply dipping, ENE strike	ZFMENE0159A	22	338
ertical or steeply dipping, ENE strike	ZFMENE0159B	15	346
ertical or steeply dipping, ENE strike	ZFMENE0168	14	350
ertical or steeply dipping, ENE strike	ZFMENE0169	11	354
ertical or steeply dipping, ENE strike	ZFMENE0401A	21	356
ertical or steeply dipping, ENE strike	ZFMENE0401B	15	361
ertical or steeply dipping, ENE strike	ZFMENE1061A	20	365
ertical or steeply dipping, ENE strike	ZFMENE1061B	15	373
ertical or steeply dipping, ENE strike	ZFMENE1192A	18	377
ertical or steeply dipping, ENE strike	ZFMENE1192B	11	383
ertical or steeply dipping, ENE strike	ZFMENE1208A	18	385
ertical or steeply dipping, ENE strike	ZFMENE1208B	18	394
ertical or steeply dipping, ENE strike	ZFMENE2120	21	402
ertical or steeply dipping, ENE strike	ZFMENE2248	17	408
ertical or steeply dipping, ENE strike	ZFMENE2254	14	415
entire Levels and selice in a CNC stailes		22	420

DZ orientation group	Zone ID	Total CL	Page
Vertical or steeply dipping, ENE strike	ZFMENE2325A	15	429
Vertical or steeply dipping, ENE strike	ZFMENE2325B	14	433
Vertical or steeply dipping, ENE strike	ZFMENE2383	14	437
Vertical or steeply dipping, ENE strike	ZFMENE2403	13	442
Vertical or steeply dipping. ENE strike	ZFMENE3115	22	446
Vertical or steeply dipping. ENE strike	ZFMENE3135	10	452
Vertical or steeply dipping. ENE strike	ZFMENE3151	10	454
Vertical or steeply dipping. ENE strike	ZEMENE8031	10	456
Vertical or steeply dipping. ENE strike	ZEMENE8034	10	458
Vertical or steeply dipping, NE strike	ZEMNE0065	17	471
Vertical or steenly dipping, NE strike		14	476
Vertical or steeply dipping, NE strike	ZEMNE0808B	14	478
Vertical or steeply dipping, NE strike		14	480
Vertical or steeply dipping, NE strike	ZEMNE0810	17	482
Vertical or steeply dipping, NE strike		12	402
Vertical or steeply dipping, NE strike		21	404
Vertical of steeply dipping, NE strike		21 10	400
Vertical of steeply dipping, NE strike		19	494 500
Vertical of steeply dipping, NE strike		10	500
Vertical or steeply dipping, NE strike	ZFMNE2308	13	504
Vertical or steeply dipping, INE strike	ZFMNE2309	15	508
Vertical or steeply dipping, NE strike	ZFMNE2332	11	511
Vertical or steeply dipping, NE strike	ZFMNE3112	19	513
Vertical or steeply dipping, NE strike	ZFMNE3118	21	520
Vertical or steeply dipping, NE strike	ZFMNE3134	10	525
Vertical or steeply dipping, NE strike	ZFMNE3137	20	527
Vertical or steeply dipping, NE strike	ZFMNE3266	10	532
Vertical or steeply dipping, NE strike	ZFMNE3542	9	534
Vertical or steeply dipping, NNE strike	ZFMNNE0725	16	536
Vertical or steeply dipping, NNE strike	ZFMNNE0828	11	540
Vertical or steeply dipping, NNE strike	ZFMNNE0860	12	542
Vertical or steeply dipping, NNE strike	ZFMNNE0869	21	544
Vertical or steeply dipping, NNE strike	ZFMNNE0929	12	551
Vertical or steeply dipping, NNE strike	ZFMNNE1132	11	553
Vertical or steeply dipping, NNE strike	ZFMNNE1133	12	555
Vertical or steeply dipping, NNE strike	ZFMNNE1134	12	557
Vertical or steeply dipping, NNE strike	ZFMNNE1135	10	559
Vertical or steeply dipping, NNE strike	ZFMNNE2008	14	561
Vertical or steeply dipping, NNE strike	ZFMNNE2255	14	565
Vertical or steeply dipping, NNE strike	ZFMNNE2263	15	569
Vertical or steeply dipping, NNE strike	ZFMNNE2273	15	574
Vertical or steeply dipping, NNE strike	ZFMNNE2280	15	578
Vertical or steeply dipping, NNE strike	ZFMNNE2293	14	582
Vertical or steeply dipping, NNE strike	ZFMNNE2300	15	585
Vertical or steeply dipping, NNE strike	ZFMNNE2312	18	589
Vertical or steeply dipping, NNE strike	ZFMNNE3264	10	595
Vertical or steeply dipping, NNE strike	ZFMNNE3265	11	597
Vertical or steeply dipping, NNE strike	ZFMNNE3546A	11	599
Vertical or steeply dipping, NNW strike	ZFMNNW0100	22	601
Vertical or steeply dipping, NNW strike	ZFMNNW0101	11	609
Vertical or steeply dipping, NNW strike	ZFMNNW0404	22	611
Vertical or steeply dipping, NNW strike	ZFMNNW0806	13	619
Vertical or steeply dipping, NNW strike	ZFMNNW0823	14	621
Vertical or steeply dipping. NNW strike	ZFMNNW0999	10	623
Vertical or steeply dipping, NNW strike	ZFMNNW1034	20	625
Vertical or steeply dipping, NNW strike	ZFMNNW1204	13	632

DZ orientation group	Zone ID	Total CL	Page
Vertical or steeply dipping, NNW strike	ZFMNNW1205A	20	636
Vertical or steeply dipping, NNW strike	ZFMNNW1205B	21	642
Vertical or steeply dipping, NNW strike	ZFMNNW1209	22	648
Vertical or steeply dipping, NNW strike	ZFMNNW3113	9	652
Vertical or steeply dipping, NNW strike	ZFMNNW3524	13	654
Vertical or steeply dipping, NNW strike	ZFMNNW3534	11	656
Vertical or steeply dipping, NNW strike	ZFMNNW3550	10	658
Vertical or steeply dipping, NNW strike	ZFMNS3154	9	660
Vertical or steeply dipping, NW strike	ZFMNW0002	22	662
Vertical or steeply dipping, NW strike	ZFMNW0003	22	666
Vertical or steeply dipping, NW strike	ZFMNW0016	13	673
Vertical or steeply dipping, NW strike	ZFMNW0017	16	675
Vertical or steeply dipping, NW strike	ZFMNW0029	13	679
Vertical or steeply dipping, NW strike	ZFMNW0036	14	681
Vertical or steeply dipping, NW strike	ZFMNW0805A	22	683
Vertical or steeply dipping, NW strike	ZFMNW0805B	22	690
Vertical or steeply dipping, NW strike	ZFMNW0851	11	695
Vertical or steeply dipping, NW strike	ZFMNW0854	11	697
Vertical or steeply dipping, NW strike	ZFMNW0974	11	699
Vertical or steeply dipping, NW strike	ZFMNW0997	11	701
Vertical or steeply dipping, NW strike	ZFMNW1173	13	703
Vertical or steeply dipping, NW strike	ZFMNW1200	23	705
Vertical or steeply dipping, NW strike	ZFMNW3511	21	712
Vertical or steeply dipping, NW strike	ZFMNW3552	12	714
Vertical or steeply dipping, NW strike	ZFMNW8043	10	716
Vertical or steeply dipping, WNW strike	ZFMWNW0001	24	718
Vertical or steeply dipping, WNW strike	ZFMWNW0004	24	733
Vertical or steeply dipping, WNW strike	ZFMWNW0019	13	744
Vertical or steeply dipping, WNW strike	ZFMWNW0023	13	746
Vertical or steeply dipping, WNW strike	ZFMWNW0024	12	748
Vertical or steeply dipping, WNW strike	ZFMWNW0035	12	750
Vertical or steeply dipping, WNW strike	ZFMWNW0044	14	752
Vertical or steeply dipping, WNW strike	ZFMWNW0123	20	756
Vertical or steeply dipping, WNW strike	ZFMWNW0137	14	764
Vertical or steeply dipping, WNW strike	ZFMWNW0809A	14	766
Vertical or steeply dipping, WNW strike	ZFMWNW0809B	13	768
Vertical or steeply dipping, WNW strike	ZFMWNW0813	16	770
Vertical or steeply dipping, WNW strike	ZFMWNW0835	16	776
Vertical or steeply dipping, WNW strike	ZFMWNW0836	13	784
Vertical or steeply dipping, WNW strike	ZFMWNW0853	13	786
Vertical or steeply dipping, WNW strike	ZFMWNW1035	18	788
Vertical or steeply dipping, WNW strike	ZFMWNW1053	14	792
Vertical or steeply dipping, WNW strike	ZFMWNW1068	11	795
Vertical or steeply dipping, WNW strike	ZFMWNW1156	12	797
Vertical or steeply dipping, WNW strike	ZFMWNW2225	15	799
Vertical or steeply dipping, WNW strike	ZFMWNW3259	22	803
Vertical or steeply dipping, WNW strike	ZFMWNW3262	20	808
Vertical or steeply dipping, WNW strike	ZFMWNW3267	17	813
Vertical or steeply dipping, WNW strike	ZFMWNW3268	9	819
Vertical or steeply dipping, WNW strike	ZFMWNW3512	13	821
Vertical or steeply dipping, WNW strike	ZFMWNW3519	13	823
Vertical or steeply dipping, WNW strike	ZFMWNW3520	13	825
Vertical or steeply dipping, WNW strike	ZFMWNW3538	13	827
Vertical or steeply dipping, WNW strike	ZFMWNW3571	13	829
Vertical or steeply dipping, WNW strike	ZFMWNW8042	17	831

# A7.2 Geological properties of modelled deformation zones

The geological properties assigned to each deformation zone are shown in Table A7-3.

Property	Description
Deformation zone ID	ZFMxxxxxx
Version number	Geometrical version of the deformation zone (from RVS).
Total confidence level (CL)	The sum of the four confidence categories: interpretation, information density, interpolation and extrapolation according to the methodology presented in Hermanson and Petersson (2022).
Geological character	Describes the general geological character of the modelled deformation zone.
Deformation style	Description of the structural characterisation. Only presented if information/ data exist.
Deformation description	Style of the kinematics and sense of displacement. Only presented if information/ data exist.
Alteration	First, second and third order of alteration associated with the zones. Type of alteration presented only if information/data exists.
Fracture orientation and type	Description of fracture orientation, character and style of occurrence i.e. if sealed or open are dominant.
Fracture comment	Additional information related to fractures e.g. information regarding fracture aperture, alteration etc.
Fracture fill mineralogy	Type of mineral occurrences within fractures. Mineral coating or filling specified only if information/data exist.
Property confidence level	Quantitative judgement of the confidence level in each of the categories: Deformation style, deformation description, alteration, fracture orientation and type and fracture fill mineralogy. Also presented for lineaments and seismic reflectors.
Object geometry	Describes the geometry of the modelled deformation zone.
Strike/dip	The orientation of each zone is recorded as strike and dip using the right-hand-rule method, i.e. a zone with orientation 118/77 means that the zone strikes N62°W and dips 77° to the SSW. With numerical estimate of uncertainty.
Length	Length refers to the inferred total trace length of the deformation zone at the ground surface. No length is provided for the deformation zones that fail to intersect the ground surface. See also section 5.3.3 in the main report.
Mean thickness	Thickness refers to the total zone thickness, i.e. damage zone and fault core. If ductile deformation is present along the zone, this is also included in the thickness estimate. If there are data from boreholes, the modelled thickness reflects the value calculated from the borehole intersection (single intersection) or from the borehole intersection judged to be most reliable (more than one intersection). Mean thickness provided with numerical estimate of uncertainty. Min-Max thickness within brackets. See also section 5.3.4 in the main report.
Max depth	Zones with trace lengths exceeding 2 100 m at the ground surface terminate at the base of the model volume i.e. $-2$ 100 m. Less extensive deformation zones extended to a depth that is approximately the same as its trace length at the ground surface. See also section 5.3.2 in the main report.
Geometrical constraints	Truncation against other zones, open ends and surface planar cuts are specified if present.
Basis for modelling	Specification of type of data used as a basis for the modelling work.
Outcrops	Outcrop ID specified if present.
Boreholes	Borehole ID, possible deformation zones interpreted during single hole interpreta- tion (SHI), target and geometrical intercepts and additional comments specified, if present. The degree of detail given in the geometric and target intervals (two decimals) is an effect that originates from the digital CAD modelling tool, RVS. The real uncertainty where a deformation zone may intersect a borehole is possibly within several meters. However, the level of detail of the CAD calculated intersections have been retained so changes to the geometric model can be identified.
Tunnels Lineament and or seismic indications	Tunnel ID and chainage specified, if present. Lineament and or seismic reflector ID specified, if present.

 Table A7-3. Explanation of properties shown in the deformation property tables.

Property	Description
Modelling procedure	Description of the modelling procedure and the source data used in the develop- ment of the 3D geometry, truncations against surrounding zones and use of general geological concept.
Object confidence estimate	Quantitative object confidence estimates for the four categories: interpretation, information density, interpolation and extrapolation according to the methodology presented in Hermanson and Petersson (2022). See also section 5.7 in the main report.
Fracture character	Describes the general character of observed fractures in the modelled deformation zone.
Orientation	The mean orientation of each set of fractures along a zone is recorded as strike and dip using the right-hand-rule method. Previously interpretation presented by Stephens et al. (2007) and Stephens and Simeonov (2015) was followed as precisely as possible, however minor adjustments have been implemented in a few cases where data adjustments have occurred in SICADA or new borehole data have been added.
Fracture frequency	Sealed fracture networks and crush zones are included in the estimation of total fracture frequency along each zone. The frequency of fractures in such structures is calculated on the basis of the size of the rock fragments (i.e. the piece length) inside the network or crush zone and the length of the borehole occupied by the structure, both of which have been recorded during the mapping work. A direct count of fractures has not been made. Data from percussion boreholes are omitted due to the intrinsic limitations of the data on fractures from these boreholes.
Rock quality designation (RQD)	The percentage of the drill core in lengths of 10 cm or more.
Fracture fill mineralogy	Number of occurrences of identified minerals in the deformation zone target sections of core drilled boreholes.
Individual intercepts	Lists of all intercepts with cored and percussion drilled boreholes. Detailed information of individual intercepts in the existing tunnels in SFR and the cooling water tunnels to the powerplant are listed in Curtis et al. (2011).
Stereoplot	Fracture clusters are presented in an inferred, ranked order of interest and plotted consistently in the following colours: Primary cluster (red); Secondary cluster (blue); Third cluster (green); Fourth cluster (purple); Unassigned fractures (grey). The mean orientation of each set of fractures along a zone is recorded as strike and dip using the right-hand-rule method. Where data are available, the mean pole and Fisher k value for each fracture set have been calculated according to the methodology used in Stephens and Simeonov (2015).
Borehole log properties:	
– Length	Borehole length, measured from start of casing.
– Elevation	Measured from RH2000 elevation model., from the start of casing.
<ul> <li>Open fractures</li> </ul>	Frequency of fractures designated as open or partly open (in p_fract_core).
<ul> <li>Sealed fractures</li> </ul>	Frequency of fractures designated as sealed (in p_frac_core).
<ul> <li>Open total fractures</li> </ul>	Frequency of fractures designated as open, partly open and crush.
<ul> <li>Sealed total fractures</li> </ul>	Frequency of fractures designated as sealed, including sealed network.
<ul> <li>Total fractures</li> </ul>	Frequency of fractures designated as open, partly open, crush and sealed fractures, including sealed network.
<ul> <li>Crushed zone</li> </ul>	Highly fractured sections of the drill core where individual open fractures cannot be mapped and the distance between fractures are less than about 5 cm in the core.
<ul> <li>Sealed network</li> </ul>	Highly fractured sections of the drill core where individual sealed fractures cannot be mapped and the distance between fractures are less than about 5 cm in the core.
– RQD	Summed length of all rock segments $\geq$ 10 cm per meter of drill core.
<ul> <li>Fracture open frac orientation</li> </ul>	Tadpole plot of fractures designated as open (red) and partly open (green). Direction of tadpole tail indicates dip direction, and tadpole indicates dip.
<ul> <li>Fracture sealed frac orientation</li> </ul>	Tadpole plot of fractures designated as sealed (grey). Direction of tadpole tail indicates dip direction, and tadpole indicates dip.
<ul> <li>Open aperture</li> </ul>	Measured fracture aperture in millimetre.
- Core loss	Borehole sections without recovered drill core.

# A7.3 Geological properties of modelled deformation zones

Date and time: 2024-11-18 21:17:41 Database version: skbdata\_v\_014

G		ZFM1	189		Version	number	6	Total object CL	12
GEOLO	GICAL CH	IARACTER	Pro	operty	155000	160000	16	5000 170000	
Deformation style:	Brittle	-		<u>CL</u> २	0				0
Deformation	No data	a available.		5	1000		_	$\sim$	1000
description:					67	5	J.	I some	671
Alteration:					1.00	~	X	1 1 4	
- First order:	Quartz	dissolution		3	8	2	1	MR 1	× 8
- Second order:	Albitiza	on tion			~ 020	w )	1 1	1 / K X	050
Fracture	No data	a available			50 22	1	1	HA Z	67
orientation and	NO Gate				2	1,1	X	HADA )	
type:				2	8		XX		5 8
Fracture comment	: Alterati	on pipe.		2	2002	V.S.		$\langle \mathcal{A} \rangle $	2000
Fracture fill	Calcite,	, hematite, chlori	te,		°			XX Y	9
mineralogy:	quartz,	clay minerals, p	yrite.				A	XV	10
Strike/din:	120º/83				8	1 XU		1X/	000
Length:	-	)			3695		A.	$\times$ s	6950
Mean thickness:	7 m						A V	A sum	U
Max depth:	-444 m				i c			2 7 mar	-
Geometrical	ZFMA3	, ZFMA2, Topo 4	40m grid Max	error	0000	/	$\mathbf{X}$	Went	000
constraints:	20m, 1	UNIVERSE Plan	nar Cut(s).		6690		~ \		0690
					155000	160000	16	5000 170000	Soline
					Madel	aluma DMC			N
					Baselin	e		E Lanzenser etc. Gaocadataanverkan	A
			BASIS FO	R MOD	ELLING				
Zone based on bore	hole obser	vations and patte	BASIS FOI ern of surrour	R MOD	ELLING	zones. ZF	M1189 d	oes not extend to th	he
Zone based on bore surface.	hole obser	vations and patte	BASIS FOI ern of surrour	R MOD ding de	ELLING formation :	zones. ZF	W1189 d	oes not extend to th	he
Zone based on bore surface.	hole obser	vations and patte	BASIS FOI ern of surrour	R MOD Iding de	ELLING formation :	zones. ZFI	W1189 d	oes not extend to th	he
Zone based on bore surface. Outcrops: Boreholes:	hole obser	vations and patte	BASIS FOI ern of surrour	R MOD ding de	ELLING	zones. ZFI	V1189 d	oes not extend to th	he
Zone based on bore surface. Outcrops: Boreholes:	hole obser	vations and patte	BASIS FOI ern of surrour	R MODI	ELLING	zones. ZFI	W1189 d	oes not extend to th	he
Zone based on bore surface. Outcrops: Boreholes:	ehole obser	vations and patte	BASIS FOI ern of surrour	R MODI	ELLING formation : Geometric	zones. ZFI	M1189 d	oes not extend to th	he
Zone based on bore surface. Outcrops: Boreholes: Borehole	PDZ	vations and patte Target in Sec_up [m]	BASIS FOI ern of surrour ntercept Sec_low	R MODI ding de Sec	ELLING formation : Geometric :_up [m]	zones. ZF	M1189 d	oes not extend to th	ne
Zone based on bore surface. Outcrops: Boreholes: Borehole	hole obser	vations and patte	BASIS FOI ern of surrour ntercept Sec_low [m]	R MODi ding de Sec	ELLING formation : Geometric :_up [m]	zones. ZFl : intercept Sec_lo [m]	M1189 d	oes not extend to th omment	ned by
Zone based on bore surface. Outcrops: Boreholes: Borehole	PDZ	vations and patte	BASIS FOI ern of surrour ntercept Sec_low [m]	R MOD ding de Sec	ELLING formation : Geometric :_up [m]	zones. ZFl intercept Sec_lo [m]	M1189 d	oes not extend to th omment uget intercept defir U3, composed of v	ned by uggy
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A	Phole obser	Target in Sec_up [m] 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00	R MOD ding de Sec	ELLING formation : Geometric :_up [m] :48.76	zones. ZFI	M1189 d w C w C m D m	oes not extend to th omment arget intercept defir U3, composed of vi etagranite subjecte	ned by uggy ed to a
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A	Phole obser	Target in Sec_up [m] 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00	R MOD ding de	ELLING formation : Geometric _up [m] 248.76	zones. ZFI	M1189 d w C T R m si	oes not extend to th omment arget intercept defir U3, composed of vi etagranite subjecte rong albite-hematite	ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A	Phole obser	Target in Sec_up [m] 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00	R MOD ding de	ELLING formation : Geometric c_up [m] 248.76	zones. ZFI intercept Sec_lo [m] 309.00	W1189 d w C T R m si cl	oes not extend to th omment arget intercept defir U3, composed of vi- etagranite subjecte rong albite-hematit- nlorite alteration.	ned by uggy ed to a e-
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Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A	Phole obser	Target in Sec_up [m] 240.00 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00	R MOD ding de	ELLING formation : Geometric _up [m] 248.76	zones. ZFI intercept Sec_lo [m] 309.00 309.00	M1189 d w C T R D T R C T C C C T T C C C T C C C C C C C	oes not extend to the omment arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematiti- nlorite alteration. arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematiti- nlorite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A	PDZ DZ4 DZ5	Target in Sec_up [m] 240.00 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00	R MOD ding de	Geometric -up [m] 248.76	zones. ZFI : intercept Sec_lo [m] 309.00 309.00	M1189 d w C T R D R C R C C C C C C C C C C C C C C C	oes not extend to the omment arget intercept defir U3, composed of vi- rong albite-hematit- nlorite alteration. arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematit- nlorite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: KFM02A KFM02A KFM02A	PDZ DZ4 DZ5	Target in Sec_up [m] 240.00 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00	R MOD ding de	Geometric -up [m] 248.76	zones. ZFI : intercept Sec_lo [m] 309.04 309.04	M1189 d w C T R D R T R R r si c c C	oes not extend to the omment arget intercept defir U3, composed of vi- etagranite subjecte rong albite-hematit- nlorite alteration. arget intercept defir U3, composed of vi- etagranite subjecte rong albite-hematit- nlorite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A KFM02A Tunnels: Lineament and/or seismic	PDZ DZ4 DZ5 -	Target in Sec_up [m] 240.00 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00	R MOD ding de	ELLING formation : Geometric Lup [m] 248.76	zones. ZFI : intercept Sec_lo [m] 309.04 309.04	M1189 d w C T R D R r st c C C R r st c C	oes not extend to the omment arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematiti- nlorite alteration. arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematiti- nlorite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
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Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A Tunnels: Lineament and/or seismic indications:	PDZ DZ4 DZ5 - -	Target in       Sec_up [m]       240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00	Second	ELLING formation Geometric Lup [m] A8.76 A8.76 CEDURE	zones. ZFI : intercept Sec_lo [m] 309.00 309.00	M1189 d w C T R D S C C C C C C C C C C C C C C C C C C	oes not extend to the omment arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematit- horite alteration. arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematit- horite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A Tunnels: Lineament and/or seismic indications: Modelled as a steep	PDZ DZ4 DZ5 - - -	Target in         Sec_up [m]         240.00         240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00 MODELLIN hat occurs be	Sec 3 PRO	ELLING formation : Geometric :_up [m] 248.76 248.76 248.76 CEDURE he two ger	zones. ZFI	M1189 d W C W C T R D S C C C C C C C C C C C C C	oes not extend to the omment arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematiti- norite alteration. arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematiti- nlorite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A Tunnels: Lineament and/or seismic indications: Modelled as a steep beneath drill site 2.	PDZ DZ4 DZ5	Target in         Sec_up [m]         240.00         240.00         alteration pipe t         placed at 266 m	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00 310.00 MODELLINI hat occurs be along DZ4. N	Sec 3 3 3 3 4 5 4 5 5 6 7 2 2 2 2 2 2 2 2 2 2 2 2 2	ELLING formation : Geometric Lup [m] 248.76 248.76 248.76 CEDURE he two ger upported b centre centre b centre b ce	zones. ZFI	M1189 d w C T T R D m s cl cl zones 2 rrence o	oes not extend to the omment arget intercept defin U3, composed of vi- etagranite subjecter rong albite-hematiti- norite alteration. arget intercept defin U3, composed of vi- etagranite subjecter rong albite-hematiti- nlorite alteration.	ned by uggy ed to a e- ned by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A Tunnels: Lineament and/or seismic indications: Modelled as a steep beneath drill site 2.1 that is parallel to KF	Phole obser	vations and patter Target in Sec_up [m] 240.00 240.00 240.00 240.00 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00 310.00 MODELLING hat occurs be a along DZ4. N rehole length associated to	Sec Sec Sec Sec Sec Sec Sec Sec	ELLING formation : Geometric Lup [m] 248.76 248.76 248.76 248.76 CEDURE he two ger upported b analysis of analysis of	zones. ZFI	W1189 d W C W C T R D m si cl cl cl cl cl cl cl cl cl cl	oes not extend to the omment arget intercept defin U3, composed of vi- etagranite subjecter rong albite-hematite horite alteration. arget intercept defin U3, composed of vi- etagranite subjecter rong albite-hematite horite alteration.	he hed by uggy ed to a e- hed by uggy ed to a e- e- hed by uggy ed to a e-
Zone based on bore surface. Outcrops: Boreholes: Borehole KFM02A KFM02A Tunnels: Lineament and/or seismic indications: Modelled as a steep beneath drill site 2.1 that is parallel to KF These data indicate steeply inclined and	Phole obser	rations and patter Target in Sec_up [m] 240.00 240.00 240.00 240.00	BASIS FOI ern of surrour ntercept Sec_low [m] 310.00 310.00 310.00 MODELLING hat occurs be a along DZ4. N rehole length associated w he borehole. I	Second Se	ELLING formation : Geometric Lup [m] 248.76 248.76 248.76 248.76 CEDURE he two ger upported b analysis of and DZ5 i e geometry	zones. ZFI sintercepti Sec_lo [m] 309.00 309.00 309.00 309.00 surface a n KFM02A supported	W1189 d W C W C T R D m S C C C C T R C C C C C C C C C C C C C	oes not extend to the omment arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematite norite alteration. arget intercept defir U3, composed of vi- etagranite subjecter rong albite-hematite norite alteration.	he hed by uggy ed to a e- hed by uggy ed to a e- hed by uggy ed to a e-

G	ZFM	1189	Version number 6 Total object CL 12
	0100	200	20 50 m
		JECI	CONFIDENCE ESTIMATE
Category	Obj	ect CL	Comment
INTERPRETATION			
Data source		2	KFM2A
Results of interpreta	ation	3	High confidence observation in KFM2A.
INFORMATION DENS	SIIY	4	4
Number of observat	tion points	1	Cingle cheer ation point at death
	Ivation points		
Geometry			
		1	Information from a single sub-surface obs. point is not enough/sufficient to put constrains on the geometry of the entire zone. At least one more observation point is required to enable interpolation. The zone not intersected by KFM02B provide some constraints on the vertical extent of the zone.
Geological indicator	rs	1	Information from a single sub-surface obs. point is not enough/sufficient to put constrains on the geometry of the entire zone. At least one more observation point is required to enable interpolation. The zone not intersected by KFM02B provide some constraints on the vertical extent of the zone. Single observation point at depth. Zone modelled mainly based on surface geophysical data.
Geological indicator	rs	1	Information from a single sub-surface obs. point is not enough/sufficient to put constrains on the geometry of the entire zone. At least one more observation point is required to enable interpolation. The zone not intersected by KFM02B provide some constraints on the vertical extent of the zone. Single observation point at depth. Zone modelled mainly based on surface geophysical data.
Geological indicator	rs	1 1 2	Information from a single sub-surface obs. point is not enough/sufficient to put constrains on the geometry of the entire zone. At least one more observation point is required to enable interpolation. The zone not intersected by KFM02B provide some constraints on the vertical extent of the zone. Single observation point at depth. Zone modelled mainly based on surface geophysical data. ZFM1189 does not extend to the surface. Truncated against ZFMA2 and ZFMA3.







G		ZFM1	203		Version	number	3	Total object CL	20
GEOLO	GICAL CH			Property	y 155000	160000	16	5000 170000	
Deformation atula:	Drittle			CL	_				
Deformation description:	Faults reverse compoi Steep \ strike-s dextral NNW fa predom	dipping gently to how reverse dip- e sinistral strike-s nents of moveme NSW faults show lip displacement and sinistral. A s ault shows a ninantly dextral s	the slip or slip ent. v s, both steep ense	3	00 670000 6710000	2 T	5	A Congression	00 6705000 5710300
Alteration:	of snea	Ir.			6700			AP/ 1/2	57000
- First order:	Oxidati	on		з		L	2D	XX /	
- Second order:	Not obs	served		U	8	C SILL	X	AV7	0
- Third order:	Not obs	served dipping fractures	、		0000	1466	1×2	VY	9500
orientation and type:	domina fracture Open a Quantit span in	tes. Steeply dipp as are also prese and sealed fractu ative estimate an clude crush zone fracture network	oing ent. res. nd es and	2	669000		X		6690000 66
Fracture comment:	No data	a available.			155000	160000	101	170000	20.900
Fracture fill	No data	a available.			155000	100000	100	170000	N
mineralogy:		OFONETRY			Baselin	c DMS		D Lastmitteret, Geschickungenerischer	A
Strike/din:	242º/10								
Length:	1127 m	)							
Mean thickness:	10 m (8	3 - 10 m)							
Max depth:	-145 m								
Geometrical constraints:	Topo 4 ZFMWI ZFMEN ZFMNE	0m grid Max erro NW2225, ZFMNI IE0159A, Trunc E2309, ZFMNNW	or 20m, NE2280, ZFM1203 /0404.	3,					
Zone based on bore	hole obser	vations and rada	BASIS ar data an	HOR MO	of surroundir	na deformati	on zon	<u></u>	
				ia patienti	or surroundi	ig deronnau	011 2011	63.	
Outcrops:	-								
Boreholes:									
		Target in	ntercept		Geometric	: intercept			
Borehole	PDZ	Sec_up [m]	Sec_l	ow s	ec_up [m]	Sec_low	C	omment	
HFM21	D71	94.00	[m] 102 (	20	94.89	105 94			
HFM42		88.50	96.3	0	91.52	101.98	So fra ap 88	everal sub-horizonta actures with conspic pertures in the interv 3,5-96,3 m.	al cuous /al
KFM07A	DZ1	108.00	183.0	00	120.68	133.80	ZI in e> (lo	FMNNW0404 also tersects DZ1 and its ttension in KFM07A ower part).	5
KFM07B	DZ2	93.00	102.0	00	93.94	104.51			
KFM07C	DZ1	92.00	103.0	00	91.98	102.23			
Tunnels:	-								
Lineament and/or	-								
seismic									
malcations.			MODEL	LING PR	OCEDURE				
MODELLING PROCEDURE Modelled by combining the upper part of DZ1 and its extension (108-185 m) in KFM07A with a fixed point at 122 m, with the borehole intervals 93-102 m in KFM07B with a fixed point at 95 m (DZ2), 92-103 m in KFM07C with a fixed point at 93 m (DZ1) and 94-102 m in HFM21 with a fixed point at 96 m (DZ1). Low radar amplitudes also observed at 118-121 m in KFM07A and 95-102 m in KFM07B. Modelled as a near-surface, sub-horizontal fracture zone with support from the orientation of near-surface fractures in the borehole intersections. Termination against ZFMENE0159A, ZFMNNW0404, ZFMNNE2309, ZFMWNW2225 and ZFMNNE2280. However, zone ZFMNNW0404 also intersects DZ1 and its extension in KFM07A (lower part). Can explain the complex interference between gently and steeply dipping structures (see Nordgulen and Saintot 2006)									

G	Z	FM1203		Version number	3	Total object CL	20
E0139A Monora ZFMENE23 ENE2325A TMENE2325B	2FMENE0051	MBNE2120 7000 TO 2003	TID CONTRACT OF CONTRACT ON CONTRACT OF CONTRACT.	MERROR KIMMURAU KIMURAU KIMURAU KIMURAU KIMURAU KIMURAU KIMURAU KIMURAU	E2308		ZFM
		OBJECT	CONFIDENCE	ESTIMATE			
Category		Object CL	Comment				
INTERPRETATION							
Data source Results of interpret	atation	2	HFM21, HFM4	<u>12, KFM07A, KFM0</u>	17AB, KF	M07AC.	
INFORMATION DEI	NSITY	5	Tight confident		LINITA, N	FWI7D, KEWI7C.	
Number of observ	ation points	3	>4				
	servation points	2	A group of clu	ster and no outlier,	evenly d	istributed.	
Geometry			Multiple observation points in the western area contribute to			area contribute to r	elative
		3	high conf. of ir	en the obs. points.	olaire		
Geological indicat	tors	2	Some discrepancies in the geological data.				
EXTRAPOLATION Dip direction			Boreboles at t	he NW side of 7EM		04 which lack indi	cation
Dipuliection		3	of a gently dipping zone at the level of linear extrapolation.			allon	
Strike direction		2	Conceptual co ZFMNNE2280	nstraints. Truncate , ZFMENE0159A, 2	d by ZFN ZFMNE2	1WNW225, 309, ZFMNNW0404	4.
		FRAG	CTURE CHARA	CTER			
Orientation:	Set G: 358.5°/7	.2°		ZFM	11203		
hand-rule)				1	N .	-	
Frequency:	Boreholes: KFM KFM07C, KFM0	107A, )7B				-	
	FRACTURE	TERZAGHI-					
	TYPE	WEIGHED		5	1.		
	Open and	6.0 m-1	7				
	partly open		1.		44	• • • • • • • •	
	Sealed	12.9 m-1	W4		-	· · · · · · · · ·	E
	network	2.2 % of DZ	1.00		324		
	Crush	1.3 % of DZ					
		intercept	1			• • • • [	
			1				
				1		. /	
				Nº .		Enural	area
			1 - <b>N</b> , -	7		Lower hemisp	ohere
			<ul> <li>Unassig</li> </ul>	ned (371)	5		
ROD	min:62 movide	0 moon:05	• Set G (2	(41) 🔺 Mear	n pole Set (	5 (268.5/82.8) Fisher к =	9.3
KUU:	min:62, max:10	u, mean:95					









G		ZFM866			Version I	number	3 Tota	al object CL	19
GE	OLOGICAL	CHARACTER	Pro	perty	155000	160000	165000	170000	
Deformation st	vle: Brittle	9		3	g				0
Deformation	Reve	rse dip-slip displa	cement		00				000
description:	alono	several gently dig	oping		67	2	P I I	y many	671
•	faults	that dip to the no	rth-east			$\langle \cdot \rangle$		1 2	1 4
	ands	south-east. Minor f	aults		- herein	5	11	12 12	5
	along	DZ2 in KFM02A.			2000	5 -	1/1	1 K L	2000
	Chlo	rite striae.			1029	~ /	A	AN	5105
Alteration:					- the	1	LITH	4) 2	
- First order:	Oxid	ation		3	5	11	XXAH	A No	
- Second orde	r: Argill	ization		U	8 1	- NO		$   \land   $	00
- Third order:	Chlo	ritization			200	VC. XW	XIA	1/15	1000
Fracture	Gent	ly dipping fractures	s		0		2 H	JV	67
orientation and	domi	nates. Sealed and	open		5	XSEC	HAX	N	
type:	fract	ures.		_	8	1 311.12	E AY	//	0
Fracture comm	nent: No d	ata available.		2	9500	- 44 14 C	~	$\langle$	500
Fracture fill	Calci	te, clay minerals, o	chlorite.		669	1 111		2	669
mineralogy:	High	frequency of fracti	ures		5	1 4	X	And manner	
	with	no mineral coating	/filling.			//	$\wedge$	5 martin	-
Strike / dim	OBJE				000		/ W	-11	0000
Strike/dip:	02 /2	.3 			669				1
Lengui. Moon thickness	s: 11 m	(11 17 m)			1.1.1.1				
Max donth:	-596	<u>(11 - 17 111)</u> m			155000	160000	165000	170000	20.901
Geometrical		NE0065 ZEMA3	Topo 40m arid	Max	100000	100000	100000	110000	N
constraints:	error	20m.	ropo rom gna	max	Baseline	olume DMS		0 2 4 8	A
		-		MOD					
Zone based on	combining bo	prehole data and p	attern of surrou	unding	deformatio	on zones.			
Outcrops:	-								
Boreholes:									
		Target i	ntoroont		Coomotria	intercent			
Borehole	PD7	i arget i	Sec low		Geometric	Sec low	Comm	ent	
Borenole	I DL	Sec_up [m]	[m]	Sec	:_up [m]	[m]	Comm	CIII	
HFM04	DZ1	61.00	64.00		53.51	65.19			
HFM05	DZ1	153.00	154.00	1	45.10	157.34			
KFM02A	DZ2	110.00	122.00	1	10.40	122.22			
KFM02B	DZ1	98.00	115.00	1	04.74	116.22			
Tunnels:	-								
Lineament and	/or -								
seismic									
indications:									
			MODELLING	PRO	CEDURE				
Modelled by cor	nbining bore	nole intervals 110-	122 m (DZ2) i	n KFM	02A, 98-11	5 m (DZ1) in	KFM02B, 6	61-64 m (DZ1)	) in
HFM04 and 153	8-154 m (DZ1	) in HFM05. Defor	mation zone pl	lane m	odelled to	pass through	fixed points	s 119 m in KFl	M02A,
113 m in KFM02	2B, 62 m in H	IFM04 and 154 m	in HFM05; gen	tly dipp	oing structu	ure. Terminate	ed against Z	ZFMA3 and	
ZFMNE0065. C	rush zone an	d clay alteration p	resent at 119 n	n in KF	M02A; low	radar amplitu	ide also ob	served at 116	-121 m
in KFM02A.									

G	<b>ZFM866</b>	Version number	3 Total object CL <b>19</b>
	A line of the line	THINK BOOS	
	200 300 500 m 1 km	2 km	

	CONFIDENCE	LOTIMATE
UDJEUI	CONFIDENCE	ESTIMATE

Category	Object CL	Comment
INTERPRETATION		
Data source	2	HFM04, HFM05, KFM02A, KFM02B.
Results of interpretation	3	High confidence observation in KFM2A, HFM04, HFM05.
INFORMATION DENSITY		
Number of observation points	3	4
Distribution of observation points	2	Three-four observation points in the western part of the modelled zone contributing to relative high conf. of interpolated geometry between the obs. points. Mainly a cluster and no outlier.
INTERPOLATION		
Geometry	3	One strong alternative based on multiples sub-surface obs. points.
Geological indicators	2	Some discrepancies in the geological data or geological character.
EXTRAPOLATION		
Dip direction	2	Conceptual constraints. Constrained down dip by ZFMA3.
Strike direction	2	Conceptual constraints. Inferred truncation against ZFMA3 and ZFMNE0065.

FRACTURE CHARACTER			
Orientation: (strike/dip right- hand-rule) Frequency:	FRAC Set G: 31.0°/25.3° Boreholes: KFM02B, KFM02A FRACTURE TERZAGHI- TYPE WEIGHED P10 Open and 7.2 m-1 partly open Sealed 4.8 m-1 Sealed 0.0 % of DZ network intercept Crush 2.9 % of DZ	URE CHARACTER ZFM866 N W	
RQD:	min:71, max:100, mean:91	Equal area Lower hemisphere Unassigned (95) Set G (61) Δ Mean pole Set G (301.0/64.7) Fisher κ = 10.8	




G		ZFM	871		Version	number	3	Total object CL	22
GE	OLOGICAL CH	IARACTER		Property					
Deformation st	yle: Brittle			3	00001			~	0000
Deformation	No data	a available.			671	8	ST.	The month	671
description:					1. 3	2	X		-
- First order:	Oxidati	on			00	21	1	121-5	1 8
- Second order	r: Argilliza	ation		3	6705	M	1 -	A A A	57050
- Third order:	Chloriti	zation			- 2	1	N	THA ST	
Fracture	No orie	nted fracture da	ta are		0 {	16	X	ATTA VE	
type:	denera	llv include the	reports		2 000	X		AV 13	0000
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	descrip	tion of two domi	nantly		67			KU V	67
	gently o	dipping fracture :	sets as			X	SU	MY I	
	frequer	ncy of steeply dig	ping		2000	141		N	5000
	fracture	es.		2	699	1	24	X	669
Fracture comm	ent: No data	a available.		2	1.1		10X		1
Fracture fill mineralogy:	clay m	inerais, chiorite a dominate.	and		00	/	$\mathbf{X}$	A second	8
	Hemati	te/adularia, laum	nontite,		0699		~		90690
	epidote	e, pyrite and qua	rtz are						
	frequer	esent. Note also	vith no		155000	160000	) 16	5000 170000	984
	mineral	l coating/filling.			- Model	volume DMS		0 2 4 8	Ň
Otaillas (alias	OBJECT	GEOMETRY			Baselli	ne		<ul> <li>We have been as a property of the second seco</li></ul>	
Strike/dip:	76°/19°								
Mean thickness	s: 20 m (1	I - 22 m)			-				
Max depth:	-278 m	•							
Geometrical	ZFMWI	NW1035, ZFMN	W0805A,						
constraints:	ZEMIN	V0805B, ZFIVINI VE3115. Topo 40	n∈0869, )m arid Ma	x error					
	20m.		Jin gina ma						
	050 / 11 /	<u> </u>	BASIS F	OR MOD	ELLING				
surface. No inte	rsection with th	e ground surfact	orenoies. I e.	nere is no	correspon	iding magi	netic line	ament at the ground	
Outcrops:	-								
Boreholes:									
		Target i	ntercept		Geometric	; intercep	t		
Borehole	PDZ	Sec up [m]	Sec_lo	W Sec	սոլալ	Sec_lo	w C	omment	
KED00	D72	444.00	[m]	- 4	_up []	[m]	<b>F</b>		
KFR02	DZ3	81.86	95.95		09.16 78.32	99.72	5 >		
KFR04		91.00	100.00	) {	34.50	100.4	9 or fil bi (1 in	either of the SHI terpreted possible I FR04 correlate with FM871. However, the re planar chlorite fille actures from 86 m hwards and some cl led fractures toward ase of the hole that the associated with the 00.5 m). A target tercept is defined at	DZs in here ed ay s the could e zone
KFR05	DZ1	85.00	87.90		76.53	96.27	7	50 m.	
KFR12	DZ1	21.25	31.50		14.74	36.79	9		
KFR13 KFR21	DZ4	61.00 -	00.80 -	1	08.57	74.99 129.2	9 6 N	o SHI available	
KFR22		-	-	1	39.98	160.1	0 N	o SHI available.	
KFR23		-	-	8	32.68	105.9	5 N	o SHI available.	
KFR31	DZ2	228.76	232.00	) 2	17.28	242.1	0		
KER32	DZ2	163.10	186.10	<u>ן 1</u>	01.72 58.02	186.2	0 N	o SHI available	
KFR37	DZ2	183.43	193.60	) 1	71.82	200.8	9		
KFR57	DZ1	15.85	25.38		6.04	25.38	3		

G		ZFM	871	Version	number	3 Total	object CL	22	-
KFR7A	DZ1	-	-	0.00	11.25	No geom the boreh the mode is interpre dominate ZFMNW0 brittle du deformat core. No ZFM871	etrical Sec_ ole not pene iled surface ted as bein d by 0805A and 0805B due to ctile style of ion seen in t target interc is defined.	low as etrates s. DZ1 g o the he ept for	
KFR7B	DZ1	0.00	17.00	0.00	20.39				1
KFR7C	DZ1	6.00	32.00	5.91	32.74				1
KFR80		-	-	0.00	12.92	No SHI a	vailable.		
KFR83		-	-	5.50	20.00	No SHI a	vailable.		1
KFR87		-	-	0.00	15.10	No SHI a	vailable.		1
KFR88		-	-	0.00	29.99	No SHI a	vailable.		1
Tunnels:	NB1	target intercept 0-	-405 - 0+432 m,	geometric inter	cept 0+380 - (	)+432 m.		1	
Lineament and	/or -								
indicationa									
indications.			MODELLING	PROCEDURE					-
Modelling proce et al. (2011). Mo and ZFMENE31 to ground surface	dure and pro odification ma 15 (only in S ce. Proposed	perties inherited fi ade so as to termir FR model), i.e. no here as an alterna	rom updated gen nate against ZFM t terminated aga ative model for 2	ological model f MNW0002, ZFM ainst ZFMNNE0 ZFM871.	or SFR as pre IWNW1035, Z 869 as in Curt	sented in Ap FMNW0805A tis et al. (201	oendix 11 in , ZFMNW08 1) but contin	Curtis 805B lued up	
ZENIE10 ZENIENE ZENIEN	54 E8031	KFR38 R09 KFR38	KFR22 KFR22 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR27 KFR26 KFR27	ACCOUNTS AND A STATE OF A STATE O	101			c	

G	Z	FM871		Version number	3	Total object CL	22				
<b>OBJECT CONFIDEN</b>	CE ESTIMATE										
Category		Object CL	Comment								
					KEDOA		<b>D</b> 05				
Data source		3	KFR22, KFR KFR12, KFR KFR7C, KFF and tDZ104,	23, KFR02, KFR03, 233, KFR13, KFR83, 280, KFR7A, KFR87 Outcrops 400 m NN	KFR31, KFR21, , KFR88, IE of the	KFR04, KFR32, KF KFR37, KFR57, KF tDZ101, tDZ102, tE silo.	R05, R7B, )Z103				
Results of interpre	etation	3	High confide tunnels.	nce observations in	multiple I	poreholes and SFR					
INFORMATION DEI	NSITY										
Number of observ	ation points	3	>4								
Distribution of obs	servation points	3	Even distribu	ution of obs. points.							
INTERPOLATION			_								
Geometry		3	One strong a	alternative based on	tunnel ar	nd borehole data.					
Geological indicat	tors	3	Interpolation	supported by data f	rom bore	holes and tunnels.					
EXTRAPOLATION				· · · <del>·</del> · ·							
Dip direction		2	Conceptual constraints. Truncated against ZFMWNW1035, ZFMNW0805A, ZFMNW0805B, ZFMNNE0869, ZFMENE3115.								
Strike direction		2	Conceptual ZFMNW080	constraints. Truncate 5A, ZFMNW0805B,	ed agains ZFMNNE	t ZFMWNW1035, 0869, ZFMENE311	5.				
		FRA		ACTER							
Orientation:											
(strike/dip right- hand-rule)											
Frequency:	Boreholes: KFR	13, KFR7B,									
	KFR03, KFR83,	KFR23,									
	KFR12, KFR7A	, KFR05,									
	KFR87, KFR02,	KFR57,									
	KFR31, KFR88,	KFR37,									
	KFR33, KFR04,	KFR80,									
	KFR32, KFR22,	KFR7C,									
	KFK21										
	EDACTURE	TEDZACHI	1								
	TVDE	WEIGHED									
		P10									
	Open and	2.7 m-1									
	partly open	2.7									
	Sealed	0.0 m-1									
	Sealed	0.0 % of DZ									
	network	intercept									
	Crush	1.4 % of DZ									
		intercept									
RQD:	min:13, max:10	0, mean:67									
Fracture fill	VE	004/01 0 100 0	VED10/61 0 60 01	VED74/0 0 11 35) VED3	0 0 17 0	KED7C/C 0 22 0					
mineralogy:	Kr	R04(91.0-100.0),	KFR13(61.0-68.0)	, KFR7A(U.U-11.25), KFR7	в(0,0-17.0,	, KFR7C(0.0-32.0)	-				
	300 -					Open and partly ope	20				
						- Scaled	-				
	se 250 -										
	u 200 -										
	ccu										
	5 150 -										
	uper uper			-							
	5 100 -										
	50 -										
							4				
	0	0 0 16			e 4	0 6 X 5					
	Aulana Cal	thome inerals of	or main Houde of	we were awall and other of	Quarte et	of allide meet alligon					
	AP C	Lat. a	He otho Jaun	alt Mit uditer Pro	- 9	own with the					
			The sec	b. 0,		Jut M.					
			OPEL								
			42.								

G	ZFM871	Version number 3 Total object CL 22
	INDIVIDU	JAL INTERCEPTS
KFR02 DZ3 (114.8-	124.45 m)	
KER03 DZ4 (81 86-	95 95 m)	
No data available	55.55 m)	
KFR04 (91.0-100.0	m)	
Elevation m.a.s.l.		ROD reversed 100 = 0 Fracture Fracture Open
Length (m, Open (m) RH2000) fracture	Sealed Open total Sealed total Total Cri s fractures fractures fractures 2	rushed Sealed low value open frac sealed frac aperture Core zone network = high value orientation orientation (mm) loss
0 2	0 0 20 0 20 0 20 0 20	0 100 0 90 0 90 0 10
92 -166		20
93 -167 -		84.0
95 -169		71.0
96 -170 -		99.0
97 -171 -		95.0
99 -173		100.0
KER05 DZ1 (85 0-8	7 9 m)	
No data available		
KFR12 DZ1 (21.25-	31.5 m)	
No data available	·	
KFR13 DZ4 (61.0-6 Flevation	8.0 m)	ROD reversed
m.a.s.l. Length (m, Open	Sealed Open total Sealed total Total Cr	100 = 0 Fracture Fracture Open rushed Sealed low value open frac sealed frac aperture Core
(m) RH2000) fracture	s fractures fractures fractures <sup>2</sup>	zone network = high value orientation orientation (mm) loss
195		
63186		77.0
64187		73.0 73.0
65 -188		97.0
67190 -		79.0
KED21 /108 57-120	26 m)	
No data available	5.20 mj	
KFR22 (139.98-160	0.1 m)	
No data available		
KFR23 (82.68-105.	95 m)	
No data available	-232 0 m)	
No data available	-232.0 111)	
KFR32 DZ2 (163.1-	186.1 m)	
No data available		
KFR33 (158.02-167	7.0 m)	
NO data available	-193 6 m)	
No data available	-199.0 m)	
KFR57 DZ1 (15.85-	25.38 m)	
No data available		
KFR7A DZ1 (0.0-11	.25 m)	POD reversed
m.a.s.l. Length (m, Open	Sealed Open total Sealed total Total Cri	100 = 0 Fracture Fracture Open rushed Sealed low value open frac sealed frac aperture Core
(m) RH2000) fracture	s fractures fractures fractures 2	zone network = high value orientation orientation (mm) loss
1		47.0
3		95.0
4		70.0
5		80.0
7		87.0
8	26	100.0
9		66.5
10		72.0

	G				ZFM8	371		Version number 3 Total object CL				22		
KFR7	B DZ1 Elevation	(0.0-17.	0 m)						RQD reversed	(Martine)		2000	0.5	
Length (m)	m.a.s.l. (m, RH2000)	Open fractures	Sealed	Open total	Sealed total	Total	Crushed	Sealed	100 = 0 low value = high value	Fracture open frac orientation	s	Fracture ealed frac	Open aperture (mm)	Core
		0 20	0 20	0 20	0 20	0 20			0 100 0	9	0 0	90	0 10	
	174			23	1	23					1		Preser	1
1	-134								52.0					
3	-136								32.0					
4	-137			-		_	-		39.0					
5	-138						1		48.0					
6	-139								53.0					
7	-140								93.0					
8	-141								85.0					
9	-142								60.5					
10	-143								66.0					
11	-144								56.0					
13	-145								13.0					
14	-146					_			18.0					
15	-147	1		23		23		1.0	75.0					
16	-148					-			56.0					
KEP7	C D71	(6 0-32 (	) m)			1			34.0					
KI KA	Elevation	(0.0-52.0	, iii)						ROD reversed					
Length	m.a.s.l. (m,	Open	Sealed	Open total	Sealed total	Total	Crushed	Sealed	100 = 0 low value	Fracture open frac	s	Fracture ealed frac	Open	Core
(m)	RH2000)	fractures	fractures	fractures	fractures	fractures	zone	network	= high value	orientation	٥	rientation	(mm)	loss
r	-139	0 20	0 20	0 20	0 20	0 20	1		0 100 0	9	0 0	90	0 10	_
7	-140					-			57.0					
8	-141					1.1			78.0					
9	142						-		58.5					
10	-143			-					46.5					
11	-144	-							52.0					
12	-145								38.0					
14	-146								72.0					
15	-147								59.0					
16	-148						10.0		51.0					
17	-149								63.0					
18	-150				C				77.0					
19	-151					1.			63.0					
20	-152				-				70.0					
21	-153								34.0					
22	-154								71.0					
23	-155	1							98.0					
25	-156								100.0					
26	-157	1							100.0					
27	-158								51.0					
28	-159	1							59.0					
29	167								73.0					
30	-101								65.0					
31	-162								53.0					
KFR8	) (0.0-	12.92 m	)											
No dat	a avail	able	-											
KFR8	3 (5.5-	20.0 m)												
No dat	ta avail	able						-						
KFR8	7 (0.0-	15.1 m)												
No dat	ta avail	able												
KFR8	3 (0.0-	29.99 m	)											
No dat	ta avail	able												

G	ZFMA1		Version number	3	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	165	000 170000	
Deformation style:	Brittle					
Deformation	No data available	2	000			0000
description:	No data avaliable.		0210	5	$\sim$	3710
Alteration:					VI ME	
- First order:	Not observed	-	$\sim$	/	2 1 2 1	
- Second order:	Not observed	-	8 7			28
- Third order:	Not observed	-	~~~ <u>105</u>			70507
Fracture orientation and	No data available		io R	1./	HA Z	
type:	No data avaliable.		3.	$\nabla$	ALLA	5
Fracture comment:	No data available	-	8	T		0
Fracture fill mineralogy:	No data available	-	5 6		XIIIS	000
OBJE	CT GEOMETRY		29 2 62		WI V	67(
Strike/dip:	84°/45°			20XID	SX /	
Length:	-			X	AV7	-
Mean thickness:	40 m (9 - 45 m)		1 1 200	M~		2000
Max depth:	-2100 m		699	211	X	669
Geometrical	ZFMWNW0001. ZFMNW	/0017.		14V	the man	
constraints:	ZFMNE0810.	,	NA N		1 7	
			00	X	Went	000
			690			20069
			ō			00
						-
			155000 160000	165	000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		& Land Hallowine, Counterpartment Ann	A
	BASI	IS FOR MOD				
Corresponds to seismic refl	ector A1/A0 Jublin et al. (2)	(02) the pos	ition of which in 3D s	nace has	been attained from	Cosma
et al. (2003).		002), illo poo		puoo nac		Cooma
ot all (2000).						
Outcrops:	-					
Boreholes: -	·					
Tunnels:	-					
Lineament and/or	A1/A0.					2
seismic indications:						2
	MODE	LLING PRO	CEDURE			
Corresponds to seismic refl	ector A1/A0, the position of	which in 3D	space has been atta	lined from	n Cosma et al. (2003	3).
Mandalla da da basa at da				11111001		A
Modelled to the base of the	model volume with termina	alion against	ZFMWNW0001, ZFN	/NW0017	and ZFMENE0810	. An
Modelled to the base of the alternative interpretation of bedroek inside rock demain	the seismic reflector A1/A0	is that it is re	ZFMWNW0001, ZFN elated, wholly or partl	/NW0017 ly, to com	and ZFMENE0810 positional variations	. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or partl	/NW0017 ly, to com	and ZFMENE0810 positional variations	). An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	/NW0017 ly, to com	and ZFMENE0810	o. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or part	/INW0017 ly, to com	and ZFMENE0810	9. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	ANW0017 ly, to com	and ZFMENE0810	9. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	/INW0017	and ZFMENE0810	o. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	/INW0017 ly, to com	and ZFMENE0810	. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	is that it is re	ZFMWNW0001, ZFM elated, wholly or parti	/INW0017 ly, to com	and ZFMENE0810 positional variations	. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	The seismic reflector A1/A0 RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	/INW0017 y, to com	and ZFMENE0810 positional variations	. An s in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	EFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or partil	ANW0017 y, to com	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or partil	ANW0017 by, to com	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	is that it is re	ZFMWNW0001, ZFN elated, wholly or partil	ANW0017 by, to com	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	RFM032.	autori against is that it is re	ZFMWNW0001, ZFN elated, wholly or partil	ANW0017 by, to com	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFN elated, wholly or partil	ANW0017 by, to com	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFM elated, wholly or partil	ANW0017 by, to com	and ZFMENE0810 positional variations	An as in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFM elated, wholly or parti	ANW0017 by, to com	and ZFMENE0810 positional variations	An as in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	aloh aganst is that it is re	ZFMWNW0001, ZFM elated, wholly or parti	ANW0017 by, to com	and ZFMENE0810 positional variations	An as in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFM elated, wholly or parti	ANW0017 by, to com	and ZFMENE0810 positional variations	An as in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	aloh aganst is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	ZFMA1	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	ANW0017 by, to com	and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	ANW0017 by, to com	r and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is re	ZFMWNW0001, ZFN elated, wholly or parti	ANW0017 by, to com	r and ZFMENE0810 positional variations	An as in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termination terminatinter termination termination termination termination terminatio	and against is that it is re	ZFMWNW0001, ZFM blated, wholly or partil	ANW0017 by, to com	r and ZFMENE0810 positional variations	An a in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termination terminatinter termination termination termination termination terminatio	and against is that it is re	ZFMWNW0001, ZFM elated, wholly or parti	ANW0017 by, to com	r and ZFMENE0810 positional variations	An as in the
Modelled to the base of the alternative interpretation of bedrock inside rock domain	model volume with termina the seismic reflector A1/A0 RFM032.	and against is that it is ne	ZFMWNW0001, ZFM elated, wholly or parti	ANW0017 y, to com	r and ZFMENE0810 positional variations	An as in the

G		ZFMA1		Version number	3	Total object CL	10			
<b>OBJECT CONFIDENCE ES</b>	TIMATE									
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	A1							
Results of interpretation		2	Medium cor	nfidence in seismic r	eflector A	A1.				
INFORMATION DENSITY										
Number of observation p	points	1	1							
Distribution of observation	on points	1	Single observation point in the form of a seismic reflector.							
INTERPOLATION	•									
Geometry		1	Geometry supported by surface geophysical data.							
Geological indicators		1	Indirect sup	port by geophysical	data.					
EXTRAPOLATION										
Dip direction			Modelled ar	nd extrapolated base	ed on info	ormation from seismi	С			
		1	reflector A1	. '						
Strike direction		0	Conceptual	constraints. Trunca	ted again	st ZFMWNW0001,				
		2	ZFMNW00	ZFMNW0017, ZFMNE0810.						
	FRACTURE CHARACTER									
			No data available							
INDIVIDUAL INTERCEPTS										
			No data avail	able						

G		ZFM	A2			Version	number	4	Total object CL	21	
GEOLOG	SICAL CH	ARACTER		Prope CL	erty	155,000	160000	) 165	000 170000		
Deformation style:	Brittle			3		8				8	
Deformation description:	Evidence dip-slip sinistral and rev respect interval frequen breccia.	ce show strike sli components with dextral and non- erse movements ively. Fault core s with elevated fr cy, cohesive /cataclasite and o	p and n mal racture crush			6705000 67100	z	5	A Com	6705000 671030	
Alteration:	201100.					2000	the design of the second secon	AAX	XIII 3	0000	
- First order:	Oxidatio	on		2		670	IHE		WY / V	670	
- Second order:	Quartz	dissolution		5			KAR				
- Third order: Fracture orientation and type:	Carbon Three fi conspic fracture dipping Open a Quantit span in	atization racture sets are suous, a gently-di e set and steeply- NE and NW sets nd sealed fractur ative estimate an clude a crush zoi	ipping s. res. nd ne and	2		665000 6695000				6690000 6695000	
Fracture comment:	No data	available	ö.	3				1.5.6.7			
Fracture fill	Chlorite	e, calcite,				155000	160000	165	000 170000	N	
mineralogy:	hematit clay mir quartz. fracture coating	e/adularia, prehn herals, laumontite Note high freque s with no minera /filling in KFM02/	hite, e, ency of I A.			Baselin	volume DMS ie		9 2 4 9 Frankright Coste annexed	A	
<b>A</b>	OBJECT	GEOMETRY									
Strike/dip:	82°/24°										
Mean thickness:	34 m (2	0 - 50 m)									
Max depth:	-576 m										
Geometrical	Topo 40	Om grid Max erro	r 20m,								
constraints:	ZFMNV	V0017, ZFMA3, Z	ZFMF1,	Trunc_A	\2.						
Based on intersection	s along th	e boreholes and	around	and bor	ehole	e reflection	n seismic (	data (seis	mic reflector A2).		
			3						,		
Outcrops:	-										
Boreholes:											
		Target in	tercept		Ģ	Geometric	: intercep	t			
Borehole	PDZ	Sec_up [m]	Sec_l	low	Sec	_up [m]	Sec_lo	w C	omment		
HFM01	D71	35.00	44 0	00	2	21.00	55.11	1			
HFM02	DZ1	42.00	47.0	00	(	6.41	44.60	)			
HFM03		-	-		(	6.85	26.00	Ac m cr 0 15 No im all	cording to the geole apping two gently d ush/fracture zones a 5.5-15.8 and 21.1-2 <sup>-</sup> ordman 2003), but t age quality is too lo ow interpretation.	ogical ipping at 1.2 (cf. he ow to	
HFM14	DZ1	68.00	76.0	00	9	7.06	134.5	7	•		
HFM14	DZ2	92.00	104.0	00	9	7.06	134.5	7	M45 and 00		
HFM15	DZ1	86.00	96.0	00		-	-	ZF int sp	M15 ends 20 m ab MA2. The target ercept is inferred to lay to ZFMA2.	o be a	
	DZ1 D72	121.00	148.0	00	10	00.05	185.1	9 0			
HFM27	DZ2	26.00	30.0	00		4.40	40.5	3			
KFM01A	DZ1	Z1 29.00 51.0		00	3	6.89	71.74	29 1 ac St	-36 m and 48-51 m Ided (cf. Table 3-2 i ephens et al. 2007)	n	
KFM01B	01B DZ1 16.00 6		64.0	00	3	3.50	70.22	2 53	n Stephens et al. 20	able 3- 007).	
KFM01C	DZ1 23.00 4		48.0	00	) 73		73.21 138.55				

G		ZFM	A2	Version	number	4	Total object CL	21
KFM01C	DZ2	62.00	99.00	73.21	138.55	Z	FMENE1192A also	
KFM01D		68.00	68.00	37.04	37.04 75.23 fra bo as fra en 1B		No mapping or borenole image available for the interval. According to the drilling report (Claesson al. 2007) an unstable, fractured section at 68 m borehole length, interpre as the same gently dippi fracture zone as was encountered in KFM01A 1B and 1C.	
KFM02A	DZ6	417.00	442.00	416.70	455.79			
KFM02B	DZ3	202.00	242.00	227.89	265.29	2 3 2 r	13-232 m added (cf. -2 in Stephens et al. 007). DZ2 and DZ3 nerged.	Table
KFM04A	DZ3	202.00	242.00	227.89	265.29	2 3 2 r	13-232 m added (cf. -2 in Stephens et al. 2007). DZ2 and DZ3 nerged.	Table
KFM05A	DZ1	102.00	114.00	95.23	138.41			
KFM10A KFM10A	DZ2 DZ3	430.00	449.00	475.01	500.11			
Lineament and seismic indications:	/or A2.		MODELLING	PROCEDURE				2
Modelling takes 64 m in KFM011 at 85 m (DZ1, a point at 413 m ( fixed point at 10 Zone ZFMA2 al: DZ2), HFM27 (I close to and stri intersections clo KFM04A and 48 strike against ZI	account of: 1) ( 3 with fixed poin nd DZ2), 417-4 DZ3), 202-242 (2 m in KFM05A so intersects pe DZ1) and KFM0 kes subparallel se to the surfac 33-488 m in KFI FMNW0017 and	Ground and bor nt at 40 m (DZ1 42 m in KFM02, m in KFM04A w (DZ1), and 43( prcussion borehole to the borehole ce. Low radar and M10A. Modelled d ZFMA3.	ehole reflection and extension a A with fixed point at fixed point at 0-449 m and 478 oles HFM01 (DZ (DZ1). Probable , and with fractu mplitudes also o I so as to splay f	seismic data. 2 tt 53-64 m), 23- t at 423 m (part 234 m (DZ2 ar 3-490 m in KFW (1), HFM14 (DZ interference in ring related to s bserved, for ex- rom ZFMF1 at	) Intersection 48 m and 62 t of DZ6), 41 nd extension 110A with fixe 1 and DZ2), KFM04A with stress-releas, ample, at 38- depth up to t	ns alor -99 m 213-2 ed poir HFM1 h ZFM e proc -42 m he sur	g the borehole intervin KFM01C with fixe m in KFM02B with fixe m in KFM02B with fi 32 m, DZ3), 102-114 ht at 485 m (DZ2 and 5 (DZ1), HFM19 (DZ NE1188, which is sit esses along the bore in KFM01B, 232-242 face, and to terminal	vals 16- d point xed 4 m with d DZ3). Z1 and cuated ehole 2 m in te along

G	2	ZFMA2	Version number 4 Total object CL								
OBJECT CONFIDEN	CE ESTIMATE										
		-									
Category		Object CL	Comment								
INTERPRETATION											
Data source		2	A2, HFM01, KFM01A, KF KFM04A, KF	HFM02, HFM03, H M01B, KFM01C, K M05A, KFM10A	FM04, HF FM01D, K	M14, HFM19, HFN FM02A, KFM02B,	127,				
Results of interpre	etation	3	High confide	nce observations in	multiple b	oreholes.					
INFORMATION DEM	NSITY										
Number of observ	ation points	3	>4								
Distribution of obs	ervation points	3	Majority of th two drill hole modelled zon western part however the m towards th group of clus	the drill holes are place s (KFM02A and KFI ne. The sub-surface is higher from the c distance is > 1400n he east. This constel stered obs. points ar	ced in the M02B) in t information entral par n. The zor lation can ad the line	westernmost part a he central area of t on density from mo- t of the modelled zo he is extrapolated c be considered as t ament as an outlier	and he st one . 1500 wo				
INTERPOLATION			group of olde								
Geometry		3	One strong a	alternative based on	available	sub-surface observ	ation/				
Geological indicat	ors	3	Interpolation	supported by key g	eological	parameters, foremo	ost				
EXTRAPOLATION											
Dip direction		2	Conceptual constraints. Inferred truncation against surrounding steeply dipping and gently dipping zones ZFMNW0017, ZFMA3, ZFMF1.								
Strike direction		Conceptual of steeply dippi ZFMF1.	Conceptual constraints. Inferred truncation against surrounding steeply dipping and gently dipping zones ZFMNW0017, ZFMA3, ZFMF1.								
Orientetien	Cat C: 40.49/40	FRAG	STURE CHAR	ACTER							
(strike/dip right-	Set G. 12.4712	.4		ZF	MA2						
hand-rule)				1 miles							
Frequency:	Boreholes: KFM KFM01A, KFM0 KFM01B, KFM1 KFM02B, KFM0 FRACTURE TYPE Open and partly open Sealed Sealed network Crush	102A, 11C, KFM04A, 0A, KFM01D, 15A TERZAGHI- WEIGHED P10 8.5 m-1 8.8 m-1 7.5 % of DZ intercept 1.4 % of DZ intercept	W- Unass Set G	igned (616) (317)	n pole Set G	Equal Lower hemisp	area hhere				
ROD	min:14 max:10	0 mean .85									
NQU.	11111.14, IIIax.10	u, mean.00									



















	G				ZFM	A2		Version number <b>4</b> Total object Cl			object CL	21	
KFM0 Length (m)	5A DZ1 Elevation m.a.s.l. (m, RH2000)	Open fractures 0 20	-114.0 Sealec fracture	Dpen tota s fractures	Sealed total fractures 0 20	Total fractures 0 20	Crushed zone	Sealed network	RQD reversed 100 = 0 low value = high value 0 100 0	Fracture open frac orientation 90	Fracture sealed frac orientation	Open aperture (mm) 0 0 10	Core loss
103 104 105 106 107 108 109 110 111 112 113	-83 -84 -85 -86 -87 -88 -89 -90 -91 -91 -92	E		F					90.6 93.5 82.8 100.0 59.2 80.0 100.0 78.8 79.8 72.0 98.0		1 1 1 1 1	et	C





G		ZFM	A3		Version	number	3	Total object CL	20
GEOLO	GICAL CH	IARACTER		Propert CI	<b>y</b> 155000	160000	) 16	5000 170000	
Deformation style:	Brittle			3	9				0
Deformation	Dip-slip	reverse faults ir	1	<b>.</b>	000			m	000
description:	possibl	e coniugate syst	em.		671	5	V P	The second	671
	Oblique	e to strike-slip str	iae			<	V		2. 1
	present	t on faults with th	ne		al and a	$\sim$		1211	2
	same s	trike.			000	5	-1	/ XI K	× 00
Alteration:					5705	M	1 -	A M M	10507
- First order:	Oxidati	on		2	- R		1	THILS	reaction 14
- Second order:	Quartz	dissolution		2	2	11		AHA N	3
- Third order:	Not obs	served			8 { \		XAX		5 8
Fracture	Gently	dipping fractures	s with		2 00	X		XV/ VS	000
orientation and	variable	e orientation			67	IKE		HIV	67
type:	domina	tes. Sealed and	open			KAR	20	XX/	
	fracture	es. Quantitative				0016	S	AV7	0
	estimat	e and span inclu	ıde		200	4 /4-	Mrs<		5000
	crush z	one and fracture	)		699	1	A	XI	699
	networl	KS.		2			H V	the same	
Fracture comment	: No data	a available.						2 7 incare	
Fracture fill	Calcite,	, chlorite, quartz,			000		$\langle \times \rangle$	hard	000
mineralogy:	hematit	te/adularia, pyrite	e, clay		050		~ \		10060
	mineral	ls, prehnite. Note	e high		0				Ø
	frequer	ncy of fractures v	vith no						22.50
	mineral	coating/filling.			155000	160000	) 16	5000 170000	
<b>0</b> ( )) ( ))	OBJECT	GEOMETRY			Model	volume DMS		0 2 4 8	Ň
Strike/dip:	49%/22%	,			Baselin	c		S Laitmiteret, Goldcourserius	N
Length:	3196 m	)  1 50 m)							
Mean thickness:	23 m (1	n - 58 m)							
Max depth:	-10001			)					
Geometrical		NVVU123, ZFIVIVV		о,					
constraints.		11100001, ZFIVINI	0m arid I	Max arror					
	20m	100023, 10p0 4	un giu i						
	20111.		BASIS	FOR MO					
Corresponds to seis	mic reflecte	or A3, the positio	on of which	ch in 3D s	pace has bee	en attained	from Co	osma et al. (2003).	
Supported by boreh	ole observa	ations.						()	
,									
Outcrops:	-								
Boreholes:									
		Target i	atorcont		Geometric	intorcon	+		
Borehole	PD7	raigern	Sec	low	Ocometric	Sec la		omment	
Derenere		Sec_up [m]	_000_ [m		ec_up [m]	[m]			
HFM04	DZ2	183.00	187	00	181.35	209.9	)1		
HFM29		-	-		191.65	199.7	0		
KFM02A	DZ3	160.00	184.	00	159.87	184.1	0		
KFM02B	DZ2	145.00	204.	00	154.92	178.3	8		
KFM03A	DZ4	803.00	816.	00	810.87	834.8	4		
Tunnels:	-								
Lineament and/or	A3.								
seismic									3
indications:				<u> </u>		<u> </u>			
			MODEL	LING PR	OCEDURE				
Corresponds to seis	mic reflecte	or A3, the positio	on of which	ch in 3D s	bace has bee	en attained	d from Co	osma et al. (2003).	
Terminated against	ZFMWNW	0001, ZFMWNW	/0023, ZF	-MWNW0	123, ZFMNN	W0823 ar	nd ZFMN	NE0828. Fixed poin	nt
intersections at 163	m along D	Z3 (160-184 m) i	in KFM02	2A, at 158	m along DZ2	2 (145-204	1 m) in K	FM02B, at 814 m al	ong DZ4
(803-816 m) in KFM	103A and at	185 m along DZ	22 (183-1	187 m) in I	HFM04. Mod	elled zone	also frin	ges on the lower pa	irt of
HFM29. Low radar a	amplitude a	lso observed at	160-184	m in KFM	02A and at 8	13-817 m	in KFM0	3A.	

G	ZFMA3	Version number 3	Total object CL <b>20</b>
27ALM	Zauderstell Development ZEMENEO169	ZFMA2	DEZA ZEMENEGORZO LIMINI
	ZFMA3	ZFMA3	25 THEN HURBOR
2.54MMMMHT 12.8	200	DE ZEMAT	5.5
	ZFMA7 0 100 200 300 500 m 1 km	2 km	N arman

	OBJECT	CONFIDENCE ESTIMATE
Category	Object CL	Comment
INTERPRETATION		
Data source	2	A3, HFM04, HFM29, KFM02A, KFM02B, KFM03A
Results of interpretation	3	High confidence observations in multiple boreholes.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	2	Two clusters and the lineament considered as an outlier.
INTERPOLATION		
Geometry		Multiple sub-surface obs. points where measurable apertures,
	3	occurrence of episynites are noted in SHI. In combination with the
		interpreted seismic reflector, indicative of one strong alternative.
Geological indicators	3	Supported by key geological parameters.
EXTRAPOLATION		
Dip direction		Conceptual constraints. Inferred truncation against surrounding
	2	steeply dipping zones ZFMWNW0001, ZFMWNW0123,
		ZFMWNW0023, ZFMNNW0823, ZFMNNE0828.
Strike direction		Conceptual constraints. Inferred truncation against surrounding
	2	steeply dipping zones ZFMWNW0001, ZFMWNW0123,
		ZFMWNW0023, ZFMNNW0823, ZFMNNE0828.









G		ZFM	A4		Version I	number	17						
GEOI		IARACTER		Property CI	155000	160000	) 16	5000 170000					
Deformation styl	Brittle			2	-				0				
Deformation description:	Dip-slip minor fa the SSI along n steeply	o movement alon ault that dips ger E. Strike-slip mov ninor fault that is dipping and strik	g ntly to vement kes		05000 6710000								
Alteration:	NO.				10 2V	1		AIN 12	67				
- First order:	Ovidati	00			2	1 1	N	THY S	1				
- First order:	Not ob	onucl		2	. { ]	112	N	XTHAN N	2				
- Third order	Not obs	served			82	m 2		XIII	000				
Fracture	Gently	dinning fractures			670	lite		MAN /	670				
orientation and type:	domina orientat fracture estimat crush z fracture	tes. Variable tion. Open and s es. Quantitative e and span inclu ones and sealed a networks.	ealed de I			6695000							
Fracture comme	ZFMA4     Version number     3     Data object U.       GEOLOGICAL CHARACTER     Property CL     11000     110000		V.	0									
Fracture fill mineralogy:	Chlorite present fracture along a fracture of fracture	e, calcite. Laumo t along steeply di ss (strike ENE) a gently dipping b. Note high frequ ures with no mino diffilion		155000	155000 160000 165000 17000 Model volume DMS Baseline								
Striko/din:	63º/25º	GEOWIETKT			-								
Length:	3650 m	<b>N</b>			-								
Moan thicknose:	26 m (1	  3 - 30 m)			-								
Max donth:	20 III (1	n - 59 m			-								
Geometrical	ZEM///	NIN/0123 7EM/N/			-								
constraints:	ZFMWI ZFMNN 20m.	NW0001, ZFMN NW0001, ZFMN NW0823, Topo 4	NE0828, 0m grid N	, ⁄lax error									
			BASIS	FOR MOD	ELLING								
Corresponds to se Supported by bore	eismic reflecto ehole observa	or A4, the positio ations.	n of whic	h in 3D spa	ce has bee	n attainec	from Co	sma et al. (2003).					
Outcrops: Boreholes:	-												
		Target in	ntercept		Geometric	intercep	t						
Borehole	PDZ	Sec_up [m]	Sec_l	ow Se	c_up [m]	Sec_lo [m]	ow C	omment					
HFM18	DZ2	36.00	49.0	0	20.49	47.02	2						
HFM26	DZ1	-	-		20.77	72.3	7						
HFM26	DZ2	60.00	95.0	0	20.77	72.3	7						
KFM03A	DZ1	356.00	399.0	00 3	361.81 390.07								
		· ·											
Tunnels: Lineament and/o seismic indications:	- or A4.								3				
			MODEL	LING PRO	CEDURE								
Corresponds to se Terminated again intersections at 38 (60-95 m) in HFM 46 m) in HFM26.	eismic reflecto st ZFMWNW0 39 m along D2 26. Low rada	or A4, the positio 0001, ZFMWNW Z1 (356-399 m) i r amplitude also	n of whic 0023, ZF n KFM03 observed	h in 3D spa MWNW012 A, at 46 m d at 386-390	ce has bee 3, ZFMNN along DZ2 ) m along D	n attainec W0823 ar (36-49 m) 0Z1 in KFN	I from Co nd ZFMNI in HFM1 M03A. Zo	sma et al. (2003). NE0828. Fixed poir 8 and at 70 m alon ne also intersects [	nt g DZ2 DZ1 (12-				



Category	Object CL	Comment						
INTERPRETATION								
Data source	2	A4,HFM18, HFM26, KFM03A						
Results of interpretation	3	High confidence observations in KFM03A.						
INFORMATION DENSITY								
Number of observation points	2	3						
Distribution of observation points	2	Two clusters and the lineament considered as an outlier.						
INTERPOLATION								
Geometry	2	Low data quality from percussion drill holes do not allow strong correlation with cored boreholes						
Geological indicators	2	Some discrepancies in the geological data.						
EXTRAPOLATION								
Dip direction	2	Conceptual constraints. Inferred truncation against surrounding steeply dipping zones ZFMWNW0001, ZFMWNW0123, ZFMWNW0023, ZFMNNW0823, ZFMNNE0828.						
Strike direction	2	Conceptual constraints. Inferred truncation against surrounding steeply dipping zones ZFMWNW0001, ZFMWNW0123, ZFMWNW0023, ZFMNNW0823, ZFMNNE0828.						

	FRAC	FURE CHARACTER
Orientation: (strike/dip right- hand-rule)	Set G: 333.7°/5.1°	ZFMA4
Frequency:	Boreholes: KFM03A	
	TYPE WEIGHED P10	
	Open and 2.7 m-1 partly open	
	Sealed 0.0 % of DZ network intercept	W-
	Crush 0.4 % of DZ intercept	$\mathbf{h}$
		Equal area
		<ul> <li>Unassigned (82)</li> <li>Set G (71)</li> <li>Δ Mean pole Set G (243.7/84.9) Fisher κ = 6.5</li> </ul>

ZFMA4	Version number	<b>B</b> Total object CL <b>17</b>
min:3, max:100, mean:94		
	KFM03A(356.0-399.0)	
60 50 50 40 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Envirant Orange state reader	Open and partly open Sealed
	EFMA4 min:3, max:100, mean:94	ZFMA4     Version number     C       min:3, max:100, mean:94     KFM03A(356.0-399.0)     Image: Comparison of the second se

	G ZFMA4						Ve	ersion nu	umt	ber	Tot	Total object CL									
										IND	IVI	DUAL IN	ITERCE	PTS				•			
HFM1	3 DZ2 (	36.0	-49.	.0 m	1)																
Length (m)	Elevation m.a.s.l. (m, RH2000)	Op fract	en ures	Se frac	aled tures	Open fract	total	Seale frac	d total	Tot fracti	al ures	Crushed zone	Sealed network	RQD reverse 100 = 0 low value = high valu	ed	Fractur open fra orientati	e ac on	Fracture sealed fra orientatio	ac on	Open aperture (mm)	Core loss
		0	20	0	20	0	20	0	20	0	20			0 100	0 0		90 (	)	90	0 10	
37	-26					12.2			-							-			-		
38														100.0		5		-		-	
20										-				100.0			100				
	-28													98.3							
40	-29 -													100.0	I.						
	-30									<b>1</b>	- 1			100.0	1					-	
42	-31										. 1			100.0						*	
43		·												99.6		-	•				
44	-32							1	_					100.0		S	-		-		
45	-33													100.0		~		100	~		
46	-34								• • •				1.0	100.0				1			
47	-35													95.7		4					
48				1					-					96.5		14		A.L.			






G		ZFM	A5		Version n	umber	3 Total object CL	18
GEOLO	GICAL CI	HARACTER	I	Property	155000 160000 165000 170000			
Deformation style:	Brittle			2	9			0
Deformation	No cor	nplementary data	a	_				1000
description:	availat	ble.			67	NI	All mon	67
Alteration:					1. 1.	~		3
- First order:	Oxidat	ion		2	8	2	11621	2 0
- Second order:	Not ob	served		_	~ 0200	A	XVVV	5000
- Third order:	Not ob	served			10 5V	1 1	THIN V	5
orientation and	domina	ates Variable	<b>,</b>		2	4,4	X ALLA	de la
type:	orienta	ition. No mean va	alue		8 { /	The	SS/17/2	3 8
	estima	ted. Dominated b	by 🛛		2000			5 000
	sealed	followed by oper	n and		6	1 See	AN V	67
	partly of	open fractures.		2	$\langle \rangle$	KANA		
Fracture comment:	No dat	a available.	inerele		8	1 Miles		8
mineralogy:	Quartz	and prehnite alo	inerais.		6950	1 Ch	TX S	6950
milleralogy.	more s	teeply dipping	''9		9	1 11	XX -	00
	fractur	es.					~ 73	÷ .
	OBJEC	I GEOMETRY			000		1 hours	00
Strike/dip:	77°/31	0			0599	$\sim$		1069
Length:	2842 n	n 5 10 m)						G
Mean thickness:	16 m (	<u>5 - 16 M)</u> m			155000	160000	105000 170000	20.000
Geometrical	-1219 ZEMW	7EMW/NW/0023 7EMNNE0828				160000	105000 170000	N
constraints:	constraints: ZFMNNW0823, Topo 40m grid M			ax error	Baseline	lume DMS	0 2 4	A m
	20m.							
			BASIS F	OR MOD	ELLING			
Corresponds to seis	mic reflect	or A5, the positio	on of which	in 3D spa	ce has beei	n attained fror	n Cosma et al. (2003).	
Supported by borend	Die observ	ations.						
Outcrops:	-							
Boreholes:								
		Target in	itercent		Geometric	intercent		
Borehole	PDZ		Sec lov	w		Sec low	Comment	
		Sec_up [m]	[m]	Sec	:_up [m]	[m]		
HFM06	DZ1	61.00	71.00		54.33	72.27		
HFM08	DZ1	136.00	141.00	) 1	20.28	139.45		
							No mapping or bor	ehole
							interval According	to the
KFM03A		60.00	62.00		20.80	39.22	drilling report (Clae	sson
							and Nilsson 2004)	a flat-
							dipping fracture zor	ne at
							about 60-62 m.	
KFM03B	DZ1	24.00	42.00		23.76	42.26		
Tunnels:	-							
Lineament and/or	A5.							
seismic								3
indications:								
			MODELL	ING PRO	CEDURE			
Corresponds to seis	mic reflect	or A5, the positio	on of which	in 3D spa	ce has beer	n attained from	n Cosma et al. (2003).	104 40
i remination adainst		VUUZ3, ZEIVIININVV	ozs and Zi		∠o. ⊢ixea p	unt intersecti	uns at 40 m along DZ	(24-42

G	ZFMA5	Version number	3	Total object CL	18
	ZFMA4 ZFMA5		TE-MMMM0001		
	9033 5 ZFMA6-e	ZFMNNW0823		×	

OBJECT	CONFIDENCE	ESTIMATE

Category	Object CL	Comment
INTERPRETATION		
Data source	2	A5, HFM06, HFM08, KFM03A, KFM03B
Results of interpretation	3	High confidence observation in HFM06, HFM08.
INFORMATION DENSITY		
Number of observation points	3	4
Distribution of observation points	1	If there is a geometric coincidence between the seismic reflector and the borehole observation points, the reflector shall not be regarded as an observation point. Henceforth, reflector not considered as an outlier. Looking at the entire modelled zone, the observation points are restricted to most western part of the zone and perhaps can be considered as a cluster. Since the reflector is not considered an observation point in this case, all obs.points are restricted to a small area considering t
INTERPOLATION		
Geometry	3	One strong interpolation alt. Based on sub-surface obs. points in combination with high-confidence seismic reflector.
Geological indicators	2	Some discrepancies in the geological data.
EXTRAPOLATION		
Dip direction	2	Conceptual constraints. Inferred truncation against surrounding steeply dipping zones ZFMWNW0023, ZFMNNW0823, ZFMNNE0828.
Strike direction	2	Conceptual constraints. Inferred truncation against surrounding steeply dipping zones ZFMWNW0023, ZFMNNW0823, ZFMNNE0828.





G	ZFMA6-e		Version number	3	Total object CL	13
GEOLOGICAL	CHARACTER	Property CL	155,000 160,000 165,000 170,000			
Deformation style:	Brittle	3	0			0
Deformation	No data available.		00		$\sim$	000
description:			2	5	TT mm	671
Alteration:			{	V	The	3
- First order	Oxidation	-	$\sim$		1 LJ S	
- Second order:	Chloritization	2	8 7		11115	1 8
- Third order:	Not observed	-	102 July	/ /	all IX A	1050
Fracture orientation	Fractures that dip to the		° K	~ /	THAN Z	.9
and type:	south and east		201		ALLA Z	
and type:	dominates Variable		9	T		0
	orientation No mean		500		XIIIS	000
	value estimated.		67	NG3	MY / //	670
	Dominated by open	1		ATT>	XX /	
	followed by sealed and		1 K Slitt	ST.	NY	12
	partly open fractures.		1 10 00	MAS -	N	000
Fracture comment:	No data available.		569	1	XI	695
Fracture fill mineralogy:	Chlorite and calcite.	1	°	142	X	Ō
OBJE				1 St	3 73	
Strike/dip:	77°/31°		8		1 Junear	9
Length:	2206 m		0000		w	000
Mean thickness	10 m (6 - 32 m)		- 69	$\langle \cdot \rangle$		666
Max denth:	-997 m		- CL (7			
Geometrical	ZEMNNE0828 ZEMNNW	0823	155000 160000	) 165	000 170000	20.510
constraints:	ZEMWNW0023 Topo 40r	n arid Max	100000			N
conociantoi	error 20m.	in gha max	Baseline DMS		0 2 4 8	A
	BASI	S FOR MOL	DELLING			
Corresponds to seismic ref	lector A6, the position of wh	ich in 3D spa	ace has been attaine	ed from C	osma et al. (2003).	
Supported by a borehole of	bservation.					
Outononoi						
Outcrops:	-					
Borenoles: -						
Tunnels:	-					
Lineament and/or	A6.					
seismic indications:	-					3
	MODE	LLING PRC	CEDURE			
Corresponds to seismic ref	lector A6, the position of wh	ich in 3D sp	ace has been attaine	ed from C	osma et al. (2003). T	-he
zone has been divided into	two separate segments with	h different te	rminations. The east	tern part i	s terminated against	
ZFMWNW0023, ZFMNNW	0823 and ZFMNNE0828, wl	hile the west	ern part is terminate	d against	ZFMWNW0023 and	i
ZFMWNW0123. Fixed poin	it intersection at 59 m along	DZ1 (54-66	m) in HFM07.			
		the second se			3	
1985	ZFMA5				3	
Inne	EM14		10			
	NING 1					
	20023					
	ZFMA6-W		ZFMA5	Same		
	WNW			CAC	¥ /	
	10723	700		Sec. Se	Ş	
		<rm< td=""><td>A6-0</td><td></td><td></td><td></td></rm<>	A6-0			
			.0.6		5	
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"NUT				1		
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0						1
	0 100 200 300 500 m	1 km	2 km			<
		0	TE	MNNEG		

G		ZFMA6-	е	Version number	3	Total object CL	13
OBJECT CONFIDENCE ES	STIMATE			•			
Category		Object CL	Comment				
INTERPRETATION							
Data source		2	A6, HFM07				
Results of interpretation	า	3	High confid	ence observation in	HFM07.		
INFORMATION DENSITY	,						
Number of observation	points	1	1				
Distribution of observati	ion points	1	Single obse	ervation point at dep	th and a s	seismic reflector.	
INTERPOLATION							
Geometry		1	Geometry supported by surface geophysical data.				
Geological indicators		1	Indirect support by geophysical data.				
EXTRAPOLATION							
Dip direction			Conceptual constraints. Inferred truncation against surrounding				
		2	steeply dip	oing zones ZFMWN	N0023, Z	FMNNW0823,	-
			ZFMNNE0828.				
Strike direction			Conceptual	constraints. Inferred	d truncatio	on against surroundi	ng
2		steeply dipping zones ZFMWNW0023, ZFMNNW0823,					
			ZFMNNE08	328.			
	CTURE CHA	RACTER					
			No data avail	able			
INDIVIDUAL INTERCEPTS							
			No data avail	able			

G		ZFMA	6-w		Versi	on number	3	Total	object CL	13
GEOLO	GICAL CH	ARACTER	1	Property CL	1550	00 16000	0 16	5000	170000	
Deformation style:	Brittle			3	8					9
Deformation description:	No data	a available.			671000	5		~		671000
Alteration:						5	Y	11	12	1.1
- First order:	Oxidati	on		2		5	~ ) ;	3.		
- Second order:	Chloriti	zation		2	2000	al		IN	FI	2000
- Third order:	Not obs	served			670	1		AIA		620
Fracture orientation and	Fractur and eas	es that dip to the st dominates. Va	south siable		5	11	V	AH	A	
type:	orientat	ion. No mean va	alue		8	F	XAX	DANUV 3		
	estimat	ed. Dominated b	y open		202			NAY		2001
	followe	d by sealed and	partly	1	°			XX		0
<b>F</b>	open fra	actures.				KAR		M /	$\checkmark$	
Fracture comment:	No data	a avallable.			00	1010	X	AX	/	00
mineralogy:	Chiorite	e and calcite.			66950	Lall	K	X		66950
	OBJECT	GEOMETRY					(d)	A	Service .	
Strike/dip:	77°/31°					~ \		2/	5 maren	
Length:	812 m	, <u>, , , , , , , , , , , , , , , , , , </u>								0000
Mean thickness:	10 m (6	5 - 32 m)			- 99				1 9699	
Max depth:	-330 m	W/0000 Tana 4	Om arid M							
Geometrical	20m 7	NVVUUZ3, TOPO 4	om gna wa	ax enor	155000 160000 165000 170000				20.510	
constraints.	2011, 21	20m, 2FMWWWWU123.				110000	N			
						10del volume DMS Baseline			0 2 4 8	A
			BASIS F	OR MOD	ELLING	3				
Corresponds to seis Supported by a bore	mic reflecto hole obser	or A6, the positio vation.	n of which	in 3D spa	ce has	been attaine	d from Co	osma et	al. (2003).	
Outcrops:	-									
Boreholes:										
		Target in	ntercept		Geometric interce		ot			
Borehole	PDZ	Sec_up [m]	Sec_lov [m]	w Se	c_up [n	n] Sec_l [m]	ow C	Commer	nt	
HFM07	DZ1	54.00	66.00		53.27	64.8	4			
I unnels:	-									
Lineament and/or	A6.									2
indications.										5
maications.	1		MODELL		CEDUR	E				
Corresponds to seis	mic reflecto	or A6, the positio	n of which	in 3D spa	ce has	been attaine	d from Co	osma et	al. (2003). T	Гhe
zone has been divid	ed into two	separate segme	ents with di	fferent ter	minatio	ns. The east	ern part is	s termina	ated against	t
ZFMWNW0023, ZFM	/NNW0823	3 and ZFMNNE0	828, while	the weste	ern part	is terminated	l against	ZFMWN	IW0023 and	ł
ZFMWNW0123. Fixe	ed point int	ersection at 59 n	n along DZ	1 (54-66 ו	m) in HF	-M07.				

G	Z	FMA6-w	1	Version number 3 Total object CL 13					
27MAS 27MAS 0 100 200 300	ZFMAA ZFMAGO-W WWWIO23 500 m		ZFMAG-0		i Z	ZEMNNW082	INNOU.		
Category		Object Cl	Comment						
INTERPRETATION			Comment						
Data source		2	A6, HFM07						
Results of interpre	etation	3	High confide	ence observation in H	IFM07.				
INFORMATION DEI	NSITY	1	4						
Distribution of obs	servation points	1	Single obser	rvation point at depth	and a s	eismic reflector			
INTERPOLATION			Chigle obser	valori point at depti	runa a o				
Geometry		1	Geometry s	upported by surface	geophysi	cal data.			
Geological indicat	tors	1	Indirect supp	port by geophysical of	data.				
EXTRAPOLATION									
Dip direction		2	Conceptual steeply dipp	constraints. Inferred ing zones ZFMWNW	truncatio /0023, ZF	n against surroundii FMWNW0123.	ng		
Strike direction		2	Conceptual steeply dipp	constraints. Inferred ing zones ZFMWNW	truncatio /0023, ZF	n against surroundii -MWNW0123.	ng		
		FRAG	CTURE CHAF	RACTER					
Orientation:				ZFM	IA6-w				
(strike/dip right-					N				
hand-rule)	Doroholooy			in the second se		1			
Frequency:	Borenoles: -					~			
	FRACTURE	TERZAGHI-	1						
	TYPE	WEIGHED		1	1.1				
		P10	1 7	1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -	- P.	Ţ			
	Open and	0.0 m-1	1			t			
	Sealed	0.0 m-1		1997 - Mar		F	9		
	Sealed	0.0 % of DZ			1		2		
	network	intercept	W-	(* * )	-		-E		
	Crush	0.0 % of DZ	-		4	-	5		
		intercept		1. A.					
			1	· · · · · · · · · · · · · · · · · · ·		. 1			
			X			. /			
				1.					
				>	6. C				
				> .		Equa	l area		
					5	Lower hemis	phere		
			HFMC	97 (93)	5				
RQD:									
Fracture fill	No data availab	le							
mineralogy:									



G		ZFM	A7		Version	number	4	Total object CL	17
GEO	DLOGICAL	ICAL CHARACTER			155000	160000	) 16:	5000 170000	
Deformation st	vle: Britt	e		3	9				0
Deformation description:	Strik stee strik obse dipp	e-slip movement a oly dipping fault that es ENE. No fault-sl erved on the gently ing fractures.	long at lip data	-	000 671000	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	5	J.J.	000 671000
Alteration:		0			1 205	y		A M M	10507
- First order:	Oxid	ation		-	° R	1	1	THACE	(C)
- Second order	r: Not	observed		2	2	2 AMA 12			1
- Third order:	Not	observed			8		XXX		8
Fracture	Gen	tly dipping fractures	s are		200	VI.X		ALIS	1000
orientation and	l cons	picuous. Variable			°			V V	9
type:	orier	tation. Sealed frac	tures		5	X		M N	
Fuendaria e e maria	dom	inates.	2	2	8	040.	X	AX/	8
Fracture comm	ient: No c	ita avallable.			660	141	1 al and	$\sqrt{\langle}$	9501
mineralogy:	Calc	ne, chionie atite/adularia, preh	nite		66	1 1	1000		66
mineralogy.	clav	minerals	inite,		1.1		10X	A more	
	OBJE	CT GEOMETRY			8			La man	9
Strike/dip:	57°/2	23°			0008	$t \cdot t$		w	000
Length:	3496	3 m			66				666
Mean thickness	s: 7 m	(6 - 32 m)							
Max depth:	-149	5 m			155000	160000	165	000 170000	2030
Geometrical	ZFM	WNW0123, ZFMW	/NW0023,		Model	volume DMS		0 2 4 8	N
constraints:	ZFM	WNW0001, ZFMN	NE0828,		Baselin	c		S Calcinateret, Catcherson Kats	A
	ZFM	NNW0823, Topo 4	10m grid Max er	ror					
	20m	•		MOD					
Corresponds to	soismic rofle	ctor A7 the positio	DASIS FUR		co has hos	n attainer	from Ba	lu and Cosma (200)	5)
Supported by bo	prehole obse	rvations.		D Spa		in attained			0).
Outcrops:	-								
Boreholes:									
		Torgoti	ntoroont		Coomotrio	intereen			
Borehole	PD7	Taiget i	Sec low		Geometric	Sec lo		omment	
Dorenoie	102	Sec_up [m]	[m]	Sec	:_up [m]	[m]		omment	
HFM18	DZ3	119.00	148.00	1	38.76	146.0	8 ZI in	-MNE0065 also tersects DZ3.	
KFM03A	DZ2	448.00	455.00	4	44.71	452.1	2		
Tunnala									
Tunnels:	- /or \								
seismic									З
indications:									0
			MODELLING	PRO	CEDURE				
Corresponds to seismic reflector A7, the position of which in 3D space has been attained from Balu and Cosma (2005). Terminated against ZFMWNW0001, ZFMWNW0023, ZFMWNW0123, ZFMNNW0823 and ZFMNNE0828. Fixed point intersections at 450 m along DZ2 (448-455 m) in KFM03A and at 144 m along DZ3 (119-148 m) in HFM18. Low radar amplitude also observed at 450-505 m along DZ2 in KFM03A. The steeply dipping zone ZFMNE0065 is also modelled to intersect DZ3 in HFM18. For character and kinematics of DZ2 in KFM03A, see Nordgulen and Saintot (2006). DZ2 in KFM03A occurs in close spatial association with a thicker amphibolite body. Fine fracture network with quartz and epidote cut by open fracture with chlorite and corrensite occurs at 450-501 m. Apart from this narrow interval, which defines the fault core, the zone shows a "damage zone" character. Fault-slip data only observed on one steeply dipping fracture. The gently									
aipping fractures	s do not sho	w evidence for she	ar deformation.	•					

G	ZFMA7	Version number	4 Total object C	└ 17
G		Version number		
<u>0 10 20</u>	TFINAND STOLE IN 2 Km	2 CZ CZ	0	
	OBJECT CONFIDENC	E ESTIMATE		

Category	Object CL	Comment
INTERPRETATION		
Data source	2	A7, HFM18, KFM03A
Results of interpretation	3	High confidence observation in KFM03A and HFM18.
INFORMATION DENSITY		
Number of observation points	2	2
Distribution of observation points	1	Two sub-surface obs. points c. 800m apart.
INTERPOLATION		
Geometry	3	One strong interpolation alternative due to two sub-surface obs. points supported by reflector.
Geological indicators	2	Some discrepancies in the geological data.
EXTRAPOLATION		
Dip direction	2	Conceptual constraints. Inferred truncation against surrounding steeply dipping zones ZFMWNW0023, ZFMWNW0123 ZFMWNW0001 ZFMNNW0823, ZFMNNE0828.
Strike direction	2	Conceptual constraints. Inferred truncation against surrounding steeply dipping zones ZFMWNW0023, ZFMWNW0123 ZFMWNW0001 ZFMNNW0823, ZFMNNE0828.

	FRAC	TURE CHARACTER
Orientation: (strike/dip right- hand-rule)	 Boreboles: KEM03A	ZFMA7 N
	FRACTURE TYPE     TERZAGHI- WEIGHED P10       Open and partly open     0.5 m-1       Sealed     16.1 m-1       Sealed     0.0 % of DZ intercept       Crush     0.0 % of DZ intercept	W W W G G G G G G G G G G G G G G G G G

G	ZFMA7	Version number 4	Total object CL <b>17</b>
RQD:	min:70, max:100, mean:96		
Fracture fill mineralogy:		KFM03A(448.0-455.0)	
nin olacegy.	30 25 - source 20 - 20 - 20 - 20 - 20 - 20 - 20 - 20 -		Open and partly open Sealed
	Carde Chone Cantheens Enters	NO DEFECTIONS INFERDED ON OUR WARTS FROM	are grante grant



G		ZFM	<b>A8</b>		Vers	sion nu	mber	5	Total object CL	16
GEOLOG	ICAL CH	ARACTER		Proper	rty 155	000	160000	1	65000 170000	_
Deformation style:	Brittle			3						0
Deformation description:	Fault w west sh dip-slip movem	ith moderate dip lows a strong, re component of ent. Strike-slip	to the everse	5	671000		5	F	The	671000
	movem	ent along steep! fault that strikes	y SSE.		2000 June 1					105000
Alteration:					io z	N I	1	1	MAN 2	9
- First order:	Oxidatio	on		2	1	1	11		ALLA Y	1
- Second order:	Quartz	dissolution		3	8	K		AN Y		5 0
- Third order:	Not obs	served			2002	~ /			VAL 1	7000
Fracture orientation and type:	Steeply strike N Domina	dipping fractures dipping fractures INE dominates. ated by sealed fo	s and s that ollowed		500 E70			95000 G		
	fracture	i anu panty oper	1		66		1	10	A to	66
Fracture comment:	No data	a available.					1	R	~ ~ ~ ~ ~	
Fracture fill	Calcite,	chlorite clay mir	nerals		00		/	/	Last inner	00
mineralogy:	pyrite a	sphaltite		2	0059				v	1
	hematit	e/adularia clay		_	96					86
	along fr	s. Quartz is com	mon				100,000	10.00		20.001
	steeply	to the ESE and			1550	000	160000	1	55000 170000	N
	epidote	is present along	3			Baseline DMS			0 2 4 8	A
	fracture	s with gentle dip	os to							
	frequen	. Note also high	vith no							
	mineral	coating/filling.								
	OBJECT	GEOMETRY								
Strike/dip:	82°/35°									
Length: Mean thickness:	1893 m	22 m)								
Max denth	-494 m	) - 32 m)								
Geometrical	ZFMA3	, ZFMENE0060	A, Topo 4	10m grid						
constraints:	Max err	or 20m, 1 UNIV	ERSE Pla	anar						
	Cut(s).		DACIO			~				
Corresponds to seism	ic reflecto	or A8 identified h	v.luhlin i	in Stephe	ens and S	kanius	(2007)	Suppor	ted by borehole	
observations.			y oannin	in otopin		nagiao	(2007).	Cuppol	loa by borchoic	
0										
Outcrops: Boreholes:	-									
		Taraat is	ntorcont		Gaam	otric :	ntoroon			
Borehole F	DZ		Sec I	low	Geoin		Sec lo	w	Comment	
		Sec_up [m]	[m]	1	Sec_up [	mj	[m]			
HFM16 [	DZ1	12.00	71.0	00	66.46		108.1	6	la manufa de d	
KFM06A		51.00	51.0	00	52.37		88.33	3 ( 1 1 1 1 1 1	No mapping or borer mage available for th nterval. According to drilling report (Claess and Nilsson 2005) a ying fracture zone at 51 m.	otie ne othe son flat- t about
KFM06B [	DZ1	55.00	93.0	00	55.83		93.28	3	la manufa de d	
KFM06C		57.00	57.0	00	44.36		78.37		No mapping or boreh mage available for th nterval. According to drilling report (Claess and Nilsson 2006) a dipping fracture zone about 57 m.	nole ne o the son gently e at
Tunnels:	-									
Lineament and/or seismic indications:	A8.									2

G	ZFMA8	Version number	5	Total object CL	16
MODELLING PROCE	DURE				
Corresponds to seism ZFMENE0060A. Refle restricted in extent to (DZ1). Fixed point inte zone.	ic reflector A8 identified by Juhlin in Stephens actor is not observed along profiles 1 and 4 (Ju the west. Inferred to intersect borehole interva prsection placed at 57 m along KFM06B, wher	and Skagius (2007) uhlin in Stephens and Is 55-93 m in KFM06 e there is both a sea	. Terminat d Skagius SB (DZ1) a led fractu	tion against ZFMA3 2007) and is, there and 12-71 m in HFM re network and a cr	3 and fore, ⁄/16 rush
	THE RED ORDA TE MEN EDOROA TE		STMA ZEMAL	ENEO952A	909B
	OBJECT CONFIDENC				

Category	Object CL	Comment
INTERPRETATION		
Data source	2	A8, HFM16, KFM06A, KFM06B, KFM06C
Results of interpretation	3	High confidence observation in HFM16 and KFM06B
INFORMATION DENSITY		
Number of observation points	3	4
Distribution of observation points	1	If there is a geometric coincidence between the seismic reflector and the borehole observation points, the reflector shall not be regarded as an observation point. Henceforth, reflector not considered as an outlier. Looking at the entire modelled zone, the observation points are restricted to most western part of the zone and perhaps can be considered as a cluster. Since the reflector is not considered an observation point in this case, all obs.points are restricted to a small area considering t
INTERPOLATION		
Geometry	1	None or more than two alternative observation points exist.
Geological indicators	2	Some discrepancies in the geological data.
EXTRAPOLATION		
Dip direction	2	Conceptual constraints. Inferred truncation against surrounding steeply and gently dipping zones.
Strike direction	2	Conceptual constraints. Inferred truncation against surrounding steeply and gently dipping zones ZFMENE0060A, ZFMA3.







G		ZFMB1				Version r	number	3	Total	object CL	13		
GEOL	OGICAL CH	ARACTER		Proper CL	rty	155000	160000	165	5000	170000			
Deformation style	e: Brittle			3		8					8		
Deformation	No data	a available.				100			~		1000		
description:						67	5	T	1	man 2	67		
Alteration:						1.00	~ {	X	11	1			
- First order:	Oxidatio	on		2		0	25	/	Al.		3. 0		
- Second order:	Not obs	served		2		2 200	4	1		111	200		
- Third order:	Not obs	served				20 er	1	)	21	$\wedge \land \rightarrow$	670		
Fracture	Gently	dipping fractures	6			5		N	TH	1 2			
orientation and	domina	tes. Variable				5	16	XX	(T)H	A N	22		
type:	orientat	ion. Dominated	by			00 5	N N	X	XII		) 000		
	sealed	followed by oper	n			2029	KAN		VIT	/ / /	2200		
Eracture commo		s.		2				The	Th		U		
Fracture commen	IL: NO Gala	a avaliable.	to	2			XANN	the	NA	$\checkmark$			
mineralogy:	bematit	e, calcite, prennin o/adularia, quar	tz clav			8	11/1	1	XF	/	000		
mineralogy.	mineral	s Enidote also r	oresent			6956	1		X		695(		
	along o	ne gently dippin	a. Epidote also present			ntly dipping		9	1 1	10	$\langle \rangle$	۲.	00
	fracture	fracture.						J.	1 7	3			
	OBJECT	GEOMETRY				8		/	Va	Y inner	8		
Strike/dip:	34°/27°					005	-				1006		
Length:	3159 m	3159 m				66				S	99		
Mean thickness:	7 m (6 -	- 32 m)											
Max depth:	-1491 n	n				155000	160000	165	000	170000			
Geometrical	ZFMWN	NW0123, ZFMW	/NW0023	,		Model v	olume DMS			0 2 4 8	N		
constraints:	ZFMW	NW0001, ZFMA	3, Торо 4	0m grid		Baseline				d Latinitant Goldsheeverke	N		
	Max err	or 20m.	BASIS										
Corresponds to se	sismic reflecto	or B1 the positio	on of which	h in 3D a	Snace	has hee	n attained f	om Co	sma et	al (2003)			
Supported by a bo	orehole obser	vation.			opuoc			011 00		ui: (2000).			
Outcrops:	-												
Boreholes:													
		Target i	ntercept		G	eometric	intercept						
Borehole	PDZ	Sec_up [m]	Sec_l	low ]	Sec_	up [m]	Sec_low [m]	C	ommei	nt			
KFM03A	DZ3	638.00	646.	00	63	9.24	646.75						
Tunnels:	-												
Lineament and/o	<b>r</b> B1.												
seismic											3		
indications:													
Corresponde to as		PI the peritie		LING P			n attained f	om Co	000.04	al (2002)			
Terminated against			/∩∩23 7⊑	511 111 3D 9	space n122	and 7EM		oint int	SINA EL	ai. (2003). In at 6/3 m	along		
D73 (638-646 m)		ow radar amplit	iude alen	ohserve	d at 6	25-650 m	nalona D73	in KFN	1030	n al 045 m	alony		
D23 (030-040 III)	11 KI W03A. L		uut aisu	0030146	u ai 0	-J-0J0 II		III IN IN	1004.				

G	ZFMB1	Version number 3	Total object CL <b>13</b>	
	TO 20.20 DOM 100			
	OBJECT CONFIDEN	CE ESTIMATE		

Category	Object CL	Comment
INTERPRETATION		
Data source	2	B1, KFM03A
Results of interpretation	3	High confidence observation in KFM03A.
INFORMATION DENSITY		
Number of observation points	1	1
Distribution of observation points	1	Single observation point at depth and a seismic reflector.
INTERPOLATION		
Geometry	1	Geometry supported by a lineament and a single intercept.
Geological indicators	1	Single observation point at depth. Zone modelled mainly based on
	•	surface geophysical data.
EXTRAPOLATION		
Dip direction		Conceptual constraints. Inferred truncation against surrounding
	2	steeply and dipping zones ZFMWNW0001 ZFMWNW0023,
		ZFMWNW0123.
Strike direction		Conceptual constraints. Inferred truncation against surrounding
	2	steeply and dipping zones ZFMWNW0001 ZFMWNW0023,
		ZFMWNW0123.

	FRAC	FURE CHARACTER
Orientation: (strike/dip right- hand-rule)	Set G: 119.9°/9.8°	ZFMB1 N
hand-rule) Frequency:	Boreholes: KFM03AFRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open1.4 m-1Sealed9.1 m-1Sealed9.1 m-1Sealed0.0 % of DZ interceptCrush0.0 % of DZ intercept	W E
		Equal area Lower hemisphere Unassigned (28) • Set G (16) Δ Mean pole Set G (29.9/80.2) Fisher κ = 5.7



G	ZFMB10	)	Ver	sion nu	umber	5	Total	object CL	10
GEOLOGICAL	CHARACTER	Property	15	5000	160000	) 16	5000	170000	
Deformation style:	Brittle		0						0
Deformation	No data available.		000				~		000
description:			67		5	T	11	man and a second	671
Alteration:					5	Y	11	2	
- First order:	Not observed		0		5	_ /	1	~ > > >	
- Second order:	Not observed		500	n	}		$I \mathbb{N}$	, MI	2000
- Third order:	Not observed		670	55	1		ALA		670
Fracture orientation and type:	No data available.			5	1	X	AH	A	040145
Fracture comment:	No data available.		8	11		XXX		1	00
Fracture fill mineralogy:	No data available.		000	5 1			AU	1 5	000
OBJE	CT GEOMETRY		67	3	IKE		HY.		67
Strike/dip:	27°/35°		<	00		ZALL)	X7	$\checkmark$	
Length:	892 m		8	10	716	X	XE	/	00
Mean thickness:	10 m (6 - 32 m)		950	Mart	246	1 mar	VI		9500
Max depth:	-1479 m		66			1000		2	66
Geometrical	ZFMWNW0001, ZFMWN	W1035,			/	C X	-	2 martin	
constraints:	ZFMNV0805A, ZFMNV0	)805B,	0		/		1	5 Income	Q
	Topo 40m grid Max error	20m,	0000			$\bigvee$	w		000
	ZFIMINE0008B.		669			$\langle \cdot \rangle$			699
			15	5000	160000	165	000	170000	20.910
				Model vol	Ima DMS			0 Z 4 8	N
				Baseline				S California est Caldacharaverkas	A
	BASI	S FOR MOD	ELLI	NG					
The modelled zone is based	I on the reprocessed seism	ic data and r	esult	ing refl	ector ge	ometry as	s reporte	ed by Juhlin a	and
Zhang (2010).									
Outcrops:	-								
Boreholes: -									
Tunnels:	-								
Lineament and/or	B10.								2
seismic indications:									2
	MODE	LLING PRO	CED	URE					
The modelled zone is based	on the reprocessed seism	ic data and r	esult	ing refl	ector ge	ometry as	s reporte	ed by Juhlin	and
Zhang (2010). The main cor	clusion from the report is t	hat a new rei	flectio	on (B10	)) has be	en identi	fied that	t may extend	below
the SFR site. This reflection	was not clearly observed in	n the previou	is pro	cessin	g Juniin	and Pain	1 (2005) hlin ond	. The reflection	On IS
that the dip of the reflection	is uncertain. On shot gathe	inal lu lite se	to di	n at a g	entineu sliahtly s	hallower	anale w	hile on the s	). Note
sections it appears to dip at	a greater angle. This discre	enancy is nro	bhahl	v due ti	o the cro	oked nat	ure of th	ne profiles H	owever
reflections are clearly obser	ved in shot gathers and its	presence be	low S	FR is I	nighly pr	obable. S	see Juhl	in and Zhand	(2010)
for further details. In accord	ance with earlier modelling	work at Fors	mark	, ZFME	310 has	been tern	ninated	against the r	najor
WNW-ESE and NW-SE, cor	mposite ductile and brittle d	eformation z	ones	(ZFM)	WNW00	01, ZFMV	VNW10	35, ZFMNWO	)805A
and ZFMNW0805B).									

G	ZFI	MB10	Version number	5	Total object CL	10			
EBECT CONFIDENCE ESTIMAT									
	C	BJECT CONF	IDENCE ESTIMATE						
	Obj	ect CL Con	nment						
Data source		1 B10							
Poculte of interpretation		2 Mod	ium confidence in the soisr	mic roflocto	r B10				
INFORMATION DENSITY			ium confidence in the seisi	inic renecic	<i>i</i> D10.				
Number of observation r	ooints	1 1							
Distribution of observation	on points	1 Sinc	le observation point in the	form of a s	eismic reflector				
INTERPOLATION									
Geometry		1 Geo avai	metry supported by seismic lable.	c data. No	sub-surface obs. po	oint			
Geological indicators		1 Indir	ect support by geophysical	l data.					
EXTRAPOLATION									
Dip direction		1 Extr Trur ZFN ZFN	apolated based on informal icated by steeply dipping zo IWNW1035, ZFMNW08054 INE0808B.	tion from s ones ZFM A, ZFMNW	eismic reflector B10 VNW0001, 0805B and	).			
Strike direction		2 Con ZFN and	ceptual constraints. Trunca IWNW0001, ZFMWNW103 ZFMNE0808B.	ated by stee 35, ZFMNW	eply dipping zones 0805A, ZFMNW08	05B			
1									
		FRACTUR	E CHARACTER						
		FRACTUR No da	E CHARACTER ta available						

G	Z	FMB23	-е	Version number	3	Total object CL	11		
GEOLOGICAL	CHARACTE	ER	Property CI						
Deformation style:	Brittle-Duct	ile	1						
Deformation	No data av	ailable.							
description:									
Alteration:			_						
- First order:	Not observ	ed							
- Second order:	Not observ	ea od	_						
Fracture orientation	No data av	eu ailable							
and type:	No data av								
Fracture comment:	No data av	ailable.							
Fracture fill	No data av	ailable.							
mineralogy:				No fio	iure a	available			
OBJ Strike/din:		TRY		110 119					
Strike/dip:	30-725-								
Mean thickness	- 15 m (6 - 3	2 m)							
Max depth:	-2100 m	2 111)							
Geometrical	ZFMWNW	0001, ZFMNEC	065,						
constraints:	ZFMNNW0	823, ZFMWN	V0023,						
	Topo 40m	grid Max error	20m.						
		BAS	IS FOR MOD						
Corresponds to seismic ref	flectors B2 ar	nd B3, which ha	ave been com	bined into a single z	zone with	two separate segme	ents		
east and west of zone ZFM	INE0065. Th	e positions of t	hese reflector	s in 3D space have	been atta	ined from Cosma et	al.		
(2003).									
Outeren									
Borobolos:	-								
Borenoles									
Tunnels:	-								
Lineament and/or	B2, B3.						3		
seismic indications:		MOD					Ű		
Corresponds to solemic ref	floctors B2 or	NUCDI d B3 which h	ELLING PRO	CEDURE	zono with	two coporato cogm	onte		
east and west of zone ZFM	1NF0065. Th	e positions of t	hese reflector	s in 3D space have	been atta	ined from Cosma et			
al.(2003). Modelled to the l	base of the m	nodel volume w	ith terminatio	n against ZFMWNW	/0001, ZF	MWNW0023, ZFMN	IE0065		
and ZFMNNW0823 in the	eastern segm	ent; and ZFM	WNW0001, Z	FMNNW0101 and Z	FMNE006	5 in the western se	gment.		
No figure available									
		OBJECT	CONFIDENC	E ESTIMATE					
Catagory		Object Cl	Commont						
		Object CL	comment						
Data source		1	B2. B3						
Results of interpretatio	n	3	High confide	ence in the seismic r	eflector B	2,B3.			
INFORMATION DENSIT	Y								
Number of observation	n points	1	1						
Distribution of observa	tion points	1	Single obse	rvation point in the f	orm of a s	eismic reflector.			
			Constant	and the second	- 1- 1-	aula aurfaire l	- lint		
Geometry		1	Geometry s	upported by seismic	data. No	sub-surface obs. po	oint		
Geological indicators		1	Indirect sup	nort by geophysical	data				
EXTRAPOLATION			mancot sup	port by geophysical	<b>uuu</b> .				
Dip direction			Extrapolate	d based on informati	on from s	eismic reflector B2	and		
		1	B3. Truncat	ed by steeply dippin	g zones Z	FMWNW0001,			
			ZFMNE006	5, ZFMNNW0101.					
Strike direction		2	Conceptual	constraints. Truncat	ed by ste	eply dipping zones			
L				001, ZEMINE0065, Z		J101.			
		FRAG	CTURE CHAI	RACTER					
			No data availa	able					
INDIVIDUAL INTERCEPT	S								
			No data availa	able					

G	Z	FMB23-	·W	Version number	4	Total object CL	11			
GEOLOGICAL	CHARACTE	ER	Property CL							
Deformation style:	Brittle		1							
Deformation	No data av	ailable.								
description:										
Alteration:			_							
- First order:	Not observ	ed	_							
- Second order:	Not observ	ed	_							
- Third Order.	No data av	ailable								
and type:	NO Gala av	allable.								
Fracture comment:	No data av	ailable.	_							
Fracture fill	No data av	ailable.								
mineralogy:		TOV		No fic	iure a	available				
Strike/din:		IRI								
Length:	-									
Mean thickness:	15 m (6 - 3	2 m)								
Max depth:	-1185 m	=,								
Geometrical	ZFMWNW	0001, ZFMNEC	065,							
constraints:	ZFMNNW0	)101, Topo 40n	n grid Max							
	error 20m,	1 UNIVERSE I	Planar							
	Cut(s).									
BASIS FOR MODELLING										
Corresponds to seismic ref	lectors B2 ar	nd B3, which ha	ave been com	bined into a single z	zone with	two separate segme	ents			
east and west of zone ZFIV	INE0065. I N	e positions of t	nese reflector	s in 3D space have	been atta	lined from Cosma et	al.			
(2003).										
Outcrops:	-									
Boreholes: -										
<b>_</b>	1									
l unnels:	-									
Lineament and/or	в2, вз.						3			
	1	MODE		CEDURE						
Corresponds to seismic ref	lectors B2 ar	nd B3, which ha	ave been com	bined into a single z	zone with	two separate segme	ents			
east and west of zone ZFM	INE0065. Th	e positions of t	hese reflector	s in 3D space have	been atta	ined from Cosma et				
al.(2003). Modelled to the l	base of the m	nodel volume w	ith terminatio	n against ZFMWNW	/0001, ZF	MWNW0023, ZFMN	E0065			
and ZFMNNW0823 in the e	eastern segm	nent; and ZFM	VNW0001, Z	-MNNW0101 and Z	FMNE006	65 in the western se	gment.			
No figure available.										
-		OBJECT	CONFIDENC	E ESTIMATE						
_			_							
		Object CL	Comment							
		4								
Data source	n	2	BZ, B3	noo in the asismi-	ofloatar	20 02				
	11 V	3	righ contide	ence in the seismic f	enector E	JZ,DJ.				
	noints	1	1							
Distribution of observation	tion noints	1	Single obse	rvation point in the f	orm of a s	eismic reflector				
INTERPOLATION			Chigie 0000							
Geometry		1	Geometry s	upported by surface	aeophys	ical data.				
Geological indicators		1	Indirect sup	port by geophysical	data.					
EXTRAPOLATION										
Dip direction			Extrapolate	d based on informati	ion from s	eismic reflector B2	and			
		1	B3. Truncat	ed by steeply dippin	g zones Z	ZFMWNW0001,				
			ZFMNE006	5, ZFMNNW0101.						
Strike direction		2	Conceptual	constraints. Truncat	ted by ste	eply dipping zones				
L			∠⊦mwnw0	001, ∠FMNE0065, Z		0101.				
		FRAG	TURE CHAI	RACTER						
		1	No data availa	able						
INDIVIDUAL INTERCEPT	S									
			No data availa	able						

-		ZFN	<b>/B4</b>		Version	number	3		Total object CL	13	
GEOLO	GICAL CH	ARACTER	ER Proper		ty						
Deformation style:	Brittle			3							
Deformation	Gently	south-east and	south								
description:	dipping	faults show di	p-slip								
	sense c	of movement. F	ment. Reverse								
	dip-slip	movement alo	ong two								
Alteration:	01 11030	raulis.									
- First order:	Not obs	erved									
- Second order:	Not obs	erved									
- Third order:	Not obs	erved									
Fracture	Fracture	es show variat	ble								
orientation and	orientat	ion. No mean	value			lo fio	ure	a	vailable		
туре:	calculat	ed. Dominated	Dy on and				juiu		vanabio		
	partly o	pen fractures.	en anu								
Fracture comment	No data	a available.		2							
Fracture fill	Chlorite	, calcite, clay i	minerals.								
mineralogy:	Quartz	and prehnite a	long								
	more st	eeply dipping									
		S.									
Strike/din:	52º/20º	GEOWETRY									
Lenath:	-										
Mean thickness:	12 m (6	- 32 m)									
Max depth:	-1874 n	n									
Geometrical	ZFMWN	VW0001, ZFM	WNW012	23,							
constraints:	ZFMEN	E0062A, ZFM	NE0065.								
Corresponde to esia	mia roflaate	P4 the peak	BAS	IS FOR MO	ODELLING	n ottoine	d from	Coor	ma at al. (2002)		
Supported by a bore	hole obser	vation.	lion of wr	NCN IN 3D S	space has bee	en attained		Cosi	na et al. (2003).		
Outcrons:											
Boreholes:											
		<b>T</b> 4		4	0						
Borehole	PD7	Target	Sec		Geometric	Sec l	01 0W	Co	mment		
Dorenole	102	Sec_up [m]	1900	_10 W	Sec_up [m]	[m]	0	00	liniterit		
KFM02A	DZ8	893.00	90	<b>mj</b> 5.00	892.69	904.9	99				
KFM02A	DZ8	893.00	90	<b>mj</b> 5.00	892.69	904.9	99				
KFM02A Tunnels:	DZ8	893.00	90	<b>mj</b> 5.00	892.69	904.9	99				
KFM02A Tunnels: Lineament and/or	DZ8 - B4.	893.00	90	<b>mj</b> 5.00	892.69	904.9	99			2	
KFM02A Tunnels: Lineament and/or seismic indications:	DZ8 - B4.	893.00	90	<b>mj</b> 5.00	892.69	904.9	99			3	
KFM02A Tunnels: Lineament and/or seismic indications:	DZ8 - B4.	893.00	909 909	5.00	892.69	904.9	99			3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis	DZ8 - B4. mic reflecto	893.00 or B4, the posit	MODE	ELLING PF	892.69 ROCEDURE space has bee	904.s	d from	Cosr	na et al. (2003).	3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against	DZ8 B4. DIC reflecto ZFMWNW0	893.00 or B4, the positi 001, ZFMENE	MODE	ELLING PF alich in 3D s ZFMNE000	892.69 ROCEDURE space has bee 65 and ZFMW	904.5 904.5 en attainee NW0123.	d from 0 Deforr	Cosr	na et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m alo	DZ8 - B4. mic reflecto ZFMWNW0 ong DZ8 (8)	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	909 MODE tion of wh 50062A, 2 (FM02A.	ELLING PF bich in 3D s ZFMNE000	892.69 ROCEDURE space has bee 65 and ZFMW	904.5 904.5 en attained NW0123.	d from t Deforr	Cosr	na et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m alo No figure available.	DZ8 - B4. mic reflecto ZFMWNW0 ong DZ8 (8)	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	<b>MODE</b> tion of wh E0062A, <i>X</i> FM02A.	ELLING PF	892.69 ROCEDURE space has bee 65 and ZFMW	904.s 904.s n attained NW0123.	d from d Deforr	Cosr	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ale No figure available.	DZ8 B4. mic reflecto ZFMWNW0 ong DZ8 (80	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	MODE tion of wh 50062A, 2 (FM02A.	ELLING PF	892.69 ROCEDURE space has bee 65 and ZFMW	904.s 904.s en attained NW0123.	99 d from ( Deforr	Cosr	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ale No figure available.	DZ8 B4. mic reflecto ZFMWNW0 ong DZ8 (80	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	MODE tion of wt 50062A, 2 FM02A.	ELLING PF nich in 3D s ZFMNE000	892.69 ROCEDURE space has bee 65 and ZFMW	904.s 904.s en attained NW0123.	d from ( Deforr	Cosr	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category	DZ8 B4. mic reflecto ZFMWNW0 ong DZ8 (8:	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	MODE tion of wh 50062A, 2 FM02A.	ELLING PF aich in 3D s ZFMNE000 CONFIDEI	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA	904.s 904.s en attained NW0123.	99 d from 0 Deforr	Cosr	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATION	DZ8 B4. mic reflecto ZFMWNW0 ong DZ8 (8:	893.00 or B4, the positi 0001, ZFMENE 93-905 m) in K C	MODE tion of wh 50062A, J FM02A.	ELLING PF aich in 3D s ZFMNE000 CONFIDEI	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA	904.s 904.s en attained NW0123.	d from t	Cosr	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATION Data source	DZ8 B4. mic reflecto ZFMWNW0 ong DZ8 (8:	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K C	MODE tion of wh 20062A, 2 FM02A.	ELLING PF aich in 3D s ZFMNE000 CONFIDEI Commer B4, KFM	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA nt	904.s 904.s en attained NW0123.	d from t	Cosr	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp	DZ8 B4. B4. CFMWNW0 Dng DZ8 (8 N N	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	MODE           tion of wh           50062A, 2           FFM02A.           PBJECT           ect CL           2           3	ELLING PF bich in 3D s ZFMNE000 CONFIDEI B4, KFMi High con	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA NCE ODE 102A fidence obser	904.s 904.s n attained NW0123.	d from 0 Deforr	Cosr natio	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp INFORMATION D	DZ8 B4. B4. CFMWNW0 Dng DZ8 (8 N retation ENSITY	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K	MODE ion of wh concert, i FM02A.	ELLING PF sich in 3D s ZFMNE000 CONFIDEI B4, KFM High con	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA NCE ODE 102A fidence obser	904.s 904.s n attained NW0123.	d from ( Deforr	Cosr natio	ma et al. (2003). on zone plane plac	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIO Data source Results of interp INFORMATION DD Number of obse Diatibution of co	DZ8 B4. B4. CFMWNW( ong DZ8 (8: N retation ENSITY rvation point	893.00 or B4, the positi 2001, ZFMENE 93-905 m) in K C Obje	MODE           iion of wh           0062A, j           FM02A.           PBJECT (           ect CL           2           3           1	ELLING PF 5.00 ELLING PF nich in 3D s ZFMNE000 CONFIDEI Commer B4, KFM High con 1 Sincle of	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA NCE ODE DE D	904.s 904.s n attained NW0123.	d from ( Deforr	Cosr natio	ma et al. (2003). on zone plane plac	3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp INFORMATION DI Number of obse Distribution of o INTERPROLATION	DZ8 B4. B4. mic reflecto ZFMWNW( ong DZ8 (8 N retation ENSITY rvation poir pservation	893.00 or B4, the position of	MODE           ion of wh           c0062A, j           iFM02A.           PBJECT (           ect CL           2           3           1	ELLING PF bich in 3D s ZFMNE000 CONFIDEI B4, KFM High con 1 Single ob	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA nt 02A fidence obser	904.s 904.s en attained NW0123. FE	d from ( Deforr (FM02)	Cosr natio	ma et al. (2003). on zone plane plac	3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp INFORMATION DI Number of obse Distribution of o INTERPOLATION Geometry	DZ8 - B4. B4. mic reflecto ZFMWNW( ong DZ8 (8: N retation ENSITY rvation point oservation joint	893.00 or B4, the position of	MODE           ion of wh           condition of	ELLING PF bich in 3D s ZFMNE000 CONFIDEI B4, KFM High con 1 Single ob Geometri	892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  nt  02A fidence obser  pservation poir	904.s 904.s en attained NW0123. <b>FE</b>	d from ( Deforr (FM02)	Cosr natio	ma et al. (2003). on zone plane plac smic reflector.	3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp INFORMATION DI Number of obse Distribution of o INTERPOLATION Geometry Geological indic	DZ8 - B4. B4. mic reflecto ZFMWNW( ong DZ8 (8) N retation ENSITY rvation poir pservation join pservation join ators	893.00 or B4, the position of	MODE           ion of wh           condition of	ELLING PF 5.00 ELLING PF nich in 3D s ZFMNE000 CONFIDEI Commer B4, KFM High con 1 Single ot Geometr Indirect s	892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  nt  02A fidence obser  sservation poir  y supported by upport by deo	904.s 904.s en attainee NW0123. <b>FE</b> vation in k nt at depth y surface physical (	d from ( Deforr CFM02/ a and a geophy data.	Cosr matic	ma et al. (2003). on zone plane plac smic reflector.	3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp INFORMATION DI Number of obse Distribution of o INTERPOLATION Geometry Geological indic EXTRAPOLATION	DZ8 - B4. B4. mic reflecto ZFMWNW( ong DZ8 (8) N retation ENSITY rvation poir pservation   ators	893.00 or B4, the position of	MODE           ion of wh           constant           c	ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI Commer B4, KFMI High con 1 Single ob Geometr Indirect s	892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  nt  02A fidence obser  sservation poir  y supported by upport by geo	904.s 904.s en attainee NW0123. TE vation in k ht at depth y surface physical o	d from ( Deforr CFM02/ a and a geophy data.	Cosr matic	ma et al. (2003). on zone plane plac smic reflector.	3	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATION Data source Results of interg INFORMATION DI Number of obse Distribution of o INTERPOLATION Geometry Geological indic EXTRAPOLATION Dip direction	DZ8 - B4. mic reflecto ZFMWNWO ong DZ8 (8 N retation ENSITY rvation poir pservation join ators	893.00 or B4, the position of	MODE           iion of wh           constant           constant <tdo< td=""><td>ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI Commer B4, KFMi High con 1 Single ob Geometr Indirect s Conceptu</td><td>892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  nt  02A fidence obser  pservation poir  y supported by upport by geo ual constraints</td><td>904.s 904.s 904.s rn attainee NW0123. <b>TE</b> vation in P nt at depth y surface physical o</td><td>A from ( Deforr Deforr (FM02/ a and a geophy data.</td><th>Cosr natio</th><th>ma et al. (2003). on zone plane place smic reflector. Il data.</th><td>3 ced at</td></tdo<>	ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI Commer B4, KFMi High con 1 Single ob Geometr Indirect s Conceptu	892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  nt  02A fidence obser  pservation poir  y supported by upport by geo ual constraints	904.s 904.s 904.s rn attainee NW0123. <b>TE</b> vation in P nt at depth y surface physical o	A from ( Deforr Deforr (FM02/ a and a geophy data.	Cosr natio	ma et al. (2003). on zone plane place smic reflector. Il data.	3 ced at	
KFM02A Tunnels: Lineament and/or seismic indications: Corresponds to seis Terminated against fixed point 903 m ald No figure available. Category INTERPRETATIOD Data source Results of interp INFORMATION DI Number of obse Distribution of o INTERPOLATION Geometry Geological indic EXTRAPOLATION Dip direction	DZ8 - B4. mic reflecto ZFMWNWO ong DZ8 (8 N retation ENSITY rvation poir pservation join ators	893.00 or B4, the position of	MODE           iion of wh           condition o	ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI Commer B4, KFM High con 1 Single ob Geometr Indirect s Conceptu steeply d	892.69  ROCEDURE space has bee 55 and ZFMW  NCE ESTIMA  NCE ESTIMA  O2A fidence obser pservation poir y supported by upport by geo ual constraints ipping zones 2	904.s 904.s 904.s rn attainee NW0123. <b>TE</b> vation in P tat depth y surface physical o . Inferred ZFMWNW	A from ( Deforr Deforr (FM02/ a and a geophy data.	Cosr natio	ma et al. (2003). on zone plane place smic reflector. Il data. against surroundir	3 ced at	
KFM02A         Tunnels:         Lineament and/or seismic indications:         Corresponds to seis         Terminated against fixed point 903 m ald         No figure available.         Category         INTERPRETATION         Data source         Results of interp         INFORMATION DI         Number of obse         Distribution of o         INTERPOLATION         Geological indic         EXTRAPOLATION         Dip direction	DZ8 - B4. mic reflecto ZFMWNW0 ong DZ8 (8 mic reflector STY Tration point Servation joint poservation joint ators	893.00 or B4, the posit 0001, ZFMENE 93-905 m) in K C C Obje nts points	MODE           iion of wh           cooleda, i           cFM02A, i           cFM02A, i           cect CL           2           1           1           2	ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI B4, KFMI High con 1 Single ob Geometr Indirect s Conceptu steeply d ZFMENE	892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  O2A fidence obser  pservation poir  y supported by upport by geo Jal constraints ipping zones 2 0062A, ZFMN	904.9 904.9 904.9 In attainee NW0123. ITE	A from ( Deforr Deforr (FM02/ a and a geophy data.	Cosr natio	ma et al. (2003). on zone plane place smic reflector. Il data. against surroundir IWNW0123,	3 Ced at	
KFM02A         Tunnels:         Lineament and/or seismic indications:         Corresponds to seis Terminated against fixed point 903 m ald         No figure available.         Variable         Category         INTERPRETATION         Data source         Results of interp         INFORMATION DI         Number of obse         Distribution of of         INTERPOLATION         Geological indic         EXTRAPOLATION         Dip direction         Strike direction	DZ8 - B4. mic reflector ZFMWNW0 ong DZ8 (8 DZ8 (8 M N retation ENSITY rvation poin poservation join ators	or B4, the position of the pos	MODE           iion of wh           constant           model           iion of wh           constant           iiion of wh           constant           iiiion of wh           iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI CONFIDEI B4, KFM High con B4, KFM High con 1 Single ob Geometr Indirect s Conceptu steeply d ZFMENE Conceptu steeply d	892.69  ROCEDURE  space has bee 65 and ZFMW  NCE ESTIMA  O2A fidence obsen  pservation poir y supported by upport by geo Jal constraints ipping zones 2 ioneg zones	904.9 904.9 904.9 904.9 In attained NW0123. IFE	A from ( Deforr Deforr (FM02/ a and a geophy data. (0001, truncat	Cosr natio	ma et al. (2003). on zone plane plan smic reflector. Il data. against surroundir IWNW0123, against surroundir	3 ced at	
KFM02A         Tunnels:         Lineament and/or seismic indications:         Corresponds to seis         Terminated against fixed point 903 m ald         No figure available.         Category         INTERPRETATION         Data source         Results of interp         INFORMATION DI         Number of obse         Distribution of o         INTERPOLATION         Geological indic         EXTRAPOLATION         Dip direction         Strike direction	DZ8 - B4. mic reflector ZFMWNW0 ong DZ8 (8: DZ8 I mic reflector Tration point pservation point ators I	893.00  or B4, the posit 0001, ZFMENE 93-905 m) in K  C C Obje  nts points	MODE           mode           ion of wh           condex           condex           ion of wh           condex           condex           ion           i	ELLING PF 5.00 ELLING PF hich in 3D s ZFMNE000 CONFIDEI CONFIDEI B4, KFM High con B4, KFM High con B4, KFM High con Conceptu steeply d ZFMENE Conceptu steeply d ZFMENE	892.69 ROCEDURE space has bee 65 and ZFMW NCE ESTIMA NCE ESTIMA 02A fidence obsen y supported by upport by geo ual constraints ipping zones 2 0062A, ZFMN val constraints ipping zones 2 0062A, ZFMN	904.9 904.90	A from ( Deforr Deforr (FM02/ a and a geophy data. (0001, truncat (0001,	Cosr natio	ma et al. (2003). on zone plane place smic reflector. Il data. against surroundir IWNW0123, against surroundir IWNW0123,	3 ced at	





G	Z	ZFMB5-e		Version number	3	Total object CL	11		
GEOLOGICAL	CHARACTE	ER	Property CI						
Deformation style:	Brittle		1						
Deformation	No data av	ailable.							
description:									
Alteration:			_						
- First order:	Not observ	ed	_						
- Second order:	Not observ	ed	_						
- Third order:	Not observ	ed	-	-					
and type:	No data av	ailable.							
Fracture comment:	No data av	ailable.	_						
Fracture fill	No data av	ailable.							
mineralogy:		TOV		No fia	iure a	available			
OBJI Striko/dip:					,				
Length:	-								
Mean thickness	- 15 m (6 - 3	2 m)							
Max depth:	-2100 m	2 111)		-					
Geometrical	ZEMWNW	0001. ZEMNE0	065.						
constraints:	ZFMNNWC	823. ZFMWNV	V0023.						
	Topo 40m	grid Max error	20m.						
		-							
		BAS	IS FOR MOD	ELLING					
Corresponds to seismic ref ZFMNE0065.	flector B5, wh	nich has been d	livided into tw	o separate segment	ts east an	d west of zone			
Outeranet									
Outcrops: -									
Borenoles: -									
Tunnels:	-								
Lineament and/or	B5.						•		
seismic indications:							3		
MODELLING PROCEDURE									
Corresponds to seismic ref	flector B5, wh	nich has been d	livided into tw	o separate segment	ts east an	d west of zone			
ZFMNE0065. The position the model volume with term	of the reflect nination agai	or in 3D space nst ZFMWNW0	has been att 0001, ZFMWN	ained from Cosma e NW0023, ZFMNE006	t al. (2003 65, ZFMN	<ol> <li>Modelled to the b NW0823 and</li> </ol>	base of		
ZFMNNW0101 in the easter	ern segment;	and ZFMNNW	0101 and ZF	MNE0065 in the wes	stern segr	nent.			
No figure available.									
		OBJECT	CONFIDENC	E ESTIMATE					
Category		Object CL	Comment						
		4	Dr						
Data source	-	1	B5	l'ideana la seleccia en fluctere DE					
	n V	3	High confide	ence in seismic refie	CTOF B5.				
INFORMATION DENSIT	1 nointo	1	1						
Distribution of observation	tion points	1	I Single observation point in the form of a seismic reflector						
	tion points	I	Single obse		UTTE UT a S				
Geometry		1	Geometry	upported by surface	deonhyei	cal data	———		
Geological indicators		1	Indirect supported by surface geophysical data.						
EXTRAPOLATION			manoot sup	goophysical			———————————————————————————————————————		
Dip direction			Extrapolate	d based on informati	on from s	eismic reflector B5.			
		1	Truncated b	y steeply dipping zo	nes ZFM	WNW0001, ZFMNE	0065,		
Strike direction		2	Conceptual	constraints. Truncat	ed by ste	eply dipping zones			
L		2	ZFMWNW0	001, ZFMNE0065, Z	FMNNW	0823, ZFMWNW002	23.		
		FRAC	CTURE CHAI	RACTER					
	c	1	vo data availa	adie					
	3	N	No data avail	able					

G	Z	ZFMB5-w		Version number	4	Total object CL	11		
GEOLOGICAL	CHARACTE	ER	Property CL		•				
Deformation style:	Brittle		1						
Deformation	No data av	ailable.		7					
description:									
Alteration:	Natabaam	د ما	_						
- First order:	Not observ								
- Second order:	Not observ	ed	-						
Fracture orientation	No data av	eu ailahle							
and type:	No data av								
Fracture comment:	No data av	ailable.							
Fracture fill	No data av	ailable.							
mineralogy:				No fig	uire :	availahle			
OBJI	ECT GEOME	TRY		i no ng	juici				
Strike/dip:	58°/18°								
Length:	-	<b>0</b> )							
Mean thickness:	15 m (6 - 3	2 m)							
Max deptn:	-1992 m		0065						
Geometrical		1001, ZFIMINE(	JU65, n grid Max						
constraints.	error 20m	1 UNIVERSE	Planar						
	Cut(s).		i lanai						
		BAS	IS FOR MOD	ELLING					
Corresponds to seismic ref	lector B5, wh	hich has been o	divided into tw	o separate segmen	ts east an	d west of zone			
ZFMNE0065.									
	1								
Outcrops: -									
Dorenoies: -									
Tunnels:	I _								
Lineament and/or	B5								
seismic indications:	20.						3		
MODELLING PR				CEDURE					
Corresponds to seismic ref	lector B5, wh	hich has been o	divided into tw	o separate segmen	ts east an	d west of zone			
ZFMNE0065. The position	of the reflect	or in 3D space	has been att	ained from Cosma e	t al. (200	<ol><li>Modelled to the b</li></ol>	ase of		
the model volume with tern	nination agaii	nst ZFMWNW	0001, ZFMWN	W0023, ZFMNE006	65, ZFMN	NW0823 and			
ZFMINNW0101 in the easter	ern segment;	and ZEMINNN	/0101 and ZF	MINE0065 in the we	stern segi	ment.			
No figure available.									
			CONFIDENC						
		OBJECT	CONFIDENC	EESTIMATE					
Category		Object Cl	Comment						
INTERPRETATION			Comment						
Data source		1	B5						
Results of interpretatio	n	3	High confide	idence in seismic reflector B5.					
INFORMATION DENSITY	Y								
Number of observation	points	1	1						
Distribution of observation	tion points	1	Single obse	servation point in the form of a seismic reflector.					
INTERPOLATION									
Geometry		1	Geometry s	supported by surface geophysical data.					
Geological indicators		1	Indirect sup	port by geophysical	data.				
EXTRAPOLATION			For the	dhaaad 14 - 1					
Dip direction		1	Extrapolate	a pased on informati	ion from s	eismic reflector B5.	0101		
Strike direction			Concentuel	against ZEMWNW0	1001, 2HN	INEUU65, ZEMINNW	0101.		
		2		5 ZEMNNIMA101	ateu ayall	$131 \angle 1100000000000000000000000000000000$			
				$, \perp $ within volume.					
		FRA	CTURE CHAP	RACTER					
			No data availa	able					
INDIVIDUAL INTERCEPTS	S								
			able						

G		ZFMB6		Version number	3	Total object CL	11	
GEOLOGICAL	CHARACTE	ER	Property CL					
Deformation style:	Brittle		1					
Deformation	No data av	ailable.						
description:								
Alteration:								
- First order:	Not observ	ed						
- Second order:	Not observ	ed						
- Third order:	Not observ	ed						
Fracture orientation	No data av	ailable.						
and type:								
Fracture comment:	No data av	ailable.						
Fracture fill	No data av	ailable.						
mineralogy:			1	No fio	iure a	available		
OBJ Strike/dim		IRY						
Strike/dip:	32-/32-							
Length: Mean thickness:	- 15 m (6 - 2	2 m)		-				
Max dopth:	2100 m	2 111)		-				
Geometrical	-2100 m		N/0823					
constraints:	ZEMNEOOR	55 ZEMWNW(	1023					
oonstraints.	21 1011 12000	, 21 Million (1970)	020.					
	1	BAS	IS FOR MOD					
Corresponds to seismic ref	lector B6, the	e position of wh	hich in 3D spa	ce has been attaine	d from Ba	alu and Cosma (200	5).	
					a		0).	
Outcrops:	-							
Boreholes: -	•							
Tunnels:	-							
Lineament and/or	B6.						3	
seismic indications:		MOD						
			LLING PRO		al frame Di	alu and Caama (200	<u></u>	
Modelled to the base of the	nector B6, the	e position of wr	nich in 3D spa			alu and Cosma (200	5). .d	
7EMNNW0823			allon against		VIVVINVVUC	23, ZEWINE0005 an	u	
No figure available.								
		OBJECT						
Category		Object CI	Comment					
INTERPRETATION		0.0,000.02						
Data source		1	B6					
Results of interpretatio	n	3	High confide	idence in seismic reflector B6				
INFORMATION DENSIT	Y	J. J	- ingit eetina		0.0. 20.			
Number of observation	points	1	1					
Distribution of observa	tion points	1	Sinale obse	bservation point in the form of a seismic reflector.				
INTERPOLATION								
Geometry		1	Geometry s	y supported by surface geophysical data.				
Geological indicators		1	Indirect sup	upport by geophysical data.				
EXTRAPOLATION			•					
Dip direction			Extrapolate	d based on informati	ion from s	eismic reflector B6.		
		1	Truncated b	y steeply dipping zo	nes ZFM	WNW0001, ZFMNE	0065,	
			ZFMNNW0	823, ZFMWNW0023	i.			
Strike direction		2	Conceptual	constraints. Truncat	ted by ste	eply dipping zones		
L		2	ZFMWNW0	001, ZFMNE0065, Z	ZFMNNW	0823, ZFMWNW002	23.	
		FRAG	No data arri					
	e		NO GATA AVAIL	aule				
	0		No data avail	able				

G		ZFM	B7		Version	number	5	Total object CL	16
GEOI	LOGICAL CH	ARACTER	Pr	operty	155000	160000	16500	0 170000	
Deformation styl	e: Brittle			3	9				0
Deformation description:	Gently dip-slip reverse dipping shows a strike-s	dipping fault sho and oblique-slip component. Ste faults with SW s a dominant dextr lip with a oblique	ws with a eeply strike ral		6705000 671000	J.	Y	J.J.	6705000 671000
Alteration:	Compor				>	1.1	V/A	ATTA Va	
- First order:	Oxidati	on		2	8 { \	T	SX	MTA	8
- Second order:	Quartz	dissolution		3	82	W AN	X	XV/ VS	000
- Third order:	Not obs	served			19		SI	SU V	67
Fracture orientation and type:	Two se conspic sets str steeply is gentl by seal and par	ts of fractures ar cuous. One of the ikes SSW and di to the WNW, the y dipping. Domir ed followed by o rtly open fracture	e bese bese bese bese bese bese bese be	2	00 6695000				00 6695000
Fracture comme	nt: No data	a available.		2	0006	$\sim$		w	0006
Fracture fill mineralogy:	Calcite mineral hematit laumon present with no	and chlorite. Cla s, pyrite, prehnit e/adularia, epido tite are also loca t. Note also fractu mineral coating/	y e, ote and illy ures filling.		155000	160000 volume DMS e	16500	0 170000 0 2 4 8 Extension Contaction of the low	
	OBJECT	GEOMETRY							
Strike/dip:	1°/20°								
Length:	-								
Mean thickness:	28 m (6	- 32 m)							
Geometrical constraints:	ZFMWI ZFMEN Trunc_l	NW0809A, Trunc IE0401A, ZFMN B7_2.	EB7_1, NE0725,						
Corresponds to seismic reflector B7, the position of which in					ce has bee	en attained fro	m Balu	and Cosma (200	5).
Supported by borehole observations.							Daia		
Outcrops: Boreholes:	-								
		Target in	tercept		Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	Con	nment	
KFM06A	DZ4	318.00	358.00	3	21.08	346.20	ZFN	IENE0060A also rsects DZ4.	
KFM06C	DZ2	359.00	400.00	3	59.17	401.62			
Tunnels:	-								
Lineament and/o seismic indications:	or B7.								2
Corrospondo to a	niomio roflacto	pr D7 the peoiltin				n ottoined fre	m Dolu	and Coome (200)	5)
Terminated agains m along DZ4 (318 ZFMENE0060A is	Corresponds to seismic reflector B7, the position of which in 3D space has been attained from Balu and Cosma (2005). Terminated against ZFMWNW0809A, ZFMNNE0725 and ZFMENE0401A. Deformation zone plane placed at fixed point 323 m along DZ4 (318-358 m) in KFM06A and at 361 m along DZ2 (359-400 m) in KFM06C. The steeply dipping zone ZFMENE0060A is also modelled to intersect DZ4 in KFM06A. Zone ZFMB7.						oint 323		



Category	Object CL	Comment
INTERPRETATION		
Data source	2	B7, KFM06A, KFM06C
Results of interpretation	3	High confidence observation in KFM06A and KFM06C.
INFORMATION DENSITY		
Number of observation points	2	2
Distribution of observation points	1	C. 250 meter between obs. points.
INTERPOLATION		
Geometry	3	One strong interpolation alternative.
Geological indicators	2	Some discrepancies in the geological data.
EXTRAPOLATION		
Dip direction		Extrapolated based on information from seismic reflector B7.
	1	Terminated against ZFMWNW0809A, ZFMENE0401A and
		ZFMNNE0725. Open ended in down-dip direction.
Strike direction		Extrapolated and modelled based on information from seismic
	2	reflector B7. Terminated against ZFMWNW0809A, ZFMENE0401A
		and ZFMNNE0725.








G	ZFMB8		Version number	6	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Defermation at day	Deittle	CL				
Deformation style:	Brittle	3	0000			0000
Deformation description:	No data avallable.		5710	5	$\sim$	3710
Alteration:					N KZ	U U
- First order:	Not observed		$\sim$	1	1 LJ S	-
- Second order:	Not observed	1	00 7	-1	11/15	2 8
- Third order:	Not observed		102	1 -	A A A A	705(
Fracture orientation and	No data available.		° R	1	THAN S.	9
type:			2.11		AHA NE	
Fracture comment:	No data available.		00 {	XXX	VIIA 15	8
Fracture fill mineralogy:	No data available.		2002		AL IS	2000
OBJE	CT GEOMETRY		io X		X V	9
Strike/dip:	17°/25°			TAN		
Length:	519 m		8	X	AX/	8
Mean thickness:	6 m (6 - 32 m)		0360	1 ales	$\sqrt{1}$	9501
Max depth:	-826 m	_	99	112		66
Geometrical	ZFMWNW0137, ZFMENI	E2320,		R	Any more	
constraints:	ZFMNNW0100, Topo 40	m grid Max			S inneres	0
	Trupo B8 PUB25 1 UN		DDÓG	$\bigvee$	w	0000
	Planar Cut(s)	IVERSE	666			666
			155000 160000	) 165	5000 170000	20.50
			Medel volume DMS		0 7 4 8	N
			Baseline		d Lattratevel Goddaneer-volue	A
	BASI	S FOR MOD				
Corresponds to seismic refle Supported by a borehole ob	ector B8, the position of where the servation.	ich in 3D spa	ace has been attaine	ed from C	osma et al. (2006).	
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	B8.					3
seismic indications:						Ŭ
	MODE	LLING PRC	CEDURE			
Corresponds to seismic fem			ACE has been allaine		osma et al. (2006). o rock domain PEM	125
Modelling takes account of	a fixed point intersection at	317  m along	horehole interval 3	16-322 m	in DRT1/KFK001 an	d the
results from the drilling of H	FM31, where the zone was	not intersed	ted. Zone is modelle	d to lie cl	ose to the base of bo	orehole
KFM07A. The position of bo	orehole DBT1/KFK001 is un	certain. Zon	e ZFMB8 is.			
					120.	
	1 1 1 1 1 1 1 1					
		ZFMWNW0137	Solution			
		A COMPANY	Sand S			
	ZEM	R8		$\checkmark$		-
						1160
					29441	
		INEORIO CONTRACTOR		and all		
		U		and the second		
	ee la					
				And Contraction of the second		
				<_X		
	279441	WINWTOOS	: I Kan	Jan		
			the state			
			and a state	J James		
		ZFMENE1200				
	0 100 200 300 500 m	m	2 km			
			THURSTAND	-		

G		ZFMB8	B8Version number6Total object CL1								
<b>OBJECT CONFIDENCE EST</b>	IMATE										
Category		Object CL	ct CL Comment								
INTERPRETATION											
Data source		1	B8								
Results of interpretation		3	High confidence in seismic reflector B8.								
INFORMATION DENSITY											
Number of observation po	pints	1	1								
Distribution of observatior	n points	1	Single observation point in the form of a seismic reflector.								
INTERPOLATION											
Geometry	1	Geometry supported by surface geophysical data.									
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		1	Extrapolate Truncated ZFMENE2 ZFMWNW0	ed based on informat by steeply dipping zo 320. Constrained by 0137 ZFMEW0137, 2	tion from ones ZFN KFM07A ZFMENE	seismic reflector B8. INW1200, ZFMNNW in ENE and HFM31 2320.	′0100, in NW.				
Strike direction		1	Extrapolated and modelled based on information from seismic reflector B8. Truncated by steeply dipping zones ZFMNW1200, ZFMNNW0100, ZFMENE2320. Constrained by KFM07A in ENE and HFM31 in NW. ZFMWNW0137 ZFMEW0137, ZFMENE2320.								
	No data available										
INDIVIDUAL INTERCEPTS											
			No data avai	lable							

G		<b>ZFME1</b>		Version number	3	Total object CL	10			
GEOLOGICAL	CHARACTE	ER	Property							
Deformation style:	Brittle		1							
Deformation	No data av	ailable.								
description:										
Alteration:										
- First order:	Not observ	ed								
- Second order:	Not observ	ed								
- Third order:	Not observ	ed		-						
Fracture orientation and type:	No data av	ailable.								
Fracture comment:	No data av	ailable.								
Fracture fill	No data av	ailable.								
mineralogy:				<ul> <li>No figure available</li> </ul>						
OBJ		TRY								
Strike/dip:	299°/12°			_						
Length:	-	0)								
Mean thickness:	15 m (6 - 3	2 m)		-						
Max depth:		102 ZEMNIEC	065	-						
constraints:		123, ZFIVINEU	,005,							
constraints.		JUZA.								
		BAS								
Corresponds to seismic ref	flector E1, the	e position of wh	nich in 3D spa	ace has been attaine	d from Co	osma et al. (2003).				
Outoropoi										
Borobolos:	-									
Dorenoles										
Tunnels:	-									
Lineament and/or	E1.						0			
seismic indications:							2			
		MODE	ELLING PRO	CEDURE						
Corresponds to seismic ref	flector E1, the	e position of wh	nich in 3D spa	ace has been attaine	ed from Co	osma et al. (2003). N	/lodelled			
to the base of the model vo	plume with te	rmination agair	nst ZFMWNW	/0123, ZFMNE0065	and ZFM	ENE0062A.				
No figure available										
		OBJECT	CONFIDENC	E ESTIMATE						
		Object CL	Comment							
		1	<b>F</b> 4							
Data source	~	1	E1 Madium aar	fidance in eciemie r	ofloator F	4				
	V	2				1.				
Number of observation		1	1							
Distribution of observation	tion points	1	I Single obse	ruption point in the f	orm of a c	oismic rofloctor				
	tion points	I	Single ubse							
Geometry		1	Geometry s	upported by surface	aponhysi	cal data				
Geological indicators		1	Indirect sup	nort by geophysical	data					
EXTRAPOLATION		1								
Dip direction			Extrapolate	d based on informati	ion from s	eismic reflector E1.				
			Truncated b	y steeply dipping zo	nes ZFM	WNW0123, ZFMNE	0065.			
		1	Open ender	in downdip directio	n. ZFMEN	NE0062A. Constrain	ed by			
			KFM07A in	ENE and HFM31 in	NW. ZFN	WNW0137 ZFMEW	/0137,			
			ZFMENE23	20. Constrained by	KFM07A i	n ENE and HFM31	in NW.			
Strike direction		2	Conceptual	constraints. Truncat	ted by ste	eply dipping zones				
		-	ZFMWNW0	123, ZFMNE0065. Z	FMENEC	062A.				
		FRAG		AUIER						
	c		no data avalla	aue						
	•		No data availa	able						

ENE		ZFMENE	0060	)A	Version	number	3	Total object CL	22
GEC	DLOGICAL CH	IARACTER		Propert	<b>y</b> 155000	160000	16	5000 170000	
Deformation st	vle: Brittle			3	0				0
Deformation description:	yre: Bittle Two ste SW stri mover faults s or oblig shows with mo show re with ste dip-slip	eeply dipping fau ke show oblique eent with dominar lip component S tal fault shows d eent. Steep NE-S how strike-slip, c ue- slip. One fau dextral strike-slip oderate dip to no everse dip-slip. F eep dip to south s or dextral strike-	Its with nt ub- ip-slip W lip-slip It . Fault rth caults show -slip.	3	6700000 6705000 6710000	J.	5		6700000 6705000 671000
	Steep I	NNW faults show	, ue-slin		95000	All -	Mes -	X	95000
Alteration:	1070130		ue onp.		66	1	12		669
- First order:	Oxidati	on		3				2 A Demander	
- Second order	Cuartz	dissolution			000		$\mathbf{X}$	Wind	000
Fracture orientation and type:	Two se conspic WSW t dipping followe open fr	ts of fractures ar cuous. Steeply di o SSW and gent . Dominated by s d by open and pa actures.	e pping ly sealed artly		155000 Model Baselir	160000 volume DMS	16	5000 170000	0699 z
Fracture comm	ent: No data	a available.		2					
Fracture fill mineralogy:	Calcite laumon hematii epidote commo	and chlorite, tite, prehnite, te/adularia, quart and clay minera in in both steeply	z, Ils ⁄ and						
	OBJECT	GEOMETRY	·						
Strike/dip:	241°/85	5°							
Length:	3122 m	1							
Mean thickness	s: 17 m (1	<u> 5 - 64 m)</u>							
Geometrical	-21001 ZEMW	NW0809A ZEMI	VW0003	Topo	00				
constraints:	40m gr	id Max error 20m	1. 1.	ropo					
Zone ZFMENE0	060 consists o	f different branch	BASIS nes. Zone	FOR MC	DELLING	eaments su	pported	by borehole observ	ations.
Outcrops:	-								
Boreholes:									
		Target in	ntercept		Geometric	c intercep	t		
Borehole	PDZ	Sec_up [m]	Sec_l	ow s	Sec_up [m]	Sec_lo	w C	omment	
HFM09	DZ1	18.00	28.0	0	5.52	22.96	6		
KFM01C	DZ3	235.00	252.0	00	228.16	250.6	C 2 ir d F 2 a a 2	nly borehole interva 35-252 m and 305-3 cluded in the DZ eterministic modellin ractured rock betwe 52 and 305 m, and nd 450 m inferred to ffected by DZ (cf. Ta in Stephens et al. 2	als 330 m ng. een 330 o be able 3- 2007).
KFM06A	DZ4	318.00	358.0	00	318.49	358.6	8 Z D	FMB7 also intersec	ts
	1								
Lineament and/ seismic indications:	/or MFM00	060, MFM0060G	0.						2

ENE	ZFM	ENE006	60A	Version number	3	Total object CL	22	
MODELLING PROCED	URE				I			
branches are described separately in subsequent property sheets, it should be recalled that these probably constitute elements of one and the same structure. At the surface, zone ZFMENE0060A corresponds to the low magnetic lineaments MFM0060 and MFM0060C0. Modelled to the base of the model volume using the dip estimated by connecting these lineament segments with the borehole intersections 235-252 m in KFM01C (part of D23) and 318-358 m in KFM06A (D24). Deformation zone plane placed at fixed points 247 m and 324 m in KFM01C and KFM06A, respectively. Model implies that this zone also intersects DZ1 in HFM09. The gently dipping zone ZFMB7 is also modelled to intersect borehole KFM06A along D24. For this reason, there are some difficulties to separate the influence of zones ZFMENE0060A and ZFMB7 along this borehole interval.								
		OBJECT	CONFIDENC	EESTIMATE				
Category		Object CL	Comment					
INTERPRETATION								
Data source		2	MFM0060G	0, HFM09, KFM01C	, KFM06A			
Results of interpreta	ition	3	High confide	ence observation in l	KFM06A, I	KFM01C.		
INFORMATION DENS	ITY		_		,			
Number of observati	ion points	3	4					
Distribution of obser	vation points	3	Even distrib	ution of obs naints				
		5		ation of obs. points.				
Coometry		2	One atron -	internalation alternat	ivo			
Geometry		3	One strong	interpolation alternat	ive.			
Geological indicators	S	2	Some discr	epancies in the geolo	ogical data	l.		
EXTRAPOLATION								
Dip direction		3	Extrapolate modelled zo	d to the base of the r one > 2000 m.	nodel volu	ime. Strike length c	of the	
Strike direction		3	Conceptual zone is sup	understanding of the ported by lineament.	e site and	that the entire mod	elled	







ENE		ZFMENE	0060	)B	,	Version I	number	3	Total object CL	15
GEOL	OGICAL CI	GICAL CHARACTER				155000	160000	) 1	65000 170000	
Deformation style	e: Brittle			CL 3	-	0				0
Deformation description:	Two st SW str Moven strike-s horizon moven faults s or oblic shows with m show r with st dip-slip Steep	eeply dipping fau ike show oblique nent with domina slip component S ntal fault shows d nent. Steep NE-S show strike-slip, o que-slip. One fau dextral strike-slip oderate dip to no everse dip-slip. F eep dip to south so or dextral strike NNW faults show	Its with nt ub- lip-slip W dip-slip Jt b. Fault raults show -slip. /	3		5000 6700000 6705000 671000	2	2		570000 5700000 571000
Alteration:	revers	e dip slip or obliq	ue-slip.			699		All	X	6695
- First order:	Oxidat	ion		2		1	/	R.	and the second	
- Second order:	Not ob	served		3		8			Land manual	8
- Third order:	Not ob	served			0059		$\sim$	· We	10069	
orientation and type:	conspi sets st steeply is sub- that stu to the	cuous. One of the rikes SSW and d / to the WNW, the horizontal. Fractu- rike NS and dip s east are also pres	e ese ips e other ures teeply sent.	2		155000 Model v Baselin	160'000 volume DMS e	) 1	55000 170000 •	<sup>Q</sup> Ref
Fracture commen	nt: No dat	a available.								
Fracture fill	No dat	a available.								
mineralogy:										
Strike/dip:	0BJEC 236º/7	B°								
Length:	1069 r	n								
Mean thickness:	15 m (	3 - 50 m)								
Max depth:	-644 m	1								
Geometrical	ZFME	NE0060A, ZFMW	/NW0809	А, Тор	0					
constraints:	40m g	rid Max error 20m	n. BASIS							
Zone based on su splay to ZFMENE	rface lineam 0060A.	ents supported b	y boreho	le obse	ervation	s. Model	led to the	base of	the model volume a	is a
Outcrops:	-									
Boreholes:	÷									
		Target i	ntercept		Ge	eometric	; intercep	t		
Borehole	PDZ	Sec up [m]	Sec_	low	Sec	սո [m]	Sec_lo	w	Comment	
KFM06A KFM06A	DZ2 DZ3	195.00 195.00	[m 278. 278.	<b>]</b> 00 00	19	5.00 5.00	[m] 236.3 236.3	0	245-260 m added (o Fable 3-2 in Stepher 2007). DZ2 and DZ3 merged. 245-260 m added (o Fable 3-2 in Stepher 2007). DZ2 and DZ3	of. hs et al. of. hs et al.
									merged.	
Tunnels:	-									
Lineament and/o seismic indications:	r MFM0	060G1.			DUDE				1	
At the surface, cou	surface. corresponds to the low magnetic lineam					1 and its	sinferred	continue	ation to the ENE close	se to
MFM0060. Modell lineament segmer two zones along b radar penetration	ed to the bas orehole inte also along th	se of the model v porehole intersect rval 245-260 m).	ion 195-2 Deforma val 267-2	a spla 278 m ii tion zor 70 m.	n KFM n KFM	ZFMENE 06A (DZ2 e placed	E0060A. D 2, DZ3 and at fixed p	Dip estin d less fr oint 221	nated by connecting actured rock betwee m in KFM06A. Dec	these in these reased

ENE	ZFM	ENE006	<b>0</b> B	Version number	3	Total object CL	15			
	2 MENE0060A AMENE0060A AMMARA000 AMMARA00 AM		SEMMANNIZ ZF ZFM	MENE006	OB	MNE0808C	C			
		OBJECT (	CONFIDENC	EESTIMATE						
Category		Object CL	Comment							
INTERPRETATION										
Data source Results of interpre	etation	2	MFM0060G High confide	0, HFM09, KFM010 ence observation in	2, KEM064 KEM06A	A KFM01C				
INFORMATION DEI	NSITY	J								
Number of observ	ation points	2	4		• .					
	servation points	1	Less than tw	o subsurface obs.	points.					
Geometry		1	Geometry s	upported by a linear	ment and a	a single intercept.				
Geological indicat	ors	1	Single obser	vation point at dep	th. Zone m	nodelled mainly base	ed on			
			surface geo	ohysical data.						
Dip direction			Extrapolated	to the base of the	model vol	ume. Strike length o	of the			
		2	modelled zo	ne < 2000 m.						
Strike direction		3	Conceptual zone is supp	understanding of th ported by lineament	e site and	that the entire mod	elled			
		FRAC	TURE CHAF	ACTER						
Orientation:	Set SSW: 210.1	l°/89.3°		ZFME	ENE0060B	L				
(strike/dip right- hand-rule)	Set G: 122.0°/3	.8°		1 met	N	~				
Frequency:	Boreholes: KFM	106A	1							
	FRACTURE	TERZAGHI-		f		1				
	TYPE	WEIGHED				Y				
	Open and	16 m-1	-			F				
	partly open			1.1		. 1				
	Sealed	9.1 m-1		10 C		•].	<u></u>			
	Sealed	2.9 % of DZ	VV-			· · · ·	-			
	Crush	0.1 % of DZ	4.		887 A.	• •				
		intercept	4			1				
				1.						
				1.		1.37				
				X						
						Equal a	area			
			• Unas	signed (109)	Ś	Lower nemispi				
			Set S     Set G	SW (231) 🛕 Mean (134) 🔺 Mean	pole Set SSV pole Set G (2	V (120.1/0.7) Fisher κ = 32.0/86.2) Fisher κ = 39	13.2 6			
RQD:	min:80, max:10	0, mean:99								







ENE	ZFMENE006	0 <b>C</b>	Version number	3 Total object CL	5
GEOLOG		Property	155000 160000	165000 170000	
Deformation style:	Brittle	CL			
Deformation style: Deformation description:	Two steeply dipping faults with SW strike show oblique movement with dominant strike-slip component Sub- horizontal fault shows dip-slip movement. Steep NE-SW faults show strike-slip, dip-slip or oblique- slip. One fault shows dextral strike-slip. Fault with moderate dip to north show reverse dip-slip. Faults with steep dip to south show dip-slip or dextral strike-slip. Steep NNW faults show reverse dip or oblique-slip.	3	5000 670000 6705000 6710000	COCCUTA 6000 6700000 670000 670000 670000 670000 670000 670000 670000	
Alteration:			89	90	
- First order:	Oxidation	3	24	A B man	
- Second order:	Not observed		8	X hard B	
Fracture orientation and type: Fracture comment: Fracture fill mineralogy:	Two sets of fractures are conspicuous. One of these sets strikes SSW and dips steeply to the WNW, the other is sub-horizontal. Fractures that strike NS and dip steeply to the east are also present. Dominance of sealed fractures. Open fractures significant in the sub horizontal set. Mean value and span include sealed fracture networks and crushed rock. No data available. Calcite and chlorite in both steeply and gently dipping fractures. Hematite/adularia, quartz and prehnite	2	Baseline		
Strike/dip: Length: Mean thickness: Max depth: Geometrical constraints:	predominantly in steeply dipping fractures but also in gently dipping fractures. Clay minerals predominantly in gently dipping fractures but also in steeply dipping fractures. <b>OBJECT GEOMETRY</b> 243°/75° 1156 m 21 m (3 - 50 m) -594 m ZFMENE0060A, Topo 40m grid 20m.	Max error			

ENE		ZFMENE	<b>20060C</b>	Version	number	3	Total object CL	15
BASIS FOR MC	DELLING						1	
Zone based on ZFMENE0060A	surface lineam	ents and a bore	nole observatior	n. Modelled to th	e base of the	mode	el volume as a splay	r to
Outcrops:	-							
Boreholes:								
		Target i	ntercept	Geometric	c intercept			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	С	omment	
KFM01C	DZ3	305.00	330.00	304.27	329.14	C 2: in di F 2: a: a: 2	nly borehole interva 35-252 m and 305-3 icluded in the DZ eterministic modellin ractured rock betwe 52 and 305 m, and nd 450 m inferred to ffected by DZ (cf. Ta in Stephens et al. 2	als 330 m ng. een 330 o be able 3- 2007).
Tunnels:	-							
Lineament and seismic	/or MFM22	281G.						2
indications.			MODELLING	PROCEDURE				
At the surface, of the base of the in and its extension point 312 m in k	corresponds to model volume a n with the bore (FM01C.	the low magneti as a splay from 2 hole intersection	c lineament MF ZFMENE0060A 1 305-330 m in k	M2281G and its . Dip estimated b KFM01C (part of	inferred conti by connecting DZ3). Deform	nuatio linea natior	on to the WSW. Mo ment segment MFN a zone plane placed	delled to /2281G at fixed
ZEMNWOOT		2 FME 2 Z F 200 300 300		A GOC ZFMWNW0123		Z.	TEMMUL MENE0061 ZFMENE2254 ZFMENE1192A ZFMENE0060A	

ENE	ZFM	ENE006	50C	Version number	3	Total object CL	15
OBJECT CONFIDEN	CE ESTIMATE						
Category		Object CL	Comment				
INTERPRETATION							
Data source		2	MFM0060G	61, KFM06A			
Results of interpre	etation	3	High confid	ence observation in h	KFM06A.		
INFORMATION DEI	NSITY	-	-				
Number of observ	ation points	2	2		-1-1-		
	servation points	1	Less than t	wo subsurface obs. p	oints.		
		1	Coomotry	upported by a linear	ont and a	aingle intercent	
Geometry Ceological indicat		1	Geometry s	supported by a linear	ient and a	a single intercept.	ad an
Geological Indical	1015	1	Single Obse	nhysical data	I. Zone m		eu on
EXTRAPOLATION			Sunace gee				
Dip direction			Extrapolatio	on in dip direction sur	ported by	subsurface obs	oint
Dip direction		2	Strike lengt	h of the modelled zor	1e < 2000	m.	01111.
Strike direction		0	Conceptual	understanding of the	site and	that the entire mod	elled
		3	zone is sup	ported by lineament.			
				· · · ·			
		FRA	CTURE CHA	RACTER			
Orientation:	Set SW: 235.5°	/80.8°		ZFMEI	VE0060C	5 · · · · · · · · · · · · · · · · · · ·	
(strike/dip right-	Set G: 39.4°/11	.7°			N		
hand-rule)			_			4	
Frequency:	Boreholes: KFN	101C					
		TEDZAOLU	1	1			
	TYPE			1		. <	
				1		Y	
	Open and	7.1 m-1				t is the second se	
	partly open	7.11111	/				
	Sealed	29.5 m-1	1	100 C 100 C 100 C	417 .	· · · F	
	Sealed	11.0 % of	W-		· · ·	i -1	<b>E</b>
	network	DZ				1 1 1 mar 1	
		intercept	1				
	Crush	0.0 % of DZ	1				
		intercept		\			
				1		/	
				$\mathbf{h}$		1	
						A. 19	
				·		Equal a	area
			• Unas	ssigned (138)	S	Lower nernispi	licite
			• Set 9	SW (172) 🔺 Mean	pole Set SW	/ (145.5/9.2) Fisher κ =	12.6
			• Set (	G (73) 🔺 Mean	pole Set G	309.4/78.3) Fisher $\kappa = 2$	18.8
RQD:	min:72, max:10	0, mean:94					
Fracture fill							
mineralogy:			K	FM01C(305.0-330.0)			-
						Open and partly ope	en
	200 -					Sealed	
	8						
	2 150 -						
	uno						
	0 100 J						
	100						
	NUN						
	50 -				-		
		_					
	o <u> </u>						-
	Aularia	alone monte mero	coldote mainte	wonthe menal avail of	Me Alue	quart ninera teolife	
	20.	10 May Mi	to they	aun alten dites pre		own	
		U.		ALCIAN OF		UNKI	
			.0	OF.			
			4				



ENE			ZFMEN	E006	61		Version	number	3	Tot	tal object CL	20
GEO	DLOGIC	CAL CH	ARACTER		Prope	rty	155000	16000	0	165000	170000	
Deformation st		Brittla			3							0
Deformation	yie.	Steenly	dipping faults w	ith	5		000			~		0000
description:		WSW. E	ESE and SW stri	ke all			671	5		1	h some	671
		show st	rike-slip displace	ement.				<	V	11	1 1 2	1.1
		Steeply	dipping fault wit	h			a landa	R	/		123/1	2
		NNW st	rike shows dip-s	lip			000	1		NI	141	5 00
		displace	ement.	•			102	M	1	XI	XI IN	105
Alteration:							a Re		X	IT	AN	(Alternational)
- First order:		Oxidatio	on		3		2	11	_	XA	HA N	L'er
- Second order	:	Not obs	erved		5		8					5 8
- Third order:		Not obs	erved				000 2	W X		$\langle \rangle \rangle \langle \rangle$		000
Fracture	e Steeply dipping fractures with						19		450	A H	UV	67
orientation and	rientation and WSW and SSW strike dominates. Dominance of							X	2AL	DAX.	N	
type:	ype: dominates. Dominance of sealed fractures. Mean value						0	O Sh.	XX	-11	17	0
	sealed fractures. Mean value and span include sealed						1000	1 14-1	1 des	$\leq$	1	500
		and spa	an include sealed	2	2		669	1 1	216	X	2	699
		fracture	networks.				1	1	Tel	Y	Also more	
Fracture comm	ent:	No data	available.					1		~		-
Fracture fill		Calcite,	chiorite, laumor	itite,			000	V	$\backslash$	w		000
mineralogy.		quartz,	a.			9993		~	/	S 10 5	9690	
Strike/din:		250º/85										-
Length:		2431 m					155000	10000	0	105000	170000	20.910
Moan thickness		11 m (3	- 50 m)				155000	16000	0	165000	170000	N
Max denth:	,	-2100 m	n <u>- 50 m</u>				Baselin	volume DMS				A
Geometrical		ZEMNW	V0017 ZEMENE	0060A	Topo 40	m					Cardinal Processing Street Street Street	
constraints:		arid Ma	x error 20m.		1000 101							
		3		BASIS	6 FOR M	ODE	LING					
Zone based on s	surface	lineame	ents supported b	y boreho	ole obser	vatior	ns.					
Outcrops:		-										
Boreholes:												
			Target ir	torcont		G	oomotri	- intorco	nt.			
Borehole	РГ	DZ	raiget i	Sec	low	- 0		Sec	ow	Comm	ent	
201011010			Sec_up [m]	_000 ml		Sec_	up [m]	_000_i	1			
KFM01D	D	Z4	670.00	700.	.00	66	1.78	691.	36			
KFM06A	D	Z8	788.00	810.	.00	78	5.82	806.	36			
Tunnels:		-										
Lineament and/	/or	MFM00	61, MFM0061G									
seismic												2
indications:												
MODELLI						ROCI	EDURE					
At the surface, c	orrespo	onds to t	he low magnetic	lineame	ents MFN	M0061	and MF	M0061G	). Mod	elled to t	he base of the	e model
volume using dip		ated by	connecting linea	ments M		i and		GU With	the bo	renole in	itersections 6	70-700 7 m in
KFM01D and KF	√24) an M06∆	respect	ivelv	(DZO).	Delotitia	αιοΠ Ζ	one pian	e piaced		a points (		/ 111 111
IN NOTE and KE	WOUA,	respect	.iv Ciy.									

ENE	ZFMENE0061	Version number 3	Total object CL 20	)
MENET22088	ZFMENE0190A ZFMENE0190A ZFMENE23200 ZFMENE2325A ZFMENE2325B ZFMENE2325B ZFMENE2325B ZFMENE2325B ZFMENE2325B ZFMENE2325B ZFMENE2325B ZFMENE2325A	NENE2120 TUNE200 TUNE TUNE200 TUNE TUNE200 TUNE TUNE200 TUNE TUNE200 TUNE TUNE200 TUNE	2000 2000 2000 2000 2000 2000 2000 200	
	OBJECT CONFIDENC	EESTIMATE		

Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM2281G, KFM01D, KFM06A
Results of interpretation	3	High confidence observation in KFM01C.
INFORMATION DENSITY		
Number of observation points	2	2
Distribution of observation points	2	Two intercepts and the reflector considered as an outlier. Three
	2	scattered observation points.
INTERPOLATION		
Geometry		Interpreted NE-striking fractures and laumontite perhaps
	2	strengthens interpretation of one strong interpolation geometry,
	2	however west of the last obs. point there is room for the zone to
		follow MFM2074G, MFM0061 or MFM0061G0.
Geological indicators	3	Supported by key geological parameters.
EXTRAPOLATION		
Dip direction	2	Extrapolated to the base of the model volume. Strike length of the
	3	modelled zone > 2000 m.
Strike direction	2	Conceptual understanding of the site and that the entire modelled
	3	zone is supported by lineament.







ENE		ZFMENE	0062A		Version r	number	3	Total object CL	20
GEOLC	GICAL CH	ARACTER	Prop	berty L	155000	160000	1650	000 170000	
Deformation style:	Brittle		3	3	9				0
Deformation	No data	a available.		-	000			$\sim$	000
description:					67	2	F	1 mm	671
Alteration:							2	1 1 2	
- First order:	Oxidati	on				5	1	V M I i	3
- Second order:	Not obs	served		1	2000	1 -	V	NFI	5 000
- Third order:	Not obs	served			670	1	+		010 man
Fracture	Steeply	dipping fracture	s		5		NI	THE	(and the fill
orientation and	domina	ting in NE orient	ation .		5	110-	X	AHAN N	2
type:	Gently	dipping fractures	s are		8		X	VIIA	5 8
	also pre	esent. Dominate	d by		202		KI	(HI)	2000
	sealed	followed by oper	n and 2	2	°			K V	0
<b>F</b>	partly o	pen fractures.				XXX	H		
Fracture comment	NO data	a avallable.	-		8	1 XUV			00
Fracture fill	Chiorite	e, calcite, adulari	a,		1950	1464		XX	950
mineralogy.					99	1 11	X		66
Striko/din:	60º/95º	GEOWETRT					1 h	Any men	
Jongth:	2/20 m				0		X	1 S Income	0
Mean thickness:	14 m (1	5 - 64 m			0000	$\sim$		w	000
Max donth:	-2100 m	n - 04 m			669			N .	666
Geometrical	ZFMW/	NW0123 ZEMW			1.10				
constraints:	40m ar	id Max error 20n	1400001, 10p0 1	,	155000	160000	1650	00 170000	20.900
	.om g					1			N
					Baseline	olume DMS		d Latinitari Latinoversia	A
			BASIS FOR	MODE	LLING				
Zone based on suffa	ace excava	tion, borehole of	oservations and	i surfac	ce lineame	ents.			
Outcrops:	AFM00	1243							
Boreholes:									
		Target in	ntercept	0	Geometric intercept				
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	Co	omment	
HFM25	DZ4	143.00	155.00	14	42.98	187.48			
HFM25	DZ5	169.00	187.00	14	42.98	187.48			
Tunnels:	-								
Lineament and/or	MFM00	62, MFM0062G	0.						
seismic									2
indications:									
			MODELLING	PROC	EDURE				
Zone ZFMENE0062	consists o	f different branch	nes, the most p	romine	nt of whic	n is denoted	ZFMEN	E0062A. Though	the
branches are descri	bed separa	tely in subseque	ent property she	ets, it	snould be	recalled that	these	probably constitute	е
MEMO062C0 and a	a the same	SILUCTURE. AT THE	surrace, corres	sponds	to the low	magnetic lin	leamen	timated by connect	ctina
lineaments MEMOOR	2 and MEN	10062G0 with th	e horehole inte	ise Ui l rsectio	ne 1/12-15	5 m and 160	187 m	in HFM25 (D74 a	and D75
respectively).				130000	13 1-0-10		107 11	11 1 1 WZJ (DZ4 8	

ENE ZFM	ENE006	S2A         Version number         3         Total object CL         20
	062A 200	ZEMAA ZEMENERARE ZEMENERARE ZEMENERARE ZEMENERARE ZEMENERARE ZEMAA
	OBJECT	CONFIDENCE ESTIMATE
Category	Object CL	Comment
INTERPRETATION		
Data source	3	MFM0062G0, HFM25, AFM001243
Results of interpretation	3	High confidence observations in AFM001243.
INFORMATION DENSITY		
Number of observation points	2	3
Distribution of observation points	1	Less than two subsurface obs. points.
		Interpreted NE striking fractures and loumantite perhaps
Geometry	2	strengthens interpretation of one strong interpolation geometry, however west of the last obs. point there is room for the zone to follow MFM2074G, MFM0061 or MFM0061G0.
Geological indicators	3	Supported by key geological parameters.
EXTRAPOLATION		
Dip direction	3	Extrapolated to the base of the model volume. Strike length of the
	5	modelled zone > 2000 m.
Strike direction	3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.

ENE	ZFMENE006	2A Version number	3 Total object CL 20
FRACTURE CHARAC	CTER		
Orientation: (strike/dip right- hand-rule) Frequency:	Set NE: 36.7°/86.4° Boreholes: -	ZFMENEC	0062A
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open0.0 m-1Sealed0.0 m-1Sealed0.0 % of DZ interceptCrush0.0 % of DZ intercept	W Unassigned (87) Sct NE (115) Mean po	Equal area Lower hemisphere
RQD:			
Fracture fill mineralogy:	No data available		





ENE	ZFMENE00	62B	Version number	3	Total object CL	18
GEOLOGICAI	CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation style:	Brittle	1	9			0
Deformation description:	No data available.		671000	5	m m	671000
Alteration:			~ {	Y	11/4	
- First order:	Oxidation	1	0 27	/ _	V W JZ	
- Second order:	Not observed		m 200		MM	200
- Third order:	Not observed		670		ANY	670
Fracture orientation and type:	No data available.	-	SIL	X	ALL Con	C40014
Fracture comment:	No data available.	-	000	20X	$\mathbb{Z}$	000
Fracture fill	No data available.		620		JULY / P	6700
mineralogy:	ECT GEOMETRY			ATT	XX Y	
OBJ Striko/dip:			1 K Chill	SP	NY	
Strike/dip.	50 /02		00	XX	AN	000
Length. Moon thickness:	10 m (2, 26 m)		695	A	X	695(
Mean unickness:	10 m (2 - 30 m)		°	14/2	X	60
Max depth:				1 Charles	- And man	
Geometrical	ZFMENE0062A, Topo 40m	n grid ivlax			La Income	0
constraints:	error 20m.		000	$\sim$	w	000
			666	$\langle \cdot \rangle$		699
			155000 160000	16/	5000 170000	20.90
			133000 100000	, 10.	170000	N
			Model volume DMS Baseline		0 2 4 8	A
	BASI	S FOR MOD	ELLING			
Zone based on surface lin	eaments. Modelled to as a sp	play from zoi	ne ZFMENE0062A.			
Out and a second	[					
Outcrops:	-					
Borenoles: -						
Tunnols:						
Lineament and/or	- MEM0062C1					
seismic indications:	MI-1000231.					3
	MODE		CEDURE			
At the surface, correspond	to the low magnetic linear	ent MEM006	CEDURE 32G1 Modelled to a	maximun	n denth of 780 m as	a solav
from zone ZEMENE0062A	with a din of 82 degrees to t	the NNW		maximum	in deptin of 760 m as	a spiay
	A with a dip of 82 degrees to t					
ENEUTUSA					ZFMENE0103A	_
				-		
			A REAL PROPERTY AND INCOME.	1		
	ZFMENE2383					
ZFMEI	VE2400			/		
	+03	751		3		
			LINEOU			
		5				
					$\wedge$	
1		and the second division of the second divisio		F		
						71-
				/	N	21
	0 100 200	300	500 m Z	MNE23	32	
$\zeta$		1				
1						

ENE	ZFN	IENE00	62B	Version number	3	Total object CL	18	
OBJECT CONFIDENCE	STIMATE			•		•		
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM00620	61				
Results of interpretation	n	3	High confid	ence observation in	AFM0012	43.		
INFORMATION DENSIT	Y							
Number of observation	n points	1	1					
Distribution of observa	1	The zone is vertically extrapolated based on a single intercept to the base of the modelled volume. Large dist, between obs. points.						
INTERPOLATION								
Geometry		1	Geometry s splay.	supported by surface	egeophys	ical data. Modelled	as a	
Geological indicators		1	Indirect sup	port by geophysical	data.			
EXTRAPOLATION								
Dip direction		1	No subsurfa	ace obs. point. High	uncertain	ty in dip-direction.		
Strike direction		2	Conceptual understanding of the site and that the entire modelled					
		5	zone is supported by lineament.					
		FRA	CTURE CHA	RACTER				
	_		No data avail	able				
INDIVIDUAL INTERCEPT	S							
			No data avail	able				

ENE	ZFMENE00	62C	Version number	4	Total object CL	10
GEOLOGICAI	CHARACTER	Property CL	155000 160000	0 1650	000 170000	
Deformation style:	Brittle	1	0			0
Deformation description:	No data available.		671000		~ ~	671000
Alteration:			{	Y	1 12	
- First order:	Oxidation		5		1 1 2 2	
- Second order:	Not observed	2	2000	-V	NFL	3000
- Third order:	Not observed		670	1 1	VI AL	670
Fracture orientation and type:	No data available.		S	M	ALA La	Kreto I.S
Fracture comment:	No data available.		000	XAX	11/15	000
Fracture fill	No data available.		200		(MIN)	700
mineralogy:					K Y	9
OBJ	ECT GEOMETRY					
Strike/dip:	66°/80°		8	X		00
Length:	342 m		1	1 and	XX	950
Mean thickness:	5 m (1 - 13 m)		99	Mr X	A.	66
Max depth:	-384 m			1 L	Any sum	
Geometrical	ZFMENE0062A, Topo 40m	grid Max		X	1 January	0
constraints:	error 20m.		000		win	000
			665		N	699
			155000 160000	) 1650	00 170000	20.510
			100000 100000	, 1000		N
			Baseline Model volume DMS		0 2 4 8	A
Zana kasadan sufa sufa sufa	BASI	S FOR MOL				
Zone based on surface lin	eaments. Modelled to as a sp	play to zone	ZFMENE0062A.			
Outoropol	Γ					
Boreholes: -						
Borenoles.						
Tunnels:	-					
Lineament and/or	MFM0062G2.					4
seismic indications:						I
	MODE	LLING PRO	CEDURE			
At the surface, correspond	is to the low magnetic lineam	ent MFM006	62G2. Modelled to a	maximum	depth of 320 m as	a splay
from zone ZFMENE0062A	with a dip of 80 degrees to t	the NNW.				
NEOBOBC		2	FMA1			
ZFMA8						
ZFM	ENE0062A	ZFMEN	E0062C			
	0 100 <200 3	00	500 m	<fma3< th=""><th>1°</th><th></th></fma3<>	1°	
<b> </b>		4			V	

ENE	ZFN	IENE00	62C	Version number	4	Total object CL	10
<b>OBJECT CONFIDENCE E</b>	ESTIMATE						
Category		Object CL	Comment				
INTERPRETATION							
Data source		1	MFM00620	62			
Results of interpretation	on	1	Low confide	ence in lineament MI	FM00620	62.	
INFORMATION DENSIT	Υ						
Number of observation	n points	1	1				
Distribution of observation points		1	Single observation point in the form of a lineament.				
INTERPOLATION			- · ·				
Geometry	Geometry		Geometry supported by surface geophysical data. Modelled as a splay				as a
Geological indicators		1	Indirect support by geophysical data.				
EXTRAPOLATION							
Dip direction		1	No subsurfa	ace obs. point. High	uncertair	ity in dip-direction.	
Strike direction		0	Conceptua	understanding of th	e site and	d that the entire mod	elled
		3	zone is sup	ported by lineament			
		FRA	CTURE CHA	RACTER			
			No data avail	able			
INDIVIDUAL INTERCEPT	S						
			No data avail	able			

ENE		ZFMENE	0103A		Version r	number	<b>1</b> Total	object CL	15
GEOLOG	SICAL CH	ARACTER	Prop	perty	155000	160000	165000	170000	
Deformation style:	Brittle			3	9				0
Deformation	No data	a available.		-	1000				000
description:					67	E I	11	many	67
Alteration:						$\langle \cdot \rangle$	11	2	1 4
- First order:	Oxidati	on		2	-	5		m la	3. 0
- Second order:	Not obs	served		5	5000	1	VN	1 KI	3000
- Third order:	Not obs	served			670	11	AII	XIX	610
Fracture	Steeply	dipping fracture	s with		5		J/ TH	1 5	(Address)
orientation and	ENE st	rike dominates.			5	1/2	XXIIII	1 18	2
type:	Domina	ance of sealed			2000	The second	XXII		) 000
	tracture	es. Quantitative	da		2019	11 ANS	XVV	///	2002
	coolod	e anu span inclu fractura potworki		2		1 ACCES	AV		
Fracture comment:	No data		5.				2 NI	$\checkmark$	
Fracture fill	Calcite	chlorite			000	11 MA		/	000
mineralogy:	hematit	e/adularia. laum	ontite.		5695	1 11/2	X	1	695
	quartz.	,	,		9	1 11	X	2 million	9
	OBJECT	GEOMETRY					~ 7	y man	
Strike/dip:	238°/84	1°			000		hor	8	00
Length:	2004 m				0059	$\checkmark$			20069
Mean thickness:	12 m (3	3 - 50 m)			Ō				ø
Max depth:	-2100 r	n						100	20.000
Geometrical	ZFMNV	V1200, Topo 40r	n grid Max erro	or	155000	160000	165000	170000	N
constraints:	20m, 1	UNIVERSE Plar	har Cut(s).		Model v	olume DMS		0 2 4 8	Â
				MODE				S Gettesteret Gridener-erkes	
Based on surface line	eament an	d a borehole obs	servation. Zone	7FM	=NF0103 c	onsists of two	segments.	ZEMENE01	03A and
ZFMENE0103B, judg	ed to con	stitute elements	of one and the	same	structure.		,		
Outcrops:	-								
Boreholes:									
		Torratin				intercent			
Borehole	PD7	i arget ir	Sec low		Seometric	Sec low	Comme	nt	
Borenoie		Sec_up [m]	[m]	Sec	_up [m]	[m]	Comme	in	
KFM05A	DZ4	892.00	916.00	8	91.84	915.83			
Tunnalar									
Lineament and/or	- MEM01	03 MEM0103C	n						
seismic		05, 101 100 10500	0.						2
indications:									2
			MODELLING	PROC	EDURE				
Zone ZFMENE0103	consists o	f two segments,	the most prom	inent o	f which is o	denoted ZFME	ENE0103A.	The subordi	nate
component is an exte	ension to t	he north-east wit	h slightly differ	ent str	ike and is o	denoted ZFME	NE0103B.	These two	
segments are judged	to constit	ute elements of o	one and the sa	me str	ucture. Zor	ne ZFMENE01	013A corre	sponds at th	е
surface to the low ma	ignetic line	eaments MFM01	03 and MFM01	103G0	Modelled	down to c.140	0 m depth,	using the dip	0
estimated by connect	ing these	mineaments with	the borehole in	itersec	tion 892-9	16 m in KFMO	5A (UZ4). D	verormation z	zone
plane placed at fixed	POILIT 200	111 111 KEIVIUSA. L	vecreaseu rada	a pene	ananon als	s along the bo		vai 905-912	

ENE	ZFM	ENE010	)3A	Version number	4 Total object CL	5		
ZFMENEDODUC ZFMENEDODUC	ZEMENE IN AMERICAN ZEMPEZSA ZEMENE ZEMENE	auguation of the second		ZEMNE2332	ZFMENEO060B ZFMILEDBUG ZFMILEDBUG E00027A			
0 100 200 300	500 m	1 km	V	3	2 km			
				U				
		OBJECT	CONFIDENCE	ESTIMATE				
Category		Object CL	Comment					
INTERPRETATION		2	MEM0103G0	KEM05A				
Results of interpre	etation	2	Medium confidence observation in KFM05A.					
INFORMATION DEI	NSITY	2	2					
Distribution of obs	servation points	1	More than 700 m between the surface lineament and borehole					
INTERPOLATION			Intercept at depth.					
Geometry		1	Geometry supported by a lineament and a single intercept.					
Geological indicat	ors	1	Single observation point at depth. Zone modelled mainly based surface geophysical data.					
EXTRAPOLATION								
Dip direction		3	modelled zone > 2000 m.					
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by lineament.					
		50.44						
Orientation:	Set ENE: 55.8°/	89.1°		ZFMEI	JE0103A			
(strike/dip right-				La de la dela dela dela dela dela dela de	N			
Frequency:	Boreholes: KFM	105A						
	FRACTURE TYPE Open and partly open Sealed Sealed network Crush	TERZAGHI- WEIGHED P10 1.0 m-1 13.2 m-1 7.9 % of DZ intercept 0.0 % of DZ intercept	• Unassi • Set EN	pned (62) ≡ (95) ▲ Mean p	Equal area Lower hemisphere sole Set ENE (325.8/0.9) Fisher κ = 41.7			
RQD:	min:7, max:100	, mean:96			and the second second class of the			




ENE	ZFMENE01	03B	Version number	4	Total object CL	11
GEOLOGICAI	L CHARACTER	Property CL	155000 16000	0 165	5000 170000	
Deformation style:	Brittle	1	0			0
Deformation	No data available	-	000		~ -	0000
description:			2			671
Alteration:			{	V	The	
- First order:	Oxidation	-	$\sim$		X W Y	
- Second order:	Not observed	2	00 7	-1	/ X/ / S	2 8
- Third order:	Not observed		202 Jun 202	1 3		70507
Fracture orientation	No data available		° R		THU S	
and type:			7.1.1		ALLA	
Fracture comment:	No data available		8	T		
Fracture fill	No data available		82		XU/ 3	0000
mineralogy:			6	A A	WI V	670
OBJ	ECT GEOMETRY			EX DO	XX/	
Strike/dip:	248°/84°			SP	NY	
Length:	432 m		1 1000	VE	M	0000
Mean thickness	12 m (1 - 13 m)		1699	Al	$\times$	3695
Max depth:	-2100 m			MH D	and the same	U.S.
Geometrical	ZEMENE0103A Topo 40m	arid Max			17	
constraints:	error 20m 1 LINIVERSE P	lanar	8		had a	8
constraints.	Cut(s)	anai	005	V	We	006
	000(0).		66			66
			155000 160000	0 165	000 170000	26.91
						N
			Baseline Model volume DMS		0 2 4 8	A
	<b>.</b>	0 500 100				
Zone based on ourface lin	BASI					
Zone based on surface in	eaments. Modelled as a spla		EU103A.			
Outcrops:						
Boreholes: -	-					
Dorenoles.						
Tunnels:	-					
Lineament and/or	MFM0103G1.					
seismic indications:						2
	MODE	LLING PRO	CEDURE			
Zone ZFMENE0103 consi	sts of two segments, the mos	st prominent	of which is denoted	ZFMENE	0103A. The subordi	nate
component is an extension	n to the north-east with slight	ly different st	trike and is denoted	ZFMENE	0103B. These two	
segments are judged to co	onstitute elements of one and	the same s	tructure. At the surfa	ice, corres	sponds to the low ma	agnetic
lineament MFM0103G1. N	lodelled with the same dip, th	he same thic	kness and to the sar	me depth	(c.1400 m) as	
ZFMENE0103A.						
			-08	080		
			ZEMNEOS			
					<pre> </pre>	
		th				
		14			$( \land \land )$	
			Nr. T			
			200 24	No.		
ZFME	NEOTOS	<u>-</u>	N RA	·***48		
	ZEN	_				
					$\sim$	
	-/	Ento		n		
				$\langle$		
	s					
E0062B		MA2				
	115					
	75MENE00624					
	ZFMENE0002A			~ _		
					~	
	7 Shus			N		
	ZFMENE0169			1		
0	100 200 300	50	00 m			
ZFMNE2332		50		-		1

ENE	ZFN	IENE01	03B	Version number	4	Total object CL	11		
OBJECT CONFIDENCE	ESTIMATE								
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0103G	i1					
Results of interpretation	on	2	Medium cor	nfidence in lineamer	nt MFM01	03G1.			
INFORMATION DENSIT	Υ								
Number of observation	n points	1	1						
Distribution of observe	ation points	1	Single obse	rvation point in the f	form of a	lineament.			
INTERPOLATION									
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		1	No subsurface obs. point. High uncertainty in dip-direction.						
Strike direction		2	Conceptual	understanding of th	e site and	that the entire mod	elled		
	3	zone is supported by lineament.							
		FRA	CTURE CHA	RACTER					
			No data avail	able					
INDIVIDUAL INTERCEPT	S								
			No data avail	able					

ENE	ZFMENE015	9A	Version n	umber	4	Total object CL	22
GEOLOG	ICAL CHARACTER	Property CL	155000	160000	165	000 170000	
Deformation style:	Brittle	3	8				8
Deformation	Faults dipping gently to the		100			$\sim$	1000
description:	north show reverse dip-slip or		67	5	T	1 mon	67
-	reverse sinistral strike-slip			5	Y	12	1 4
	components of movement.		- And A	5	/	V 12 1 0	2
	Steep WSW faults show		> 2000	1	-1	MPL	5 000
	strike-slip movement, both		2010	2		A M M	105 200
	dextral and sinistral. A steep		a the			THILLS	
	NNW fault shows a		1	110		ALLAN	2
	predominantly dextral sense		8 { /		ANY		5 8
	of shear.		8 2	X		XV/ S	000
Alteration:			67	IKE	120	WIV	671
- First order:	Oxidation	3		A CO	RID	SX /	
<ul> <li>Second order:</li> </ul>	Not observed	J		DU	A	AV 7	-
- Third order:	Not observed		200	A H	Mes -	N	2000
Fracture	Gently dipping fractures		699		A	XI	9696
orientation and	dominates. Steeply dipping			1	AV	All more	
type:	fractures are also present.			10		1 Junior	
	Dominated by sealed followed		8		1	hard	0
	by open and partly open		0050				2069
	fractures.		96			1. D	66
Fracture comment:	No data available.	2					
Fracture fill	Calcite, chlorite, clay minerals,	_	155000	160000	165	000 170000	
mineralogy:	hematite/adularia, laumontite,		Model vo	luma DMS			N
	prehnite and epidote in sub-		Baseline	Iune DH5		d Latinitariat Goldenerska	A
	norizontal and gently dipping						
	ractures. Note also some						
	gently dipping fractures with						
		l	-				
Strike/din:			-				
Longth:	1834 m		1				
Moan thickness	18 m (4 - 22 m)		1				
Max depth:			1				
Geometrical ZEMNW0017 Topo 40m grid Ma		ax error	1				
constraints:	20m. 1 UNIVERSE Planar Cut(s						
constraints.	ZUIII, TUINIVEINGE FIAIIAI CUI(S	·/·	1				

	ENE		ZFMENE0159A Version number 4				Total object CL 2	2			
	BASIS FOR MO	DELLING	G			•		<b>i</b>			
	Based on surface lineament, excavations and borehole observations. Zone ZFMENE0159A consists of two segments, ZFMENE0159A and ZFMENE0159B, judged to constitute elements of one and the same structure.										
	Outcrops:	A	FM001	265, PFM0070	97						
	Boreholes:										
		Target intercept Geometric intercept									
	Borehole	PDZ	:	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	Comment			
	HFM22			-	-	185.82	208.73	No indication of possible zone according to the borehole image or mapping. Located close to (c. 120 m) KFM08D DZ1 (confidence level = 1). Highly uncertain branch of ZFMENE0159A. Lineamer MFM0159G (confidence level = 1.916).	nt		
	KFM07A	DZ3		417.00	422.00	395.32	601.56	Fractured rock beneath DZ3, between 422 and 507 m, inferred to be affected by DZ (cf. Table 3-2 in Stephens et al. 2007).	7		
	KFM08D	DZ2		318.00	324.00	298.14	331.90				
	KFM09A	DZ3		217.00	280.00	205.17	258.04	ZFMNNW0100 also intersects DZ3.			
	KFM09B	DZ1		106.00	132.00	106.46	132.15	Only borehole intervals 9- 43 m, 59-78 m and 106-13 m included in the DZ deterministic modelling (cf. Table 3-2 in Stephens et a 2007). Fractured rock between these modelled zones and between 132 and 308 m inferred to be affected by DZ.	2 I.		
	Tunnolo										
	ineament and	or M	FM01	59 MEM0159G							
	seismic indications:							2	2		

## MODELLING PROCEDURE

Zone ZFMENE0159 consists of two branches. The most prominent branch is denoted ZFMENE0159A and an inferred splay from this branch is denoted ZFMENE0159B. Though the branches are described separately in subsequent property sheets, it should be recalled that these probably constitute elements of one and the same structure. At the surface, corresponds to the low magnetic lineaments MFM0159 and MFM0159G, and excavation AFM001265. Modelled down to 1900 m depth, using the dip estimated by connecting these lineaments with the borehole intersections 417-422 m in KFM07A (DZ3), 318-324 m in KFM08D (DZ2), 217-280 m in KFM09A (DZ3) and 106-132 m in KFM09B (part of DZ1). Deformation zone plane placed at fixed points 419 m in KFM07A, 322 m in KFM08D, 244 m in KFM09A and 121 m in KFM09B. Decreased radar penetration also along the borehole intervals 418-422 m in KFM07A and 119-122 m in KFM09B.

ENE	ZFM	ENE015	59A	Version number 4 Total object CL					
	ZFMENE1200		ZFMENE2325A ZFMENE2325A ZFMENE2325A ZFMENE2325A	E0159A	ZE ME				
		OBJECT							
Category		Object CL	Comment						
							265		
Data source		3	PFM007097	KFIVIU(A, KFIVIU(b)),	KFIVIU9E	, HEIVIZZ, AEIVIUU I.	200,		
Results of interpretation		3	High confide	nce observation in m	nultiple bo	preholes and outcro	ops.		
INFORMATION DEI	NSITY								
Number of observ	ation points	3	>4						
Distribution of obs	servation points	3	Even distribu	ition of obs. points.					
			Coordination	un n a sta al la consta a sa la	filling and see	ithin functionen interv	a nata al		
Geometry		3	by GSHL as	ipported by minerals	tillings w	itnin fractures interpondent	preted		
Geological indicat	tors	-	Interpolation	supported by minera	al fillings	within fractures fror	n		
Coological malea		2	boreholes ar	nd outcrops.	ai illingo				
EXTRAPOLATION				•					
Dip direction		2	Extrapolation supported by multiple subsurface obs. points.						
Strike direction		3	Conceptual	understanding of the	site and	that the entire mod	elled		
			zone is supp	orted by lineament.					
		FRAC	CTURE CHAR	ACTER					
Orientation:	Set WSW: 248.	8°/83.7°		ZFMEN	E0159A				
(strike/dip right-	Set SSW: 212.7	7°/89.3°			Ņ				
nano-rule)	Set SSF 150 5	°/88.0°		11		1			
	000000000000000000000000000000000000000	,00.0		Je. i		. /			
Frequency:	Boreholes: KFN KFM07A, KFM0	109B, 09A, KFM08D		filler -					
	FRACTURE	TERZAGHI-	1			· · · · · · · · · · · · · · · · · · ·			
	TYPE	WEIGHED	-		· · ·	· · · · · · · ·			
		P10	M		1	. · · · · -			
	Open and	3.7 m-1	VV			• • •	- 1		
	partly open	135m1	-			• • • • +			
	Sealed	12.3 III-1				1			
	network	DZ		V					
		intercept		\ ····		-			
	Crush	0.4 % of DZ		12.	1 2.14		_		
		intercept		the		Equal ar	ea		
			Unass	igned (129)	Los the	Lower hemisphe	ere		
			Set S	SW (172) A Mean po SW (150) A Mean po	le Set SSW	(128.8/0.3) Fisher κ = 2	40.0		
			Set G	(95) A Mean po	le Set G (0.	4/80.4) Fisher κ = 13.1			
			Set S	5E (109) 🔺 Mean po	le Set SSE	69.5/2.0) Fisher $\kappa = 49$	.0		
RQD:	min:20, max:10	0, mean:96	1						











ENE		Z	ZFMENE0159B		)B		Version I	number	4	Total object CL	15
GEO	OLOG	ICAL CH	ARACTER		Proper CL	rty	155000	160,000	) 16	5000 170000	
Deformation st	vle:	Brittle			3		9				0
Deformation	<u>j.e.</u>	Steep fa	ault with ENE str	rike	<u> </u>		000		_	~	000
description:		shows of	dextral strike-slip	)			671	5		The second	671
		displace	ement.					5	V	1 The	1
Alteration:							al and a	$\sim$		1211	2
- First order:		Oxidatio	on		•		000	7	-1	NFR	5 00
- Second order	r:	Not obs	erved		3		2025	M			105
- Third order:		Not obs	erved						1	THINK	(Altrenti
Fracture		Steeply	dipping fracture	es with			2	111		AHANN	
orientation and	I	ENE-W	SW and SSW st	trike			8 1		XAX		5 8
type:		are pror	minent. Steeply	dipping			200	V X		AV/V	000
		fractures with NNW-SSE and ESE strike and gently dipping					6	IKE		HL V	67
							5	KIE	TALL?		
		fracture	ent.			2	1312	AL-	AV/	0	
		Domina	ince of sealed		2		1000	14	and the second		500
		fracture	s. Quantitative		-		669	1	211	X	699
		estimat	e and span inclu	ide			1	-/	Id X	the summer	
Erecture comm	sealed fracture networks.		s.				1		L / J man	-	
Fracture comm	ient:	No data avallable.				000	1		war	0000	
minoralogy:		bomotit	bematite/adularia_prehnite				9999		~ \		9690
mineralogy.		and oth	and other minerals								e e
							155000	100000	101		20.510
Strike/din: 240°/80°						155000	160000	10:	170000	N	
Length:		671 m					Baseline	olume DMS		0 2 4 8	A
Mean thickness	s:	14 m (2	- 36 m)							a Checking and Checking and And	
Max depth:	-	-1850 n	<u>່,                                     </u>								
Geometrical		ZFMEN	E0159A, Topo 4	40m grid l	Max erro	or					
constraints:		20m, 1	UNIVERSE Plar	nar Cut(s)	).						
				BASIS	FOR M	ODEI	LING				
Based on surfac	e line	aments a	nd a borehole of	bservatio	n. Zone i	ZFME	ENE0159	consists of	of two se	gments, ZFMENE0	159A
and ZFMENE01	59B, j	udged to	constitute eleme	ents of on	he and th	ne sar	ne struct	ure.			
Outoronou											
Borobolos:		-									
Borenoies.											
	_		Target in	ntercept		G	eometric	intercep	t		
Borehole	F	PDZ	Sec up [m]	Sec_l	ow	Sec	up [m]	Sec_lo	ow C	omment	
		270	074.00	[m]				[m]	_		
KEM08D	L	JZ3	371.00	396.0	00	37	1.15	396.4	.8		
Tunnoloi											
Lineament and	lor	- MEM23	2660								
	/01		2000.								2
indications:											2
indications.				MODEL	I ING PE	ROCE					
Zone ZFMFNF0	)159 c	onsists of	two branches	The most	promine	ent br	anch is d	enoted 7F	MENFO	159A and an inferre	d splav
from this branch	is de	noted ZFI	MENE0159B. Th	nough the	branche	es are	e describe	ed separa	telv in su	bsequent property	sheets.
these branches	are in	ferred to a	constitute eleme	nts of one	e and the	e san	ne structu	ire. At the	surface	corresponds to the	low
magnetic lineament MFM2326G0. Modelled as a splay from					rom zone	e ZFN	MENE015	59A by cor	nnectina	this lineament to the	Э
borehole interse	borehole intersection 371-396 m along KFM08D (DZ3). D					ation z	one plan	e placed a	at fixed p	pint 384 m (sealed f	fracture
network).			-	. ,						`	

ENE ZFM	ENE01	59B	Version number	4	Total object CL	15
159A <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup> <sup>150A</sup>		20 500 m	2309 2309 200 275MN20	NE2293	0	
	OBJECT	CONFIDENCE	ESTIMATE			
Category	Object CI	Comment				
INTERPRETATION	Object OL	Comment				
Data source	2	MFM2326G0	, KFM08D			
Results of interpretation	3	High confider	ice observation in l	KFM08D.		
INFORMATION DENSITY						
Number of observation points	2	2				
Distribution of observation points	1	Less than two	subsurface obs. p	oints.		
Geometry	1	Not sure if the Perhaps two propagate in surface obs.	EZFMENE0159A v alternatives for the other direction. Diff point.	videns or i geometry icult to say	f it is split into a spl . Could the zone y from a single sub	ay? -
Geological indicators	1	Single observ surface geopl	ation point at depth	h. Zone m	odelled mainly base	ed on
EXTRAPOLATION						
Dip direction	2	Extrapolation Strike length	in dip direction sup of the modelled zor	ported by ne < 2000	subsurface obs. pom.	oint.
Strike direction	3	Conceptual u zone is suppo	nderstanding of the orted by lineament.	e site and	that the entire mod	elled





ENE		ZFMENE0168			Version I	number	1 Tot	al object CL	14
GEOLO	GICAL CH	IARACTER	Pro	operty CL	155000	160000	165000	170000	
Deformation style:	Brittle			3	8				9
Deformation	No data	a available.			100		~		1000
description:					67	NI		1 minus	67
Alteration:					1.00	5	1	1 1 4	1 -
- First order:	Oxidati	on		3	0	5	$\langle \rangle$	1 m	3. 0
- Second order:	Not obs	served		5	2 200		VI	111	500
- Third order:	Not obs	served			670	11	A	AND	020
Fracture orientation and type:	Steeply NE-SW and NN domina fracture Domina fracture	r dipping fracture f to NNE-SSW st IW-SSE strike tes. Gently dipping are also present ance of sealed bs. Quantitative	es with trike ing ent.	2	6700000				6700000
	estimat	estimate and span include sealed fracture networks. No data available.			2000	JA HAK	81	1	0000
	sealed				9699	1 111	X	1	3695
Fracture comment:	No data					1 11	V	the man	
Fracture fill	Chlorite	e, hematite/adula	aria,		R		A	- incase	-
mineralogy:	quartz,	calcite and clay			000		/ Wr	1	000
	mineral	S.			059	$\sim$	1.		1069
OBJECT GEOMETRY					Ø				9
Strike/dip:	255°///	,•				et	)		20.00
Length: Mean thickness	991 m	) 26 m)			155000	160000	165000	170000	N
Mex denths	10 11 (2	<u>- 30 m</u>			Model v	olume DMS		0 2 4 8	Ä
Geometrical	-1000 II	11 NN/2225 Topo /	10m arid Max	orror	Baselin			Statistent Golderen kas	
constraints.	20m 1	LINII/ERSE Plan	nar Cut(s)	enoi					
constraints.	2011, 1		BASIS FOI						
Zone based on surfa	ce lineame	ents and borehol	le observation	S.					
Outcrops:	-								
Borenoles:									
		Target in	ntercept		Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	:_up [m]	Sec_low [m]	Comm	ent	
KFM08D	DZ11	819.00	842.00	8	318.79	841.72			
Tunnels	Τ-								
Lineament and/or	MEM01	680							
seismic		000.							2
indications:									-
			MODELLIN	<b>G PRO</b>	CEDURE				
At the surface, corres	At the surface, corresponds to the low magnetic lineament MEM0168G and its probable continuation along MEM2324G								
Modelled at depth us KFM08D (DZ11). De	Modelled at depth using the dip estimated by connecting these lineaments with the borehole intersection 819-842 m along KFM08D (DZ11). Deformation zone plane placed at fixed point 838 m (sealed fracture network).								



OBJECT	CONFIDENCE	ESTIMATE
00000	VUIII IDEIIVE	

Category	Object CL	Comment			
INTERPRETATION					
Data source	2	MFM0168G, MFM2324G, KFM08D			
Results of interpretation	2	Medium confidence observation in KFM08D.			
INFORMATION DENSITY					
Number of observation points	2	2			
Distribution of observation points	1	Less than two subsurface obs. points.			
INTERPOLATION					
Geometry	1	Geometry supported by a lineament and a single intercept.			
Geological indicators	1	Single observation point at depth. Zone modelled mainly based on			
	I	surface geophysical data.			
EXTRAPOLATION					
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point.			
	2	Strike length of the modelled zone < 2000 m.			
Strike direction	3	Conceptual understanding of the site and that the entire modelled			
	5	zone is supported by lineament.			

	FRACI	URE CHARACTER
Orientation: (strike/dip right- hand-rule) Frequency:	Set NE: 45.3°/81.8° Set SSE: 175.3°/87.6° Boreholes: KFM08D FRACTURE TERZAGHI- TYPE WEIGHED P10	ZFMENE0168
	Open and partly open4.0 m-1Sealed27.9 m-1Sealed1.2 % of DZnetworkinterceptCrush0.0 % of DZintercept	$Unassigned (114)$ $Set NE (80)$ $Set SE (74)$ $M = n pole Set NE (315.3/8.2) Fisher \kappa = 19.0$ $Mean pole Set SES (85.3/2.4) Fisher \kappa = 42.0$
RQD:	min:86, max:100, mean:97	





ENE	ZFMENE0 <sup>2</sup>	169	Version number	3	Total object CL	11			
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000				
	Prittle	CL							
Deformation style:	No data available		0000		~	0000			
description:			671	V F	The man	671			
Alteration:				Y					
- First order:	Oxidation	2	e pr	- /	V 1 3				
- Second order:	Not observed	<u> </u>	~~ 000		AND	2000			
- Third order:	Not observed		61	17		670			
Fracture orientation	No data available.		2	X	ATTA Z				
Fracture comment:	No data available.	-	8	ALC Y	ATTA (3				
Fracture fill	No data available.		2 000		XV/ V3	0000			
mineralogy:			67		KU V	67			
OBJI	ECT GEOMETRY								
Strike/dip:	65°/90°		00	X	AX/	00			
Length:	1598 m		6950	K	$\times$	3950			
Mean unickness: Max denth:	-1100 m		°	142	A to a	0			
Geometrical	ZEMENE0062A ZEMNNV	V0101			1 To man				
constraints:	Topo 40m grid Max error 2	20m, 1	000	$\langle \times \rangle$	hard	000			
	UNIVERSE Planar Cut(s).		660	~ /		1069			
			e de la companya de la compa			9			
			455000 40000	400	470000	20.9-0			
			155000 160000	) 10:	170000	N			
			Model volume DMS     Baseline		0 2 4 8 2 Laterature ( Graduine revealer)	A			
BASIS FOR MODELLING									
Zone based on surface line	eament.								
Outcrops:	-								
Boreholes: -									
Tunnala									
Lineament and/or	- MEM0169_MEM0169G								
seismic indications:						2			
	MODE	LLING PRC	CEDURE						
At the surface, correspond an assumed dip of 90 degr strike.	s to the lowmagnetic lineam ees based on a comparison	ents MFM01 with high co	69 and MFM0169G. Infidence, vertical an	Modellec d steeply	to a depth of 1100 dipping zones with l	m, using ENE			
383				915 21		5			
No. of Concession, Name						$\leq$			
			1 ( C						
ZFMENE006	2B								
			The s						
		Z	FMENE0062A			-			
	all								
1						e			
14/		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~							
			E016	<b>9</b> •					
	ZFMNE2332								
4					5				
					1125				
			$\sim$						
					N				
			L			-			
0	100 200 300		500 m						
				1					
						<			
OBJECT CONFIDENCE ESTIMATE									
	Object CL	Comment							
Data source	1	MFM01690	3						
			•						

ENE	ZFI	MENE0	169	Version number	3	Total object CL	11						
Results of interpretatio	n	2	Medium co	Medium confidence in lineament MFM0169G.									
INFORMATION DENSIT	Y												
Number of observation	points	1	1	1									
Distribution of observa	1	Single obs	ervation point in the f	form of a	lineament.								
INTERPOLATION													
Geometry	1	Geometry supported by surface geophysical data.											
Geological indicators		1	Indirect support by geophysical data.										
EXTRAPOLATION													
Dip direction			No subsurface obs. point, supported only by surface data. High										
		1	uncertainty in dip-direction. Strike length of the modelled zone <										
			2000 m.										
Strike direction		з	Conceptual understanding of the site and that the entire modelled										
		5	zone is supported by lineament.										
FRACTURE CHARACTER													
No data available													
INDIVIDUAL INTERCEPT	INDIVIDUAL INTERCEPTS												
			No data avai	lable									

ENE			ZFMENE	040 <sup>°</sup>	1A	١	Version number 4 Total object CL					
GE	OLOG	ICAL CH	ARACTER		Proper	ty	155000	160000	1	55000 170000		
Deformation at	n dou	Drittlo			CL		_					
Deformation St	yie:	Steenly	dipping fault wit	th SW	3		00				0000	
description		strike s	hows oblique-sli	n			671	2	5	~~~	6710	
description.		displace	ement with a stru	pna			-	(	V	VI MA		
		strike-s	lip component.	ong				$\sim$	/	1 hully	-	
Alteration:							000	5 5	-1	/ M/ / ·	3 00	
- First order:		Oxidati	on				1020	my i		XXXXX	105-02-02	
- Second orde	r:	Not obs	erved		3		" R		L	THIN Z	(CARANTAL O	
- Third order:		Not obs	served				2	11	_ >>	AHAN NE		
Fracture		Steeply	dipping fracture	es with			8 1 /		AN)		6	
orientation and	ł	NNE st	rike dominates.					V.X		AV IS	2000	
type:		Fractur	es with more gei	ntle			°			V V	6	
		dips as	well as steeply	dipping			1	XXX	AL			
		Tracture	s that strike NVV	are			8	140	X	AX/	8	
			fractures followe	d by			1000	211-1	1 miles	$\mathbf{V}$	950	
		open ar	nd partly open	,u by		8	99	1	100	A the second sec	66	
		fracture	s. Quantitative						R	n An man		
		estimat	e and span inclu	ıde	2		8	/	Y	La Inner	0	
		sealed			0000	$t \cdot t$	$\checkmark$	w	000			
Fracture comm	nent:	No data	a available.			1	66		21.00		669	
Fracture fill		Calcite,	chlorite, quartz,									
mineralogy:		laumon	tite, hematite/ad	ularia.			155000	160000	16	5000 170000		
		Only calcite, chlorite and					Model v	olume DMS		0 2 4 8	N	
		some p			Baseline			d Calmitered Gentacoprovidus	N			
		(DZ1)		10113								
		OBJECT	GEOMETRY									
Strike/dip:												
Length:		2565 m										
Mean thicknes	s:	10 m (3	- 50 m)									
Max depth:		-2100 n	ſ									
Geometrical		ZFMNV	V0017, Topo 40	m grid Ma	ax error							
constraints:		20m, 1	UNIVERSE Plai	nar Cut(s	5). CEOD MC	ODEL						
Zone based on	surfac	e lineama	ants and borehol	A observ	ations 7	one 7		4014 cor	neiste of	two seaments		
ZFMENE0401A	and Z		401B. judged to	constitu	te elemer	nts of	one and	the same	structu	e.		
Outcrops:		-										
Boreholes:												
			Target in	ntercept		Ge	ometric	intercept	t			
Borehole	F	PDZ	See up [m]	Sec_	low a	C		Sec_low		Comment		
			Sec_up [iii]	[m	1	Sec_t	ւթ [ուլ	[m]				
HFM13	I	DZ1	162.00	175.	30	145	6.65	172.5	3			
									0	Only borehole interva	als	
									5	90-616 m and 685-	/20 m	
										Iciuded in the DZ	ng (cf	
KEM05A		77	685.00	720	00	682	67	718 7	7 7	ahle 3-2 in Stenhen	s et al	
KI WOOA		020	000.00	720.	00	002		110.1		007). Fractured rock	3 Ct al.	
									b	etween 616 and 685	5 m.	
									a	nd 720 and 796 m in	nferred	
									t	b be affected by DZ.		
Tuncilar		1										
I unnels:	Vor			0								
seismic	/01		01, WFW0401G	υ.							2	
indications:											2	
				MODEL	LING PR	ROCE	DURE					
Zone ZFMENEC	)401 c	onsists of	two branches, t	the most	prominer	nt of w	/hich is d	enoted ZI	MENE	0401A. Though the		
branches are de	escribe	ed separa	tely in subseque	ent prope	rty sheets	s, it sh	nould be	recalled th	hat thes	e probably constitute	9	
elements of one	and t	he same	structure. At the	surface,	correspo	onds to	o the low	magnetic	lineam	ents MFM0401 and		
IVIFIVIU401G0, a	nd the	in interrec	i continuation to	the bore	e north-ea	ast. M	UDEIIED	20WN to 19	SOU M D	eptn, using the dip	62-176	
m in HFM13 (D	71) D	eformatio	n zone plane pla	aced at fi	xed point	s 717	m in KFI	M05A and	1170 m	in HFM13. Decrease	ed radar	
penetration also	alond	the bore	hole interval 714	4-723 m i	in KFM05	5A						





	ENE					ZF	Ī	E	NE	04	<b>10</b> '	1A	V	ersion	num	ber	4	ŀ	Total	obje	ct CL	21
										IN	DIVI	DUAL IN	ITERCE	PTS								
HFM1	3 DZ1 (	162	2.0-1	75.3	m)																	
Length (m)	Elevation m.a.s.l. (m, RH2000)	Oj frac	pen tures	Sea fract	aled tures	Open fract	total tures	Seale frac	d total tures	To fract	tal ures	Crushed zone	Sealed network	RQD rev 100 = low va = high	versed = 0 alue value	Frac open orient	ture frac ation	s	Fracture ealed frac rientation	ap	Open erture (mm)	Core loss
		0	20	0	20	0	20	0	20	0	20			0	100 0		90	0	9	0 0	10	
163 164 165 166 167 168 169 170	-136 - -137 - -138 - -139 - -140 - -141 -													83. 91. 96. 96. 98. 100 100	7 9 0 9 6 .0	Ser 1	strate be		the speed has			
171 172 173 174	-142 -143 - -144 - -145 - -146 -													94. 91. 100 100	9 9 .0 .0 .0		N. N.		· · · · · · · · · · · · · · · · · · ·	ama la sul		



ENE	Z	FMENE	0401	1B		Version number 4			Total object CL 1	
GEOLOG		RACTER		Prope	rty	155000	160000	16	5000 170000	
Deformation style:	Brittle			3		0				0
Deformation description:	Steeply of strike sho displacer	dipping fault wit ows strike-slip ment.	h SSE	0		671000	5	671000		
Alteration:						- here	5~		V M I R	3
- First order:	Oxidation	า		2		2 2000	1		NPL	5000
- Second order:	Not obse	rved		5		C 610	1		AN	620
- Third order:	Not obse	rved				5		N	THAN 5	(MACHED AL)
Fracture	Steeply of	dipping fracture	s with			5	16	X	ATTHAN NE	2
orientation and	SW strike	e dominates.	. II .			00 2	1 de la			) 000
type:	Fractures	s with more ger	ntie dipping			2200	11/2		XIY I V	\$700
	fractures				NRE	AT	XX Y			
	also pres	ent Dominanc	e of				XIM	St	NY	
	sealed fr	actures. Quant	itative	2		000	1 th	X	AM	000
	estimate and span include					2699	1	1	XI	695
	sealed fracture networks.					<sup>O</sup>		192	A A A A A A A A A A A A A A A A A A A	9
Fracture comment:	No data available.								2 TH man	
Fracture fill	Calcite, o	chlorite, laumor	ntite,			8		$\boldsymbol{X}$	hard	00
mineralogy:	hematite	adularia.				0059		$\checkmark$		10065
	OBJECT (				Ō				Ø	
Strike/dip:	63°/88°								)	20.900
Length: 359 m						155000	160000	16	5000 170000	N
Mean thickness: 8 m (1 - 13 m)						Model Bacelin	volume DMS		0 2 4 8	Â
Geometrical ZEMENE0401A Topo 40m grid				Max erro	or	Dascilli	c		2 (antmatered Gerzhenserverver)	
constraints:	20m.		ioni gila		01					
			BASIS	FOR M	IODE	LLING				
Zone ZFMENE0401B	consists of	f two segments	, ZFMEN	IE0401A	A and	ZFMENE	0401B, ju	dged to o	constitute elements	of one
	0.									
Outcrops:	-									
Boreholes:										
		Target ir	ntercept	Geometric			: intercept	t		
Borehole	PDZ	Sec up [m]	Sec_l	ow	Sec	սոլայ	Sec_lo	w C	omment	
			[m]		000	_սբ [ույ	[m]			
KFM05A	DZ3	590.00	616.0	00	610.96		615.8	C 55 1 5 T 20 5 a to to	Only borehole intervals 590-616 m and 685-720 m included in the DZ deterministic modelling (cf. Table 3-2 in Stephens et al. 2007). Fractured rock between 616 and 685 m, and 720 and 796 m inferred to be affected by DZ.	
Tunnels: -										
Lineament and/or MFM0401G1										
seismic indications:										1
MODELLING PROCEDURE										
At the surface, corres	ponds to th	e low magnetic	c lineame	ent MFM	0401	G1. Mode	elled as a s	splay from	n zone ZFMENE04	01A,
using the dip estimated by connecting lineament MFM0401G1 with the borehole intersection 590- 616 m in KFM05A (part of DZ3). Deformation zone placed at fixed point 611 m in KFM05A										

ENE	ZFM	ENE040	)1B	Version number	Total object CL	15					
ZFMNE2282 ZFMNE2282 ZFMNE2282	ENE0060A	STA	ZFME DO m MENE2383		TEM	ZEMMUELL ZEMENEODGO	A				
	~~~	OBJECT	CONFIDENCE	ESTIMATE							
Category		Object CI	Comment	-							
INTERPRETATION											
Data source Results of interpre	etation	2 3	MFM0401G1, High confiden interval and lo	KFM05A ce observation in w confidence for t	KFM05A f the whole	or the densely fract interval.	ured				
INFORMATION DEI	NSITY	2	2								
Distribution of obs	servation points	1	Less than two	subsurface obs.	points.						
INTERPOLATION			Zono intorcon	tod by a single be	robolo M	delled as a splay [	Difficult				
Geometry		1	to justify multi	ple options for geo	ometry due	e to lack of data.	Jincun				
Geological indicat	ors	1	Single observation point at depth. Zone modelled mainly based on surface geophysical data.								
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.								
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
		FRAG	CTURE CHARA	CTER							
Orientation: (strike/dip right- hand-rule)	Set SW: 223.4°, Set NNW: 335.6	/81.7° S°/87.0°		ZFME	NE0401B	_/					
Frequency:	Boreholes: KFM	105A		1.		X					
	FRACTURE TYPE Open and partly open Sealed Sealed network Crush	IERZAGHI- WEIGHED P10 3.0 m-1 13.4 m-1 10.6 % of DZ intercept 0.0 % of DZ intercept	Unassig Set SW Set NM	ned (54) (120) ▲ Mean   N (39) ▲ Mean	S poole Set SW poole Set NNV	Equal / Lower hemispl (133.4/8.3) Fisher к = 12 V (245.6/3.0) Fisher к =	area here 2.9 30.8				

ENE	ZFMENE0401B	Version number 4	Total object CL <b>15</b>								
RQD:	min:27, max:100, mean:96										
Fracture fill mineralogy:	KFM05A(590.0-616.0)										
	100 -		Open and partly open Sealed								
	g 80 -										
	50 - 60 -										
	б зад 40 -										
	20 -										
		┛┛┛									
	Give chore continents penate uno	ale minted wated walls penne of	esterna								
		lecter 0									
	4										



ENE		ZFMENE	1061A		Version	number	4	Total object CL	20
GEO	LOGICAL CH	IARACTER	Pro	perty	155000	160000	16	5000 170000	
GEO Deformation sty Deformation description: Alteration: - First order: - Second order: - Third order: Fracture orientation and type:	rith -slip which e g fault pping ows ement Jlt nent.	perty CL 3 3	155000 0000129 0005029 0005699 0005699 0005699	160000			0000 6695000 6700000 6705000 6710000		
Fracture comme	promine sealed partly o Quantit span in network	as gently dipping fractures are prominent. Dominated by sealed followed by open and partly open fractures. Quantitative estimate and span include sealed fracture networks.			155000 Model   Baselin	160000 volume DMS e	165	0000 170000 	z z
Fracture fill	Calcite	, chlorite, laumor	ntite,						
mineralogy:	quartz,	te/adularia, pyrite clay minerals.	э,						
Otalia /dia	OBJECT	GEOMETRY							
Lenath:	58°/82°	 ]							
Mean thickness	: 48 m (3	3 - 50 m)							
Max depth:	-1200 r	n							
Geometrical	ZFMNN 20m 1	W0100, Topo 4	0m grid Max e	error					
constraints.	2011, 1	UNIVERSE FIAI	BASIS FOR		ELLING				
Zone based on s ZFMENE1061A a	urface lineame and ZFMENE1	ents and borehol 1061B, judged to	e observations constitute ele	s. Zone ments	ZFMENE of one and	1061 cons I the same	ists of tw structure	o segments, e.	
Outcrops: Boreboles:	-								
Borenoica.		Target in	toroopt		Coomotrio	intercent			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_lo [m]	w C	omment	
KFM08A	DZ1	244.00	315.00	2	49.46	321.90	0 3 <sup>-</sup> 0 7 20 20 20 20 20 20 20 20 20 20 20 20 20	Only borehole interval 244- i15 m included in the DZ leterministic modelling (cf. able 3-2 in Stephens et al. 2007). Fractured rock between 172 and 244 m, and 315 and 342 m inferred	
KFM08C	DZ4	829.00	832.00	8	26.09	951.02	2 ZI in	MENE1061B also tersects DZ4.	
KFM08C	DZ5	946.00	949.00	8	26.09	951.02	2		
		1.20	102.37		4.33	102.3	ı		
Tunnels:	-								
Lineament and/ seismic indications:	or MFM20	054G0.							1
Zone ZFMENE10 ZFMENE1061A. corresponds to th in the vicinity of a recognised on the	D61 consists o These segme ne low magnet a topographic l e basis of an a	f two segments with two segments with the segment of the segment of the segment defined analysis of old re-	with slightly dif constitute ele M2054G0 and d by a depress fraction seism	ferent of ments its infe sion in t	orientation of one and rred contin the bedroc Isaksson a	s, the mos d the same nuation to t k surface, and Keisu	t promine structur the south the form (2005). F	ent of which is denc e. At the surface, i-west. This lineame of which has been Possible correlation	ited ent lies also

ENE	ZFM	ENE106	61A	Version number	4	Total object CL	20						
with a low velocity seis using the dip estimated intersection 244-315 m Decreased radar pene 829-832 m and 946-94	with a low velocity seismic refraction anomaly (see Isaksson and Keisu (2005) and Figure 5-33 in SKB (2005). Modelled using the dip estimated by connecting lineament MFM2054G0 and its extension to the south-west with the borehole intersection 244-315 m in KFM08A (part of DZ1). Deformation zone plane placed at fixed point 277 m in KFM08A. Decreased radar penetration also along the borehole interval 272-276 m in KFM08A. Zone also intersects borehole intervals 829-832 m and 946-949 m in KFM08C (DZ4 and DZ5, respectively), close to its north-eastern termination.												
And													
		Object CL	Comment										
Data source		2	MFM20540	0. KFM8A. KFM8C	KFM19								
Results of interpret	tation	3	High confid	ence observation in	KFM08A a	ind KFM08C.							
INFORMATION DEN	SITY				,								
Number of observa	ation points	3	4										
Distribution of obse	ervation points	2	Zone interc obs. points of KFM08A	epted by three boreh KFM08A and KFM08 and KFM19.	oles. More 3C and > 1	e than 700m betwe 150 m between inte	ercept						
INTERPOLATION													
Geometry		3	One strong	interpolation alterna	tive.								
Geological indicato	ors	2	Some discr	epancies in the geolo	ogical data	1.							
EXTRAPOLATION				<u> </u>									
Dip direction		2	Extrapolation	n in dip direction sup h of the modelled zo	oported by ne < <u>200</u> 0	subsurface obs. p m.	point.						
Strike direction		3	Zone mode High confid understand	lled length < 2000 m ence in this category ng of the site.	. Intersecter based on	ed in multiple bore conceptual	holes.						












ENE		ZFMENE	1061B	6	Version	number	3	Total object CL	15
GEO	LOGICAL CH	ARACTER	Pr	operty	155000	160000	1650	00 170000	
Deformation stv	le: Brittle			3					0
Deformation description:	Steeply strike s core wi frequen crush z	dipping fault with hows oblique slip th elevated fract icy and a 10 cm one identified all KEM08C	th ENE p. Fault ure wide ong	<u> </u>	05000 671000	R	5	J.J.	05000 671000
Alteration:	DZ4 III	RI MOOC.			67	1	17	HA VZ	29
- First order:	Oxidati	on		0	2	1,1	X	HILA S	7
- Second order:	Not obs	served		3	8 (		NYX N		3 8
- Third order:	Not obs	served			2000	M. A		XV/ VS	000
Fracture orientation and type:	Few fra ENE sti to steep conspic sealed later do estimat crush z	ictures. Fracture rike that dip mod bly to the SSE and cuous. Open and fractures where minates. Quanti e and span inclu ones along a sin	s with lerately re the tative lde lgle,	1	000 6695000 6				000 9699 000
Erecture comme	short be	orehole interval.			0599				1069
Fracture comme	Calcite	chlorite			U I				Ű
mineralogy:	hematit	e/adularia. clav			155000	160000	10500	170000	20 911
	mineral	S.			155000	160000	10500	0 170000	N
	OBJECT	GEOMETRY			Baselin	volume DMS lie		0 2 4 8	A
Strike/dip:	35°/81°	1							
Length:	432 m								
Mean thickness:	<u>: 1 m (1 ·</u>	- 13 m)			_				
Max depth:	-1200 n		40m arid Ma		-				
constraints:	error 20	00009A, 1000 0m, ZFMENE106 Cut(s).	61A, 1 UNIVE	ERSE					
			BASIS FO	R MOD	ELLING				
Zone based on si ZFMENE1061A a	urface lineame and ZFMENE1	ents and a boreh 061B, judged to	ole observat constitute el	ion. Zon lements	e ZFMENE of one and	E1061 consis I the same s	sts of two tructure.	segments,	
Outcrops:	-								
Boreholes:									
		Target ir	ntercept		Geometric	: intercept			
Borehole	PDZ	Sec. up [m]	Sec_low	Soc		Sec_low	Cor	nment	
		Sec_up [m]	[m]	Sec	:_up [m]	[m]	Onl	y geometrical inte	ercept
KFM08C	DZ4	829.00	832.00		-	-	with surf aga ZFM inte	the central zone ace due to trunca inst ZFMENE106 IENE1061A also rsects DZ4.	ition 1A.
Tunnels:	-								
Lineament and/o seismic indications:	or MFM20	954G1.							2
A			MODELLIN	G PRO	CEDURE				
At the surface, co lineament MFM20 point 829 m in KF	orresponds to t 054G1 with the <u>FM08C. De</u> cre	the low magnetic e borehole inters ased radar pene	c lineament N section 829-8 stration also a	/IFM205 332 m (D along the	4G1. Mode Z4) in KFN e borehole	elled using th 408C. Deform interval 827-	ne dip es mation z <u>-832 m</u> .	imated by connection placed	cting at fixed

ENE	ZFM	ENE106	Version number     3     Total object CL     15
ZFMENE2248		CEMENT De Sources	<image/>
Category INTERPRETATION		Object CL	Comment
Data source		2	MFM2054G1, KFM108C
Results of interpre	etation	3	High confidence observation in KFM08C.
INFORMATION DEP	NSITY	2	2
Distribution of obs	servation points	1	Single observation point at depth and surface lineaments.
INTERPOLATION			
Geometry		1	One sub-subsurface observation point and lineament.
Geological indicat	ors	1	Single observation point at depth. Zone modelled mainly based on
			surface geophysical data.
EXTRAPOLATION Dip direction			Extrapolation in dis direction supported by subsurface absurpaint
Dipuliection		2	Strike length of the modelled zone < 2000 m.
Strike direction		3	Zone modelled length < 2000 m. Intersected in multiple boreholes. High confidence in this category based on conceptual understanding of the site.
		FRAG	
Orientation:	Set ENE: 62.0°/	59.4°	ZEMENE1061B
(strike/dip right- hand-rule)			N
Frequency:	Boreholes: KFN	08C	
	FRACTURE	TER74GHL	
	TYPE	WEIGHED	
		P10	
	Open and	11.7 m-1	
	Sealed	22 4 m-1	
	Sealed	0.0 % of DZ	W-
	network	intercept	
	Crush	2.7 % of DZ	1 +
		intercept	$1 \qquad \qquad$
			Fould area
			Lower hemisphere
			• Unassigned (20)
			<ul> <li>Set ENE (12) Δ Mean pole Set ENE (332.0/30.6) Fisher κ = 89.2</li> </ul>
RQD:	min:75, max:98,	mean:90	





ENE			ZFMENE	1192	A	Version r	number	<b>1</b> Total	object CL	18
GE	OLOG	ICAL CH	ARACTER		Property CL	155000	160000	165000	170000	
Deformation st	vle:	Brittle			3	8				9
Deformation description:		No data	a available.		-	671000	N	-7	M	671000
- First order:		Ovidati	on			1.0	$\sim$	1 / 1	2/6	
- Second orde	r:	Not obs	served		3	000	7 -	1/1/	1 13	2 00
- Third order:		Not obs	served			2025	m 1	XIX		1050
Fracture		Fractur	e set with NE stri	ike		" R		_17+4		9
orientation and	ł	and ste	ep dip to the SE	is		5	11th	XAH	AN	2
type:		promine	ent. Gently dippir	ng		000		XXII	$\left( \right)$	000
		fracture	es are also prese	nt.		00/9		XVIY		100
		where t	he former domin	es	2			AX	$\langle Y \rangle$	U U
Fracture comm	ent:	No data	available.	aics.			C M C	2 N	Y	
Fracture fill		Chlorite	e, laumontite,			0000	XIN GC		/	000
mineralogy:		hematit	e/adularia, calcit	e,		699	1 114	$< \times'$	L .	9699
		quartz,	pyrite.			- t-	1 14	X	and	
		OBJECT	GEOMETRY					11	2 mars	1
Strike/dip:		66°/88°				0000		1 mm		0000
Length: Mean thicknes		1099 m	50 m)			6669	, i			699
Max denth:	э.	-1100 n	n <u>- 50 m</u>			1.1				
Geometrical			0m arid Max erro	or 20m.		155000	160000	165000	170000	20.91
constraints:		ZFMEN	1E0060A, 1 UNIV	ERSE PI	anar	Model	volume DMS		0 2 4 0	N
		Cut(s).				Baseline	e		S Laitmateret, Griddenerwei von	A
		I		BASIS	FOR MOD	ELLING				
Zone based on	surfac	e lineame	ents and a boreh	ole observ	vation. Zo	ne ZFMENE	1192 consists	of two segr	nents,	
ZFMENE1192A	and Z	FMENE1	192B, judged to	constitute	e elements	s of one and	the same stru	icture.		
Outenener		1								
Boreholes:		-								
Borenoies.										
	_		Target in	ntercept		Geometric	: intercept			
Borehole	F	DZ	Sec_up [m]	Sec_lo [m]	Se Se	c_up [m]	Sec_low [m]	Commei	nt	
KFM01A	[	DZ2	386.00	412.0	0	371.60	412.40	New SHI Table 3-2	DZ from ES 2 in SKB Ste	iHI (cf. phens
KFM01A	[	DZ5	267.00	285.0	0	253.10	309.33	01 01. 200		
KFM01C	[	DZ1	23.00	48.00	)	30.60	34.25	ZFMA2 a DZ1. Fra between inferred t DZ (cf. T Stephens	also intersect ctured rock 48 and 62 n to be affected able 3-2 in s et al. 2007	ts n d by ).
Tunnels		[								
Lineament and	/or	 MFM22	5360							
seismic		1011 10122								2
indications:										
			-	MODELL	ING PRC	CEDURE				
Zone ZFMENE <sup>+</sup> slightly different ZFMENE1192A connecting linea Deformation zon borehole interva zone ZFMA2 is influmore of early	192 c trends corres ament ne plar al 390-4 also m	onsists of s. These f sponds at MFM225 ne placed 400 m. Zo nodelled t	f two segments, I two segments are t the surface to the 3G0 with the bor I at fixed points 2 one also intersect o intersect boreh	labelled Z e judged t ne low ma ehole inte 277 m and cts boreho nole KFM0	FMENE1 <sup>2</sup> to constitu agnetic line rvals 267 I 402 m in ble interval 01C along	192A and ZF te elements ament MFN 285 m (DZ5 KFM01A, D 23-48 m (D DZ1. For th interval	FMENE1192B, of one and the M2253G0. Moo 5) and 386-412 becreased rada 0Z1) in KFM01 is reason, the	, following lin e same stru delled using 2 m (DZ2) in ar penetratio C. However re are difficu	neaments wi cture. Zone the dip estin KFM01A. In also along , the gently c lities to sepa	th nated by the dipping rate the
	es / El	VIEINE115	SZA and ZEMA2	along this	s porenole	interval.				

ENE	ZFM	ENE119	Version number	4 Total object CL 18
	NE2254 ZFMENE0060 ZFMENE0060 VE2282 <sup>40,00</sup> VE2282 <sup>40,00</sup> ZFMENE0060 VE2282 <sup>40,00</sup> ZFMENE0060 VE2282 <sup>40,00</sup> VE2282 <sup>40,00</sup>	DA DA DA DA DA DA DA DA DA DA DA DA DA D	CONFIDENCE ESTIMATE	TEMMMERINA TEMMMERINA TEMMMERINA ZEMENEOU ZEM
Category		Object CI	Comment	
		Object OL		
Data source		2	MFM2253G0, KFM01A, KFM01C	
Results of interpre	tation	3	High confidence observation in KFM	101C.
INFORMATION DEN	ISITY		0	
Number of observe	ation points	2	3	
Distribution of obs	ervation points	2	Two intercepts c. 250 in between an	nd the lineament considered as
			all outlier. Three scattered observat	
Geometry		2	Modelled as a splay to ZFMENE006 the SHI compared to ZFMENE0060. depth, the extrapolation alternative a fully ruled out. This gives at least alt	60A. Limited information from A. Due to limited information at along MFM2253G1 cannot be ernatives for the geometry.
Geological indicate	ors	2	Interpolation supported by mineral fi boreholes.	illings within fractures from
EXTRAPOLATION				
Dip direction		2	Extrapolation in dip direction suppor Strike length of the modelled zone <	ted by subsurface obs. point.
Strike direction		3	Conceptual understanding of the site	e and that the entire modelled









ENE	ZFMENE11	92B	Version number	4 Total object CL	11
GEOLOGICA	CHARACTER	Property	155000 160000	165000 170000	(
Deformation style:	Brittle				0
Deformation	No data available	-	00	~	000
description:	No data avallabic.		2	177	671
Alteration:				1 1 1 2	
- First order:	Oxidation		$\sim$	1 May 4	
- Second order:	Not observed	2		AL Y	000
- Third order:	Not observed		202	X X X X	105
Fracture orientation and type:	No data available.		" S	KARA KAN	9
Fracture comment:	No data available.		8	×11/1 5	000
Fracture fill	No data available.				200
mineralogy:					G
OBJ					
Strike/dip:	60°/88°		8		00
Length:	758 m		80 m		950
Mean thickness:	3 m (2 - 36 m)		6	N V	66
Max depth:	-760 m	047 T		LA -	
Geometrical	ZFMENE0060A, ZFMNV0	017, Topo			0
constraints:	40m grid Max error 20m, 1				000
	UNIVERSE Planar Cul(s).		666		699
			155000 160000	165000 170000	
			100000	103000 170000	N
			Baseline DMS	0 Z 4 8 Contrational Conductioners for	A
	DACI				
Zone based on surface lin	eaments Zone ZEMENE119	2 consists of	two segments ZEMEN	E1192A and ZEMENE1192B	3
judged to constitute eleme	ents of one and the same stru	icture.			,
judged to constitute cieffic					
Outcrops:	-				
Boreholes: -	•				
Tunnels:	-				
Lineament and/or	MFM2253G1.				2
seismic indications:	Mape				
Zono ZEMENE1102 oonoi	MODE	LLING PRO	CEDURE	P following lineaments with	
2011 ZFIVIEINE 1 192 CONSI	sis of two segments, labelled	d to constitu	92A and ZFIMEINE 1192	b, following ineaments with	
ZEMENE1192B correspon	iese two segments are judge	magnetic line	amont MFM2253G1 M	odelled with the same din th	
same thickness and to the	same depth as ZEMENE119	92A.			
				-229	
			4	NNEE	
				TEMMS	
2					
E ST				ZFMENE0061	-
2	E I				
2	3			$\sim$	
N N					
1	ĕ		12	ZFMENE2254	
	ZEME	NE11	02R	10	
A CONTRACTOR OF A CONTRACTOR O				ZFMENE1400	
				0,0000000000000000000000000000000000000	4
	CMD9			Λ	
	ZFMEN	FOOCO			
		-0000C		2FMENE00con	
				1-0060A	
			N		
0 100 200					
0 100 200	300 500 m				1
	300 500 m				
	300 500 m			In Standard	

ENE	ZFN	IENE11	92B	Version number	4	Total object CL	11						
<b>OBJECT CONFIDENCE E</b>	STIMATE			•									
Category		Object CL	Comment										
INTERPRETATION													
Data source		1	MFM2253G	61									
Results of interpretation	n	2	Medium co	nfidence for the linea	ament MF	M2253G1.							
INFORMATION DENSIT	Y												
Number of observation	n points	1	1										
Distribution of observa	tion points	1	Single obse	ervation point in the f	form of a	lineament.							
INTERPOLATION													
Geometry		1	Splay to ZF	MENE0060A. Possi	bility to m ata availa	odel along the							
Geological indicators		1	Indirect support by geophysical data.										
EXTRAPOLATION													
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.										
Strike direction	3	Conceptual zone is sup	understanding of th ported by the linear	e site and nent.	that the entire mod	lelled							
		FRA	CTURE CHA	RACTER									
	_		No data avail	able									
INDIVIDUAL INTERCEPT	INDIVIDUAL INTERCEPTS												
			No data avail	able									

ENE	ZFMENE1208	BA	Version r	number	5	Total object CL	18
GEOLOG	ICAL CHARACTER	Property CL	155000	160,000	16500	00 170000	
Deformation style:	Brittle	3	8				00
Deformation	Steeply dipping faults with		100		~	~	1000
description:	NNW-SSE strike show		67	N	F	1 mm	67
-	evidence for both sinistral and		1.00	- 5	2	1 1 4	1 -
	dextral strike-slip. One steeply		0	5	11	10012	3. 0
	dipping fault with ENE strike		2 200	1 -	V	NFL	5000
	also shows a strike-slip		670	11	A		670: 670:
	displacement.		5		$\sim$	THAN 5	(red) to 18
Alteration:	0.11.1		5	110	XX	THAT NO	2
- First order:	Oxidation	3	00 / /		X		5 00
- Second order:	Not observed		002		X	N/V	2000
- Third order:	Not observed		°			K V	9
Fracture	Steeply dipping fractures that			X	HAS		
orientation and	strike WSW, SSW and SSE,		8	13116	2	X/	0
type:	and gently dipping fractures,		9500	16	~	VZ	9500
	especially in KFM09A (DZ1)		66	1 111	N		669
	dominatos Dominatod by		100	1 1	X	An more	
	sealed followed by open and				1	a for the second	-
	partly open fractures	2	0000			war	0000
Fracture comment:	No data available.		669	, i i i		N	1699
Fracture fill	Calcite, chlorite,						
mineralogy:	hematite/adularia, laumontite,		155000	160000	16500	0 170000	20.510
	quartz, clay minerals. Epidote						N
	also present in KFM07A (part		Baseline	olume DMS		0 2 4 8	A
	of DZ4).						
	OBJECT GEOMETRY						
Strike/dip:	240°/81°						
Length:	1082 m						
Mean thickness:	10 m (3 - 50 m)						
Max depth:	-1100 m						
Geometrical	ZFMNW0003, Topo 40m grid Ma	ax error					
constraints:	20m, 1 Surface Planar Cut(s), 1						
	UNIVERSE Planar Cut(s).						

386

## ZFMENE1208A

BASIS FOR MODELLING Zone based on borehole observations.

Outcrops: -

ENE

		Target i	ntercept	Geometric	: intercept		
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	Comment	
HFM23	DZ1	26.00	42.00	8.26	10.21	Target intercept is outside geometrical intercept.	
HFM28	DZ1	12.02	65.00	7.11	21.89	Target intercept is partly outside of geometrical intercept.	
KFM07A	DZ4	857.00	897.00	870.66	895.24	ZFMENE1208B also intersects DZ4. Divided into three separate zones at 803-840 m, 857-897 m and 920-999 m (cf. Table 3-2 in Stephens et al. 2007). Fractured rocks between these modelled zones inferred to be affected by DZ.	
KFM09A	DZ1	15.00	40.00	16.27	41.51		
KFM09B	DZ1	DZ1     13.00     40.00     16.27     41.51     ZFMENE1208B also intersects DZ1. Only borehole intervals 9       DZ1     9.20     43.00     21.52     35.25     Sector and the DZ deterministic model Table 3-2 in Stephe 2007). Fractured row between these mod zones and between and 308 m inferred affected by DZ.					
Tunnels:	-						
Lineament and seismic indications:	/or -						
			MODELLING	PROCEDURE			
Zone ZFMENE1 and ZFMENE12 same structure. present. Zone m and 9-43 m in K zone ZFMENE0 KFM09B. Decre 50 m in KFM09E termination agai	208 consists of 08B are descrived Magnetic data odelled by coor FM09B (part of 159A. Deform ased radar pe 3. Zone also ir nst ZFMNW00	of two sub-paralle ibed separately i a re absent or of nnecting borehold f DZ1) and, with ation zone plane netration also alc tersects borehold 003 and blind, so	el segments. The n the property s poor quality close intervals 857- the assistance placed at fixed ong the boreholo e intervals 26-4 as to avoid inte	ough these two sheets, they are i be to the reside 897 m in KFM07 of fracture orient points 883 m in e intervals 880-8 2 m in HFM23 (I prsection along H	segments with inferred to cons nce area and r A (part of DZ4 tation data, ass KFM07A, 30 r 86 m in KFM0 271) and 12-65 IFM20.	identity codes ZFMENE1208A stitute elements of one and the nagnetic lineaments are not ), 15-40 m in KFM09A (DZ1) suming an orientation parallel to n in KFM09A and 28 m in 7A, 30-32 m in KFM09A and 26 5 m in HFM28 (DZ1). Inferred	

Version number

5

Total object CL

18

ENE	ZFM	ENE120	<b>A8</b>	Version number <b>5</b> Total object CL							
ZF MNINO03	ZFN ZFMNW0017 100 200	IENE1208B			ZFMENE0159A Kranogo E2320						
		OBJECT	CONFIDENCE	ESTIMATE							
		Object CL	Comment								
Data source		2	HFM23, HFM	/28, KFM07A, KFM09A	, KFM09B						
Results of interpre	etation	3	High confide	nce observations in mul	tiple boreholes.						
INFORMATION DEM	NSITY										
Number of observ	ation points	3	4								
	ervation points	2	A group of c	ustered observation poi	nts and at least one outlier.						
Geometry		2	The zone is	internolated horizontally	parallel to ZEMENE1208B						
Geological indicat	ors	2	Interpolation	supported by mineral fi	llings within fractures from						
	0.0	2	boreholes.								
EXTRAPOLATION											
Dip direction		2	Extrapolation	n in dip direction suppor	ted by subsurface obs. point.						
Otvilue dimention		-	Strike length	of the modelled zone <	2000 m.						
Strike direction		2	points. Strike	e length < 2000 m.							
		FRAG	CTURE CHAR	ACTER							
Orientation:	Set SW: 234.1°	/87.4°		ZFMENE1	208A						
(strike/dip right-	Set G: 75.9°/9.0	)° 8/00 08		N							
nano-rule)	Set SSE: 164.3	/00.0-		A start and a start a							
Frequency:	Boreholes: KFN	109B,	-								
				1							
	FRACTURE	TERZAGHI-									
	TYPE	WEIGHED	1								
		P10	-	1436	2. S						
	Open and	4.0 M-1	W		E E						
	Sealed	13.4 m-1									
	Sealed	18.5 % of	1	1	•						
	network	DZ	1	· · · · · · ·	***						
		intercept		1	1.1.1.1.1.1						
	Crush	0.9 % of DZ		× ··· · ·							
		mercept	1 [		- Caral						
					Equal area						
			• Unass	igned (134)	Lower hemisphere						
			Set Si	W (243) A Mean pole	Set SW (144.1/2.6) Fisher $\kappa = 11.0$						
			<ul> <li>Set G</li> <li>Set S</li> </ul>	(247)	Set G (345.9/81.0) Fisher κ = 26.3 Set SSE (74.3/4.0) Fisher κ = 44.9						
RQD:	min:3, max:100	, mean:94									



	ENE					Ζ	FN	IE	NE	12	208	BA	Ve	ersio	n nur	nber	5	)	Tota	al ob	ject C	Ľ	18
										IND	DIVI	DUAL IN	TERCE	PTS	i				•				
HFM2	3 DZ1 (	26.	0-42.	.0 n	1)																		
Length (m)	Elevation m.a.s.l. (m, RH2000)	Ofrad	pen tures	Se	aled	Ope fra	n total ctures	Seale	ed total	Tot fract	al ures	Crushed zone	Sealed network	RQD r 100 low = hig	eversed 0 = 0 value h value	Frac oper orien	ture frac tation	5	Fracture ealed fra rientatio	c n	Open apertur (mm)	e	Core loss
		0	20	0	20	0	20	0	20	0	20			0	100	0	90	0		90 0		10	
27	-18 -		-		-	L	-											1		-		-	
28	-19							-						9	6.5	1-	-	-1-1		-			
29	20					L					1			9	6.5		5			1.			
30	-20			-										8	8.3	11	12			R			
31	-21				- L.									10	0.0			×		3			
32	-22 -				-	ι.			-		-			10	0.0		1	10	*	1			
33	-23					-									5.5	*	•	à		1			
34	-74 -														5.6	1.	1 1			1			
35						-					- 1			9	0.4	·· 🕂		-	177				
36	-25	-												5	1.5				190				
37	-26 -										20			9	0.8	3 1		B.		1			
38	-27 -													4	9.7	1	1	Tao	~	1			
39	-28						100	F.						7	4.4	2	1			-			
40	1 20													9	1.4		-						
41	-29			÷. •										7	5.3		.M.	1		1		-	









ENE	ZFMENE1208	8B	Version n	umber	<b>5</b>	5 Total object CL			
GEOLOG	ICAL CHARACTER	Property CL	155000	160000	165,000	170000			
Deformation style:	Brittle	3	8				00		
Deformation description:	Steeply dipping faults with NNW SSE strike, sub-parallel to the tectonic foliation, show both sinistral and dextral displacement. One steeply dipping fault with W strike along DZ2 in KFM09A shows dextral strike-slip displacement, possibly conjugate to the sinistral displacement along the NNW- SSE faults.		670000 6705000 67100	e e e e e e e e e e e e e e e e e e e	5		6700000 6705000 67100C		
Alteration:				SHE	X	VY I			
- First order:	Oxidation	3	2000	24 40		M	2000		
- Second order:	Not observed	Ŭ	699	1 111	$\sim$	$\langle \rangle$	699		
- Third order:	Not observed			1 1	1X	the man			
Fracture orientation and type:	Steeply dipping fractures that strike WSW, NE and NNW, and gently dipping fractures dominates. Sealed and open fractures, with a dominance of open fractures in the gently dipping set. Quantitative estimate and span include	2	155000 Big Model vr Baseline	160000 plume DMS	165000	170000	0000699 z		
	sealed fracture networks and								
Fracture comment: Fracture fill mineralogy:	No data available. Calcite, chlorite, laumontite, hematite/adularia, quartz, clay minerals. Epidote also present in KFM07A (part of DZ4).								
	OBJECT GEOMETRY								
Strike/dip:	240°/81°								
Length:	1111 m								
Mean thickness:	13 m (3 - 50 m)								
Max depth:	-1100 m								
Geometrical constraints:	2FMINW0003, Topo 40m grid Ma 20m, 1 Surface Planar Cut(s), 1 UNIVERSE Planar Cut(s).	ax error							

## **ZFMENE1208B**

Version number

5

18

BASIS FOR MODELLING Zone based on borehole observations.

-

Outcrops:

Borehole	PDZ	Target in	ntercept	Geometric	intercept			
		Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	Comment		
HFM28		-	-	86.07	121.33			
KFM07A	DZ4	803.00	840.00	792.28	828.35	ZFMENE1208A also intersects DZ4. Divided intr three separate zones at 803-840 m, 857-897 m and 920-999 m (cf. Table 3-2 ir Stephens et al. 2007). Fractured rocks between these modelled zones inferred to be affected by DZ.		
KFM09A	DZ2	86.00	116.00	85.16	116.30	Fractured rock between 8 and 15 m, 40 and 86 m, and 116 and 124 m inferred to be affected by DZ (cf. Table 3-2 in Stephens et al. 2007).		
KFM09B	DZ1	59.00	78.00	60.81	79.88	ZFMENE1208A also intersects DZ1. Only borehole intervals 9-43 m, 59-78 m and 106-132 m included in the DZ deterministic modelling (cf. Table 3-2 in Stephens et al. 2007). Fractured rock between these modelled zones and between 132 and 308 m inferred to be affected by DZ.		
unnels:	-							
ineament and	/or -							
eismic dications:								
			MODELLING	PROCEDURE				
agnetic data a odelled by cor FM09B (part o FMENE0159A ecreased rada	re absent or connecting boreh f DZ1) and, w . Deformation or penetration	of poor quality closed ole intervals 803- ith the assistance zone plane place also along the bor	se to the reside 840 m in KFM of fracture orie d at fixed point rehole interval	nce area and ma 07A (part of DZ4) entation data, ass s 817 m in KFM0 92-106 m in KFM	agnetic lineame ), 86-116 m in suming an oriei 07A, 94 m in Ki 109A. Zone als	ents are not present. Zone KFM09A (DZ2) and 59-78 m in ntation parallel to zone FM09A and 66 m in KFM09B. o intersects borehole HFM28.		

ENE	ZFM	ENE120	Version number         5         Total object CL         18					
Trimene 1208a Trimene 1208a Trimen								
OBJECT CONFIDENCE ESTIMATE								
Category		Object CL	Comment					
INTERPRETATION		2	HEM28 KEM07A KEM09A KEM09B					
Results of interpre	etation	3	High confidence observations in multiple boreholes.					
INFORMATION DEM	NSITY							
Number of observ	ation points	3	>4 A group of clustered observation points and at least one outlier					
INTERPOLATION		2						
Geometry		2	The zone is interpolated horizontally parallel to ZFMENE1208A and ZFMENE0159A.					
Geological indicat	ors	2	Interpolation supported by mineral fillings within fractures from boreholes.					
EXTRAPOLATION			Extrapolation in dis direction supported by subsurface abounding					
Dip direction		2	Strike length of the modelled zone < 2000 m.					
Strike direction		2	No surface lineament. Supported by geological concept and subsurface observation points. Strike length < 2000 m.					
		FRAC	CTURE CHARACTER					
Orientation:	Set WSW: 237.	4°/86.9°	ZFMENE1208B					
(strike/dip right- hand-rule)	Set G: 71.5*/10 Set SSE: 159.2	°/89.3°	N					
Frequency: Boreholes: KFM09B, KFM07A, KFM09A								
	FRACTURE TYPE	TERZAGHI- WEIGHED P10						
	partly open Sealed Sealed	3.9 m-1 16.5 m-1 9.8 % of DZ	W-					
	network Crush	intercept 0.0 % of DZ intercept						
			Equal area					
			• Unassigned (137) • Set WSW (284) • Mean pole Set WSW (147.4/3.1) Fisher $\kappa = 16.5$ • Set G (197) • Mean pole Set G (341.5/79.9) Fisher $\kappa = 26.1$ • Mean pole Set SE (62.20.2) Fisher $\kappa = 22.2$					
RQD:	min:64, max:10	0, mean:97	- Set SSE (105)					











ENE		ZFMENE212		0	Version I	Version number 5		otal object CL	21	
GEOLO		Property	155000	160000	165000 170000					
Deformation style:	Brittle			3		8			0	
Deformation	No data	a available.		Ŭ						
description:	description:				67	5		> mon	67	
Alteration:	eration:				1.00			1 1 4		
- First order:	Oxidati	on		З	0	2		1 mg	0	
- Second order:	Not obs	served		U	200	w T	V	VPL	200	
- Third order:	Not observed				670	1 1	INV	670		
Fracture orientation and type:	Three sets of fractures present. Two sets dip steeply and strike NE and NNW. Third set is gently dipping. Open and partly open fractures dominate in the steeply dipping NNW set. Both sealed and open/partly open fractures are present in the steeply dipping ENE set.			2	66956000 6700000	6695000 EFOODO				
Fracture comment:	Apertur	Apertures are commonly less		2			A	A survey	-	
	are pre	are present.			6000		~ ~	with	0000	
Fracture fill	Domina	Dominance of chlorite, calcite,			669			N	699	
mineralogy:	quartz, adularia and clay				1.10					
	mineral	minerals in sealed fractures.			155000	160000	165000	170000	20.50	
Calcite, chl		chlorite, clay minerals,			Madala	aluma DMS			N	
	hematite dominate in open				Baseline			Contrainerst Conductorswerkers	A	
Strike/din: 238°/70°					-					
Length:	238 m				-					
Mean thickness:	10 m (1	- 13 m)								
Max depth:	-240 m									
Geometrical ZFM		INNW1205B, Topo 40m grid Max error								
constraints:	20m, 1	Surface Planar (	Cut(s), 1							
	UNIVE	RSE Planar Cut(	s).							
BASIS FOR MODELLING										
Zone based on surfa	ce lineame	ents and borehole	e observa	ations.						
Outcrops:	1.									
Boreholes:	1									
						•				
Boroholo	Target interc		itercept		Geometric	See low	Com	mont		
Dorenole	FDZ	Sec_up [m]	Sec_ic	Se Se	c_up [m]		Com	ment		
HFM22	D71	110.00	129.0	0	112.88	126.33				
KFM08D	DZ1	184.00	210.0	0	187.99	206.38	1			
KFM23	DZ1	21.70	35.00	2	17.85	100.64	1			
				1			• 			
Tunnels: -										
Lineament and/or MFM2120G.						3				
At the surface, corresponds to the low magnetic lineament MEM2120C. Modelled down to 250 m denth, using the din										
estimated by connect KFM08D (DZ1). Defo zone.	ting linean	nent MFM2120G one plane placed	with the b at fixed p	borehole ir point 115 n	tersection 7 n in HFM22	110-129 m in F and 197 m in	HFM22 ( KFM08	DZ1), 184-210 in D. Inferred to be	n a minor	

ENE	ZFN	IENE21	20 Version number 5 Total object	<sup>t CL</sup> <b>21</b>				
A REMUNIVO404	KERNINWIZOLA KERNINWIZOLA							
		OBJECT						
		Object CL	Comment					
Data source		2	MFM2120G, HFM22, KFM08D, KFM23					
Results of interpre		2	Medium confidence observations in KFM08D.					
Number of observ	vation points	3	4					
Distribution of obs	servation points	3	Even distribution of obs. points.					
			Lincoment combined with herebala aba, points averaget and stra					
Geometry		3	alternative.					
Geological indicat	ors	3	Interpolation supported by key geological parameters, foremost					
EXTRAPOLATION								
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.					
Strike direction		3	Conceptual understanding of the site and that the entire modelled					
			zone is supported by the lineament.					
Orientation <sup>.</sup>	Set WSW: 236	FRAC 0°/89.7°						
(strike/dip right-	Set NNW: 355.3	3°/80.3°	ZFMENE2120 Ņ					
hand-rule)	Set G: 348.6°/5	.2°	A State of the sta					
Frequency:	Boreholes: KFM	123, KFM08D						
	FRACTURE	TERZAGHI-		X-				
	TYPE	WEIGHED	/	7				
P10Open and partly open11.1 m-1Sealed15.9 m-1Sealed2.0 % of D2networkinterceptCrush1.6 % of D2		P10 11.1 m-1	1	1				
		11.111-1		•				
		15.9 m-1	W-A	E				
		2.0 % of DZ intercept		· - +				
		1.6 % of DZ		1				
		intercept		1				
				Equal area				
			• Unassigned (109)	remisphere				
			Set WSW (187) Δ Mean pole Set WSW (146.0/0.3) Fisher κ = 21.5					
			Set G (114) ▲ Mean pole Set G (258.6/84.8) Fisher	$r \kappa = 34.1$				
RQD:	min:7, max:100	, mean:84						








ENE		ZFMEN	E2248		Version r	number	6	Total object CL	17
GEO	LOGICAL CH	ARACTER	Pro	perty	155000	160000	16	5000 170000	
Deformation stv	le: Brittle			3	8				e
Deformation description:	No data	a available.			671000	2	5	m m	671000
Alteration:					1.00	~ {	Y	114	1 1
- First order:	Oxidati	on		з	0	5	/	V P	3. 0
- Second order:	Not obs	served		5	2 200	w T		MM	200
- Third order:	Not obs	served			670	1		AIRIN	670
Fracture orientation and type:	Three s fracture sealed open au fracture estimat sealed fracture dipping Steeply	sets of steeply di sets of steeply di set. Dominated by fractures followend partly open set. Quantitative e and span inclu fracture network as as well as gen fractures are pro- dipping fracture	pping / d by lde s s tty esent. s	2	6695000 670000				6695000 6700000
	strike NE, NNW and NW.					1		2 7 incent	
Fracture comme	ent: No data	a available.			000		X	how	000
Fracture fill	Chlorite	e, calcite,			0599		~ \		690
mineralogy:	nematit	e/adularia, laum	ontite,		U I				Q
	fracture	s with gentle to				100 000			26.940
	modera	te dips to the SE	and		155000	160000	16	5000 170000	N
	steep d	ips with NW strik	ke.		Model v	olume DMS		0 2 4 0	A
	OBJECT	GEOMETRY			Duscinic			d Lastmitevel Certhicknewskie	
Strike/dip:	236°/80	)°							
Length:	1314 m								
Mean thickness	: 36 m (3	8 - 50 m)							
Max depth:	-1300 r	n							
Geometrical	ZFMNN 40m gr	W0100, ZFMWI	NW0809A, Top	)0 anar					
constraints.	Cut(s).								
Zana haaad an a			BASIS FOR	MODI	LLING				
Zone based on s	unace lineame	ents and borenoi	e observations	<b>.</b>					
Outcrops: Boreholes:	-								
		Target in	ntercept		Geometric	intercept			
Borehole	PDZ	See up [m]	Sec_low	Soc	un [m]	Sec_lov	v C	omment	
		Sec_up [m]	[m]	Sec	-up [m]	[m]			
KFM08A	DZ5	775.00	843.00	7	74.94	837.14	8 T 2	40-843 m added (cf able 3-2 in Stephen 007).	f. is et al.
KFM27	DZ1	30.00	92.00		5.89	84.26		•	
Tunnels:	-	400							
Lineament and/		48G.							2
seismic									2
				PRO					
At the surface or	prresponds to	the low magnetic	lineament ME	M224	BG and ite	inferred cor	ntinuati	on to the south-was	t
Modelled down to 775-843 m in KFI	Modelled down to 1300 m depth, using the dip estimated by connecting lineament MFM2248G with the borehole intersection 775-843 m in KFM08A (DZ5 and extension along borehole interval 840-843 m) and 30-92 m in KFM27 (DZ1). Deformation								
zone plane place	d at fixed poin	t 789 m in KFM0	08Ă		/				

ENE ZF	MENE22	48 Version number 6 Total object CL 17								
CFMENE2248       True To B         DEJECT CONFIDENCE ESTIMATE       Comment         INTERPRETATION       Diject CL       Comment         Data source       2       MFM2248G, KFM08A, KFM27										
Catanan	Object Cl	Commont								
	Object CL	Comment								
	2	MEM2248G KEM08A KEM27								
Results of interpretation	2	Medium confidence observations in KEM08A and KEM27								
INFORMATION DENSITY										
Number of observation points	2	3								
Distribution of observation points	2	Two intercepts c. > 750m in between and the lineament considered as an outlier. Three scattered observation points.								
INTERPOLATION										
Geometry	2	Due to lack of surface observations in the western part of the zone and subsurface information from eastern part, uncertainty arises regarding the zones current geometry along the strike and the dip. This lend support for more than one alternative interpolations.								
Geological indicators	2	Single observation point at depth. Zone modelled mainly based on surface geophysical data.								
EXTRAPOLATION										
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.								
Strike direction	3	Zone modelled length < 2000 m. Intersected in multiple boreholes. High confidence in this category based on conceptual understanding of the site.								











ENE		ZFMEN	E2254		Version	n number <b>4</b> Total object CL				
GEOLO	GICAL CH	IARACTER	Pro	operty	155000	160000	165000	170000		
Deformation style:	Brittle			3	Q				0	
Deformation	Steeply	/ dipping faults w	rith NE	-	1000				000	
description:	strike s	how oblique-slip			67	N	FILL	man 2	67	
-	displac	ement. One fault	t		1. 1.		11	1	1 1	
	shows	both normal and			0	2	1/1	a la	3. 0	
	dextral	strike-slip compo	onents		2 200	w F	VN	141	200	
Alteration	of mov	ement.			P 610	1 1	AL	$\lambda \land \mathcal{A}$	670	
Alteration:	Ovidati	on			2		W/alt	1 2	3	
- First order:	Not ob	sonvod		3	. { }	1/1	XXTH	72 1	2	
- Third order:	Not ob	served			00 2	1-20	XXII		0000	
Fracture	Fractu	es with steen dir	to the		670	11000	S VIY	/ //	670	
orientation and	FSF de	ominates. Domin	ated		1	Lette	TON	$\langle \rangle$		
type:	by sea	led followed by o	pen			X SHE		Y		
	and pa	rtly open fracture	s.	2	000	2011 rec		/	000	
Fracture comment	: No dat	a available.			9699	1 111	XX	{	9695	
Fracture fill	Laumo	ntite, chlorite,			-+-	1 14	X	and the second	C I	
mineralogy:	hemati	te/adularia, calcit	ie.		R		~ /	- marine		
	OBJECT	GEOMETRY			000		/ W	1	000	
Strike/dip:	240°/8	3°			0599	~			0690	
Length:	9/1 m	22 \			- U				U	
Mean thickness:	3 m (2	- 36 m)			155000	400000	105000	170000	20.510	
Geometrical	-970 m		W0404 Topo	40m	155000	160000	165000	170000	N	
constraints:	arid Ma	ax error $20m$ 1 S	urface Planar	40111	Baselin	volume DMS e		0 2 4 8 	A	
oonotrainto.	Cut(s).					3				
	/		BASIS FOR	R MODE	ELLING					
Zone based on surf	ace lineam	ents and borehol	e observation	s.						
Outcrops:	-									
Boreholes:										
		Target in	atorcont		Goomotric	intorcont				
Borehole	PD7	raiget i	Sec low	<u> </u>	ocometric	Sec. low	Comme	nt		
		Sec_up [m]	[m]	Sec	:_up [m]	[m]				
							HFM01 I	OZ1 is inferre	ed to	
HFM01	DZ1	-	-		3.95	37.50	be a ma	nifestation of	f	
				_			ZFMA2.			
KFM01A	DZ3	639.00	684.00	6	41.59	691.21				
KFM01D		-	-	2	26.06	55.06				
Tunnels:										
Lineament and/or	MFM22	254G.								
seismic									2	
indications:										
			MODELLING	<b>PRO</b>	CEDURE					
At the surface, corre	esponds to	the low magnetic	c lineament M	FM225	4G. Model	led down to 1	000 m depth	, using the d	lip	
estimated by conne	cting linear	TIENT INFM2254G		noie int	ersection (	039-684 M IN	NFIVIU1A (DA	(3). Deformation	ation	
manifestation of 7F	MA2.			, 13 a130						

ENE	ZFN	IENE22	54	Version number	4	Total object CL	14
	ZFMENE0061 ZFMENE111 ZFMENE006 200 300 2	1E2254 92A 04 500	*FROID	ZEMMUEZZE	Kering	ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEMMERSS ZEM	E OC
		OBJECT	CONFIDENCE	ESTIMATE			
		Object CL	Comment				
Data source		2	MFM2254G,	HFM01, KFM01A, K	(FM01D	No SHI interpreted	)
Results of interpre	etation	3	High confider	ce observations in	KFM01A	•	·
INFORMATION DEN	NSITY	2	2				
Distribution of obs	servation points	2	More than 60	0 m between the su	hsurface	observation points	
INTERPOLATION			more than ee		boundoo	obconvation pointe.	
Geometry		1	Geometry su	ported by a lineam	ent and a	single intercept.	
Geological indicat	ors	1	Indirect suppo	ort by geophysical d	ata.		
EXTRAPOLATION							
Dip direction		2	Extrapolation	in dip direction sup	ported by	subsurface obs. po	oint.
Otvilue dimention			Strike length	of the modelled zon	<u>e &lt; 2000</u>	<u>m.</u>	a mia a l
Strike direction		2	concept and	upport by surface ill subsurface observa	tion point	Supported by geor	ogical
			oonoopt and t				
Orientations	0 - 1 NE - 50 - 00/7	FRAC	TURE CHAR	ACTER			
(strike/dip right-	Set INE: 53.2-77	7.0*		ZFME	NE2254		
hand-rule)				1 miles		+	
Frequency:	Boreholes: KFM	101A, KFM01D				X	
	FRACTURE	TERZAGHI-		1		. \	
	TYPE	WEIGHED	Y			· /	
	Openand	P10		1			
	Open and	1.1 m-1	7			F	
	Sealed	50 m-1	-1.		4.	F	
	Sealed	0.0 % of DZ	W.	· · · ·			F
	network	intercept			1		
	Crush	0.0 % of DZ	4.			F	
		intercept	Z			L	
			$\setminus$				
			1			T	
				1			
				X		/	
					-	Equal	area
			()	T-	Ś	Lower nemisp	incre i
			Set NE	(184) 🔺 Mean p	ole Set NE	(323.2/13.0) Fisher κ = 1	95.8
RQD:	min:16, max:10	0, mean:97					



	ENE			ZF	MEN	E22	54	V	ersion num	<sup>ber</sup> 4	Total o	bject CL	14
						INDIVI	DUAL IN	TERCE	EPTS				I
HFM0	1 DZ1	(3.95-37	.5 m)										
Length (m)	Elevation m.a.s.l. (m, RH2000)	Open fractures	Sealed fractures	Open tota fractures	I Sealed total fractures	Total fractures	Crushed zone	Sealed network	RQD reversed 100 = 0 low value = high value	Fracture open frac orientation	Fracture sealed frac orientation	Open aperture (mm)	Core loss
		0 20	0 20	0 0 20	0 20	0 20			0 100 0	90	0 90	0 10	
	-2			1-1-1-1									
5	3								100.0				
6	1 4								100.0				
	-5								100.0				
8	1 -6								100.0				
9	7								100.0				
10	-8								100.0				
11	-9								100.0				
12	-10								100.0				
13	-11								100.0				
14	-12								100.0				
15	-13								100.0				
16	-14	-							100.0				
17	-15								100.0				
18	-16								100.0				
19	-17								100.0				
20	-18								100.0				
21	-19								100.0				
22	-20								100.0				
23	-21								100.0				
24	-22								100.0				
25	-23								100.0				
26	-24								100.0				
27	-25								100.0				
28	-26								100.0				
29	-27								100.0				
30	-28								100.0				
31	-29								100.0				
32	-30					1			100.0		20		
33	-31			1					69.9	÷		-	
34	.32			0					100.0				
35	32								90.4	+			
36	33		1						100.0	1.			
37	-34										100	10	



ENE		ZFMEN	E2320	)	Version	number	<b>5</b> <sup>To</sup>	tal object CL	22
GEO		HARACTER		Property	155000	160000	165000	170000	_
Defermetions				CL					12
Deformation st	yie: Brittie			3	0000				0000
description:	Steep	auits with ENE-V	1211		6710	2	1mm		3710
description.	displa	show surke-slip	hich		•	1	2//	1 mg	
	have	lextral strike-slip	Steen			$\sim$	XX	LJ G	-
	NNW-	SSE faults show	strike		000	5 =	-1/7	1113	2 00
	slip dis	placement. four	of		7050	w )	X	1/1/1	1050
	which	have sinistral stri	ke-slip.		° R	1	174	1	
	A stee	p fault with SE st	rike		2	11	XA	TA S	5
	shows	dextral strike-slip	)		8 {			$1/\Lambda$	2 00
	displa	cement. Gently di	pping		2 00	XV		VI	000
	faults	show dip-slip or o	blique-		61		2 H	UV	67
	slip m	ovement, the latte	er with				APX	X	
	a dom	inant strike-slip			9	CALL	2	17	0
Alteration:	compe	inent.			9500	-466	Carl	<	9500
- First order:	Oxidat	ion			66	1 11	S	2 m	66
- Second order	r: Chlori	ization		3			A	And man	
- Third order:	Quartz	dissolution			8		XV	A man	00
Fracture	Steep	y dipping fracture	s with		0050			1.1	1006
orientation and	I WSW,	NNW-SSE, ENE	-WSE,		99			S	66
type:	NNE,	and SE strike are					1 - 1		20.001
	Domin	atod by soalod fo	es.		155000	160000	165000	170000	
	by one	aleu by sealeu lu	noweu	2	Model	volume DMS		0 2 4 8	Ň
	fractur	es.	·	2	Baselin	e		S Laitmateret, Goldatzierweisen	N
Fracture comm	ent: No da	a available.			-				
Fracture fill	Calcite	e, chlorite, laumor	ntite,						
mineralogy:	hemat	ite/adularia, prehi	nite,						
	pyrite,	quartz, clay mine	erals.						
Striko/din:		I GEOMEIRY							
Length:	1715 r	1 n			_				
Mean thickness	s: 25 m (	 16 - 51 m)			-				
Max depth:	-1700	m							
Geometrical	ZFMN	W0017, ZFMNE2	308, Topo	40m					
constraints:	grid M	ax error 20m, 1 S	urface Pla	nar					
	Cut(s)		D 4 010 1						
Zone based on s	surface linear	ents and borehol	e observat	tions.	ELLING				
			0.000114						
Outcrops:	-								
Borenoles:									
		Target in	ntercept		Geometric	c intercept			
Borehole	PDZ	Sec up [m]	Sec_lo	W Sec	up [m]	Sec_low	Comm	nent	
	D74	225.00	[m]		10.40	[m]			
KEM070	DZ4	225.00	245.00		219.49	252.27			
	<u>UZZ</u>	308.00	300.00		228 24	417.50			
KEM08D	DZ3 D76	582.00	634.00	) 4	50.04 582 13	635 50			
KFM08D	DZ7	582.00	634.00	) !	582.13	635.50			
KFM09B	DZ3	363.00	413.00		376.25	409.15			
Tunnels:	-								
Lineament and	or MFM2	320G.							0
seismic									2
indications.			MODELL	ING PRO	CEDURE				
At the surface. c	orresponds to	the low magnetic	lineamen	t MFM232	0G and its	inferred con	tinuation to	the south-west	t.
Modelled down	to 1700 m der	th, using the dip	estimated I	by connec	ting lineam	ent MFM232	20G and its	inferred contin	uation
to the south-wes	st with the bor	hole intersection	s 225-245	m in KFM	07B (DZ4)	, 308-388 m	and 429-43	9 m in KFM07	C (DZ2
and DZ3, respec	ctively), 582-6	34 m in KFM08D	(DZ6, DZ7	and interi	nediate bo	rehole interv	al) and 363	-413 m in KFN	109B
(DZ3). Deformat	tion zone plan	e placed at fixed	points 236	m in KFM	07B, 352 n	n in KFM07C	; 598 m in l	KFM08D and 3	887 m in
KFM09B. Decre	ased radar pe	netration also alo	ng the bor	enole inter	val 232-24	ບ m in KFM(	J/B.		

ENE	ZFN	IENE23	<b>20</b> Version number <b>5</b> Total object CL <b>22</b>									
ZFMENE1208B	ZFMENE 1208B       ZFMENE 1208B         ZFMENE 1208B       ZFMENE 0199A         ZFMENE 2329A       ZFMENE 2329A         ZFMENE 2329A       ZFMENE 232A         ZFMENE 232A       ZFMENE 232A         ZFMENE 232A       ZFMENE 232A         ZFMENE 232A       ZFMENE 232A         <											
		OBJECT	CONFIDENCE ESTIMATE									
Category		Object CL	Comment									
INTERPRETATION		0										
Results of interpre	etation	2	High confidence observations in multiple boreholes.									
INFORMATION DEI	NSITY	, , , , , , , , , , , , , , , , , , ,	righ comache obcorraitore in manpre perenered									
Number of observ	ation points	3	>4									
Distribution of obs	servation points	3	Even distribution of obs. points.									
Geometry			Several obs, points from depth where fracture filled minerals									
Coomony		3	supporting interpolation in horizontal direction for the entire zone.									
Geological indicat	ors	3	Interpolation supported by key geological parameters, foremost fracture orientation pattern.									
EXTRAPOLATION												
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.									
Strike direction		2	Conceptual understanding of the site and that the entire modelled									
		3	zone is supported by the lineament.									
Orientation	Set W/S/M- 241	FRAC										
(strike/dip right-	Set G: 138.6°/1	.9°	ZEMENE2320 N									
hand-rule)	Set SSE: 166.0	°/82.0°										
Frequency:	Boreholes: KFM KFM07C, KFM0	109B, 07B. KFM08D										
	FRACTURE	TERZAGHI-										
	TYPE	WEIGHED										
	Open and	P10										
	partly open	5.7 11-1	W-									
	Sealed	16.5 m-1										
	Sealed	6.5 % of DZ										
	network Crush	0.7 % of DZ										
	Grubii	intercept										
			Equal area Lower hemisphere									
			<ul> <li>Onassigned (404)</li> <li>Set WSW (456)</li> <li>Δ Mean pole Set WSW (151.1/5.6) Fisher κ = 23.3</li> </ul>									
			Set G (166) Δ Mean pole Set G (48.6/88.1) Fisher κ = 21.9     Set SEE (107) Δ Mean pole Set SEE (76.6/0.0) Fisher κ = 20.0									
DOD		0	• Set SSE (197) ▲ Mean pole Set SSE (76.0/8.0) Fisher K = 40.0									
RQD:	min:68, max:10	u, mean:98										















ENE		ZFMENE	2325A		Version I	number	<b>4</b> Tot	al object CL	15
GEOLO	GICAL CH	ARACTER	Pro	perty	155000	160000	165000	170000	
Deformation style:	Brittle			<u>י∟</u> २	0				0
Deformation style. Deformation description:	Steeply SSE strike-s both no reverse displace	r dipping faults w rike show sinistra lip, oblique-slip v ormal-dextral and e-sinistral ements, and dip- ement	ith al vith slip	5	6705000 671000	zz	A	L-J	6705000 671000
Alteration:	uispiac	chicht.			2	1.4	WAD	HA 2	
- First order:	Oxidati	on		_	2	1/1	SXIT	$T \rightarrow \gamma$	2 0
- Second order:	Not obs	served		3	200	The second	XX	1/ 3	0000
- Third order:	Not obs	served			20	INTERS	S W		670
Fracture orientation and type:	Steeply vary in to SSE fracture Quantit span in network	dipping fracture strike from ENE are prominent. S s dominates. ative estimate ar clude sealed frac (s.	s that to NE Sealed nd cture	2	00 6695000			- sere - Second	00 6695000
Fracture comment	: No data	a available.			005	$\sim$	w		1006
Fracture fill mineralogy:	Calcite, hematit mineral	, chlorite, laumon e/adularia, clay s, epidote, quart:	itite, z.		155000	160000	165000	170000	99
	OBJECT	GEOMETRY			Model	olume DMS		0 2 4 8	N
Strike/dip:	239°/82	20			Baseline			S Californite et Geblaccerereitas	N
Length:	1496 m	 							
Mean thickness:	23 m (3	s - 50 m)							
Max depth:	-1500 II	NOO17 ZEMNIE2	209 Topo 40r	~					
constraints:	grid Ma Cut(s).	ix error 20m, 1 S	urface Planar	11					
			BASIS FOR	MOD	ELLING				
Zone based on surf	ace lineame	ents and borehole	e observations	3.					
Outcrops:	-								
Boreholes:									
		Target in	ntercept		Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	:_up [m]	Sec_low [m]	Comm	ent	
KFM09B	DZ4	520.00	550.00	5	20.51	549.71			
Turnela									
Lineament and/or seismic indications:	Lineament and/or MFM2325G. 2 indications:								
			MODELLING	PRO	CEDURE				
At the surface, corresponds to the low magnetic lineament MFM2325G and its inferred continuation to the south-west. Modelled down to 1400 m depth, using the dip estimated by connecting lineament MFM2325G and its inferred continuation to the south-west with the borehole intersection 520-550 m in KFM09B (DZ4). Deformation zone plane placed at fixed point 528 m in KFM09B. Decreased radar penetration also along the borehole interval 522-529 m.									

ENE	ZFM	ENE232	25A	Version number 4 Total object CL 15							
ZFMENE1208B ZFMNW0017 ZFMENEO(	ZFMENE 1208       ZFMENE 1208         TEMENE 1208       ZFMENE 01505         TEMENE 2320       ZFMENE 2320         ZFMENE 2320       ZFMENE 2320         TEMENE 2320       ZFMENE 2320										
		OBJECT (	CONFIDENCE	ESTIMATE							
Category		Object CL	Comment								
INTERPRETATION Data source Results of interpre INFORMATION DEN	etation NSITY	<mark>2</mark> 3	MFM2325G, KFM09B High confidence observations in KMF09B.								
Number of observ Distribution of obs	ation points servation points	2 1	2 Single observ	vation point at dept	h and a su	Irface lineament.					
Geological indicat	ors	1 1	Limited data Single observ surface geop	from depth. Based vation point at depti hysical data.	mainly on h. Zone m	surface data. odelled mainly base	ed on				
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.								
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
		FRAC	TURE CHAR	ACTER							
Orientation: (strike/dip right- band-rule)	Set ENE: 58.1%	′88.0°		ZFME	NE2325A						
Frequency:	Boreholes: KFM	109B	-								
	FRACTURE TYPE Open and partly open Sealed Sealed network Crush	TERZAGHI- WEIGHED P10 2.8 m-1 16.4 m-1 15.0 % of DZ intercept 0.0 % of DZ intercept	W		• + - - - -		E				
RQD:	min:72, max:10	0, mean: <u>9</u> 7	Unassi     Set EN	gned (169) E (103) 🔺 Mean	S pole Set ENE	Equal Lower hemisp (328.1/2.0) Fisher κ =	area ohere 21.5				





ENE		ZFMENE	2325	5B	\	/ersion	number	5 <sup>Tota</sup>	l object CL	14
GEOLO	GICAL CH	ARACTER		Propert	ty	155000	160000	165000	170000	
Deformation style:	Brittle			<u> </u>	_	-				0
Deformation description:	Steeply ENE-W slip disp	dipping faults w SW strike show placement excep	rith strike- oth one				2	r C		6710000
Alteration:	that she		-3iip.			B	5 5	1/1/	121	2 8
- First order:	Oxidatio	on		_		A is	w )	XI	1 1 10	1050
- Second order:	Quartz	dissolution		3		o fr	1 1	_ 17++	$\Lambda$	Contraction of the Contraction o
- Third order:	Not obs	served				2	11	XAIL	DA No	3
Fracture orientation and type:	Steeply ENE str Sealed Quantit span in network	dipping fracture rike are promine fractures domina ative estimate ar clude sealed frac s.	s with nt. ates. nd cture			and allow				000 6700000
Fracture comment:	No data	a available.		2	100	CAO	1 11/2	X	1	695
Fracture fill mineralogy:	Chlorite clay mir hematit pyrite. E dipping	e, calcite, laumor nerals, e/adularia, quart Epidote on gently fractures.	ntite, z, /			abesphore			and the second	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
	OBJECT	GEOMETRY								
Strike/dip:	247°/81	0				155000	160000	165000	170000	20.5
Length:	511 m					Madala	volume DMS		0 7 4 8	N
Mean thickness:	6 m (2 -	- 36 m)				Baselin	e		Statistical Goldson was	A
Max depth:	-550 m				1					
Geometrical	ZFMEN	IE2325A, Topo 4	10m grid	Max erro	r					
constraints:	20m, 1	Surface Planar (	Cut(s), 1							
	UNIVE	RSE Planar Cut(	<u>s).</u>							
Zone based on surfa	ce lineame	ents and a boreh	ole obsei	rvation.	DEL	LING				
Outcrops:	-									
Boreholes:										
		Target in	itercent		Ge	ometric	intercent			
Borehole	PDZ	Sec_up [m]	Sec_l	ow s	Sec_u	ip [m]	Sec_low	Comme	ent	
KFM09B	DZ5	561.00	574.0	00	566	.21	573.21			
Tunnels:	-	500								
Lineament and/or seismic indications:	seismic 1 indications:									
			MODEL	LING PR	OCE	DURE				
At the surface, corres Modelled as a splay continuation to the so	At the surface, corresponds to the low magnetic lineament MFM2056G and its inferred continuation to the south-west. Modelled as a splay from zone ZFMENE2325A, using the dip estimated by connecting lineament MFM2056G and its inferred continuation to the south-west with the borehole intersection 561-574 m in KFM09B (DZ5). Deformation zone plane placed at									

ENE	ZFM	ENE232	25B	Version number 5 Total object CL 14								
ZFMENE1208B												
		OBJECT	CONFIDENCE	ESTIMATE								
		Object CL	Comment									
Data source		2	MFM2056G,	KFM09B								
Results of interpre		3	High confide	nce observation in k	KFM09B.							
Number of observ	vation points	2	2									
Distribution of obs	servation points	1	Single obser	vation point at depth	n and a su	urface lineament.						
INTERPOLATION		1	Limited data	from donth Doood	mainhean	autoaa data						
Geological indicat	ors	1	Single obser	vation point at depth	nainiy on n. Zone m	odelled mainly base	ed on					
		1	surface geop	physical data.		, , , , , , , , , , , , , , , , , , , ,						
EXTRAPOLATION			Extrapolation	in din direction sur	ported by	subsurface obs	aint					
Dip direction		2	Strike length	of the modelled zor	ne < 2000	m.	Jint.					
Strike direction		2	Extrapolation	supported by surfa	ice geoph	ysical data, subsurf	ace					
		2	site.		arconcep		Ji li le					
		FRAC	TURE CHAR	ACTER								
Orientation:	Set ENE: 67.2°/	87.3°		ZFME	NE2325B							
(strike/dip right- band-rule)					N							
Frequency:	Boreholes: KFM	109B	-			-						
	FRACTURE	TER74CUI		1		· X						
	TYPE	WEIGHED		1:		. \						
	Open and	P10	_/			1						
	partly open	0.4 111-1	1			ſ						
	Sealed	12.0 m-1	1		1 .							
	network	3.7 % of DZ intercept	VV-		-		E					
	Crush	0.0 % of DZ	1			· F						
		intercept	X			· /						
						1						
				1		1						
				X	1							
					1	Equal Lower hemisp	area here					
			• Unass	igned (37)	5							
RQD:	min:46, max·10	), mean:91	Set El	ve (57) 🛕 Mean j	pole Set ENI	: (337.2/2.7) Hisher к = .	30.3					
		.,	i									





ENE			ZFMENI	E238	3		Version	number	5	Fotal object CL	14
GEO	DLOGIC		ARACTER		Proper CL	rty	155000	160000	165000	) 170000	
Deformation st	yle:	Brittle			3		8				8
Deformation		No data	available.				100		~		1000
description:							67	2	F	1 mm	67
Alteration:							1 10	~ {	~ /	1 1 4	1
- First order:		Oxidatio	n		З		0	2		1 m	3. 0
- Second order	r:	Not obs	erved		Ŭ		200	w T	V	VPI	200
- Third order:		Not obs	erved				670	1 1	A	$1 \wedge 1 >$	670
Fracture		Steeply	dipping fracture	s with			5		W.	THAN 5	Conception of the Conception o
orientation and	1	NE strike dominates.					5	10	XX	5	
туре:		Dominated by sealed followed					00 2	0	6XY	$4   / \rangle$	
		fractures. Quantitative					670	11 AM	AN AS	$(Y) \setminus Y$	9029
	estimate and span include sealed fracture networks.				2				TAN	$\neq \downarrow$ $\downarrow$	
					2			<u>C Miles</u>	X	VY I	
Fracture comm	ent:	No data	available.				000	MA LE	K	M	000
Fracture fill		Calcite,	chlorite,				3695	1 11		KI	695
mineralogy:		hematit	e/adularia, laum	ontite,				1 1	1X	The man	Ø
		quartz,	pyrite.	-					A	The man	
	0	BJECT	GEOMETRY				8		XI	de la companya de la	00
Strike/dip:		241°/80	0				000	~			10069
Length:		953 m					Ō				Ø
Mean thickness	s: :	36 m (2	- 36 m)						10 1		20.901
Max depth:		<u>-1267 m</u>					155000	160000	165000	170000	N
Geometrical		ZFMEN	E0103A, Topo 4	0m grid	Max erro	or	Model	volume DMS		0 2 4 8	Å
constraints:		20m, 1	UNIVERSE Plar	har Cut(s	).		Baselin	ic .		Contrainered Gelduckerservices	~
				BASIS	FOR M	ODE	LLING				
Zone based on s	surface	lineame	ents and a boreh	ole obsei	rvation.						
Outcrops:		-									
Boreholes:											
			Target ir	ntercept		G	eometrie	c intercept			
Borehole	PC	DΖ	Sec_up [m]	Sec_l [m]	low ]	Sec_	up [m]	Sec_low [m]	Com	nment	
KFM05A	DZ	Z5	936.00	992.0	00	93	5.92	992.90	950- Tabl 2007	992 m added (c e 3-2 in Stepher 7).	f. ns et al.
Tunnels:		-									
Lineament and	/or	MFM23	83G.								
seismic											2
indications:											
				MODEL	LING PI	ROCI	EDURE				
At the surface, c estimated by con	At the surface, corresponds to the low magnetic lineament MFM2383G. Modelled down to 1000 m depth, using the dip estimated by connecting lineament MFM2383G with the borehole intersection 936-992 m in KFM05A (DZ5 and extension										
along borenole i	nterval	900-992	m). Deformatio	n zone p	iane pla	cea a	t fixea po	Dint 959 m in	KENU5A		

ENE	ZFN	IENE23	83	Version number 5 Total o			14		
ZF	MENEO103A	E0401A ZFMENE2	2 ZFM 403	ENE2383	ZFMA2	MENE0062B			
		OBJECT (	CONFIDENCE	ESTIMATE					
Category         INTERPRETATION         Data source         Results of interpretation         INFORMATION DENSITY         Number of observation points         Distribution of observation points         INTERPOLATION         Geometry         Geological indicators         EXTRAPOLATION         Dip direction         Strike direction		Object CL           2           2           1           1           2           3	Comment         MFM2383G, KFM05A         Medium confidence observation in KFM05A.         2         Single observation point at depth and a surface lineament.         Limited data from depth. Based mainly on surface data.         Single observation point at depth. Zone modelled mainly based on surface geophysical data.         Extrapolation in dip direction supported by subsurface obs. point.         Strike length of the modelled zone < 2000 m.						
FRACTURE CHARACTER									
Orientation: (strike/dip right- hand-rule) Frequency:	Set NE: 46.4°/8 Boreholes: KFM FRACTURE TYPE Open and partly open Sealed Sealed network Crush	8.1° TERZAGHI- WEIGHED P10 1.3 m-1 10.1 m-1 4.6 % of DZ intercept 0.0 % of DZ intercept	• Unass • Set NI	ZFME	NE2383	Equal Lower hemisp	area here 59.7		
RQD:	min:85, max:10	0, mean:99							







ENE		ZFMENE2403			3	Version number 5			al object CL	13		
GEOLOGICAL CHARACTER				Property CI	155000	160000	165000	170000				
Deformation st	vle:	Brittle			3	0				0		
Deformation	<u>,</u>	No data available.				1000				000		
description:						67	2		y promy	87		
Alteration:						1	- 5 ~		1 1 2	1		
- First order:		Oxidation			з	0	5	/ /	and the second s	3. 0		
- Second order	r:	Not observed			, v	200	w F	VI	111	2000		
- Third order:		Not observed				~ e10	11	A	$A \land \mathcal{A}$	670		
Fracture	Fracture Steeply dipping fractures that			s that		2		W all	11 2	(constraint)		
orientation and	ientation and strike SW and SE, as well as			ell as		. { }	1/1	TIX	17 1	7		
type:		genuy c	Sealed fractures	ale		82		XX		0000		
		domina	tes Quantitative	5		670	11000	and)		670		
		estimat	e and span inclu	de	2		LAR	TAY	AVX /			
		sealed	fracture network	s.	-		1 SULO	TAN	AVY			
Fracture comm	ent:	No data available.				0000	SH LC		000			
Fracture fill		Calcite, laumontite, chlorite,				699	1 11	X	9696			
mineralogy:		epidote, hematite/adularia					and the same					
		prehnite.						1	- incase	-		
OBJECT GEOMETRY						000		/ W	1	000		
Strike/dip:		244°/90	)°			0699	~			0690		
Length:		957 m	00)			-				U		
Mean thickness	s:	4 m (2 -	- 36 M)			155000	100000	105000	170000	20.0.0		
Max depth:		-950 m	W/0122 Topo 4	0m arid M	lov orror	155000	160000	165000	170000	N		
constraints.		2FIVIVINVU123, Topo 40m grid r			lax enoi	Baselin	volume DMS		0 2 4 8	A		
constraints.		UNIVERSE Planar Cut(s)							Construction Construction-wave			
	BASIS FOR MODELLING											
Zone based on surface lineaments and a borehole observation.												
Outcrops:		-										
Boreholes:												
		Target intercept				Geometric intercent						
Borehole	F	PDZ o r i		Sec_lo	ow ou	F1	Sec_low	Comme	ent			
			Sec_up [m]	c_up [m] [m]		:_up [m]	[m]					
HFM32			-	-	1	41.56	164.36					
								275-284	1 m inferred to	o be a		
KFM10A			275.00	284.0	0 2	275.36	284.00	DZ (cf.	Table 3-2 in	N NI-1		
								Stepher	ns et al. 2007	). Not		
		I						recogni	recognized in SHI.			
Tunnels:		-										
Lineament and	/or	MFM2403G.										
seismic							2					
indications:												
MODELLING PROCEDURE												
At the surface, corresponds to the low magnetic lineament MFM2403G. Modelled down to 950 m depth, using the dip												
estimated by co	nnecti	ng linear	nent MFM2403G	with the b	borehole in	tersection	275-284 m in l	KFM10A. D	etormation zo	one		
plane placed at fixed point 281 m in KFM10A.												

ENE	ZFMENE2403			Version number	5	Total object CL	13			
ZFMENE0401A ZFMENE0401A ZFMENE0401B ZFMENE2383 ZFMENE2403 ZFMENE2403 ZFMENE062B										
		OBJECT	CONFIDENCE	ESTIMATE						
Category		Object Cl	Comment	ESTIMATE						
INTERPRETATION Data source Results of interpretation		2 1	MFM2403G, HFM32 (not recognized in SHI), KFM10A Low confidence in KFM10A in 275-284 m, which is only inferred to be a DZ (cf. Table 3-2 in Stephens et al. 2007).							
Number of observ	ation points	2	2							
Distribution of observation points INTERPOLATION Geometry		1	Limited data from depth. Based mainly on surface data.							
Geological indicators EXTRAPOLATION Dip direction		2	Indirect support by geophysical data.           Extrapolation in dip direction supported by subsurface obs. point.							
Strike direction		3	Strike length of the modelled zone < 2000 m. Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.							
		FRAG	CTURE CHAR	ACTER						
Orientation: (strike/dip right- hand-rule)	Set SW: 221.2% Set G: 188.8%/14	/81.1° 4.1°		ZFME	NE2403	~				
Frequency:	Borenoles: KFM FRACTURE TYPE Open and partly open Sealed Sealed network Crush	TERZAGHI- WEIGHED P10 3.4 m-1 21.7 m-1 15.0 % of DZ intercept 0.0 % of DZ intercept	• Unass • Set St • Set G	igned (16) V (18) ▲ Mean p (16) ▲ Mean p	Sole Set SW pole Set G (S	Equal a Lower hemispl (131.2/8.9) Fisher к = 1 28.8/75.9) Fisher к = 15.	area here 30.0 1			
RQD:	min:40, max:100	0, mean:91								




ENE		ZFMEN	E3115		Version number <b>9</b> Total object CL				22			
GEOL	LOGICAL CH	ARACTER	Pro	operty CL	155000	160000	165	5000 170000				
Deformation styl	e: Brittle			3	8				0			
Deformation	No data	a available.			1001		-	~	1000			
description:					67	5	F	1 mm	67			
Alteration:					1.00	$\sim$	X	11/2				
- First order:	Oxidatio	on		3	8							
- Second order:	Argilliza	ation			~ 050	1111	0500					
- I nira oraer:	Quartz				N 61	1	1 7	HIN VY	19			
orientation and	fracture	S Dominated by	,		2	1.1	ALLA	3				
type:	sealed	followed by oper	n and		8 { }	115	T-V	SITT A G	3 0			
	partly o	pen fractures.			000 2	to the		XV/ VS	0000			
Fracture comme	nt: Fracture	es aperture up to	o 1		67	KER	1 kel	HIV	67			
	mm.	mm.				X	AH)					
Fracture fill	Predom	ninant minerals i	n		8	1 3/1.2	X	AV7	9			
mineralogy:	sealed	fractures are cal	cite,		9500	- A 64	1×	VI	9500			
	chlorite	and laumontite	and in		66	1 1	12		669			
	calcite a	actures are chio	ne,					And man				
	OBJECT	GEOMETRY			8		1	La Inner	Q			
Strike/dip:	238°/84	<u>°</u>			8000	1		w	0006			
Length:	797 m				66				666			
Mean thickness:	10 m (2	? - 36 m)										
Max depth:	-1050 n	n			155000	160000	165	000 170000	20.310			
Geometrical	Topo 40	0m grid Max erro	or 20m,		Model v	olume DMS		0 2 4 8	N			
constraints:	ZFMW	NW0001, ZFMN	W0805A,	(	Baseline			d Laittrateret Laizhiorenweiken	N			
	ZEMINV	VUUU2, ZEIMIVVIN Cut(c)	w1035, 1 Sur	tace								
	Fidilal	Cut(S).	BASIS FOR									
Zone based on su	Irface lineame	ents and a boreh	ole observatio	on.								
Outcrops:	-											
Boreholes:												
		Torratio			Coomotrio	intercent						
Borehole	PD7	i arget i	Sec low	-	Geometric	Sec. Io		omment				
Borenoie		Sec_up [m]	[m]	Sec	:_up [m]	[m]		omment				
KFR102A	DZ3	422.00	503.00	4	46.49	475.59						
KFR104	DZ2	149.00	154.00	1	35.57	158.26						
KFR105	DZ1	45.00	52.00		43.24	53.88						
KFR118	DZ1	22.60	36.40		10.20	77.69						
Tunnels:	-			04								
Lineament and/o		15G, MSFR081	TO, MSFRTUU	JU1.					1			
indications.									•			
			MODELLING	G PRO	CEDURE							
The position of the	e zone on the	ground surface	is based on th	he linea	ments MFN	M3115G, N	SFR08	116 and MSFR100	01			
defined by magne	tic minima (Is	aksson et al. 20	07 and SFR r	nodel v	ersion 1.0)	with furthe	r extens	ion to the south-we	est to			
allow termination a	at ZFMWNW	1035. Forward m	nodelling of m	agnetic	data along	profiles 20	and 42	(see Appendix 6, 0	Curtis et			
al. 2011) provide v	weak support	for the modelled	zone thickne	ess and	the subver	tical dip to	the nort	h-west. The zone is	3			
Intersected by bor	enole KFR10	2A (422-503, DZ	23), KFR104 (	149-15	4, DZ2), KF	-R105 (45-	52, DZ1 ₄♀∊∶∽ י	) and KER118 (22.)	6-36-4,			
DZ1). Deformation	i zone is plac	eu at fixed point	402,5 IN KER	(102A, '	151,5 IN KF	K104 and	48,5 IN I	NFK105.				













ENE	ZFMENE3 <sup>2</sup>	135	Version number	7	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittlo	CL				
Deformation	No data available.	2	1000	_	~	0000
description:			2 ei	VF	1 mm	671
Alteration:		_	$\sim$	X	1 1 2	
- First order:	Not observed		8 2		1212	8
- Third order:	Not observed	-	1000		A A A	7050
Fracture orientation	No data available.		° R		THAN Z	0
and type:			1	X	AHAN 12	
Fracture comment:	No data available.	_	2000		XIII	0000
Fracture fill	No data avallable.		670		MANY	6700
OBJ	ECT GEOMETRY			2AD		-
Strike/dip:	82°/90°		8	X		8
Length:	370 m		9	1 cm	$\sqrt{7}$	9500
Mean thickness:	<u>5 m (1 - 13 m)</u>		66	11		66
Max depth:	-520 m	024 Tana		R		
Constraints:	40m grid Max error 20m 1	US4, TOPO	8	$\sim$	La man	8
constraints.	Planar Cut(s).	Juliace	0055			1006
			ö			66
						20.910
			155000 160000	) 165	000 170000	N
			Baseline Model volume DMS		0 Z 4 8	A
	BASI					
Zone based on surface line	eament.					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MSFR08113.					4
seismic indications:						1
Deceder mentelinger	MODE	LLING PRO		ing of line		
Forsmark model stage 2.3	(Isaksson et al. 2007)	del version 1	.0 that is a modifical		ament MFM3135G	n
T ofsmark model stage 2.5	(15ak35011 ct al. 2007).					
9,r813			~ ~			
	A REAL					
	102A (FR101					
FR32 80	KITT STUND	FMIN				
	KER27	105B	0805A			
KERTO N	KER103					
		ZFMWNW:	3262			
	2FMWNW8040	UER106				
KER104		35				
	JENE3.		ZFMWNW0835	1		
	105 ZENIL					
ST MNWP						
ST COL	3	EMWA				
AND	E	WW3267				
NY						
	ZFN	WNW3268				
			N			
0 100 200	300 500 m	ZEMMAN	A			
			001			

ENE	ZF	MENE3	3135 Version number 7 Total object CL 10									
OBJECT CONFIDENCE E	STIMATE			•		• •						
			_									
Category		Object CL	Comment									
INTERPRETATION												
Data source		1	MFM31350	3								
Results of interpretatio	n	1	Low confide	ence in lineament M	FM3135G	i.						
INFORMATION DENSIT	ION DENSITY											
Number of observation	points	1	1									
Distribution of observa	tion points	1	Single obse	ervation point in the	form of a l	lineament.						
INTERPOLATION												
Geometry		1	Geometry s	supported by surface	e geophys	ical data.						
Geological indicators	1	Indirect sup	port by geophysical	data.								
EXTRAPOLATION												
Dip direction		1	No subsurf uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	by surface data. Hi of the modelled zon	gh e <					
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.									
		FRA	CTURE CHA	RACTER								
			No data avai	lable								
INDIVIDUAL INTERCEPT	S											
			No data avail	lable								

ENE	ZFMENE3 <sup>2</sup>	151	Version number	4	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle	2	8			9
Deformation	No data available.		1000	_	~	1000
description:			{ }	VTV	1 mm	67
Alteration:			$\sim$	Y	112	
- First order:	Not observed		8 2	1-	1212	3 8
- Second order:	Not observed		Jun 1050	1 1	( ) [ ]	1050
Fracture orientation	No data available.		io Real	~/	THA S	
and type:			5	X	AHA Z	
Fracture comment:	No data available.		2 2	XX	VII 1 5	000
Fracture fill	No data available.		002		VIII V	2001
mineralogy:				An	XX Y	U U
OBJI Strike/din:				S	NY	
Length:	419 m		1 1000	MAS -	M	0000
Mean thickness:	5 m (1 - 13 m)		699	211	$\times$ {	699
Max depth:	-420 m			1dX		
Geometrical	ZFMNNE3264, ZFMNW08	305A, Topo			1 5	
constraints:	40m grid Max error 20m, 1	I Surface	0000		www	0000
	Flanar Cut(s).		665	$\langle \cdot \rangle$	1 N	669
			155000 160000	) 165	000 170000	- 273
			Model volume DMS		0 2 4 8	Ň
			Baseline		di Lastinatarenti Gaschausserverikan	~
7	BASI	IS FOR MOD	DELLING			
Zone based on surface line	eaments and pattern of surro	bunaing aeto	rmtalon zones.			
Outcrops:	-					
Boreholes: -						
Tunnels:	l _					
Lineament and/or	- MSFR08005.					
seismic indications:						1
The position of the zone of	MODE	ELLING PRO	CEDURE	linnom		<b>"</b> D
modelling work) The linear	ment was originally inferred	to cross ZEM	INW0805A and to c	ontinue a	short distance on th	чк е
western side of the zone. T	This extension was not consi	idered likely	conceptually and the	zone wa	s terminated against	t
ZFMNW0805A. The number	er from the associated, Fors	mark stage 2	2.3 lineament MFM3	151G Isa	ksson et al. (2007) h	as been
maintained for traceability	between the different version	ns of the line	ament interpretation	. Forward	modelling of magne	etic data
along profiles 7, 8 and 34 (	see Appendix 6 in Curtis et	al. 2011) sup	port the interred ver	tical dip c	of the inferred zone,	wnereas
	22		100 A			
	S		S.			
			MI S			
		V				
	2		AN BO			
	÷					
			A STATE			
			V			
	ZFME	NE <u>315</u> 1				
					Q I	
					7	
1900						
		100 20	200	500		
		100 200	300	/ 500 r		
			1			

ENE	ZF	MENE3	151	Version number	4	Total object CL	10				
OBJECT CONFIDENCE E	STIMATE					•					
			-								
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM3151	G							
Results of interpretatio	n	1	Low confic	lence in lineament M	FM31510	).					
INFORMATION DENSIT	Y										
Number of observation	points	1	1								
Distribution of observa	tion points	1	Single obs	ervation point in the f	form of a	lineament.					
INTERPOLATION											
Geometry		1	Geometry	supported by surface	geophys	sical data.					
Geological indicators	1	Indirect su	pport by geophysical	data.							
EXTRAPOLATION											
Dip direction		1	No subsur uncertainty 2000 m.	face obs. point, supp / in dip-direction. Stri	orted only ke length	y by surface data. Hi of the modelled zon	gh e <				
Strike direction		3 Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.									
	FRACTURE CHARACTER										
	_		No data ava	ilable							
INDIVIDUAL INTERCEPT	S										
			No data ava	ilable							

ENE	ZFMENE80	031	Ve	rsion nu	umber	4	Total	object CL	10
GEOLOGICAL	CHARACTER	Property	15	5000	160000	16	5000	170000	_
GEOLOGICAL		CL							
Deformation style:	Brittle	2	000						000
Deformation	No data available.		710		0	5	~		7100
description:			9		2	S	1	172	0
Alteration:	Not abaan od	-			$\sim$	1	11	2/2	
- First order:	Not observed	-	00		5 5		/ //	212	1 8
- Second order:	Not observed	-	050	~~		1	$\langle \rangle$	101	050
- Third order:	Not observed		67	5	1	1. /	74	VIE	67
and type	NU data avaliable.			2	1, 1	X	AL	A Z	
Eracture comment:	No data available	-	9	1	1/2	J-C	X)/T	72 7	0
Fracture fill	No data available	1	0000	5 2	TX		XU	3	0000
mineralogy:			67(	2	IKIN	CA -	M		670
OB.II	ECT GEOMETRY			10	ARD	RID	M	$\langle / \rangle$	
Strike/dip:	65°/90°			XX	Place	A	1V	/	-
Length:	537 m		2000	- the	H H	VES	NA		2000
Mean thickness:	5 m (2 - 36 m)		699	1	1 1	A	X		9696
Max depth:	-540 m				1	AV	S	and man	
Geometrical	ZFMNNE0869. ZFMWNW	1035.					2 /	J minutes	
constraints:	Topo 40m grid Max error 2	20m, 1	000			$\boldsymbol{\times}$	hor	4	000
	Surface Planar Cut(s).	- ,	0650						20069
			0					A	Ø
							5		20.910
			15	5000	160000	165	5000	170000	
				Model vol	ume DMS			0 2 4 8	Å
				Baseline				o Latinita et Geologie everes	A
	BASI	S FOR MOD	DELL	ING					
Zone based on surface line	eaments and pattern of surro	ounding defo	rmati	on zon	es.				
Outcrops:	-								
Boreholes: -									
Tunnels:	-								
Lineament and/or	MSFR08031.								1
seismic indications:									•
-	MODE	LLING PRO	CED	URE					
The position of the zone at	the ground surface is based	d on a modifi	catio	n of the	SFR ver	sion 1.0	lineam	ent MSFR08	031. The
DZ trace terminates at ZFN	INNE0869 to the NE wherea	as the linean	nent (	extends	further t	o the NE	. Howe	ver, the exist	ence of
a zone coupled with the lin	eament in this position is no	t supported t	by tui	nnel ma	apping. I	he DZ tra	ace has	a greater ex	tent in
the SVV where it terminates	and provents further interest	s the ineam	initic	nus at t	ne gener	a that the		dina gonthy to	eine
magnetic field is disturbed	and prevents further interpr	retation. The	Sillini Se to t	II NYPOL Ibo SE	mesis wa	s mai me		aps genily to	in the
SFR tunnels and caverne	Recting to the SE. However, any up between 20 and 70 degrees to the SE would generate a significant intercept in the								
remaining alternatives are	a subvertical to northwards	dip. The zon	e has	s been r	nodelled	as vertic	al since	there is no:	actual
evidence for a northerly dir	b. Forward magnetic modelli	ng has been	perf	ormed a	alona pro	files 27	28. 29 :	and 30 (see	
Appendix 6 in Curtis et al.	2011). The anomaly pattern	is weak and	the r	esults h	nave a hi	ah uncer	tainty	The clearest i	indicator
is from profile 27 where the	e modelling supports a subve	ertical dip to	the ir	ferred	zone. No	real indi	ications	of orientatio	n can be
obtained from profile 28, w	hile profiles 29 and 30 indica	ate a "slight o	dip to	wards t	he south	-east" th	ough th	e uncertainty	is high.
The inversion modelling give	ves no clear indications as re	egards orien	tatior	1.			0	,	0



		2000 m.
Strike direction	3	Conceptual understanding of the site and that the entire modelled
	1	zone is supported by the lineament.
FRACTURE CHARACTER		
		No data available
INDIVIDUAL INTERCEPTS		

No data available

ENE	ZFMENE80	)34	Version number <b>4</b>			Total object CL <b>1</b>	
GEOLOGICAL	CHARACTER	Property	155000	160000	) 165	000 170000	
GEOEOGICAE	CHARACTER	CL					
Deformation style:	Brittle	2	000				000
Deformation	No data available.		710	0	5	$\sim$	7100
description:			9	3	VI	1 mm	0
Alteration:		-	1.00	$\sim$	1		2
- First order:	Not observed		8	21	1-		4 8
- Second order:	Not observed		020	soul .	1	1 M	500
- Inird order:	Not observed		20 E		17	XINVO	61
Fracture orientation	No data available.		7	1	N	THY S	3
and type:	No data available		. {	1 1/2	N	CTHT > N	2
Fracture comment:	No data available.	-	82	1	AAX	$\times 1/$	0000
Fracture fill	no data avaliable.		670	litz	122A	MY/ /Y	670
		I		J24	ATT	XX Y	
Strike/dip:	69°/90°			Kalle	St.	NY	
Length:	683 m		000	1 felle	X	1M	000
Mean thickness:	10  m (2 - 36  m)		9695	1 1	R	$\times 1$	695
Max denth:	-680 m		9		NV	- JA	9
Geometrical		1035				179	
constraints.	ZEMNW0002 Topo 40m c	rid Max	8			West -	8
constraints.	error 20m. 1 Surface Plana	ar Cut(s).	0050			v	006
			66				90
							20.000
			155000	160000	) 165	000 170000	
			Mo	del volume DMS		0 2 4 8	Ň
			Bas	eline		Contrastered, Gelduceneeringer	N
	BASI	S FOR MOD	ELLING	i			
Zone based on surface line	eaments and pattern of surro	ounding defo	rmation 2	zones.			
Outereney							
Outcrops:	-						
Borenoles: -							
Tunnels:	-						
Lineament and/or	MSFR08034.						1
seismic indications:							•
	MODE	LLING PRO	CEDUR	E			
In the early stage of the mo	odelling work, the main supp	orting evider	nce for th	ne inferred d	lip and ge	neral orientation of	this
zone was seismic reflector	A1 Juhlin and Palm (2005).	Subsequent	ly, after	the reproces	ssing of th	e seismic data Juh	lin and
Zhang (2010), the existence	e of this reflector to the north	h of the Sing	ö zone h	as been dis	counted, i	n accordance with	the
interpretation already made	e in Forsmark model stage 2	.2 (Stephens	s et al. 2	007). Conse	equently th	e dip and detailed	
alignment of the zone were	e also revaluated. Attempts h	have been m	ade, in c	ombination	with the in	terpretation of H1	and H3
Carisson et al. (1985), to g	erierate a sub-norizontal zor	ie lying abov	e the ex	isting SFR f	acility. Thi	s geometry was no	JI
intercepts in the evicting for	bi the ineament. Other dips the	to the south where	were also	o investigate	eal mann?	main range would	the zero
has been modelled as yort	ical and is interpreted as boi	ng a membo	r of the I	=NE sub-co	t with pror	ng. Consequently,	a other
zones in this sub-set.	iour unu is interpreteu as ber				, which broth		



Geometry supported by surface geophysical data.

No subsurface obs. point, supported only by surface data. High

uncertainty in dip-direction. Strike length of the modelled zone <

Conceptual understanding of the site and that the entire modelled

Indirect support by geophysical data.

zone is supported by the lineament.

1

1

1

3

2000 m.

FRACTURE CHARACTER No data available

No data available

Geometry

EXTRAPOLATION

Strike direction

INDIVIDUAL INTERCEPTS

Dip direction

Geological indicators

G			ZFM	<b>F</b> 1		Version number 5 Total object CL 18					18	
GEO	LOG	ICAL CH	ARACTER		Prope	erty			1	-		
Deformation sty	/le:	Brittle			3	_						
Deformation description:		Lower p show st slip disp	part of DZ6 in KF rike-slip or reven placements on th	M02A rse dip ne								
		domina Both de	nt gently dipping extral and sinistra	) faults. al								
		observe faults al	ed. Gently dippin	ig 102B								
		show di oblique	p-slip displacem slip displaceme	nent or nt with								
		significa compor faults al	ant reverse dip-s nent. Steeply dip long DZ5 and D2	lip ping Z6 in			Ν	lo fig	jure	available		
		KFM02	B show strike-sli	p,								
		sinistrai slip with displace	strike-slip or op i dextral normal ement.	lique-								
Alteration:												
- First order:		Oxidation	on onved		3							
- Third order:	•	Not obs	erved									
Fracture		Fracture	es that dip gently	y to the								
orientation and		south-e	ast and south tes. Sealed fract	ures								
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		domina	tes. Open and p	artly								
		open fra	actures present a	as well d								
		crush z	ones.	ŭ								
Fracture comme	ent:	No data	available.		2							
mineralogy:		hematit	e, calcite, e/adularia. prehi	nite.								
		epidote	, clay minerals,									
		frequen	tite. Note also hi cv of fractures v	gh vith no								
		mineral	coating/filling (in	า								
		OB IECT	A). GEOMETRY									
Strike/dip:		72°/10°	CEOMEN									
Length:		-	0.50)									
Mean thickness Max depth:		44 m (2 -805 m	0 - 50 m)									
Geometrical		ZFMWN	W0001, ZFMW	NW0123	8,							
constraints:		ZFMEN	E0062A, ZFMA	3, 1 Surfa	ace Pla	nar						
		Out(0).		BASIS	FOR N	NODE	LLING					
Zone based on s	urfac	e lineame	ents and borehol	e observ	vations.	Corre	esponds to	seismic I	reflector	F1, the position of w	hich in	
	on dl			(2003). I	nouelle	u as a						
Outcrops:		-										
Borenoies.												
Borehole	F	7חי	Target ii	ntercept Sec	low		Geometric	Intercep	ow (	Comment		
			Sec_up [m]	[m	1	Sec	_up [m]	[m]				
									SHI DZ divided into t eparate zones at 41 n and 476-520 m (cf able 3-2 in Stephen	wo  7-442 f. is et al.		
KFM02A	L	JZ6	476.00	520.	00	475.67		519.4	13 2 1 1 1	2007). Fractured rock between 442 and 47 Inferred to be affecte DZ.	k 6 m d by	
KFM02B	[	DZ5	462.00	512.	00	4	72.03	515.6	63			
KEMU2B	[	JZB	462.00	512.	UU	4	12.03	515.6	03		]	
Tunnels:		-										
Lineament and/	or	F1.									2	
indications:											_	

G		ZFMF1	Version number 5 Total object CL 18								
	I	MODELLING PROCEDURE									
Corresponds to seism as a splay from ZFMA towards the north-wes at fixed point 513 m al part of DZ5, along DZ 514-518 m in KFM024	Corresponds to seismic reflector F1, the position of which in 3D space has been attained from Cosma et al. (2003). Modelled as a splay from ZFMA3 with termination also against ZFMWNW0001, ZFMENE0062A and ZFMWNW0123. Termination towards the north-west steered by the absence of this zone in especially borehole KFM05A. Deformation zone plane placed at fixed point 513 m along part of DZ6 (476-520 m) in KFM02A. The modelled zone also intersects KFM02B along the lower part of DZ5, along DZ6 and along the rock interval between these two inferred zones. Low radar amplitude also observed at 514-518 m in KFM02A.										
No figure available.											
		OBJECT	CONFIDENCE	EESTIMATE							
Category		Object CL	Comment								
INTERPRETATION		0.0,000.01									
Data source		2	F1. KFM02A	. KFM02B							
Results of interpre	etation	3	High confide	nce observations in	multiple b	oreholes					
INFORMATION DEN	NSITY	, , , , , , , , , , , , , , , , , , ,	. i.g.i comuc								
Number of observ	ation points	2	2								
Distribution of obs	servation points		Two subsurf	ace obs. points only	ca. 50 m	apart. However. the	e zone				
		1	is modelled	more than 3000 m ir	horizonta	al direction.					
INTERPOLATION											
Geometry		3	Geometry su	upported by multiple	subsurfac	e obs. points.					
Geological indicat	ors	2	Interpolation	supported by key g	eological	parameters, foremo	ost				
_		3	fracture orie	ntation pattern.							
EXTRAPOLATION											
Dip direction		2	Extrapolated Truncated by ZFMWNW0	l based on information y steeply dipping zon 123, ZFMENE0062A	on from se nes ZFMV , ZFMA3.	eismic reflector F1. VNW0001,					
Strike direction		2	Extrapolatec reflector F1. ZFMWNW0 <sup>2</sup>	I and modelled base Truncated by steep 123, ZFMENE0062A	d on infor ly dipping ., ZFMA3.	mation from seismi zones ZFMWNW0	с 001,				
		FRAG	CTURE CHAR	ACTER							
Orientation: (strike/dip right- hand-rule)	Set G: 38.4°/27	.9°		ZI	FMF1 N	4					
	FRACTURE TYPE Open and partly open Sealed Sealed network Crush	TERZAGHI- WEIGHED P10 4.4 m-1 11.4 m-1 5.5 % of DZ intercept 0.6 % of DZ intercept	Unass Set G	signed (349) (278)	s n pole Set G	Equal Lower hemisp	area ahere				
RQD:	min:1, max:100	, mean:94									







G	ZFMJ1		Version number	7	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	0 165	5000 170000	
Deformation style:	Brittle					
Deformation	No data available.	•	1000		~	0000
description:			2 61	V P	for any	671
Alteration:			_ {	Y	1 1 3	
- First order:	Not observed		0 2	_ \	V W JA	
- Second order:	Not observed	-	~~ 2200		AN	2000
- Third order:	Not observed		61 61	17	XVVX	670
fracture orientation and	No data avallable.		2	X	ATA 3	
Fracture comment:	No data available	-	g	J.S.	UTT X (	0
Fracture fill mineralogy:	No data available.		200		XU/V3	0000
OBJE	CT GEOMETRY		67		K/V	67
Strike/dip:	120°/45°					
Length:	-		8	X		0
Mean thickness:	15 m (6 - 32 m)		9 1 1	X	$\sqrt{1}$	9500
Max depth:	-1684 m		8	11		66
Geometrical	ZFMNW0029, ZFMNW00	)36, CE Diaman		1 A	- And Share	
constraints:	ZFMINW0017, 1 UNIVER	SE Planar	8		And senter	0
	Cut(s).		006	$\sim$	W	9006
			66	$\langle \cdot \rangle$	5 - <b>1</b> - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	66
						to fee
			155000 160000	) 165	000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		e cantresceret, Gaodata annvelian	N
	BASI	S FOR MOD	ELLING			
Corresponds to seismic refle	ector J1, the position of whi	ich in 3D spa	ace has been attaine	d from Co	osma et al. (2006). b	ased on
seismic reflector and pattern	n of surrounding steeply dip	ping zones.				
Outoropoi						
Boreholes: -	-					
Dereneiter						
Tunnels:	-					
Lineament and/or	J1.					З
seismic indications:						Ŭ
	MODE	LLING PRO	CEDURE	1 (		
Corresponds to seismic refi	ector J1, the position of whi /0017_ZEMNIW/0029 and Z	EMIN/NIN/OO?	ice has been attaine	a from Co	osma et al. (2006).	
	10017, ZFIVINV0029 and Z		50.			
ZINITAL ZINITANING	A REAL PROPERTY OF THE REAL PR	ZFMJ1			C ZENNI	
	100 200 300 500 m	1 km		STIMMING (	S IN	

G		ZFMJ1		Version number	7	Total object CL	10		
OBJECT CONFIDENCE ES	TIMATE								
Category		Object CI	Comment						
INTERPRETATION		Object OL	Comment						
Data source		1	J1						
Results of interpretation		3	High confid	ence in the seismic	reflector .	J1.			
INFORMATION DENSITY									
Number of observation	points	1	1						
Distribution of observati	on points	1	Single obse	ervation point in the	form of a	seismic reflector.			
INTERPOLATION									
Geometry	ry 1 Geometry supported by surface geophysical data.								
Geological indicators		1	Indirect sup	port by geophysical	data.				
EXTRAPOLATION									
Dip direction		1	Extrapolate Truncated I ZFMNW00	d based on informa by steeply dipping zo 17.	tion from sones ZZF	seismic reflector J1. MNW0029 ZFMNW	003,		
Strike direction	Extrapolated and modelled based on information from seismic reflector J1. Truncated by steeply dipping zones ZZFMNW0029 ZFMNW003, ZFMNW0017.								
		FRAG	CTURE CHA	RACTER					
			No data avail	able					
INDIVIDUAL INTERCEPTS									
			No data avail	able					

G	ZFMJ2		Version number	4 Total object CL 10	0
GEOLOGICAL	CHARACTER	Property	155000 160000	165000 170000	
Deformation style:	Brittlo				
Deformation description:	No data available.	1	5710000		
Alteration:					
- First order:	Not observed	-	$\sim$	1 L S	
- Second order:	Not observed	-	8 7 >	V V V 8	
- Third order:	Not observed		205	20 Command	
Fracture orientation and	No data available.		° R ()	CALL Sugar	
type: Fracture comment:	No data available	-		and the set of	
Fracture fill mineralogy:	No data available.	-	2		
OB.IE			64	010	
Strike/din:	102º/37º				
Length:	1430 m				
Mean thickness:	15 m (6 - 32 m)				
Max depth:	-1545 m		2000		
Geometrical	ZEMNW0003 ZEMWNW	/0004		and and a subserv	
constraints	ZEMK1 Topo 40m grid N	/ax error		A To mente	
constraints.	20m 1 UNIVERSE Plana	ar Cut(s)	8	8	
			05		
			09	8	
			155000 160000	165000 170000	
			No. 1.1 Dates	N	
			Baseline Model volume DMS		
	BASI	S FOR MOL			
Corresponds to seismic reli	ector J2, the position of whi	ich in 3D spa	ice has been attained fr	rom Cosma et al. (2006). Dased o	on
seismic reliector and pattern	Tor surrounding steeply dip	pping zones.			
Outcrops:					
Borobolos:	-				
Borenoles					
Tunnels:	-				
Lineament and/or	.12				
seismic indications:	02.			3	
	MODE	LLING PRO	CEDURE		
Corresponds to seismic refle	ector J2, the position, of wh	hich in 3D sp	ace has been attained f	rom Cosma et al. (2006).	
Terminated against ZEMNW	/0003, ZEMWNW0004 and	ZFMK1.			
reminated against 21 mitte					
	ZEMNW0002				
			- CM	11	
	ZFMIN		LEN		
	De la constante de la constant		<b>EFMNING</b>	and a second sec	
		•	0036	The second secon	
	ZEMJ	2			
	2111.0				
		10025			
	ZEMWNV	N0030			
				ZF	
			ZEMWNW002/		
	Contraction of the local division of the		1		
		- Inter		C and the second	
	COM AND AND A	5 /	ZFMWNW0004		
0 1	• 2	57	0 ,	4 km	
		7	A		
			9		

G		ZFMJ2	2	Version number	4	Total object CL	10		
<b>OBJECT CONFIDENCE ES</b>	TIMATE								
Category	Object Cl	Comment							
INTERPRETATION			Comment						
Data source		1	J2						
Results of interpretation		3	High confid	lence in the seismic	reflector .	J2.			
INFORMATION DENSITY									
Number of observation	ooints	1	1						
Distribution of observati	1	Single obse	ervation point in the	form of a	seismic reflector.				
INTERPOLATION									
Geometry	Geometry 1		Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		1	Extrapolated based on information from seismic reflector J2. Truncated by steeply and gently dipping zones ZFMNW0003, ZEMWNW0004_ZEMK1			,			
Strike direction		1	Extrapolated and modelled based on information from seismic reflector J2. Truncated by steeply and gently dipping zones ZFMNW0003, ZFMWNW0004, ZFMK1.						
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPTS									
			No data avai	lable					

G	ZFMK1		Version number	3	Total object CL	11
GEOLOGICAL	CHARACTER	Property	155000 160000	165	000 170000	-
Deformation atula:	Prittle					
Deformation	No data available	1	000		~	0000
description:			2	. P	The man	671
Alteration:			{	Y	1 12	
- First order:	Not observed		·	_ /	VM	
- Second order:	Not observed		m. 200		(NP)	2000
- Third order:	Not observed		20 20	17	MA VY	670
Fracture orientation and type:	No data available.		200	X	ATA No	
Fracture comment:	No data available.		8	XX		8
Fracture fill mineralogy:	No data available.		202		ALIS	7000
OBJE	CT GEOMETRY		io A		K V	0
Strike/dip:	52°/40°				KN.	
Length:	2333 m		00	A	AX/	00
Mean thickness:	15 m (6 - 32 m)		2950	1 million	XX	950
Max depth:	-2100 m	10000		11		66
Geometrical	ZFMWNW0004, ZFMNW	/0003,		1 D	An man	
constraints:	Topo 40m grid Max error	20m.	8	1	La man	0
			0008	$\checkmark$	w	9000
			66		1 B. A.	666
			155000 160000	165	000 170000	22.5-1
			Model volume DMS			N
			Baseline		S California and California and Ann	A
	BASI	IS FOR MOD				
Corresponds to seismic refl	ector K1, the position of wh	hich in 3D sp	ace has been attaine	d from Co	osma et al. (2006).	based on
seismic reflector and pattern	n of surrounding steeply dip	ping zones.				
Outcrops:	-					
Boreholes: -						
Tunnelei	1					
Linoamont and/or	- K1					
seismic indications	K1.					3
	MODE	ELLING PRO	CEDURE			
Corresponds to seismic refle	ector K1. the. position of wh	hich in 3D sp	ace has been attaine	ed from C	osma et al., (2006)	
Modelled to the base of the	model volume with termina	ation, against	ZFMNW003 and ZF	MWNW0	004.	•
		, ,				-
	ZEMNW0003					
				-	0	
	The Market					
1	ZENIN		Z	FMJ1		
			ZEMAN		1 may	
			W0030		Hind 1	
			00			-
	ZFMJ2					
		TOF	/			
	ZEMWNY	N0035				
	and the second sec			0		
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	-nak1					
7	FINITS					
		1	ZFMWNWO	024		
		1 .	1		4	~
	and a second		7EMW/NW0004			
	2 mg	15		-		
0	1 2	50	, d		4 km	
2		EVE				
				X	-	
					-	

G		ZFMK1		Version number	3	Total object CL	11				
<b>OBJECT CONFIDENCE ES</b>	TIMATE			•		• •					
			-								
Category		Object CL	Comment	Comment							
INTERPRETATION											
Data source		1	K1								
Results of interpretation		3	High confid	ence in the seismic	reflector k	(1.					
INFORMATION DENSITY											
Number of observation	points	1	1								
Distribution of observation	1	Single observation point in the form of a seismic reflector.									
INTERPOLATION											
Geometry		1	Geometry s	upported by surface	e geophys	ical data.					
Geological indicators		1	Indirect sup	port by geophysical	data.						
EXTRAPOLATION											
Dip direction			Extrapolated and modelled based on information from seismic								
		1	reflector K1	. Truncated against	steeply d	ipping zones					
			ZFMNW000	03, ZFMWNW0004.	Open-end	ded in downdip direc	ction.				
Strike direction		2	Conceptual constraints. Truncated against steeply dipping zones								
		2	ZFMNW0003, ZFMWNW0004.								
		FRA	CTURE CHA	RACTER							
			No data avail	able							
INDIVIDUAL INTERCEPTS											
			No data avail	able							

NE			ZFMNE	0065	)	Version	number	3	Total object CL	17
GE	OLOG	ICAL CH	ARACTER		Property	155000	160000	165	000 170000	
Deformation st	vle:	Brittle			3	9				0
Deformation description:	.y.o.	No data	a available.			671000	~	5	S m	671000
Alteration:		Ordelard				1.00	$\sim$	1		2
- First order:		Oxidatio	on		3	8	2			2 0
- Second orde	r:	Not obs	served			لم oso	w )		(MM)	0000
- Third order:		Not obs	served			P 61	1	17		67
orientation and type:	k	gentle o domina fracture orientat open fra sealed Quantit span in	lips to the south- tes. Gently dippi is are highly vari ion. Dominance actures followed and partly open. ative estimate ar clude sealed frac	-east ing able in of by nd cture	1	695000 670000				695000 670000
		network	(S.			9		47	A T	66
Fracture comm	nent:	No data	a available.					X	173 1000	
Fracture fill		Chlorite	, calcite, quartz.			8		1	had men	8
mineralogy:			•			0050	1		w	006
		OBJECT	GEOMETRY			66				66
Strike/dip:		38°/70°								24.04
Length:		4003 m				155000	160000	165	170000	
Mean thicknes	s:	26 m (15 - 64 m)				Model	volume DMS		0 2 4 0	Ň
Max depth:	: -2100 m			_	Baselir	ne		Clastinity of Geolal Networks	N	
Geometrical			NW0019, ZEMW	NVV0001,	Горо					
constraints:		40m gri	a Max error 20m							
Zono based on	curfac	olinoom	nte and horohol	o obsorva	TUR INU	DELLING				
	Sunac			e observa						
Outcrops:		-								
Boreholes:										
	r									
Develop			Target in	<u>itercept</u>		Geometrie	Seometric Intercept			
Borenole	F	עי	Sec_up [m]	Sec_lo [m]	<sup>ow</sup> s	ec_up [m]	Sec_lov [m]	v Co	omment	
HFM18	[	DZ3	119.00	148.0	0	119.11	147.59	ZF D2	MA7 also intersect	ts
HFM26			161.00	202.7	0	158.36	202.67	Ta RI siq ob alo	rget intercept defir J2. Geophysical gnature similar to th served in vuggy gr ong other borehole:	ned by nat ranite s.
Tunnolo										
i unners:	Vor		65							
seismic	1/01		00.							3
indications:										5
				MODELI		OCEDURE				
At the surface, of dip estimated by in HFM26 (RU2 m in HFM26. Th there are difficult	corresp y conn with a ne gent Ities to	oonds to t ecting lin Itered, re tly dippin separate	the low magnetic eament MFM006 d-stained bedroo g zone ZFMA7 is the influence of	c lineamer 65 with the ck). Deforr s also moo f zones ZF	nt MFM00 e borehol mation zo delled to i FMNE006	065. Modelle e intersectio one plane pla ntersect bor 55 and ZFM/	d to the bas ns 119-148 aced at fixed ehole HFM <sup>2</sup> A7 along this	e of the m in HF d points 18 along s boreho	model volume, usi M18 (DZ3) and 16 144 m in HFM18 a DZ3. For this reas le interval.	ng the 1-203 m nd 165 on,

NE	ZFMNE0065	Version number 3	Total object CL <b>17</b>
	200 300 500m 1 km		Rago Ba
	OBJECT CONFIDENC	CE ESTIMATE	

Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM0065A0, HFM18, HFM26
Results of interpretation	3	High confidence observation in HFM18.
INFORMATION DENSITY		
Number of observation points	2	2
Distribution of observation points	2	Two intercepts c. > 500m in between and the lineament considered as an outlier. Three scattered observation points.
INTERPOLATION		
Geometry	1	Surface and two sub. surface observation point (zone not defined by SHI of HFM26) do not lend much support for interpolation alternatives.
Geological indicators	1	Single observation point at depth. Zone modelled mainly based on surface geophysical data.
EXTRAPOLATION		
Dip direction	3	Extrapolated to the base of the model volume. Strike length of the modelled zone > 2000 m.
Strike direction	3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.

NE	ZFMNE006	5 Version number 3 Total object CL 17
FRACTURE CHARAC	CTER	
Orientation: (strike/dip right- hand-rule) Frequency:	Set NNE: 29.1°/85.7° Set G: 40.4°/35.1° Boreholes: -	ZFMNE0065
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open0.0 m-1Sealed0.0 m-1Sealed0.0 % of DZ interceptCrush0.0 % of DZ intercept	$U_{nassigned (57)}$ $Set NNE (33)$ $Set G (45)$ $Mean pole Set NNE (299.1/4.3) Fisher \kappa = 19.4$ $Mean pole Set G (310.4/54.9) Fisher \kappa = 6.0$
RQD:		
Fracture fill mineralogy:	No data available	





NE	ZFMNE080	<b>A8</b>	Version number	4	Total object CL	14
GEOLOGICAL	CHARACTER	Property	155000 160000	) 165	000 170000	
Deformation style:	Brittle	1				0
Deformation	No data available	•	000		~	0000
description:			5 671	-	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	671
Alteration:			{	V	The	
- First order:	Oxidation		$\sim$		1 mg 1 g	-
- Second order:	Not observed	2	000	-1	/ // / s	2 00
- Third order:	Not observed		202			705
Fracture orientation	No data available.				THIN Z	alenti G
and type:			211	X	HHAN KE	
Fracture comment:	No data available.		8	XXX	VIIA IS	00
Fracture fill	No data available.		e c		AL IS	2000
mineralogy:			° ×		K V	9
OBJ	ECT GEOMETRY					
Strike/dip:	220°/80°		8	X	AX/	0
Length:	4077 m		3/14/000	ale -	VI	9500
Mean thickness:	30 m (15 - 64 m)		66	11/2		66
Max depth:	-2100 m			19X	And summer	
Geometrical	ZFMNW0805A, Topo 40m	grid Max			L J Innand	-
constraints:	error 20m, 1 UNIVERSE F	Planar	000		wan	000
	Cut(s).		699	· \	1 N N .	1699
			155000 160000	165	000 170000	20.910
			133000 100000	105	170000	N
			Model volume DMS     Baseline			A
					2 (2 (3 (2 (2 (2 (2 (2 (2 (2 (2 (2 (2 (2 (2 (2	
	BASI	S FOR MOL				
Zone based on surface line	eaments. Zone ZFMINE0808	CONSISTS OF S	several segments, ∠i		ISA and ZEIMINEU80	ISB and
		iu the same	structure.			
Outcrops:	-					
Boreholes' -						
Borenoico.						
Tunnels:	-					
Lineament and/or	MFM0808A0.					2
seismic indications:						3
	MODE	LLING PRO	CEDURE			
Zone ZFMNE0808 consist	s of different segments, the r	most promine	ent of which is denot	ed ZFMN	E0808A. These seg	ments
are judged to constitute ele	ements of one and the same	structure. A	t the surface, corresp	bonds to t	he low magnetic lin	eaments
MFM0808A0, MFM0808B0	) and MFM0808C0. Modelle	d to the base	e of the model volum	e with a d	ip of 80 degrees to	the NW
based on comparison with	nigh confidence, steeply dip	ping zones v	with ININE STRIKE.			
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$\mathcal{L}$	<u></u>	ZFM.				
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0836						
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		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	ĸ		TIMI	
	and a	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			58	
				-		
	0 0 00					
0 0 100	200 300 500 m 1 km	0	2 km		72	

NE	ZF	MNE0808A Version number 4 Total object CL 14							
<b>OBJECT CONFIDENCE E</b>	STIMATE			•		•			
		•							
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0808/	4					
Results of interpretatio	n	3	High confic	dence in the lineame	nt MFM0	308A.			
INFORMATION DENSIT	Y								
Number of observation points		1	1						
Distribution of observation points		1	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the						
		3	modelled zone > 2000 m.						
Strike direction		2	Conceptua	I understanding of th	e site an	d that the entire mod	elled		
		3	zone is sup	ported by the linean	nent.				
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPT	S								
			No data avai	lable					

NE	ZFMNE080	)8B	Version number	3	Total object CL	14
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle					0
Deformation	No data available		00			0000
description:	NO Gala avaliable.		021	5	~~	3710
Alteration:			- (		VI MZ	U
- First order:	Ovidation	-	$\sim$	1	2 Lal S	
- Second order:	Not observed	2	8 5	1-	11/15/15	1 8
- Third order:	Not observed	-	102 June 108			1050
Fracture orientation	No data available.		° R		THA Z	
and type:			5 IL	X	AHA LE	
Fracture comment:	No data available.		8	XAX	V/// \5	00
Fracture fill	No data available.				AL S	2000
mineralogy:			° ×		K V	9
OBJ	ECT GEOMETRY			TAL		
Strike/dip:	228°/80°		8	X	AX/	8
Length:	488 m		3 1 1 2 30	the	$\sqrt{1}$	9500
Mean thickness:	10 m (1 - 13 m)		8	1000		66
Max depth:	-2100 m			18X	And man	
Geometrical	ZFMNW0805A, ZFMWNW	/0001,			I S man	-
constraints:	Topo 40m grid Max error 2	20m.	00		wenn	000
			699			1699
			155000 160000	) 40	000 170000	20.910
			155000 160000	) 10:	170000	N
			Model volume DMS     Baseline			A
			a do ante		a castration of restriction and	
	BASI	S FOR MOD	DELLING			
Zone based on surface line	eaments. Zone ZFMNE0808	consists of a	several segments, Z	FMNE08	08A and ZFMNE080	8B and
ZFMNE0808C, judged to c	constitute elements of one ar	nd the same	structure.			
Outeren						
Outcrops:	-					
Borenoles: -						
Tunnels:	-					
Lineament and/or	MFM0808B0					
seismic indications:						3
	MODE	LLING PRC	CEDURE			<b>.</b>
Zone ZFMNE0808 consists	s of different segments, the r	most promine	ent of which is denot	ed ZFMN	E0808A. These seg	ments
are judged to constitute ele	ements of one and the same	structure. A	t the surface, corresp	ponds to	the low magnetic line	eaments
MFM0808A0, MFM0808B0	and MFM0808C0. Modellee	d to the base	e of the model volum	e with a c	lip of 80 degrees to	the NW
based on comparison with	high confidence, steeply dip	ping zones v	with NNE strike.			
KFR105		-02 ×		/		
-White	ZFMENE3135 KFR	106			2.F.M.M.	
					NN	0830
		C.F.M.Var	ET.			00
	(3 <sup>13</sup> )	John Line Line Line Line Line Line Line Lin	140	1		
	Mr. M.		1905	N		
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0 100	200 300 500 m		0813			

NE	ZF	MNE0808B Version number 3 Total object CL 14							
OBJECT CONFIDENCE E	STIMATE			•		•			
		•							
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0808E	3					
Results of interpretatio	n	3	High confid	lence in the lineame	nt MFM0	308B.			
INFORMATION DENSIT	Y								
Number of observation	points	1	1						
Distribution of observation points		1	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the						
		3	modelled zone > 2000 m.						
Strike direction		2	Conceptua	I understanding of th	e site an	d that the entire mod	elled		
		3	zone is sup	ported by the linean	nent.				
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPT	S								
			No data avai	lable					
NE	ZFMNE080	<b>38C</b>	Version number	4 Total object CL	14				
---	--	--	---	--	---------------------------				
GEOLOGICAL	. CHARACTER	Property	155000 160000	165000 170000					
Deformation style:	Brittle		0		0				
Deformation	No data available	•	000	~	0000				
description:	No data avaliable.		2	272 -	6710				
Alteration:			{ >	2 The					
- First order:	Oxidation		$\sim$	1 1 2 2					
- Second order:	Not observed	2	000	ALL IS	200				
- Third order:	Not observed		202	XXXXXX	105				
Fracture orientation and type:	No data available.			VALA Kore	enti (C				
Fracture comment:	No data available.		00	11/15	000				
Fracture fill	No data available.		2 5		700				
mineralogy:					0				
OBJ									
Strike/dip:	222°/80°		00		00				
Length:	1179 m		2950		9950				
Mean thickness:	15 m (3 - 50 m)		i i i i i i i i i i i i i i i i i i i		99				
Max depth:	-2100 m	a anial Mass		A A MAN					
Geometrical	2FINIVINVUUU1, TOPO 40m	n grid iviax	8		8				
constraints.	Cut(s).	lanai	666000		00699				
			155000 160000	165000 170000	N				
			Baseline Baseline	0 2 4 5 km ( control of Contents on Sec.	A				
	BASI	S FOR MOD	DELLING						
Zone based on surface line ZFMNE0808C, judged to c	eaments. Zone ZFMNE0808 constitute elements of one ar	consists of s nd the same	several segments, ZFM structure.	NE0808A and ZFMNE0808	8B and				
Outcrops:	-								
Boreholes: -									
Tunnels:	-								
Lineament and/or	MFM0808C0.				0				
seismic indications:					3				
	MODE	LLING PRO	CEDURE						
Zone ZFMNE0808 consists are judged to constitute ele MFM0808A0, MFM0808B0 based on comparison with	s of different segments, the r ements of one and the same and MFM0808C0. Modeller high confidence, steeply dip	most promine structure. A d to the base pping zones v	ent of which is denoted t the surface, correspor e of the model volume w with NNE strike.	ZFMNE0808A. These seg ids to the low magnetic line vith a dip of 80 degrees to t	ments eaments he NW				
			4	ZEMMI MM3259	_				
ENE0060B				annos mag					
	The second secon		1E0808C	7.0					
		ZENI							
6									
RT_				<fma1< th=""><th></th></fma1<>					
Contraction of the second				N					
CO244 0	<sup>FM</sup> 48 100 200 300	5	500 m						
			and the second se						

NE	ZF	MNE08	<b>D8C</b>	Version number	4	Total object CL	14		
<b>OBJECT CONFIDENCE E</b>	STIMATE			•		•			
		•							
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM08080	2					
Results of interpretatio	n	3	High confic	lence in the lineame	nt MFM08	308C.			
INFORMATION DENSIT	Y								
Number of observation	points	1	1						
Distribution of observa	tion points	1	Single obse	ervation point in the f	form of a	lineament.			
INTERPOLATION									
Geometry		1	Geometry	supported by surface	geophys	sical data.			
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		0	Extrapolate	ed to the base of the	model vo	lume. Strike length o	of the		
		3	modelled z	one > 2000 m.		-			
Strike direction		2	Conceptua	I understanding of th	e site an	d that the entire mod	elled		
		3	zone is sup	ported by the linear	nent.				
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPT	S								
			No data avai	lable					

NE	ZFMNE08	510	Version number	3	Total object CL	12
GEOLOGICAL	CHARACTER	Property	155000 160000	165	000 170000	
Deformation style:	Brittle					0
Deformation description:	No data available.		671000	-	n m	6710000
Alteration:			~	Y	1 1 4	
- First order:	Oxidation	1	8 2		1 2	1 8
- Second order:	Not observed		~~~ 0200		MM	5000
- Third order:	Not observed		67 67	1	HIV / S	67
type:	No data available.	-		X	AAA Ne	
Fracture comment:	No data available.	1	0002	XAS	XIII 3	0000
OB.IF			67	ALC -	WY / V	670
Strike/dip:	225°/80°			XID	XX/	
Length:	2671 m			SE-	AV7	0
Mean thickness:	25 m (3 - 50 m)		1111 200	1/2	VY	9500
Max depth:	-2100 m		666	24		665
Geometrical	ZFMWNW0001, ZFMNW	0017, Торо		N X	- And second	
constraints:	40m grid Max error 20m.		0000	$\checkmark$	Ward man	0000
			669	$\langle \rangle$		699
			155000 160000	165	000 170000	20.004
			Model volume DMS	100	<u> </u>	Ň
			Baseline		f Laitnig of facilities when	A
Zone based on surface line	ament.	5 FOR MOL	JELLING			
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MFM0810.					1
seismic indications:	MODE	LLING PRO	CEDURE			
At the surface, corresponds minimum and partly by a de analysis of old refraction se degrees to the north-west b	to the low magnetic linearr epression in the bedrock sur ismic data Isaksson and Ke ased on comparison with h	nent MFM08 fface, the for eisu (2005). N igh-confiden	10. This lineament is m of which has been Modelled to the base ce zone ZFMENE225	defined p recognis of the mo 54, which	ed on the basis of a odel volume with a c lies to the south-ea	n lip of 80 st.
Embry 200 300 500 0	ZFMNE0810			LE ME	NE2248	e e e e e e e e e e e e e e e e e e e

NE	ZF	MNE08	<b>B10</b>	Version number	3	Total object CL	12				
OBJECT CONFIDENCE E	STIMATE			•							
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0810								
Results of interpretation	า	1	Low confide	ence in lineament M	FM0810.						
INFORMATION DENSITY	/										
Number of observation	points	1	1								
Distribution of observat	ion points	1	1 Single observation point in the form of a linear		lineament.						
INTERPOLATION	•			•							
Geometry		1	Geometry supported by surface geophysical data.								
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction			Extrapolated to the base of the model volume. Strike length of the								
		3	modelled zo	zone > 2000 m.							
Strike direction		•	Conceptual	understanding of th	e site and	d that the entire mod	elled				
		3	zone is sup	ported by the linear	nent.						
				•							
		FRA	CTURE CHA	RACTER							
			No data avail	able							
INDIVIDUAL INTERCEPTS	6										
			No data avail	able							

NE	ZFMNE08	42	Version number	3	Total object CL	14
GEOLOGICAL	CHARACTER	Property	155000 160000	) 165	5000 170000	
Deformation style:	Brittle		0			0
Deformation	No data available.		000		~	000
description:			2		The man	671
Alteration:				Y	12	
- First order:	Oxidation	1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	_ \	V 12	
- Second order:	Not observed		m. 200		MM	2000
- Third order:	Not observed		20 gl	17	HU / X	670
Fracture orientation and type:	No data available.		2	V	ATA Se	0.0
Fracture comment:	No data available.		00	DAX	81115	000
Fracture fill mineralogy:	No data available.		200		VICY / / /	\$700
OBJE					XX Y	U
Strike/dip:	219%80°		/Kalle	S	NY	
Length: Moan thicknose:	3149  III		000	X	1M	000
Max donth:	-2100 m		2692	N	XI	695
Geometrical		N/0853		1410	and and a second	9
constraints:	Topo 40m grid Max error	20m			1 73	
constraints.	10p0 40m gha Max enor	2011.	8		had a	8
			005		w.	1006
			99			66
			1			
			155000 160000	) 165	000 170000	
			Model volume DMS		0 7 4 8	Ň
			Baseline		Clastinatewor Gordaniewowika	~
	BASI	S FOR MOD	ELLING			
Zone based on surface line	aments and pattern of surro	ounding defo	rmation zones			
Outoropol						
Boreholes: -	-					
Borenoies						
Tunnels:	-					
Lineament and/or	MFM0842.					3
seismic indications:	MODE					ů.
At the ourface, corresponde	MODE	LLING PRO	CEDURE	one of the	a madal valuma with	a din of
80 degrees to the WNW ba	s to the low magnetic linear	1011 IVIFIVIU84	+2. Modelled to the b	hase of the	e model volume with	a dip of
			ZFMN	E084	E0860	
	0 100 200 300 500 m	1 km		2 km		

NE	ZF	MNE08	342	Version number	3	Total object CL	14	
OBJECT CONFIDENCE ES	STIMATE			•		•		
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM0842					
Results of interpretation	า	3	High confic	lence in the lineame	nt MFM08	342.		
INFORMATION DENSITY	, ,							
Number of observation	points	1	1					
Distribution of observat	ion points	1	Single obse	ervation point in the f	form of a	lineament.		
INTERPOLATION				•				
Geometry		1	Geometry	supported by surface	geophys	sical data.		
Geological indicators		1	Indirect sup	oport by geophysical	data.			
EXTRAPOLATION								
Dip direction		2	Extrapolate	ed to the base of the	model vo	lume. Strike length o	of the	
		3	modelled z	one > 2000 m.		-		
Strike direction		2	Conceptua	I understanding of th	e site an	d that the entire mod	elled	
		3	zone is sup	ported by the linear	nent.			
		FRA	CTURE CHA	RACTER				
			No data avai	lable				
INDIVIDUAL INTERCEPTS	;							
			No data avai	lable				

NE	ZFMNE087	0	Version nu	umber	4 Total	object CL	21
GEOLOG	ICAL CHARACTER	Property CL	155000	160000	165000	170000	
Deformation style:	Brittle-Ductile	1	8				00
Deformation description:	No data available.		67100	2	5		67100
Alteration:			1.00	- 5		4	1 -
- First order:	Not observed		0	5	INI		3. 0
- Second order:	Not observed		~	} -	VN	141	5000
- Third order:	Not observed		670	1 1	AII		010
Fracture	No data available.		5	1	W/TH	1 5	(red) month
orientation and			5	110-	XAH	71 18	3
type:			8//			$\left( \Lambda \right)$	5 8
Fracture comment:	No data available.		200		XXX		2000
Fracture fill	No data available.		0	INSTRUCTION	S HX	IV	61
mineralogy:			$\langle \rangle$	A REAL	HANT		
	OBJECT GEOMETRY		8	1311.6	E X	/	9
Strike/dip:	234°/76°		200	24 6 R			500
Length:	572 m		669	1 111		<u>}</u>	669
Mean thickness:	16 m (2 - 36 m)		1 3 6	1 14	XX	S mare	
Max depth:	-560 m			//	$\land$	-	-
Geometrical constraints:	ZFMNW0805B, ZFMNE3118, ZFMNNE0869, Topo 40m grid M 20m, ZFMNW0805A, 1 Surface Cut(s).	/lax error Planar	155000	160000	165000	170000	0000699
	DAGIS		Model vol Baseline	ume DMS		0 2 4 8	Å

BASIS FOR MODELLING Adopted from geological model for SFR Axelsson and Hansen (1997). Based on Intersection along SFR tunnels and boreholes, seismic refraction data.

		Target in	ntercept	Geometric	intercept	
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	Comment
HFR101	DZ1	28.00	41.00	19.14	46.16	An interval with slightly increased frequency of steeply dipping (> 65°) fractures, striking SW occurs at approximately 28–41 m length of DZ1. Control point added at 33.02 m, and 28-41 m is taken as target intercept.
KFR02	DZ1	32.50	37.50	0.00	60.98	
KFR03	DZ2	48.00	95.95	36.39	101.60	
KFR03	DZ3	48.00	95.95	36.39	101.60	
KFR03	DZ4	48.00	95.95	36.39	101.60	
KFR04	DZ2	14.00	63.00	2.73	67.68	
KFR05		-	-	103.05	131.40	
KFR20		-	-	108.61	109.68	
KFR31	DZ2	228.76	232.00	222.74	242.10	
KFR53		-	-	18.73	37.01	No SHI available.
KFR54	DZ2	27.00	40.00	25.31	42.17	
KFR55	DZ2	17.00	38.00	17.18	42.67	Subdivision of DZ2 between ZFMNE0870 an ZFMNE3118.
KFR68	DZ1	71.59	105.13	-		No geometrical intercept. Note: KFR68 is interprete as intercepting the meetir point between ZFMNNE0869 and ZFMNE0870. Since the E lacks fracture orientation data it is impossible to correlate the PDZ with ar specific steeply dipping zone. Thus, the PDZ is

NE			ZFMNE	E0870	Version	number	4		Total object CL	21
							_	tal bo	ken as target interc th ZFMNE0870 an	ept for d
KFR68	D	Z2	71.59	105.13	-	-		No as po ZF lad co sp zo tal bo ZF	o geometrical interc bte: KFR68 is interp intercepting the m int between MNE0869 and MNE0870. Since t cks fracture orienta ta it is impossible t rrelate the PDZ wit ecific steeply dippi ne. Thus, the PDZ cen as target interc th ZFMNE0870 an MNNE0869.	eept. preted eeting he BH tion o h any ng is sept for d
KFR70			-	-	34.67	102.7	1	Ju ph co inc zo int fre tha ox alt dis int	dging from the otographs of the di res there is no obv dication of a possib ne along the geom ercept. The fracture quency is generally an 10 fractures/m a idation or other erations cannot be stinguished. No targ ercept has been de	rill ious le letric e y less and get efined.
KFR7C			-	-	0.00	28.72	2	Th at ma is	e geometrical inter the modelled zone argin. No target inte defined.	cept is ercept
KFR7C	D	Z1	6.23	7.15	0.00	28.72	2	to ZF se m fra an re	le intercept is consi be dominated by 7M871. However, a ction between 6.23 contains laumontite ctures with low alp gles that are taken present ZFMNE087	short 3–7.15 e filled ha to 70.
Tunnels:		DT targ	jet intercept 0+5	i35 - 0+570 m, g	geometric interc	ept 0+470	- 0+60	0 n	n. DT - BT connecti	ion
		tunnel target i 1+050 0+010	at 0+610 m. BT ntercept 0+888 m, geometric int m.	target intercept - 0+907 m, geor ercept 1+017 -	0+640 - 0+690 metric intercept 1+050 m. NBT t	m, geomet 0+860 - 0+ arget inter	ric inte ·925 m cept -,	rce . B ge	pt 0+620 - 0+780 r T target intercept 1 ometric intercept 0-	n. BT +020 - +000 -
Lineament and seismic	/or	S8110,	S8117, S8114.							
Indications:				MODELLING	PROCEDURE					
Adopted from gr and ZFMNW080 earlier SFR moor model Stephens ZFMNNE0869 i sections (ZFMN from new boreh filled joint. Mylor the clay gouge i recorded. The s and ZFMNE087 corresponding t on multiple turn	eologica 05 and dels (se s et al. ( n the so E0870/ ole data nitizatio ndicate urface   0 is not o an are el intere	al mode modelle e, for ex 2007). I puth-we A and Z a. Axels n was a s brittle position crosse a wher cepts ar	I for SFR (Axels d to a depth of 1 cample, Axelsso t has been remo t to ZFMNW08 FMNE0870B) wi son and Hanser lso recorded an reactivation. Flu , based on a pro d by a seismic r e the magnetic f ad correlation wi	son and Hanser 1000 m. Inferred n and Hansen 1 odelled in SFR r 05A/B and ZFM ith an offset at Z n (1997) state th d, if correctly int ish-water loss a jection of tunne efraction survey ield is disturbed th borehole SHI	n 1997). Extend to be a minor z 1997). It was ren model version 1. NE3118 in the r ZFMWNW3262 I tat this zone is, f terpreted (catac ind water leakag mapping result profile. The cer f. The zone has results.	ed so as to one. This z amed ZFM 0 to extend oorth-east. has been r for most of lastic rock? je in the BT ts, lacks a thral part of been mode	b be tru zone co INE08 d from The ea ejected its leng (), indic f from corresp f the zo elled a	orre 70 ZF arlie d, b gth cate 5/6 por s a	ated against ZFMN esponds to zone 9 in the Forsmark sta MNW1035 and er subdivision into t ased on a lack of s , a water-bearing g es a ductile origin v 40-5/690 were also ading magnetic line lies beneath the pi n undulating surface	INE0869 in age 2.2 wo support ouge- vhilst o ament ier ce based



Category	Object CL	Comment
INTERPRETATION		
Data source	3	KFR02, KFR03, KFR7C, KFR20, KFR31, KFR53, KFR54, KFR55, KFR70, tDZ40, tDZ56, tDZ66 and tDZ80. The surface position, based on a projection of tunnel mapping results, lacks a corresponding magnetic lineament.
Results of interpretation	3	High confidence observations in multiple boreholes.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	2	Two clusters and the lineament considered as an outlier.
INTERPOLATION		
Geometry	3	One strong alternative based on observations of the zone in tunnels and drill holes in SFR.
Geological indicators	3	Interpolation supported by key geological parameters, foremost fracture orientation pattern.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.
Strike direction	2	Supported by geological concept and surface lineament. Strike length of the modelled zone < 2000 m.

NE	ZFMNE0870	Version number 4 Total object CL 21
FRACTURE CHARAC	TER	
Orientation: (strike/dip right- hand-rule)	Set SW: 227.3°/78.3° Set NNW: 326.8°/73.1°	ZFMNE0870
Frequency:	Boreholes: KFR31, KFR53, KFR55, KFR7C, KFR54, KFR05, KFR03, KFR68, KFR70, KFR02, KFR04, KFR20 FRACTURE TERZAGHI- TYPE WEIGHED P10 Open and 4.4 m-1 partly open Sealed 0.0 m-1 Sealed 0.0 % of DZ network intercept Crush 0.1 % of DZ intercept	<ul> <li>Unassigned (15)</li> <li>Set SW (47)</li> <li>Set NNW (8)</li> <li>Mean pole Set SW (137.3/11.7) Fisher κ = 25.9 Mean pole Set NNW (236.8/16.9) Fisher κ = 96.9</li> </ul>
RQD:	min:5, max:100, mean:62	
Fracture fill mineralogy:	KFR7C(0.0-28.72), KFR7	C(6.23-7.15), KFR55(17.0-38.0), KFR04(14.0-63.0), KFR54(27.0-40.0)





	NE						ZF	MNE	087	0	V	ersion num	ber	4	Total	object CL	21
KFR05	5 (103.	05-	131.4	4 m	)						1		1				
No dat	a avail	able	•		/												
KFR20	) (108.	61-	109.	68 r	n)												
No dat	a avail	able	1		.,												
KFR31	D72 (	228	76-2	232	0 m)	•											
No dat	a avail	ahle		202	<u>v m</u>	<u> </u>											
KED53	2 (18 7	3-3	7 01	m)													
No dat		3-J	<u></u>	,													
	a avan	27 (	,	0 ~													
KFK34	Flevation	27.0	J-4U.	.0 11	"							ROD reversed					
Length	m.a.s.l.					-			Tatal	Crushed	Sealed	100 = 0	Fracture		Fracture	Open	Core
(m)	RH2000)	frac	tures	fra	tures	frac	tures	fractures	fractures	zone	network	= high value	orientation		orientation	(mm)	loss
		0	20	0	20	0	20	0 20	0 20			0 100 0	\$	0 0	9	0 0 10	
20	-102		5 3	1		1		37	37	1		1 months		1		1200	
28												41.0					
30	-103											61.0					
31	-104 -											10.0					
32	-105 -							- · · ·				58.0					
33	-106 -								- C			54.0					
34	-107 -							50	50	×		65.0					
35	100											47.0					
36	-100								-			5.0					
38	-109 -											27.0					
39	-110											10.0					
	-111				_							39.0					
KFR55	5 DZ2 (	17.0	)-38.	.0 m	I)									_			
	Elevation m.a.s.l.											RQD reversed 100 = 0	Fracture		Fracture	Open	
Length (m)	(m, RH2000)	frac	pen tures	Se	aled	Oper	n total tures	Sealed total fractures	Total	Crushed zone	Sealed	low value = high value	open frac orientation		sealed frac	aperture (mm)	Core loss
		0	20	0	20	0	20	0 20	0 20			0 100 0		0 0	Q	0 10	
-			1-1-	<u> </u>	- <u>5</u> 2	1	1-1-	P P		-	-				alad talah 7	1	
18												78.0					
19	] -129 -											45.2					-
20												13.5					
22												95.0					
23								17				89.0					
24	-130							35	33	5. A.		67.5					
25												81.0					
26												77.0					
27	1											55.0					
20												49.0					
30	-131 -							-				83.0					
31												64.5					
32												85.0					
33									- C			69.1					
34	-132							41	41			35.0					
35								45	45			61.1					
30	]											87.0					
57											-	38.5					



NE	ZFMNE118	8	Version number 9 Total object CL			
		Property	155000 1600	00 165	5000 170000	
GEOLOG		ĊL				
Deformation style:	Brittle	3	000			000
Deformation description:	In the borehole, steeply dipping faults, which strike SE and ESE, parallel to the ductile fabric, show both strike-slip and dip-slip movement. One of these faults shows sinistral strike- slip displacement. Dextral strike-slip component of displacement along with steeply dipping fault with SE strike at the surface. The strike-slip faulting is inferred to be related, in a conjugate manner, to approximately EW		6955000 670,000 670,000 671,000	2		5695000 6705000 6705000 571000
Altoration:	compression.			14 V	And man	
- First order:	Oxidation				2 / J man	-
- Second order:	Not observed	3	0000	$\backslash$	how	0000
- Third order:	Not observed		6691	× \	S	1 9699
Fracture orientation and type:	Fracture set with SE strike and steep dip to the SW is prominent. Steeply dipping fractures with SW strike and more gently-dipping fractures are also conspicuous. Difficulties to interpret significance of fracture orientation data, since zone strikes more or less parallel to borehole KFM04A and is situated along or close to the borehole. Dominance of sealed fractures. Quantitative estimate and span include sealed fracture networks.	2	155000 1600	0 165		A.M.
Fracture comment:	No data available.					
Fracture fill mineralogy:	Chlorite, calcite, hematite/adularia, laumontite, clay minerals, quartz, prehnite, pyrite, epidote (only along steeply dipping NW fractures).					
	OBJECT GEOMETRY					
Strike/dip:	222°/87°					
Length:	606 m					
Mean thickness:	6 m (2 - 36 m)					
wax depth:		Tono 10-				
constraints:	grid Max error 20m, 1 Surface P Cut(s).	lanar				

NE		ZFMNE	E1188	Version number 9 Total object CL					
BASIS FOR MO	DELLING								
Zone based on s	surface outcrop	and borehole o	bservations.						
Outcrops:	AFM00	1097							
Boreholes:									
		Target i	ntercept	Geometric	intercept				
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	Comment			
KFM04A		290.00	370.00	289.47	471.36				
KFM04A	DZ4	412.00	462.00	289.47 471.36 C		290-370 m inferred to be a DZ (cf. Table 3-2 in Stephens et al. 2007).			
Tunnels:	-								
Lineament and/ seismic	or -								
indications:									
Identified at the	surface along a		101007 at drill a	ite 4 Modellad a	town to 600 m	donth using the din estimate	d		
Deformation zon is situated along minor zone.	e plane placed and close to th	l at fixed point 4 ne borehole. Infe	a 4 with boreno 30 m in KFM04/ erred truncation	A. Zone strikes n against ZFMNW	nore or less pa 10017 and ZFN	rallel to borehole KFM04A an IWNW0123. Inferred to be a	nd		
	ZEMININGON			ZFMA2 MENE1192B CFMENE0060C 88	D m	The second secon			

NE	ZF	<b>MNE118</b>	38	Version number	9	Total object CL	19		
OBJECT CONFIDEN	CE ESTIMATE								
		-	-						
Category		Object CL	Comment						
INTERPRETATION		2							
Results of interpre	etation	3	High confide	nce observation in k	FM04A				
INFORMATION DEI	NSITY	, , , , , , , , , , , , , , , , , , ,	i ngir bornad						
Number of observ	ation points	2	2						
Distribution of obs	servation points		Single subsu	urface obs. point. Ac	cording to	Stephens et al. (20	008b)		
		1	MFM3013G	was dropped. Reaso	oning not scale and	clarified. The zone	IS Il hole		
			direction for	c. 50 m, thus argum	ent can o	nly be made for a si	ingle		
			obs. point.				Ű		
INTERPOLATION									
Geometry		3	Geometry su	upported by a single	obs. poin	t coupled to information	ation		
		5	to the drill he	ble direction for c. 50	m accord	ding to interpreted S	SHI.		
Geological indicat	tors	2	Interpolation	supported by data f	rom outcr	ops.			
EXTRAPOLATION			_						
Dip direction		2	Extrapolation	n in dip direction sup	ported by	v subsurface obs. po	oint.		
Strike direction			Zone model	ed length $< 2000$ m.	Intersect	ed in a borehole an	d		
		3	observed on	outcrop. High confid	dence in t	his category based	on		
			conceptual u	understanding of the	site.				
		FRA		ACTER					
Orientation:	Set SW: 232.9%	/83.3°			VE1188				
(strike/dip right-	Set SE: 134.8°/	83.1°		2.11	N				
hand-rule)	Set G: 13.2°/6.1	0			• • •				
Frequency:	Boreholes: KEM	1044	_						
r requeriey.	Derendica. Iti N	10-17 (			1.4.4				
	FRACTURE	TERZAGHI-	]	1					
	TYPE	WEIGHED	4						
	Open and	55 m-1							
	partly open	0.0 11 1	1.	in the second					
	Sealed	12.2 m-1	W-		A	E HE			
	Sealed	19.0 % of	Ŧ	1. S. 1. S		·			
	network	DZ intercept	7		12.	***			
	Crush	0.1 % of DZ			1.1	and the set			
		intercept				1			
						11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
				Ser .	1 . 12.	Equal a	rea		
			• Unas:	signed (222)	5	Lower hemisph	ere		
			Set S	W (174) 🔺 Mean	pole Set SW	/ (142.9/6.7) Fisher $\kappa = 3$	12.5		
			Set S	(150)	pole Set SE	$(44.8/6.9)$ Fisher $\kappa = 20$ 283.2/83.9) Fisher $\kappa = 8$	3.0		
ROD	min:32 max:100	) mean 95							
Fracture fill	min.02, max. ro	5, mean.50							
mineralogy:	200		KFM04A(290.0	)-370.0), KFM04A(412.0-4	62.0)		-1		
	300 -					Open and partly ope Sealed	en		
	250 -								
	and and a								
	ZO			<b>H</b>					
	5 150 -								
	100 -								
	2 IO								
	50 -								
	0								
	alove mo	de merals coldore un	ne natte ontre at	ear walls despar and of	Ne quart ut	pat ende uneral reolite			
	0.04	Clay by the pro	He Jaum alt MI	other tashe pre	Redfer	5 nowner			
		2	TECTAL	0. 90.		Unk			
			NODY						







NE		ZFMNE	FMNE2282			number	6	Total object CL	15
GEO		ARACTER	Pro	perty	155000	160000	165	000 170000	
Deferretienet			(						
Deformation sty	Ie: Brittle	dipping foult wit		3	0000				0000
description	strike s	hows strike slip	11 3 1		6710	2	~		6710
accomption.	displace	ement. Steeply d	lippina			{	$\mathcal{Q}$	V The	1.0
	fault that	at strikes SE sho	ws		al and a	5	/	VM 12	2
	oblique	-slip displaceme	nt.		2000	I F		VIP 1.	5 000
Alteration:					670	1		0100	
- First order:	Oxidati	on		3	5		THE S	(ridemont)	
- Second order:	Not obs	served		Ŭ	5	NF	CHHAN NE	2	
- Third order:	Not obs	served			00	VIIA I	5 00		
Fracture	Fractur	e set with WSW	strike		0020	MY/17	100		
orientation and	and ste	ep dip is promine	ent.				A	V Y	0
type.	orientat	orientations, including gently				X	Y	M/	
	dipping	fractures are al	so		8	1 AN	4	XF	000
	present	. Sealed fracture	s		6956	1000		X	695(
	domina	tes. Quantitative	-	~	9	1 1	10	A Company	ō
	estimat	e and span inclu	de	2	1.12			177	
	sealed	fracture networks	S.		00		/	Ward .	00
Fracture comme	ent: No data	a available.			0059		~ \		1
Fracture fill	Chlorite	e, calcite,			Ö				00
mineralogy:	hematit	e/adularia, laumo	ontite,						20.000
	prennite	e, clay minerals,			155000	160000	165	000 170000	
	OBJECT	GEOMETRY			Model v	olume DMS		0 2 4 8	Å
Strike/dip:	48°/81°	0201121111			Baseline			a Lucinitient Gezächterweike	~
Length:	955 m								
Mean thickness:	: 10 m (2	2 - 36 m)							
Max depth:	-950 m	*							
Geometrical	ZFMEN	IE0060A, ZFMEN	NE0401A, Top	0					
constraints:	40m gri	d Max error 20m	i, 1 Surface Pl	anar					
	Cut(s).			HOD					
Zana haaad an a	unte e e l'in e e me	unte en el heusehel	BASIS FOR		ELLING				
Zone based on st	unace ineame	ents and porenoi	e observation:	5.					
Outcrops:	-								
Boreholes:									
				1	<u> </u>	• • • •			
Borobolo	807	l arget in	tercept		Geometric	Intercept		mmont	
Dorenole	PDZ	Sec_up [m]	Sec_low	Sec	:_up [m]	Sec_lov		omment	
			[111]			լույ	39	5-416 m added (cf	-
KFM05A	DZ2	395.00	436.00	3	396.41	436.48	Ta	ble 3-2 in Stephen	ns et al.
							20	07).	
Tunnels:	-								
Lineament and/o	or MFM22	282G.							0
seismic									2
muications:	I								
At the surface co	prresponds to t	the low magnetic	lineament M	-M228	2G Modell	ed down to	850 m (	enth using the dir	)
estimated by con	necting linear	nent MFM2282G	with the bore	hole int	tersection 3	395-436 m i	n KFM0	5A (DZ2 and its ex	tension
along borehole in	terval 395-416	5 m). Deformatio	n zone plane	placed	at fixed po	int 430 m in	KFM05	A. Decreased rada	ar
penetration also a	along the bore	hole interval 426	- 433 m.						

NE	ZFI	<b>MNE228</b>	32	Version number 6 Total object CL 1							
C ZFMWNW0123	ZFMNE	ZFMENEOU 2282 ZFMEN ENEO103A 100 20		S00 m ZFMENE23	NE0404	ZFMA2	E				
		OBJECT	CONFIDENC	EESTIMATE							
Category		Object CL	Comment								
INTERPRETATION											
Data source	atation	2	MFM2282G	KFM05A							
	NSITY	3	High confide	nce observation in K	FINIUSA.						
Number of observ	ation points	2	2								
Distribution of obs	servation points	1	 Single obse	vation point at depth	and a su	urface lineament.					
INTERPOLATION	ľ		0	- I I							
Geometry		1	Geometry s	upported by a lineam	ent and a	a single intercept.					
Geological indicat	tors	1	Indirect sup	port by geophysical c	lata.						
EXTRAPOLATION			-								
Dip direction		2	Extrapolatio	n in dip direction sup	ported by	/ subsurface obs. po	oint.				
Strike direction			Concentual	understanding of the	ite and	that the entire mod	balled				
		3	zone is supp	ported by the lineame	ent.		ciicu				
		FRAG	CTURE CHAP	ACTER							
Orientation:	Set WSW: 240.	1°/83.9°		ZFM	VE2282						
(strike/dip right-				-	Ņ						
Frequency:	Boreholes: KFM	105A	_	1 and a		1					
			_	1.: ".	• •	X					
	FRACTURE	TERZAGHI-		1.		Y .					
	I I I YPE		1	1							
	Open and	2.4 m-1	1			· · · /					
	partly open					1 + 2 m					
	Sealed	7.9 m-1	1.								
	Sealed	12.9 % of	W-	4	-		E				
	network	DZ			- 1 +	See.					
	Crush		1			··· · · · · · · · · · · · · · · · · ·					
		intercept	1			• • • • • • •					
	'			1.							
				7							
				X		A A A A A A A A A A A A A A A A A A A					
					1.4	Equal	area				
					5-	Lower hemisp	ohere				
			• Unas	signed (121)	3	and the second second					
POD:	min:7440	0	• Set V	/SW (66) 🔺 Mean po	le Set WSV	V (150.1/6.1) Fisher κ =	28.8				
KQD:		u, mean:98									





NE		ZFMNE2308 Version number 6 Total object CL						al object CL	13
GEO	LOGICAL CH	ARACTER	Pro	operty CL	155000	160000	165000	170000	
Deformation stv	le: Brittle			3	8				9
Deformation description:	No data	available.		-	671000	2	1		671000
Alteration:						1		The	
- First order:	Oxidatio	on			al and a	$\sim$	XX	213	
- Second order:	Not obs	erved		3	000	5 -	1/1	1 / 1	2 00
- Third order:	Not obs	erved			7 205	m 1	X	XI IN	705
Fracture orientation and type: Fracture comme Fracture fill mineralogy:	Steeply strike N and NN gently d conspic fracture are also estimate sealed nt: No data Chlorite hematiti other m mineral	dipping fracture E-SW to NNESS W-SSE as well a lipping fractures uous. Steeply di s with NWSE str present. Quanti e and span inclu fracture networks available. , calcite, e/adularia, quart inerals. Some cl s and epidote are	s that SW as are pping ike itative de s. z and ay e also	2	6660000 6895000 6700000 6			and a second	6690000 6695000 6700000 6
	present								
	OBJECT	GEOMETRY			155000	160000	165000	170000	22.51
Strike/dip:	216°/84	0			Model	volume DMS		0 2 4 8	N
Length:	1697 m	>			Baseline	•		S Californite at Californite Californite (Kali	N
Mean thickness:	30 m (3	- 50 m)							
Max depth:	-1/00 m		<u> </u>		-				
Geometrical		NVVUUU1, Topo 4	Om grid Max	error					
constraints:		Surface Planar (	Jut(s), T						
	UNIVER	KSE Planar Cull							
Zone based on su	urface lineame	ents and borehole	e observatior	IS.					
Outcrops:	-								
Boreholes:									
		Target in	ntercept		Geometric	intercept	_		
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	:_up [m]	Sec_low [m]	Comm	ent	
KFM08D	DZ8	644.00	689.00	6	644.03	689.12			
Tunnoloi									
Lineament and/c seismic indications:	or MFM23	08G.							1
maloutiono.			MODELLIN	G PRO	CEDURE				
At the surface, co Modelled using th (DZ8). Deformation	prresponds to t the dip estimate on zone plane	he low magnetic ed by connecting placed at fixed p	lineament M lineament M point 660 m ir	FM230 FM2308 h KFM0	8G and its 8G with the 8D.	inferred conti borehole inte	nuation to t ersection 64	he north-east. 14-689 m in K	FM08D

NE	ZFI	<b>MNE230</b>	08 Version number 6 Total object CL 13
ZFMENE1061A		1008 ATTIMUTE 2003 M1203 ATTIMUTE 2003 ATTIMUTE 2003 ATTIM	TERMNE2308 to the terms of the terms of the terms of the terms of
		OBJECT	CONFIDENCE ESTIMATE
Category		Object Cl	Comment
INTERPRETATION			
Data source		2	MFM2308G, KFM08D
Results of interpre	etation	2	Medium confidence observation in KFM08D.
INFORMATION DEM	NSITY		
Number of observ	ation points	2	2
Distribution of obs	servation points	1	Single observation point at depth and a surface lineament.
INTERPOLATION			
Geometry		1	Geometry supported by a lineament and a single intercept.
Geological indicat	ors	1	Indirect support by geophysical data.
EXTRAPOLATION			
Dip direction		0	Extrapolation in dip direction supported by subsurface obs. point.
		2	Strike length of the modelled zone < 2000 m.
Strike direction		0	Partly support by surface lineament. Supported by geological
		2	concept and subsurface observation points.
Orientation:	Set \$\$\M: 106 5	°/85.2°	
(strike/din right-	Set G: 93 4º/12	1°	ZFMINE2308
hand-rule)	001 01 001 1712		
Frequency:	Boreholes: KFM	108D	
- 17			
	FRACTURE	TERZAGHI-	
	TYPE	WEIGHED	
		P10	
	Open and	5.5 m-1	
	partly open		
	Sealed	23.0 m-1	
	Sealed	2.2 % of DZ	T W- E
	network	intercept	
	Crush	0.0 % of DZ	
		intercept	
			Found area
			Lower hemisphere
			Unassigned (133)     S
			Set SSW (361) ▲ Mean pole Set SSW (106.5/4.8) Fisher κ = 15.0
			• Set G (81) ▲ Mean pole Set G (3.4/77.9) Hisher K = 15.0
RQD:	min:62, max:10	0, mean:96	





NE		ZFMNE	2309		Version n	umber	7	Total object CL	15
GE	OLOGICAL CH	ARACTER	Prop	erty	155000	160000	1	65000 170000	_
Deformation st	vle: Brittle			_	0				0
Deformation	No data	a available.			1000		_	~	1000
description:					67	5	5	1 mm	67
Alteration:	Ovidati	00			1.7	$\sim$	1	1 L	-
- Second orde	r: Not obs	served	2		000	5 5	-1	ME	3 00
- Third order:	Not obs	served			6705	~		AIAN	6705
Fracture	No data	a available.			5	1	X	THAN 5	******
type:	2				2 { \	12	XAL	XJIHA (	2 0
Fracture comm	nent: No data	a available.			2000	N.X		XV / J	0000
Fracture fill	No data	a available.			10			XV V	67
mineralogy:	OBJECT	GEOMETRY					St	MY I	
Strike/dip:	37°/90°	CEOMETRI			2000	14	X	M	2000
Length:	801 m				699		Au	X	699
Mean thickness	s: 13 m (2	2 - 36 m)			25	/	(d)	a Ala sum	
Geometrical	-800 m	2308 ZEMENE	2320 Topo 40m	n	8		$\checkmark$	and ment	8
constraints:	grid Ma	x error 20m, 1 S	Surface Planar		0059		$\sim$		0069
	Cut(s),	2 UNIVERSE PI	anar Cut(s).		U				9
					155000	160000	16	5000 170000	20.910
					Model vo	olume DMS		0 2 4 0	Ň
			BASIS FOR		Baseline			d Cartraland, Goddaranner San	
Zone based on	surface lineame	ents.	DAGIG I OK I						
Outcrops:	-								
Boreholes:									
		Target i	ntercept	(	Geometric	intercen	t I		
Borehole	PDZ		Sec_low	Soc		Sec_lo	w (	Comment	
	0.75	Sec_up [iii]	[m]	Sec	_up [m]	[m]	_		
KFIMU8D	DZ5	546.00	571.00	5	46.98	571.0	1		
Tunnels:	-								
Lineament and	l/or MFM23	809G.							2
indications:									2
			MODELLING	PROC	EDURE				
At the surface, o	corresponds to t	the low magnetic	c lineaments MF	FM230	9G. Model	led to a d	epth of	BOO m with a dip of 8	80
minor zone. Zor	ne intersected b	v KFM08D (546	-571. DZ5) with	fix po	int placed a	at 562 m.	WILLI ININI	= strike. Interred to t	be a
	9 Ma	y 14 11002 (0 10							
•	124 AB	NFM08C	ZEMIL		ZFIN				10
	2 1 4 1				IWI				
		7	HEM38		W.				_
ā	N · W	MOSA	0		222				
5A	ZFMEN	E2120			Ű				
-	5	HEMA							
		× N							
ZFIME	NEOL	10	0309			0			
(CMA2	. L0 159B		NEGO						
HEM2,		25							
	TEMENE			100	293				
	ZFMENE28	20 02	308 JEN	NNE			1	0	
		ZEMME		5					V.
ZFME	NE2325A		ZF	M120	3	0			
					INNE23			N	
	<u> </u>			1					
	0	100 200	300		500 m				
				1		ENEOT		V	

NE	ZFI	<b>MNE230</b>	)9	Version number	7	Total object CL	15				
		OBJECT	CONFIDENC	ESTIMATE	1						
		-									
Category		Object CL	Comment								
INTERPRETATION											
Data source		2	MFM2309G,	KFM08D							
Results of interpre		3	High confide	nce observation in l	KEM08D.						
INFORMATION DEP	NSITY	0	2								
Number of observ	ation points	2	Z Single choose	votion naint at dant		rfaga lingament					
	servation points	1	Single obser	valion point at depti	i and a su	mace inteament.					
Goomotry		1	Goomotry c	innorted by a linear	ont and a	single intercent					
Geological indicat	ors	1	Indirect supr	ort by geophysical	data	i single intercept.					
EXTRAPOLATION	.013		muneet supp	Joit by geophysical	uala.						
Dip direction			Extrapolation	n in dip direction sur	ported by	subsurface obs. po	pint.				
		2	Strike length	of the modelled zor	ne < 2000	m.					
Strike direction			Conceptual	understanding of the	site and	that the entire mode	elled				
		3	zone is supp	orted by the lineam	ent.						
		FRAG	CTURE CHAR	ACTER							
Orientation:				ZFMM	VE2309						
(strike/dip right-					N						
hand-rule)				1 total		4					
Frequency:	Boreholes: KFM	108D			· · · ·	X					
				· ·		X					
	FRACTURE	TERZAGHI-		1		···· ·· · · · · · · · · · · · · · · ·					
	TYPE	WEIGHED	1								
	Open and	<u>Fiu</u> 56m1		1990 B							
	open and	5.0 11-1	7.								
	Sealed	25.6 m-1	1.	1		*					
	Sealed	3.9 % of DZ			2 D						
	network	intercept	W-				E				
	Crush	0.0 % of DZ		- 12	1						
		intercept									
			4-		••	· · · /					
			7	÷ •							
				· · ·							
				1:	1. A.						
				× · · .							
				N.		Equal	area				
				1-	5	Lower hemist	ohere				
			KFM0	8D (306)	5						
RQD:	min:17, max:10	0, mean:93									
Fracture fill			KFI	M08D(546.0-571.0)							
mineralogy.	200	-				Open and partly one	20				
	200 -					Sealed	-				
	175 -										
	8 150 -										
	9 5 125 -										
	000										
	100 - J										
	g 75 -										
	z 50 -										
	25 -				_						
	60	ite ite	als se	the the tak	alls	se &					
	pittile	Call Onlos	ine spide se	ma unon anth	egm al	Que. mine					
		Clay		13 THOLE OF	1	okrown.					
				Dette		a.					
				40							



	ZFMNE23	32	Version number	5	Total object CL	11
GEOLOGICAL	CHARACTER	Property	155000 160000	16	5000 170000	
Deformation style:	Brittle					0
Deformation	No data available	1	000		~	0000
description:			2		The man	6710
Alteration:			{	V	The	
- First order:	Oxidation		$\sim$		1412	-
- Second order:	Not observed	2	0000		/ M P 10	2000
- Third order:	Not observed		670		X// ALA	5705
Fracture orientation and	No data available.		Star 1	N	141 5	(10)11
type:			5	X	AHAN KE	
Fracture comment:	No data available.		000	X	×11/1 5	000
Fracture fill mineralogy:	No data available.		202	XSX (	MY / Y	700
OBJE				An	V Y	U
Strike/dip:	49°/85°			CHE	NY	
Length:	1270 m		00	X	AN	000
Mean thickness:	15 m (3 - 50 m)		695	X	$\times$	695(
Geometrical	-1250 III ZEMW/NW/0123 Topo 40	m arid Max	°	100	A Company	Ō
constraints:	error 20m 1 Surface Plan	nar Cut(s)		1 miles	173	
constraints.	1 UNIVERSE Planar Cut	(s)	8	$\mathbf{X}$	Not the second s	8
		(0).	00500		N.	0069
			66			66
						20.00
			155000 160000	165	000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		Calcinitizent, Calcilicitiener (Aus	N
	BASI	IS FOR MOD	ELLING			
Zone based on surface line	aments.					
Outoma						
Outcrops:	-					
Borenoies						
Tunnels:	-					
Tunnels: Lineament and/or	- MFM2332G0.					2
Tunnels: Lineament and/or seismic indications:	- MFM2332G0.					2
Tunnels: Lineament and/or seismic indications:	- MFM2332G0. MODE		CEDURE		ť to lla all	2
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145	- MFM2332G0. MODE to the low magnetic linear	ELLING PRO nent MFM233	CEDURE 32G0 and its inferred	continua 26 ZEME	tion to the north-eas	2 st.
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the porth-west	- MFM2332G0. MODE to the low magnetic lineam 0 m with a dip of 85 degrees	ELLING PRO nent MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic lineam 0 m with a dip of 85 degrees	ELLING PRO nent MFM23: s based on a	CEDURE 32G0 and its inferred comparison with zor	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees	ELLING PRC nent MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2400	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees CHWIENE ZFMENE2403	ELLING PRO nent MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees CHIMENE ZFMENE2403	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE2403	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZEMENE0062B	continua ne ZFME	tion to the north-eas	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2403 ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN	continua ne ZFME	ation to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN	continua ne ZFME	ation to the north-eas NE0062A that is situ	2 st. aated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN	continua ne ZFME	ation to the north-eas NE0062A that is situ	2 st. aated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN ZFMEN	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. aated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. aated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM233 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. aated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2403 CFMENE2403 CFMENE0062A	ELLING PRO ment MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2403 CFMENE2403 CFMENE0062A	ELLING PRO ment MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. to the low magnetic linear 0 m with a dip of 85 degrees CFWENE2403 CFMENE2403 CFMENE0062A	ELLING PRO nent MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. lated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. to the low magnetic linear 0 m with a dip of 85 degrees CFMENE2403 CFMENE2403 CFMENE0062A	ELLING PRO nent MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. ated to
Tunnels: Lineament and/or seismic indications: At the surface, corresponds Modelled to a depth of 145 the north-west.	- MFM2332G0. MODE to the low magnetic linear 0 m with a dip of 85 degrees ZFMENE2403 ZFMENE0062A	ELLING PRO ment MFM23 s based on a	CEDURE 32G0 and its inferred comparison with zor ZFMENE0062B ZFMEN NE2332 NE2332	continua ne ZFME	tion to the north-eas NE0062A that is situ	2 st. ated to

NE	ZF	MNE23	Version number         5         Total object CL         11								
<b>OBJECT CONFIDENCE ES</b>	STIMATE			• •		•					
Category		Object CL	Comment								
INTERPRETATION	ON										
Data source	Data source			MFM2332G0							
Results of interpretation	า	2	Medium confidence in lineament MFM2332G0.								
INFORMATION DENSITY	<i>,</i>										
Number of observation	points	1	1								
Distribution of observat	ion points	1	Single obse	ervation point in the	form of a	lineament.					
INTERPOLATION											
Geometry	Geometry			supported by surface	e geophys	ical data.					
Geological indicators		1	Indirect sup	port by geophysical	data.						
EXTRAPOLATION											
Dip direction		1	No subsurfa uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	/ by surface data. Hi of the modelled zon	.gh ⊧e <				
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
FRACTURE CHARACTER											
			No data avail	able							
INDIVIDUAL INTERCEPTS											
			No data avail	able							

NE		ZFMNE	3112	Version number <b>4</b> Total object CL					19
GEC		IARACTER	Pro	perty CL	155000	160000	165000	170000	
Deformation sty	/le: Brittle			3	8				9
Deformation	Minor o	ohesive breccia	s		1000				000
description:	presen	t in three of the E	ЗН		67	E T	11	y many	67
•	interce	pts.				$\langle \vee$	11	1 2	
Alteration:					a horas	5	$\wedge$	123/2	-
- First order:	Oxidati	on		~	2000	1 -	VI	1 P L	2000
- Second order	: Lamon	tization		3	220	~ /	A	AN	5029
- Third order:	Carbon	atization			a free	1	ITH	1 2	NEW I
Fracture	Fractur	e set with ENE s	strike		2	11h	XAH	DA NE	1
orientation and	domina	te followed by N	NW		8 { \	- MA	SAL	$   \land   $	8
type:	and NN	IE set. Sealed fra	acture		200	W XX	XXX	0/ 13	000
	networ	ks observed.			2 01	KEAS	AN		67
	Occurr	ence of sealed a	nd			VIGHT		$\times$ / $^{\circ}$	
	open fr	actures.				CULLO A		17	
Fracture comm	ent: Fractur	e apertures up to	o 0.5		0000	20 A Sec	81	/	000
	mm wit	h a single apertu	ure at 3		699	1 115	X	}	695
	mm (K	FR104, SHI DZ3	268-			1 11	X	2	9
	283m).						A	TY	
Fracture fill	Chlorite	e, laumontite, he	matite,		8			X	8
mineralogy:	adularia	a and calcite.			005	$\sim$	·w		006
	OBJECT	GEOMETRY			99			S	66
Strike/dip:	235°/89	9°			1.1				
Length:	474 m				155000	160000	165000	170000	30.900
Mean thickness	<b>:</b> 10 m (1	I - 13 m)							N
Max depth:	-500 m	- /			Baselin	volume DMS		0 2 4 8	A
Geometrical	ZFMN	V8043. ZFMNW	0805B. Topo 4	40m					
constraints:	arid Ma	ax error 20m. 1 S	Surface Planar	-					
	Cut(s).	, -							
			BASIS FOR	R MOD	ELLING				
Zone based on s	surface lineam	ents and borehol	le observation	s.					
Outcrops:	-								
Boreholes:									
					<u> </u>		-		
		l arget i	ntercept		Geometric	c intercept	-		
Borenoie	PDZ	Sec up [m]	Sec_low	Sec	c up [m]	Sec_low	Comm	ent	
	D70	202.00	[m]	-	00.74	[m]			
KFR102A	DZ2	302.00	325.00	4	299.74	323.06			
KFR102B	DZ4	173.00	180.00	1	169.96	180.07			
KFR104	DZ3	268.00	283.00	2	265.72	283.00	_		
KFR105	DZZ	88.50	96.50		87.40	100.05			
Tunnalai									
Tunnels:	- /	400							
Lineament and/		1126.							4
seismic									1
mulcations:			MODELLING		CEDUDE				
The position of 4	a zono ot the	around ourfere		PRO		a interpreted b	arahala se	molotiono!t	h only c
The position of the	ne zone at the	ground surface	IS DASED ON A	project	ion from th	e interpreted b		onelations, wit	n oniy a
weak and partial	agreement wi	in the ineament	IVIFIVI3112G C		by a magn	head and him day	ISAKSSON	et al. 2007). I	
central part of th	ad by KED100		Nere the mage					ni interpretatio	JII. INC
	eu by KEK102	A (302-323, DZ2	ED102A 170	1/3-18 5 m in	U, UZ4), K	275 5 0 10 10	D104 and	02 5 m in 105 (8	0,0- D105
90,0, UZZ). FIXE	u points placed	ມ at ວ I ວ,ວ M IN K	$r \kappa IUZA, 176$	,ວ m m	NEKIU2B	∠/ ၁,၁ m in KF	rk 104 and	92,3 III III KFI	RIUD.



Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM3112G. However, the modelled zone do not follow the lineament precisely, KFR102A, KFR102B, KFR104, KFR105
Results of interpretation	3	High confidence observations in multiple boreholes.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	3	Even distribution of obs. points.
INTERPOLATION		
Geometry	2	The zone has been observed in multiple boreholes (SHI interpret.) strengthening the current modelled geometry although the current geometric interpretation do not follow surface lineament precisely, henceforth there is the possibility that the zone continues SW and not truncated by ZFMNW8043.
Geological indicators	2	Interpolation supported by mineral fillings within fractures from boreholes.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.
Strike direction	2	Partly support by surface lineament. Supported by geological concept and subsurface observation points.










NE		ZFMNE	3118		Version r	number	4	Total object CL	21
GEOL	OGICAL CH	HARACTER	Pr	operty CL	155000	160000	165	000 170000	
Deformation style	e Brittle			3	0				0
Deformation	Inferre	d minor brittle-du	ctile	· ·	000			~	000
description:	shear	zone at 200 25–2	00 54		671	2	P		671
accomption	m in H	FR101 DZ3. Coh	esive			{	Q	The	
	breccia	a in KFR104 DZ1	00110			$\sim$	1	1 holy	
Alteration:	5100010				000	5 -	1-		2 8
- First order:	Oxidat	ion			7 1050	y )	-		1050
- Second order:	Quartz	dissolution		3	° Z	1		THU S	0
- Third order:	Not ob	served			2	1,1	X	ADA	
Fracture	Fractu	re set with SSW s	strike		2 { \	112	TS A		2 0
orientation and	dinning	to WNW domina	ates		00 2	the state		XIIIS	000
type:	Occurr	ence of open and	1		200	11000		WY/ //	670
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	sealed	fractures as well	as				and	XX /	
	sealed	fracture networks	s.			<u> </u>	X	NY	
Fracture commer	nt: No dat	a available.			000	11/1	y dest	IN	000
Fracture fill	Calcite	chlorite, laumon	tite		695	1	A.	XI	695
mineralogy:	and he	matite.			9	1 1	40	A A	Ö
	OBJEC	<b>GEOMETRY</b>			1. 1. 1.		X	1 13	
Strike/din <sup>.</sup>	46°/84	•			8		1	1 James -	0
Length:	743 m				000			w	000
Mean thickness	8 m (2	- 36 m)			669				666
Max denth:	-750 m	00 m			·				
Geometrical	ZEMN	M0805B ZEMW/N	JW/1035		155000	160000	165	000 170000	20.00
constraints.	ZEMEN	NE3115 Topo 40	m arid Max	error	100000	100000	100	110000	N
constraints.	20m 7	FMNW0805A 1	Surface Plai	har	Baseline	olume DMS		0 2 4 8	A
	Cut(s)		Currace r la					a cardinative, accurately of the	
	0 ut(0).		BASIS FO	R MOD	ELLING				
Modified after zon	e 12 Carlsso	on et al. (1985), Z	one based o	n surfac	e lineamen	ts, borehole	and tu	nnel observations.	
Outcrops:	-								
	Outcrops: -								
Boreholes:	Boreholes:								
Boreholes:		Townskin	4 4		0				
Boreholes:	007	Target in	ntercept		Geometric	intercept			
Boreholes: Borehole	PDZ	Target in Sec_up [m]	ntercept Sec_low	Sec	Geometric	intercept Sec_lov	/ Co	omment	
Boreholes:	PDZ	Target in Sec_up [m]	itercept Sec_low [m]	Sec	Geometric :_up [m]	intercept Sec_lov [m]	/ Co	omment	
Boreholes: Borehole HFR101	PDZ	Target in Sec_up [m] 190.00	tercept Sec_low [m] 202.00	Sec 1	Geometric :_up [m] 83.31	intercept Sec_lov [m] 203.33	/ Co	omment	
Boreholes: Borehole HFR101 KFR104	PDZ DZ3 DZ1	Target in Sec_up [m] 190.00 30.00	tercept Sec_low [m] 202.00 45.50	Sec	Geometric _up [m] 83.31 29.64	intercept Sec_lov [m] 203.33 46.12	/ Co	omment	
Boreholes: Borehole HFR101 KFR104 KFR113 KFR113	PDZ DZ3 DZ1	Target in Sec_up [m] 190.00 30.00 -	tercept Sec_low [m] 202.00 45.50	Sec 1	Geometric up [m] 83.31 29.64 1.28	intercept Sec_low [m] 203.33 46.12 2.40		omment	
Boreholes: Borehole HFR101 KFR104 KFR113 KFR114 KFR114	PDZ DZ3 DZ1	Target in Sec_up [m] 190.00 30.00 - -	tercept Sec_low [m] 202.00 45.50 - -	Sec	Geometric _up [m] 83.31 29.64 1.28 1.92	intercept Sec_low [m] 203.33 46.12 2.40 2.20 2.20		omment	
Boreholes: Borehole HFR101 KFR104 KFR113 KFR114 KFR115 KFR115	PDZ DZ3 DZ1	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           -	tercept Sec_low [m] 202.00 45.50 - - - -	1	Geometric _up [m] 83.31 29.64 1.28 1.92 0.00	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65		o SHI available. o SHI available. o SHI available. o SHI available.	
Boreholes: Borehole HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR122	PDZ DZ3 DZ1	Target in Sec_up [m] 190.00 30.00 - - - - -	tercept Sec_low [m] 202.00 45.50 - - - - -		Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 0.79	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59	V Co	omment SHI available. SHI available. SHI available. SHI available. SHI available.	
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR13	PDZ DZ3 DZ1 DZ3	Target in           Sec_up [m]           190.00           30.00           -           47.50	tercept Sec_low [m] 202.00 45.50 - - - - 61.00		Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60	V Ca	omment SHI available. SHI available. SHI available. SHI available. SHI available.	
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR53	PDZ DZ3 DZ1 DZ3	Target in           Sec_up [m]           190.00           30.00           -	tercept Sec_low [m] 202.00 45.50 - - - - 61.00 -		Geometric up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64	V Ca Na Na Na Na Na Na	omment SHI available. SHI available. SHI available. SHI available. SHI available.	
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54	PDZ DZ3 DZ1 DZ3 DZ3 DZ1	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           -           -           -           -           -           -           -           -           0.00	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50		Geometric up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 0.00	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32		omment SHI available. SHI available. SHI available. SHI available. SHI available.	
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 MER55	PDZ DZ3 DZ1 DZ3 DZ3 DZ1	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           47.50           -           0.00	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50		Geometric up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 0.00 0.00	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32	V Co	omment SHI available. SHI available. SHI available. SHI available. SHI available. SHI available.	
Boreholes:      Borehole     HFR101     KFR104     KFR113     KFR114     KFR115     KFR116     KFR13     KFR53     KFR54     KFR55	PDZ DZ3 DZ1 DZ3 DZ3 DZ1 DZ2	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           47.50           -           0.00           8.00	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00		Geometric up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 0.00 8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20	V Co	omment SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. MJF2440	) and
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55	PDZ DZ3 DZ1 DZ3 DZ3 DZ1 DZ2	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00		Geometric - up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 0.00 8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20	V Co No No No No Su Su Su Su	Domment D SHI available. D SHI available.	) and
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55	PDZ DZ3 DZ1 DZ3 DZ3 DZ1 DZ2	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00	htercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00		Geometric up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 8.36 0.00 0.00	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20		omment SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. MI available. MI available. SHI avai	) and
Boreholes:          Borehole       Image: Market state stat	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 DZ2 BT/ST 01050	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           47.50           -           0.00           8.00	htercept Sec_low [m] 202.00 45.50 - - - - 61.00 - 2.50 17.00 +166 - ?, ge		Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 0.00 8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20	V Co No No No Su Su Su Su Su Su	omment SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. MIL available. SHI av	) and
Boreholes: HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55 Tunnels:	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 DZ2 BT/ST 0+059 interse	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           -           -           -           -           -           -           -           -           -           -           0.00           8.00           target intercept 1           m, geometric intercept 1           pt 0+295           0.215	htercept Sec_low [m] 202.00 45.50 - - - - 61.00 - 2.50 17.00 +166 - ?, ge ercept 0+055	Sec     1	Geometric           _up [m]           83.31           29.64           1.28           1.92           0.00           0.79           43.88           0.00           0.00           8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20	V Co No No No No Su Su be ZF	Domment D SHI available. D SHI Available	) and 0+055 - letric
Boreholes:          Borehole         HFR101         KFR104         KFR113         KFR114         KFR115         KFR116         KFR53         KFR54         KFR55	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 DZ2 BT/ST 0+059 interce	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric interpt 0+295 - 0+315           08414	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00 +166 - ?, ge ercept 0+055 m.	Sec 1 	Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 8.36 intercept 1- 0 m. NBT ta	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20	Co     No     No     No     No     No     No     No     Su     Su     Su     So     So	D SHI available. D SHI	) and 0+055 - letric
Boreholes:          Borehole         HFR101         KFR104         KFR113         KFR114         KFR115         KFR116         KFR53         KFR54         KFR55	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 DZ2 BT/ST 0+059 interce r MSFR	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric interpt 0+295 - 0+315           08111.	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00 +166 - ?, ge ercept 0+055 m.	Sec 1 2 2 2 2 2 2 2 2 2 2 2 2 2	Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 8.36 intercept 1- 0 m. NBT ta	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 inget interce	Ca     Na     Su     Su	Domment Do SHI available. Do S	) and 0+055 - letric
Boreholes:          Borehole         HFR101         KFR104         KFR113         KFR114         KFR115         KFR116         KFR13         KFR53         KFR54         KFR55	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 DZ2 BT/ST 0+059 interce r MSFR	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric intercept 2           08111.	ntercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00 +166 - ?, ge ercept 0+055 m.	Sec 1 	Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 8.36 intercept 1- 0 m. NBT ta	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 inget interce	V Ca Na Na Na Na Su Su Sof m. Ni spt 0+29	Domment D SHI available. D SHI available	) and 0+055 - letric
Boreholes:          Borehole         HFR101         KFR104         KFR113         KFR114         KFR115         KFR116         KFR13         KFR53         KFR54         KFR55	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric intercept 1           m, geometric intercept 1           pt 0+295 - 0+315           08111.	ntercept Sec_low [m] 202.00 45.50 - - - - 61.00 - - 2.50 17.00 +166 - ?, ge ercept 0+055 m.	Sec 1 	Geometric _up [m] 83.31 29.64 1.28 1.92 0.00 0.79 43.88 0.00 0.00 8.36 intercept 1- 0 m. NBT ta	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 irget interce	V Ca Na Na Na Na Su be ZF S6 m. Ni Spt 0+29	D SHI available. D SHI	0 and 0 and 0+055 - uetric
Boreholes: Borehole HFR101 KFR104 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55 Tunnels: Lineament and/or seismic indications: Modified ofter zeen	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR0	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric intercept 1           pt 0+295 - 0+315           08111.	Itercept           Sec_low           [m]           202.00           45.50           -           -           61.00           -           2.50           17.00           +166 - ?, ge           prcept 0+055           m.	ometric ometric ometric onetric	Geometric          up [m]           83.31           29.64           1.28           1.92           0.00           0.79           43.88           0.00           0.00           8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 irget interce	V Ca Na Na Na Na Su be So C m. Ni Su be Dept 0+29	Domment D SHI available. D SHI available	D and D and D+055 - letric
Boreholes: Borehole HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55 Tunnels: Lineament and/or seismic indications: Modified after zong	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR(	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric intercept 2           08111.	Itercept           Sec_low           [m]           202.00           45.50           -           -           61.00           -           2.50           17.00           +166 - ?, ge           ercept 0+055           im.	ometric G PROC of the zon 1 - - - - - - - - - - - - -	Geometric           _up [m]           83.31           29.64           1.28           1.92           0.00           0.79           43.88           0.00           0.00           8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+10 irget interce	V Ca Na Na Na Na Su be ZF S6 m. Nl Spt 0+29	omment SHI available. SHI av	D and D and
Boreholes: Borehole HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55 Tunnels: Lineament and/or seismic indications: Modified after zone the magnetic linearmain central section	PDZ DZ3 DZ1 DZ3 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR ment MSFR	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric intercept 2           0.00111           0.00111           0.00111	htercept Sec_low [m] 202.00 45.50 - - - 61.00 - 2.50 17.00 +166 - ?, ge ercept 0+055 m. <b>MODELLIN</b> he position c odel version e pier in an	ometric i - 0+055	Geometric          up [m]           83.31           29.64           1.28           1.92           0.00           0.79           43.88           0.00           0.00           8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 trget interce	Ca     Na     Na     Na     Na     Na     Na     Na     Na     Na     Su     Su	omment SHI available. SHI av	0 and 0 and 0 to 55 - tetric 1 des with . The sament
Boreholes: Borehole HFR101 KFR104 KFR113 KFR114 KFR115 KFR116 KFR13 KFR53 KFR54 KFR55 Tunnels: Lineament and/ou seismic indications: Modified after zone the magnetic linea main central sectio interpretation. Inte	PDZ DZ3 DZ1 DZ1 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR ment MSFR	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric interpt 0+295 - 0+315           08111.	Itercept           Sec_low           [m]           202.00           45.50           -           -           61.00           -           61.00           -           61.00           -           61.00           -           61.00           -           61.00           -           61.00           -           61.00           -           61.00           -           -           61.00           -           -           61.00           -           2.50           17.00           +166 - ?, ge           ercept 0+055           m.           MODELLIN           he position codel version           podel version           epier in an a           and obsenversion	G PROO ometric - 0+059 G PROO of the zon 1.0, itsel area whe d in tures	Geometric           _up [m]           83.31           29.64           1.28           1.28           1.92           0.00           0.79           43.88           0.00           0.00           8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 inget interce	Comparison of the second	Domment D SHI available. D S	D and D and
Boreholes:           Borehole           HFR101           KFR104           KFR113           KFR114           KFR115           KFR116           KFR13           KFR53           KFR54           KFR55           Tunnels:           Modified after zone           the magnetic linea           main central sectio           interpretation. Inte           Appendix 2 (Curtic	PDZ DZ3 DZ1 DZ3 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR e 12 (Carlss: ment MSFR e 12 (Carlss: ment MSFR on of the zon rcepted by n rcepted by n	Target in           Sec_up [m]           190.00           30.00           -           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric interpt 0+295 - 0+315           08111.	Itercept           Sec_low           [m]           202.00           45.50           -           -           61.00           -           2.50           17.00           +166 - ?, ge           ercept 0+055           m.           MODELLIN           he position codel version           e pier in an a           and observe           059 target in	G PROO f the zon 1 2 3 3 4 5 4 5 4 5 4 5 5 5 5 5 5 5 5 5 5 5 5 5	Geometric           _up [m]           83.31           29.64           1.28           1.92           0.00           0.79           43.88           0.00           0.00           0.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 irget interce	Comparison of the second	omment SHI available. SHI av	) and ) and ) and ) etric 1 des with . The eament ed
Boreholes:           Borehole         HFR101           HFR101         KFR104           KFR113         KFR114           KFR114         KFR115           KFR115         KFR116           KFR13         KFR53           KFR53         KFR54           KFR55         KFR55           Tunnels:         Modified after zonative magnetic linear main central section interpretation. I	PDZ DZ3 DZ1 DZ3 DZ1 DZ2 BT/ST 0+059 interce r MSFR e 12 (Carlss ment MSFR on of the zon rcepted by n s et al. 2011) arlier interpr	Target in           Sec_up [m]           190.00           30.00           -           -           -           47.50           -           0.00           8.00           target intercept 1           m, geometric interpt 0+295 - 0+315           08111.           on et al. 1985). Th           08111 in SFR modeling beneath the nultiple borhostor.           NBT: 0+055-0+4           et das zone 12+4	Itercept           Sec_low           [m]           202.00           45.50           -           -           61.00           -           2.50           17.00           +166 - ?, ge           ercept 0+055           m.           MODELLIN           he position codel version           e pier in an a           and observe           059 target in           059 target in	G PROC f the zon 1.0, itsel area whe d in turn tercept te et al 10 20 20 20 20 20 20 20 20 20 2	Geometric          up [m]           83.31           29.64           1.28           1.28           1.92           0.00           0.79           43.88           0.00           0.00           8.36	intercept Sec_lov [m] 203.33 46.12 2.40 2.20 1.65 2.59 76.60 5.64 7.32 17.20 +130 - 1+16 urget interce	Contract of the second se	D SHI available.	D and D and D+055 - letric 1 des with . The sament ed



Category	Object CL	Comment
INTERPRETATION		
Data source	3	MFM3118G, HFR101, KFR13, KFR53, KFR54, KFR55,KFR104, KFR113, KFR114, KFR115, KFR116, tDZ73, BT/ST, NBT
Results of interpretation	3	High confidence observation in KFR54 and KFR55 and tunnel observations.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	2	Two clusters and the lineament considered as an outlier.
INTERPOLATION		
Geometry	3	One strong alternative based on fracture mineralogy in multiple boreholes.
Geological indicators	3	Interpolation supported by mineral fillings within fractures from boreholes and tunnels.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. points. Strike length of the modelled zone < 2000 m.
Strike direction	2	Partly or no support by surface lineament. Supported by geological concept and subsurface observation points.





	NE			Ζ	Έ	MNE	311	8	Ve	ersion number	4	Total o	bject CL	21
KFR11	3 (1.2	8-2.4 m	)						1		1			1
No dat	a avail	able	/											
KFR11	4 (1.9	2-2.2 m	)											
No dat	a avail	able	/											
KFR11		-1 65 m	<b>.</b>											
No dat		-1.03 II	9											
	a avail		<b>m</b> )											
NERI	0 (0.7	9-2.59	n)											
No dat	a avail	able												
KFR13	3 DZ3 (	47.5-61	.0 m)											
	m.a.s.l.									100 = 0 Fra	cture	Fracture	Open	
(m)	(m, RH2000)	Open fractures	Sealed	Open fracti	otal	Sealed total fractures	Total fractures	zone	network	= high value orie	n frac ntation	sealed frac orientation	aperture (mm)	loss
		0 20	0 2	0 0	20	0 20	0 20			0 100 0	90 0	90	0 10	
48	-171 -		1223	1	10	1	2.2.2			L			2-1-1-6	1
49	-172 -													
50	-173 -									81.0				
51	-174 -					-	-			82.0				
52	-175 -									92.0				
53	-176									79.0				
54	-177									81.0				
55	-178 -					the second second	-			85.0				
56	-179 -						-			96.0				
57	-180						· · · · ·			75.0				
58	-181									28.0				
59	-182 -					-				31.0				
60	-183 -						- C			57.0				
	-184			1										
KFR53	3 (0.0-	5.64 m)												
No dat	a avail	able												
KFR54	4 DZ1 (	0.0-2.5	m)											
	Elevation m.a.s.l.									RQD reversed 100 = 0 Fra	cture	Fracture	Onen	
Length (m)	(m, 8H20001	Open	Sealed	Open	otal	Sealed total	Total	Crushed	Sealed	low value ope	n frac	sealed frac	aperture	Core
Carl		mactures	nacture	. nacu	an	nactures	nactures		- constate	a log o	itation on a	onentation	()	
-	-	0 20	0 2	) 0 ) 0	20	0 20	0 20		-	0 100 0	90.0	90	0 10	-
1 -										at the second				
2			_			-	-			14.5				
KEDE		0.0.47	1		_	10000 B			-					
KFR55	5 DZ2 (	8.0-17.0	J m)											
	m.a.s.l.							1	Same?	100 = 0 Fra	cture	Fracture	Open	100
Length (m)	(m, RH2000)	Open fractures	Sealed fracture	Open fracti	otal	Sealed total fractures	Total fractures	Crushed zone	Sealed	= high value ope	n frac ntation	sealed frac orientation	aperture (mm)	loss
		0 20	0 2	0	20	0 20	0 20			0 100 0	90.0	90	0 10	
	1	5 20	1 2 2 5	1	LU	20	5 20			100 0	30.0			1
9										21.0				- 11
10							1000			7.0				
11										60.0				
12	1					57	57			58.0				
13										31.5				
14							_			38.0				
15							13 mars			30.0				
						26	26	[]		6.0				

NE	ZFMNE31	34	Version number	4	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	165	000 170000	
Deformation style:	Brittle	2 2				0
Deformation	No data available.	2	1000		~	0001
description:			6	T	1 mm	671
Alteration:				Y	112	-
- First order:	Not observed	_	8 2		1 2	1 8
- Second order:	Not observed	-	Juny 68	1	(MD)	050
Fracture orientation and	No data available		is Real		HU / S	67
type:			211		AAA Z	
Fracture comment:	No data available.	-	8	XX	VIIA 3	00
Fracture fill mineralogy:	No data available.		202		Alls	7000
OBJE	CT GEOMETRY		° ×		V V	0
Strike/dip:	43°/90°			A		
Length:	373 m		8	X	AX/	000
Mean thickness:	5 m (1 - 13 m)		0002	A.	X	695(
Geometrical	-570 III ZEM\//\/\/0835_ZEM\//\/	W/1035	°	NV	A second	9
constraints:	Topo 40m grid Max error	20m.			1 To make	
	ZFMWNW0001, 1 Surfac	e Planar	8	$\boldsymbol{\times}$	hand	000
	Cut(s).		000	$\sim$ /		1069
			°	$\langle \rangle$		0
						20.5-0
			155000 160000	165	000 170000	N
			Model volume DMS     Baseline		0 2 4 8	Â
	DA0				a Cancernational Constrained Sciences	
Zana hazad an aurfaga lina	BASI	IS FOR MOL	DELLING			
Zone based on sunace line	aments.					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MSFR10005_MSFR1001	1.				_
seismic indications:						1
	MODE	LLING PRO	CEDURE			
The position of the zone at	the ground surface is based	d on a linking	of lineaments MSFF	R10005 ai	nd MSFR10011 defi	ned by
2007) The zone modelled	R model version 1.0, earlier	represented	by MFM3134G In Fo	orsmark s	tage 2.3 (Isaksson e	et al.
2007). The zone modelled	inickness and vertical dip a		ues.			
			~ 5			
Ren Kenn	RERIOZO					
130	102A KERIOI					
FR32 90	KERIOL CEMAN	SFMN		X		
		305	V08050			
	Files	<b>VB</b>				
R						
Kenne A	KERI	ZFMWNW:	3262			
	- Change - C					
	WW8042	KFR10b				
KERIU			7Etalana			
1	MENE3139		111111110835	-		
KFR1	0° ZEW N					
S		-				
<u>S</u>	iii iii	-FMWNW32R-				
	2					
	S					
		/WNW3268	N			
			in the second se			
0 100 200	300 500 m	ZFMWNWO	001			

NE	ZF	MNE31	34	Version number	4	Total object CL	10				
OBJECT CONFIDENCE ES	STIMATE			• •		•					
			-								
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM31340	3							
Results of interpretation	า	1	Low confide	ence in lineament M	FM31340	).					
INFORMATION DENSITY	<i>,</i>										
Number of observation	points	1	1								
Distribution of observat	ion points	1	Single obse	ervation point in the	form of a	lineament.					
INTERPOLATION											
Geometry		1	Geometry s	supported by a linea	ment and	a single intercept.					
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		1	No subsurfa uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	y by surface data. Hi of the modelled zon	gh e <				
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
		FRA	CTURE CHA	RACTER							
			No data avail	able							
INDIVIDUAL INTERCEPTS											
			No data avail	able							

NE		ZFMNE	3137		Version	number	8	Total object CL	20
GEC	DLOGICAL CH	IARACTER	Pro	operty	155000	160000	) 16	5000 170000	
Deformation st	vle: Brittle			<u>८८</u> २					
Deformation	No data	a available.		5	1000		_	~	1000
description:					67	5	T	1 mm	671
Alteration:					100	$\sim$	X	11/2	
- First order:	Oxidati	on		3	8	25	1-	NH 13	4 8
- Second order	Not obs	served			7050	w	1 - 1	1 1 KX	0200
Fracture	Fractur	e dominated by	NE		3	1	1	THU S	67
orientation and	striking	set followed by	NNW		2	11		ALLA NE	1
type:	set. Oc	currence of seal	ed and		80		X		5 00
	open fr	actures.			0025	1175		VAL V	1002
Fracture comm	ent: Fractur	e apertures 0.5	mm or			LAR	An	XX Y	U
Fracture fill	Predon	ninant minerals i	n			XIM	SP	NY	
mineralogy:	sealed	and open fractu	res are		2000	1 pc	X		2000
	laumon	itite, adularia, ca	lcite		669		A	XI	699
	and ch	lorite. Predomina	ant		1	1	We Y		
	minera	is in sealed fract ks are adularia	ure		0 ><	/		1 January	
	laumon	itite, chlorite and			0000	6.1	$\checkmark$	win	0000
	calcite.				666		1		665
	OBJECT	GEOMETRY							20.54
Strike/dip:	231°/90	)°			155000	160000	16	5000 170000	
Length: Moon thicknose	659 m	26 m)			Model v	volume DMS		0 2 4 8	Å
Max depth:	-860 m	- 30 m)			Baselin	c		d Caldenberrd, Geldabiograwikes	~
Geometrical	ZFMW	NW1035, ZFMN	NW1034,						
constraints:	ZFMNV	V0805B, Topo 4	0m grid Max e	error					
	20m, Z	FMWNW0001, 1	Surface Plar	nar					
	Cut(s).								
Zone based on s	surface lineam	ents and boreho	le observatior						
			0.000.000.000.000						
Outcrops:	-								
Boreholes:									
		Target i	ntercept	(	Geometric	: intercep	t		
Borehole	PDZ	Sec. up [m]	Sec_low	Sec	ւ սո [m]	Sec_lo	ow C	omment	
			[m]	000	-up [iii]	[m]	_		
KFR102A	DZ1	149.00	161.00	1	47.82	160.8	6		
KFR102D	 DZ4	382.00	387.00	3	81.06	388.6	5		
		002.00	001100			00010	T	here is no SHI DZ	
							ir	terpreted in the pos	sition
							0	the target intercept	t in
							K	FR105. However, th	ne
							n	iodelled geometry	nt in
							S S S S S S S S S S S S S S S S S S S	FR105 with a section	on of
							C	ore that coincides w	vith an
							ir	terval of increased	
KFR105		191.00	205.00	2	03 95	209.6	9 fr	equency of steeply	
i i i i i i i i i i i i i i i i i i i		101.00	200.00	_	.00.00	200.0	ď	pping fractures that	t strike
							N	E at 191 to 193 m le	ength.
							a	ong with NF-striking	a
							c	rush at 202.7–203.8	and
							2	04.2–204.8 m with p	piece
							le	ngths of 30 additio	n, two
							N	E-striking sealed	
							n n	εινοικs aι 205.0−2ι I	5.05
		1		<u> </u>					]
Tunnels:	-								
Lineament and/	or MSFR1	10004.							
seismic									1
maications.									

NE ZFI	<b>MNE313</b>	37	Version number	8	Total object CL	20				
MODELLING PROCEDURE				1						
The position of the zone at the ground si.e. modified lineament MFM3137G in F magnetic area below the pier allowing of profile 40 (see Appendix 6) supports th KFR102B 109-114 m (DZ2), KFR104 3	surface is base orsmark stage correlation with e modelled vert 82-387 m and	d on the magr 2.3 (Isaksson new borehole tical dip of the KFR105 191-2	etic lineament MSF et al. 2007), with ar information. Forwar zone. Zone intercep 205 m.	R10004 in extension d modellin oted by KF	n SFR model version in through the distur ing of magnetic data R102A 149-161 m	n 1.0, rbed a along (DZ1),				
KTK 1025 119-114 m (DZ2), KTK 1104 382-387 m and KTK 105 191-205 m.										
	OBJECT	CONFIDENCE	EESTIMATE							
Category	Object CL	Comment								
INTERPRETATION										
Data source	2	MSFR10004	, KFR1012A, KFR1	02B, KFR	104, KFR105					
Results of interpretation	3	High confide	nce observation in I	KFR102B	and KFR104.					
INFORMATION DENSITY										
Number of observation points	3	>4								
Distribution of observation points	3	Cluster of bo	prehole intersections	and a line	eament as an outlie	er.				
INTERPOLATION										
Geometry	2	One strona i	nterpolation alternat	ive.						
Geological indicators	3	Interpolation boreholes.	supported by miner	al fillings	within fractures fror	n				
EXTRAPOLATION										
Dip direction	2	Extrapolation Strike length	n in dip direction sup of the modelled zo	ported by ne < <u>200</u> 0	subsurface obs. po m.	oint.				
Strike direction	2	Partly support concept and	rt by surface lineam subsurface observa	ent. Supp ation point	orted by geological s.					







NE	ZFMNE32	66	Version number	8	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	165	5000 170000	
Deformation style:	Brittle	2				0
Deformation	No data available	2	000		~	0000
description:	No data avaliable.		5 671	. F	TT	671
Alteration:			{	V	1 The	
- First order:	Not observed		$\sim$		1 W Y	-
- Second order:	Not observed	-	000	-1	/ // / s	2 000
- Third order:	Not observed	_	202			7051
Fracture orientation and	No data available.		° R	~/	THIN 3	9
type:			7 1		ALLA	
Fracture comment:	No data available.		8	A V	$\sqrt{1}$	00
Fracture fill mineralogy:	No data available.		82		AV/ VS	000
OBJE	CT GEOMETRY	•	67		HIV	67
Strike/dip:	36°/90°			28.IV	NX/	
Length:	497 m		· / / //	A	AV7	0
Mean thickness:	10 m (1 - 13 m)		1 1 200	Mrs .	NY	500
Max depth:	-500 m		699	211	XI	699
Geometrical	ZFMNW0805A, ZFMNS3	154, Topo		AN	As more	
constraints:	40m grid Max error 20m,	- , -1 -			Z Z man	
	ZFMNW0997, 1 Surface	Planar		X	how	000
	Cut(s).		059	~ \		1069
			9			Ö
			1			20.9-0
			155000 160000	165	000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		in California (California California)	N
	BASI	IS FOR MOD	ELLING			
Zone based on surface line	aments.					
Outcrops:	-					
Boreholes: -	•					
Tunnels:	-					
Lineament and/or	MFM3266G.					1
seismic indications:						
	MODE	ELLING PRC	CEDURE			
The position of the zone at	the ground surface is based	d on the mag	netic lineament MFN	13266G ir	n Forsmark stage 2.	3
(Isaksson et al. 2007). The	re has been a very minor up	odate resultir	g in lineament MSF	R08009 ir	the SFR model ver	rsion 1.0
interpretation. The stage 2.	3 number has been maintai	ined to aid tra	aceability between di	fferent ve	rsions of the lineam	ient
interpretation.						
		1				
						-
			$\sim$	<u>د</u>		6
				۱.		
					S /	
	<fm< th=""><th>A</th><th></th><th><math>\sim</math></th><th>S /</th><th></th></fm<>	A		$\sim$	S /	
		WNE32				
	ZFn.	<6 <sub>4</sub>				
	WINNE-					
		265				
	< 7.					
-1	MNA				- OST	
N0991	532				MOS	P
TEMMU	<6	6			STAR A	
			F	1		
			13			1
	75.000		ENEST			-
	ZFMNS315	4	ENE3151			4
0 100 200	ZFMNS315	4	ENE3151		XX	-
0 100 200	<b>ZFMNS315</b> 300 500 m	4	ENE3151			

NE	ZF	MNE32	266	Version number	8	Total object CL	10
OBJECT CONFIDENCE ES	STIMATE			• •		• •	
		-	-				
Category		Object CL	Comment				
INTERPRETATION							
Data source		1	MSFR0800	9			
Results of interpretation	า	1	Low confide	ence in lineament M	SFR0800	)9.	
INFORMATION DENSITY	,						
Number of observation	points	1	1				
Distribution of observat	ion points	1	Single obse	ervation point in the f	form of a	lineament.	
INTERPOLATION							
Geometry		1	Geometry s	supported by surface	geophys	sical data.	
Geological indicators		1	Indirect sup	port by geophysical	data.		
EXTRAPOLATION							
Dip direction		1	No subsurfa uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	y by surface data. Hi of the modelled zon	gh e <
Strike direction 3 Conceptual understanding of the site and that the entire n zone is supported by the lineament.						d that the entire mod	elled
		FRA	CTURE CHA	RACTER			
			No data avai	able			
INDIVIDUAL INTERCEPTS							
			No data avail	able			

GEOLOGICAL CHARACTER     Property CL       Deformation style:     No data available       Communication and description:     Not data available.       - First order:     Not observed       - Third order:     Not observed       Fracture orientation and Was depth:     -2100 m       OBJECT GEOMETRY     -215780*       Length:     -2100 m       Besits FOR MODELLING       Cone based on surface lineament.       Outcops:       Boreholes: -       Tunnels:       -       -       -       -       -       Boreholes: -       Tunnels:       -       -       -       -       -       Object of meanent and/or selsmic indications:	NE	ZFMNE35	42	Version number	<b>4</b> <sup>T</sup>	otal object CL	9
Deformation style:       No data available         Deformation:       No data available         description:       No data available         - First order:       Not observed         - First order:       Not data available.         Fracture comment:       No data available.         Fracture fill mineralogy:       No data available.         Fracture comment:       No data available.         Fracture fill mineralogy:       No data available.         Fracture comment:       No data available.         Basis For MoDELLING       Image:         Zone based on surface lineament.       Outcrops:         Immediations:       Immediate fill immediat	GEOLOGICAL	CHARACTER	Property CL	155000 160000	165000	170000	
Deformation       No data available.         description:       Not observed         - First order:       Not observed         - Second order:       Not observed         - Third order:       Not observed         Fracture crientation and Mean thickness:       No data available.         Fracture fill mineralogy:       No data available.         Fracture fill mineralogy:       No data available.         Fracture fill mineralogy:       No data available.         Beforement:       2100 m         Geometrical       ZFW/W0016. Topo 40m grid Max         constraints:       error 20m, 2 Surface Planar Cut(s).         Basis FOR MODELLING         Zone based on surface lineament.         Outcrops:       -         Tunnels:       -         Lineament and/or selsmic indications:       MFM3542.         selsmic indications:       -         Outcrops:       -         Controps:       -         Outcrops:       -         Controps:       <	Deformation style:	No data available		g			0
description: - First order: - Not observed - Third order: - Not observed - Third order: - Not observed - Third order: - Third order: - Not observed - Third order: - Not observed - Not observed	Deformation	No data available.		1000	~~~~		1000
Alteration:       Image: Prist order:       Not observed         - Strict offer:       Not observed         - Third order:       Not observed         Fracture orientation and No data available.       Image: Proceeding of the served of the s	description:			2 00	TT.	1 mm	67
First order: Not observed          - First order:       Not observed         - Third order:       Not data available.         Fracture order:       Not data available.         Fracture fill mineralogy:       No data available.         Generical       ZFNIW0016. Topo 40m grid Max         constraints:       error 20m, 2 Surface Planar Cut(s).         Basis FOR MODELLING       -         Zone based on surface lineament.       -         Outcrops:       -         Illneament and/or seismic indications:       MFM3542.         eismic indications:       MFM3542.         eismic indications:       -         ModelLino ProceDURE       -	Alteration:			_ {	$\langle \rangle$	1 1 2	-
- Second order: Not observed - Third order: Not observed -	- First order:	Not observed		· ·		212	
Third order: Not observed how data available.     Tracture orientation and No data available.     Tracture comment: No data available.     Fracture comment: No data available.     Fracture comment: No data available.     Trike/dip: deformerry     Strike/dip:	- Second order:	Not observed		- ~ 200	V	NH	2000
Fracture orientation and Mo data available. Fracture comment: No data available. Fracture fill mineralogy: No data available. Fracture fill mineralogy: No data available. Fracture fill mineralogy: No data available. Mean thickness: 300 (t5: 64 m) Mean thickness: 100 m Geometrical constraints: 27MNVV0016, Topo 40m grid Max error 20m, 2 Surface Planar Cut(s). BASIS FOR MODELLING Zone based on surface lineament. Outcrops: B Boreholes: - Tunnels: . Lineament and/or selsmit indications: 2 MODELLING PROCEDURE - Constraints:	- Third order:	Not observed		670	A	IN IN	670
Fracture comment:       No data available:         Fracture fill mineralogy:       No data available:         OBJECT GEOMETRY         Strike/dip:       2157/80°         Length:       4545 m         Max depth:       2100 m         Geometrical       ZFMWW0016, Topo 40m grid Max         constraints:       Error 20m, 2 Surface Planar Cut(s).         BASIS FOR MODELLING         Zone based on surface lineament.         Outcrops:         Tunnels:         -         Tunnels:         -         MODELLING PROCEDURE	Fracture orientation and type:	No data available.		112	KA	ALL Se	014
Fracture fill minoratogy:       No data available.         OBJECT GEOMETRY         Strike/dip:       2157/80°         Length:       4545 m         Mean thickness:       30 m (15 - 64 m)         Max depth:       -2100 m         Geometrical       ZFMNW0016, Topo 40m grid Max error 20m, 2 Surface Planar Cut(s).         Basis FOR MODELLING         Zone based on surface lineament.         Outcrops:         Boreholes: -         Tunnels:         Lineament and/or seismic indications:         MODELLING PROCEDURE	Fracture comment:	No data available.		8 { }	D-Y-	11/1	00
OBJECT GEOMETRY         Birike/dip:         Length:       215/80°         Length:       30 m (15 - 64 m)         Max depti:       2100 m         Geometrical       ZFMWW0016, Topo 40m grid Max         constraints:       2FMWW0016, Topo 40m grid Max         error 20m, 2 Surface Planar Cut(s).       90 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Fracture fill mineralogy:	No data available.		200		KU/ J	000.
Strike/dip:       215/90°         Length:       4545 m         Mean thickness:       30 m (15 - 64 m)         Max depth:       -2100 m         Geometrical constraints:       ZFMMW0016, Topo 40m grid Max error 20m, 2 Surface Planar Cut(s).         BASIS FOR MODELLING         Zone based on surface lineament.         Outcrops:         Boreholes: -         Tunnels:         Lineament and/or seismic indications:         Memory and the state of the sta	OBJE	CT GEOMETRY		o d	So th	XIV	01
Length:       4545 m         Mean thickness:       30 m (15 - 64 m)         Max depth:       -2100 m         Coonstraints:       27MINW0016, Topo 40m grid Max         error 20m, 2 Surface Planar Cut(s).       9         9       9 <th>Strike/dip:</th> <th>215°/80°</th> <th></th> <th></th> <th>AHA</th> <th><math>\sim</math></th> <th>-</th>	Strike/dip:	215°/80°			AHA	$\sim$	-
Max depth:       200 m         Geometrical constraints:       ZFMNW0016, Topo 40m grid Max error 20m, 2 Surface Planar Cut(s).         Basis For MoDELLING         Zone based on surface lineament.         Outcrops:         -         Boreholes: -         Tunnels:         -         Outcrops:         -         Boreholes: -         Tunnels:         -         Outcrops:         -         -         Boreholes: -         Tunnels:         -	Length:	4545 m		8 / / ////	A	X/	9
Max depth:       -2100 m         Geometrical constraints:       ZFMNW0016, Topo 40m grid Max error 20m, 2 Surface Planar Cut(s).         Image: Second Se	Mean thickness:	30 m (15 - 64 m)		1 1 1 1 1 1 1 200	12	17 -	500
Geometrical constraints:       ZFMNW0016, Topo 40m grid Max error 20m, 2 Surface Planar Cut(s).         Image: state of the state of t	Max depth:	-2100 m		666	$\sim 2$		669
constraints: error 20m, 2 Surface Planar Cut(s). BASIS FOR MODELLING Zone based on surface lineament. Outcrops: Boreholes: - Tunnels: Lineament and/or seismic indications: MFM3542. 2 MODELLING PROCEDURE - COUCCOURE - - COUCCOURE - COUCCOURA - COUCCOURA - COUCCOUR	Geometrical	ZFMNW0016, Topo 40m	grid Max		ax	And man	
BASIS FOR MODELLING Zone based on surface lineament. Outcrops: Tunnels: Lineament and/or seismic indications: MFM3542. 2 MODELLING PROCEDURE · () () () () () () () () () ()	constraints:	error 20m, 2 Surface Plan	nar Cut(s).		1	Timeses	1
BASIS FOR MODELLING Understand Dutcrops:   Basis FOR MODELLING Dutcrops:  Boreholes:  Tunels:  Ineament and/or seismic indications:  MFM3542.  2  MODELLING PROCEDURE				660000	~ ~	with	690000
15000 10000 10000 10000 10000         ISSIS FOR MODELLING         Zone based on surface lineament.         Outerops:         Image: Imag							G
Description       BASIS FOR MODELLING       Zone based on surface lineament.       Outcrops:       Boreholes: -       Tunnels:       Lineament and/or seismic indications:       MODELLING PROCEDURE				155000 160000	165000	170000	. 20 50
BASIS FOR MODELLING Zone based on surface lineament. Outcrops: Boreholes: - Tunnels: Lineament and/or seismic indications: MFM3542. 2  MODELLING PROCEDURE -				Model volume DMS     Baseline		0 2 4 8	Ă
Zone based on surface lineament. Outcrops: Boreholes: - Tunnels: Lineament and/or seismic indications: MODELLING PROCEDURE - - - - - - - - - - - - -		BASI	IS FOR MOD	FLUNG			
Outcrops: - Boreholes: - Tunnels: - Lineament and/or seismic indications: MFM3542. 2 • • • • • • • • •	Zone based on surface line	ament					
Outcrops: - Boreholes: - Tunnels: - Lineament and/or seismic indications: MFM3542. 2 MODELLING PROCEDURE - -							
Boreholes: - Tunnels: Lineament and/or seismic indications: MODELLING PROCEDURE -	Outcrops:	-					
Tunnels:     -       Lineament and/or seismic indications:     MFM3542.       MODELLING PROCEDURE	Boreholes: -						
Lineament and/or seismic indications: MFM3542. 2 MODELLING PROCEDURE -	Tunnels:	-					
seismic indications: MODELLING PROCEDURE - - - - - - - - - - - - -	Lineament and/or	MFM3542.					0
-	seismic indications:						2
-		MODE	ELLING PRC	CEDURE			
Envirences Envire	-						
1 00 20 300 200m 1 km 2 km		17 MM/ME3546A	ZEMME			فر ا د د ک	

NE	ZF	MNE35	542	Version number	4	Total object CL	9				
OBJECT CONFIDENCE ES	STIMATE			•							
			_								
Category		Object CL	Comment	Comment							
INTERPRETATION											
Data source		1	MFM3542								
Results of interpretation	า	2	Medium co	nfidence in lineamer	nt MFM35	42.					
INFORMATION DENSITY	r										
Number of observation	points	1	1								
Distribution of observat	ion points	1	Single obse	ervation point in the	form of a	lineament.					
INTERPOLATION											
Geometry		1	Geometry s	supported by surface	e geophys	ical data.					
Geological indicators		1	Indirect sup	port by geophysical	data.						
EXTRAPOLATION											
Dip direction		1	No subsurfa uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	/ by surface data. His of the modelled zone	gh e <				
Strike direction 1 Conceptual understanding of the site and that the entire region modelled zone is supported by the lineament.						onal					
FRACTURE CHARACTER											
			No data avai	lable							
INDIVIDUAL INTERCEPTS											
			No data avai	lable							

NNE		ZFMNN	25		Version	number	6	Total object CL	16	
GEOL	OGICAL CH	ARACTER		Prop Cl	erty	155000	160000	1	165000 170000	
Deformation style Deformation description:	e: Brittle Steeply ENE ar charact displac variable Dextral domina fault wi and cal slip cor steeply	r dipping faults w ad ESE strike erised by obliqu ement with stron e strike slip comp strike-slip comp nt on a steeply of th NW strike (ch cite). Sinistral st nponent domina dipping fault wit	vith e slip ng, yet ponent. oonent dipping lorite rike- nt on a .h	3		670000 6705000 6710000	2 and a second	212		6700000 6705000 5710000
Alteration:	dipping hlorite			6695000				6695000		
- First order: - Second order:	Oxidati Quartz	on dissolution		3		0000055		$\checkmark$	The second	000065
Fracture orientation and type:	Steeply strike S dipping steeply ESE or present fracture estimat	or dipping fracture SW dominates. fractures as we dipping fracture NW strike are a t. Dominance of es. Quantitative e and span inclu	es that Gently II as es with Ilso sealed ude	2		155000	160000 volume DMS e	1	65000 170000	м. м. м. М.
Fracture commer	sealed nt: No data	fracture network a available.	S.							
Fracture fill mineralogy:	Chlorite hematit	e, calcite, quartz, e/adularia, laum GEOMETRY	, iontite.							
Strike/dip: Length: Mean thickness: Max depth: Geometrical constraints:	201°/83 1913 m 12 m (3 -1900 n Topo 4 ZFMW	8 - 50 m) n 0 grid Max erro 0 W0001, 1 Surfa	or 20m, ace Plana	ar Cut(s	5).					
Zone based on su	rface linearn	ants and borehol	BASIS	FOR I	MODE	ELLING				
Outcrops:	<u>-</u>									
Boreholes:										
Borehole	PDZ	Target in Sec_up [m]	ntercept Sec_ [m	low ]	Sec	Geometric _up [m]	intercept Sec_lo [m]	t ow	Comment	
Tunnels: Lineament and/or seismic indications:	r MFM07	/25G.	MODEL	LING	PROC	CEDURE		·		2
At the surface, correction estimated by connict zone plane placed 773 m).	responds to ecting linean at fixed poin	the low magnetic nent MFM0725G it 770 m in KFM0	c lineame with the 06A. This	ent MFN boreho point i	M072 ble int s also	5G. Modell ersection situated a	ed down to 740-775 m along an in	o 1250 i in KFN iterval c	m depth, using the 106A (DZ7). Deform of low radar amplitud	dip lation le (768-

NNE	ZFN	INNE07	25 Version number 6 Total object CL 16							
	ANNE2280 ZFMNNE2280 ZFMNNE2285 ZFMNNE2008 ZFMNNE2008 ZFMNNE2008 ZFMNNE2008									
		OBJECT								
		Object CL	Comment							
Data source		2	MEM0725G. KEM06A							
Results of interpre	etation	3	High confidence observation in KFM06A.							
INFORMATION DEI	NSITY									
Number of observ	ation points	2	2							
Distribution of obs	servation points	1	Single observation point at depth.							
Geometry			Projected surface length c. 2000 m. and with a blind and in SW							
Geometry		2	direction within ZEMNE2282							
Geological indicat	ors	1	Indirect support by geophysical data.							
EXTRAPOLATION										
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.							
		2	Strike length of the modelled zone < 2000 m.							
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.							
		FRAG	CTURE CHARACTER							
Orientation:	Set SSW: 213.9	°/87.6°	ZFMNNE0725							
(strike/dip right-	Set G: 18.7%20.	5°	N							
Frequency:	Boreholes: KEM	106A	-							
	2010110100114									
	FRACTURE	TERZAGHI-								
	TYPE	WEIGHED								
	Open and	<u>P10</u>								
	partly open	4.111-1								
	Sealed	14.3 m-1								
	Sealed	3.6 % of DZ	W-							
	network	intercept								
	Crush	1.6 % of DZ								
		intercept								
			Unassigned (121) Set SSW (140) Mean pole Set SSW (112 pt/2 d) Sicher # = 40 E							
			<ul> <li>Set G (38) ▲ Mean pole Set G (288.7/69.5) Fisher K = 9.6</li> </ul>							
ROD.	min.16 max.10	) mean 95								





NNE	ZFMNNE08	328	Version number	6	Total object CL	11
GEOLOGICAL	CHARACTER	Property CI	155000 160000	) 16	5000 170000	
Deformation style:	Brittle	1	9			0
Deformation	No data available.	•	000		~	000
description:			2		The series	671
Alteration:			{	V		
- First order:	Oxidation		5	/	1212	
- Second order:	Not observed	2	2000	-1	MPLO	500
- Third order:	Not observed		670	1	ANN	5705
Fracture orientation	No data available.		Star 1	N	141 5	
and type:			5111	X	AHA VE	
Fracture comment:	No data available.		00	ZAX	8/1/1/5	000
Fracture fill	No data available.		5	XX	VI V	100
mineralogy:				A	V V	G
OBJI				A		
Strike/dip:	208°/80°		00	X	AV.	000
Length: Mean thickness:	10490 m		6950	X		3950
Max donth:			° /	145	A t	0
Geometrical	ZEMN\\//0016_Topo_40m_c	rid May			x Ty	
constraints:	error 20m 7EMNW0854	JIIU Max	8		had men	8
constraints.			005		. We	006
			99			66
			1 de 31			-
			155000 160000	) 165	5000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		S Latinized Grida renewike	N
	BASI	S FOR MOD	ELLING			
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
Turneler						
Tunneis:						
seismic indications:	IVIFIVIU020.					2
	MODE		CEDURE			
At the surface, correspond	s to the low magnetic linear	ent MFM082	28. Modelled to the h	ase of th	e model volume with	a dip of
80 degrees to the WNW ba	ased on comparison with hig	h confidence	e, steeply dipping zo	nes with I	NNE strike.	
Contraction of the second			2 Edwards	ZEMINIE	ZFMINE133	
		2	4	km		\$~**

NNE	NNE ZFMNNE0				6	Total object CL	11				
OBJECT CONFIDENCE E	STIMATE			•		•					
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0828,	MFM2019							
Results of interpretation	n	2	Medium co	nfidence in lineamer	nt MFM08	328 and MFM2019.					
INFORMATION DENSIT	Y										
Number of observation	n points	1	1								
Distribution of observa	tion points	1	Single observation point in the form of lineaments.								
INTERPOLATION											
Geometry		1	Geometry	supported by surface	e geophys	sical data.					
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.								
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
		FRA	CTURE CHA	RACTER							
			No data avai	lable							
INDIVIDUAL INTERCEPT	S										
			No data avai	lable							

NNE	ZFMNNE0860		Version number	3	Total object CL	12		
GEOLOGICAL	CHARACTER	Property CL	155,000 160,000	) 16	5000 170000			
Deformation style:	Brittle	1	Q			9		
Deformation description:	No data available.		671000	5	m m	671000		
Alteration:		_	$\sim$	1	11112			
- First order:	Oxidation	2	8 2		11215	1 8		
- Second order:	Not observed	_	Jun 050	1 1	X M M	0000		
- Third order:	Not observed		6		HIV / S	67		
and type:	No data available.			X	AHA Ne			
Fracture fill	No data available.		5000	6 AX	XIIIS	000		
mineralogy:			ere		WY	670		
Strike/din:	200°/80°		1 K Shike	S.	NY			
Length:	5921 m		1 10000	VX	M	000		
Mean thickness:	35 m (15 - 64 m)		9699	A	XI	9695		
Max depth:	-2100 m			H V	A and	0		
Geometrical	ZEMNNW0806, ZEMNW0	854. Topo			2 To man			
constraints:	40m grid Max error 20m.		eesbooo	$\checkmark$	Went	6690000		
			155000 160000	) 165	5000 170000	20.000		
			Model volume DMS     Baseline		0 2 4 8 Contraction of the second sec	X		
	BASI	IS FOR MOD	ELLING					
Zone based on surface line	eaments.							
Outcrops:	-							
Boreholes: -								
Tunnels:	-							
Lineament and/or seismic indications:	MFM0860.					3		
	MODE	ELLING PRC	CEDURE					
At the surface, correspond degrees to the WNW base	s to the low magnetic linearr d on comparison with high c	nent MFM086 confidence, s	<ol> <li>Modelled to base teeply dipping zones</li> </ol>	of mode	I volume with a dip c E strike.	of 80		
ZFMNNE0860								
2 FMN	E0808A		zFMNNE1132 4 km	1	2			

NNE ZFMNNE0			860	Version number	3	Total object CL	12				
<b>OBJECT CONFIDENCE E</b>	STIMATE										
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0860,	MFM2019							
Results of interpretation	n	3	High confid	dence in lineament N	IFM0860	and MFM2019.					
INFORMATION DENSIT	Y										
Number of observation	n points	1	1								
Distribution of observa	tion points	1	Single observation point in the form of lineaments.								
INTERPOLATION											
Geometry		1	Geometry	supported by surface	e geophys	sical data.					
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.								
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
		FRA	CTURE CHA	RACTER							
	-		No data avai	lable							
INDIVIDUAL INTERCEPT	S										
			No data avai	lable							

NNE		ZFMNN	E0869	Version	number	4	Total object CL 21		
GEOLO	GICAL CH	IARACTER	Prop	perty 155000	160000	) 16	5000 170000		
Deformation style:	Brittle			. <b>L</b> 3 8				0	
Deformation	Cohesi	ve breccias pres	sent in	71000		5	$\sim$	71000	
description:	KFR36	DZ1.		Q	2	S	N MZ	9	
- First order:	Oxidati	on			$\sim$	1	1 LJ L	2	
- Second order:	Not obs	served		2000	and t	-1	MPL	2000	
- Third order:	Not obs	served		670			ANN	670	
Fracture	No data	a available.		5	1.1	H	ATH S	5	
type:				8	P M	AL S		3 8	
Fracture comment:	No data	a available.		2000	VI.X		AL IS	7000	
Fracture fill	Calcite	, hematite and a	dularia,	° /	NE	An	XX Y	9	
mineralogy.	OBJECT	GEOMETRY	·		KOM	S	NY	-	
Strike/dip:	203°/86	5°		95000	1 All	Mes -	VY	95000	
Length:	902 m	20 00 m)		99		11	A to	669	
Mean thickness:	-900 m (2	20 - 60 m)				N	3		
Geometrical	ZFMNV	V0805A, ZFMW	NW1035,	00		$\mathbf{X}$	Word	000	
constraints:	ZFMNV	V0002, Topo 40	m grid Max erro	or 0599		~ \		0690	
	20m, 1	Surrace Planar	Cut(S).	1					
				155000	160000	16	5000 170000	20.00	
				Base	el volume DMS line		0 Z 4 6	Å	
			BASIS FOR	MODELLING					
Zone based on surfa	ce lineame	ents, borehole a	nd tunnel obser	vations.					
Outcrops:	-								
Boreholes:									
Dambala	007	Target i	ntercept	Geometri	ic intercept	t			
Borenoie	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_ic	w C	omment		
KFR09	DZ1	0.00	58.70	0.00	59.54	1			
KFR10	DZ1	-	-	0.00	97.48	Jupping Juppin	adging from the notographs of the di- pres there is a frequ is broken fractures the cally exceeds 10 actures/m along the terval. Oxidation of arying degrees occu- equently throughout terval 0–97 m. Both acture frequency an courrence of oxidatii sembles that for D2 FR09 DZ1 and KFR 1, but is generally s wer and less onspicuous, respect hus, ZFMNNE0869 ell have its intersec is interval, but a spi riget intercept canno	rill lency hat target urs t the on the on 21 in 236 lightly tively. may tion in ecific ot be	
KFR36	DZ1	45.00	115.50	27.84	118.8	5			
KFR68	DZ2	71.59	105.13	43.91	128.0	N as Z Z 3 la da co s f z c ta	ote: KFR68 is interp s intercepting the m bint between FMNNE0869 and FMNE0870. Since t cks fracture orienta ata it is impossible t borrelate the PDZ with becific steeply dippin bone. Thus, the PDZ ken as target inte la	breted eeting he BH tion o h any ng is acks	

NNE			ZFMNN	E0869	Version	number	4	Total object CL	21	
							fr ir P s tt ir Z Z	acture orientation da npossible to correlat DZ with any specific teeply dipping zone. The PDZ is taken as t tercept for both FMNE0870 and FMNE0869.	ata it is e the Thus, arget	
KFR68 Tunnels: Lineament and seismic	[ /or	DZ1 DT targ 0+450 I MSFR0	71.59 ret intercept: 0+4 m, geometric inter 18089.	105.13 130 0+540 m, ge ercept 0+357 0-	43.91 eometric interce +482 m.	128.03 pt 0+430- 0	N a pZZ lad c s z ta fri ir P s ti ir ZZ	ZFMNNE0869. Note: KFR68 is interpreted as intercepting the meeting point between ZFMNE0869 and ZFMNE0870. Since the BH lacks fracture orientation data it is impossible to correlate the PDZ with any specific steeply dipping zone. Thus, the PDZ is taken as target inte lacks fracture orientation data it is impossible to correlate the PDZ with any specific steeply dipping zone. Thus, the PDZ is taken as target intercept for both ZFMNE0870 and ZFMNNE0869. 5 m. BT target intercept: 0+350		
indications:										
This zone corre ZFMNNE0869 i the central secti further to the NI However, adjust at the ground su at ZFMWNW10 earlier models ( accordance with m to 60 m base mapping overvie Axelsson and H reasoning is not (sub-zones) tha seismic refraction generally lie in t al. 2011) sugge	sponds n the F on of t NE to t tments urface 35 and 200/80 n curred d on th ew dra ansen c clear. t diver on prof he ran sts a s	s to zone Forsmark che zone compare d at depth in Steph nt SKB s he results wings, al (1997) d The zon ge and co iles Keisu ge of 400 ub-vertic	3 in earlier SFR stage 2.2 mode at the ground su against ZFMNV ZFMNW0805A I d with that prese at ZFMNW0000 ens et al. (2007 ingle hole interp of the geologica I of which suppo id not include th e is interpreted to onverge in a con u and Isaksson ( 00–5000 m/s. Fo al dip. For furthe	MODELLING a models (see for a Stephens et al urface is based of V0805A based of have resulted in sented in Stephen 2. The orientation b. However, the retation (SHI) b. al SHI from KFR ort an increased e mapped paral to be a composi- nplex pattern As (2004). Two pro- proverd modelling er detail see Cur	PROCEDURE or example Axel (2007) and mo on the linearmen on the reprocess a minor adjusti ns et al. (2007). on 201/86 involv zone thickness ased methodolo (09 and KFR36 modelled thickr llel structures sh te zone consisti kelsson and Har files indicate mi g of magnetic da tis et al. (2011).	sson and H odelled to a t MSFR080 sing and re- ment of the In the SSE ves only a sl has been r bogy. The thic and the ind ness. The ex- nown in the ing of sever nsen (1997) nor low velo ata along pr	ansen 1 depth c 89. The evaluat trace le , the zo ight adj nodifies kness arlier th tunnel r al narro . The zo ocity ano ofile 18	997). It was rename f 1050m. The positi zone has been extr ion of magnetic data ngth of zone ZFMNI ne terminates at the ustment compared or considerably in has been increased as presented on the nner interpretation napping though the wer high-strain segr one is crossed by fo omalies while veloci (see Appendix 6, C	ed on of ∋nded i. NE0869 surface with from 10 e tunnel ments ur ties urtis et	



Category	Object CL	Comment
INTERPRETATION		
Data source	3	MSFR08089, KFR09, KFR10, KFR36, KFR68, intercepts the SFR
	-	
Results of interpretation	3	High confidence observation in KFR09, KFR36 and SFR tunnels.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	0	Cluster of borehole intersections with support from tunnels and a
	2	lineament as an outlier.
INTERPOLATION		
Geometry	3	Geometry supported by multiple subsurface obs. points.
Geological indicators	2	Interpolation supported by mineral fillings within fractures from
	3	boreholes and tunnels.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point.
	2	Strike length of the modelled zone < 2000 m.
Strike direction	2	Partly or no support by surface lineament. Supported by geological
	2	concept and subsurface observation points.

NNE	ZFMNNE086	<b>69</b>	Version number	4	Total object CL	21
FRACTURE CHARAC	CTER					
Orientation: (strike/dip right- hand-rule)						
Frequency:	Boreholes: KFR10, KFR68, KFR36, KFR09					
	FRACTURE TERZAGHI- TYPE WEIGHED P10					
	Open and 8.0 m-1 partly open					
	Sealed         0.0 fm m           Sealed         0.0 % of DZ           network         intercept           Crush         0.9 % of DZ           intercept         intercept					
ROD	min:0 max:94 mean:44					
Fracture fill mineralogy:	1600 - 1400 - 1200 - 800 - 800 - 90 - 200 - 0 - 90 - 90 - 90 - 90 - 90 - 90 - 9	KFR09(0.1	0-58.7), KFR36(45.0-115.	5) St. share as	Open and partiy ope	en

	NNE	-		ZFN	/NNI	E086	<b>59</b>	V	ersion numb	<sup>ber</sup> <b>4</b>	Total c	bject CL	21
-							DUAL IN	TERCE	EPTS				. — -
KFR0	9 DZ1 (	0.0-58.7	m)										
Length (m)	Elevation m.a.s.l. (m, RH2000)	Open fractures	Sealed fractures	Open total fractures	Sealed total fractures	Total fractures	Crushed zone	Sealed network	RQD reversed 100 = 0 low value = high value	Fracture open frac orientation	Fracture sealed frac orientation	Open aperture (mm)	Core loss
1		0 20	0 20	0 20	0 20	0 20			0 100 0	90 0	90	0 10	
1	-	1					1						
2					66	66			47.0				
3	•				57	57	4		55.0				
4	1				34	34			63.5				
5					21	21			48.0				
7	]					- C	5		80.5				
8					37	37			72.0				
9	-78 -				33	33			57.5				
10									50.5				
11					12 M				30.5				
12	-				41	41			82.0				
13	1								36.0				
14						·			28.5				
16						_			37.5				
17									45.0				
18					-				29.0				
19					29	29			79.0				
20	-79 -						1 C		62.0				
21	1				a case			1	46.5				
22					22	22			26.0				
24			R		24	24			52.5				
25					44	50	-		56.0				
26					43	43			29.0				
27						-			14.5				
28	-								16.5				
29					113	113	5		92.0				
30					1.000				43.5				
32	-80 -								20.5				
33									29.0				
34	-				50	50	C.		72.5				
35	1				143	143			88.0				
36	1				143	143			91.0				
37	1				126	133			56.0				
39					50	50			66.5				
40	-			-	28	28	1.1.1	1.1	87.0				
41	-				94	101	-		85.5				
42					100	100			84.0				
43	-81				69	69			54.5				
44	1				55	55			25.5				
45					69	69			45.5				
47					39	39			23.0				
48	-				36	36	2		30.0				
49	1								0.0				
50	1				27	27			27.0				
51	1				141	141			43.0				
52	]				94	94			64.5				
54				1.0	40	40			74.5				
55	-82				34	41			21.0				
56	-				65	65			31.5				
57	1			70	670	740		÷	61.5				
58	1				51	51			61.5				



NNE	ZFMNNE0869	Version number	4	Total object CL	21			
KFR68 DZ2, DZ1 (71.59-105.13 m)								
No data available								

NNE	ZFMNNE0	929	Version number	3	Total object CL	10			
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000				
Deformation style:	Brittle	1	0			0			
Deformation	No data available.		000		m	000			
description:			671	V F	The many	671			
Alteration:				Y	1 1 3				
- First order:	Oxidation	2	0 2	_ \	V 12				
- Second order:	Not observed	2	~~ 200		AND	1000			
- Third order:	Not observed		20		ANY	67(			
and type:	No data avallable.		2	V	AAA Va				
Fracture comment:	No data available.	-	0000	20X	$\mathbb{X}$	000			
Fracture fill mineralogy:	No data available.		6700		MAN V	6700			
OBJ	ECT GEOMETRY	<u> </u>		2AU					
Strike/dip:	195°/80°			X	4/7	0			
Length:	5199 m		996-200	1/2	VY	500			
Mean thickness:	35 m (15 - 64 m)		66	214		669			
Max depth:	-2100 m			10X	- And some				
Geometrical	ZFMNNW0806, ZFMWNW	/0853,			L J haven	0			
constraints:	Topo 40m grid Max error 2	20m.	DOÓE	$\bigvee$	w	0006			
			666			666			
			1. 1. 1. 1						
			155000 160000	) 16	5000 170000	2051			
			Model volume DMS		0 2 4 8	Ň			
			Baseline		d Lastinities Cardinities were	~			
Zono boood on ourfood line	BASI	S FOR MOL	DELLING						
Zone based on surface line	eaments.								
Outcrops:	-								
Boreholes: -									
Tourselas									
Lincoment and/or	- MEM0020								
seismic indications:	MFW0929.					1			
	MODE	LLING PRO	CEDURE						
At the surface, correspond	s to the low magnetic linear	nent MFM092	29. Modelled to the b	ase of th	e model volume with	n a dip of			
80 degrees to the WINW ba	ased on comparison with hig	n confidence	e, steeply alpping zo	nes with	NINE STIKE.	_			
° 0 🗁			-		ZPMNE0042				
• • • • • • • •			EMNERA						
	· / · / ·	Leonn	Erwan						
		5	active as a set to the set of the						
					MUNE 1132				
2 0 0	50								
	~								
			- 1929						
			EMNNE			1133			
	: m		Tru						
6				-		and the second se			
20									
<b>%</b>									
	5				ZE MINHEIT 34	in the second			
	Sowing	-		-					
	R.								
0 1	2		4 km						
						1			
NNE	ZF	MNNE0	929	Version number	3	Total object CL	10		
----------------------------	-----------------------	------------	---	----------------------	-----------	-----------------	-------------	--	--
<b>OBJECT CONFIDENCE E</b>	STIMATE					•			
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0929						
Results of interpretation	n	1	Low confid	ence in lineament M	FM0929.				
INFORMATION DENSIT	Y								
Number of observation	1	1							
Distribution of observa	1	Single obs	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry	supported by surface	e geophys	sical data.			
Geological indicators		1	Indirect su	oport by geophysical	data.				
EXTRAPOLATION									
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone - 2000 m.				igh ie <		
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.						
FRACTURE CHARACTER									
	No data available								
INDIVIDUAL INTERCEPT	INDIVIDUAL INTERCEPTS								
			No data avai	lable					

NNE	ZFMNNE1 <sup>2</sup>	132	Version number	3	Total object CL	11			
GEOLOGICAL	CHARACTER	Property CL	155000 160000	) 16	5000 170000				
Deformation style:	Brittle	1	8			9			
Deformation description:	No data available.		671000	5	The man	671000			
Alteration:				X	11/2				
- First order:	Oxidation	2	8 25	/	1 m 1 3	1 0			
- Second order:	Not observed	-	~~ ~~ 020	1	1 M M	2000			
- I hird order:	Not observed		19 22 O			67			
And type:	No data available.	-		X	ATA No				
Fracture comment:	No data available.	-	500		XIII 3	0000			
mineralogy:			670		W/Y	670			
OBJI Striko/dip:			/ K Chille	AL.	XY				
Length:	5476 m		000	XX	AM	000			
Mean thickness:	35  m (15 - 64  m)		695	R	XI	6950			
Max denth:	-2100 m		°	1410	A A A	Q			
Geometrical	ZEMNW0851_ZEMNW08	54 Topo			17				
constraints:	40m grid Max error 20m.	, торо	0000	$\mathbf{X}$	Went	000			
			6690	~ \		6690			
			155000		170000	20.000			
			Model volume DMS	) 16:	000 170000 0 2 4 0	N			
Baseline DMS									
	BASI	S FOR MOD	DELLING						
Zone based on surface line	eaments.								
Outcrops:	-								
Boreholes: -									
Tunnels:	[								
l ineament and/or									
seismic indications:	Mode					2			
At the surface, corresponde 80 degrees to the WNW ba	s to the low magnetic linear ased on comparison with hig	h confidence	32. Modelled to the b s, steeply dipping zo	base of th	e model volume with NNE strike.	n a dip of			
		25m 2FMNNE11 21MINE0029	22 PRIME (1)3	4.km	- Contraction of the second se				

NNE	ZF	MNNE1	132	Version number	3	Total object CL	11				
OBJECT CONFIDENCE E	OBJECT CONFIDENCE ESTIMATE										
Category	Object CL	Comment									
INTERPRETATION											
Data source		1	MFM1132								
Results of interpretation	n	2	Medium co	nfidence in lineamer	nt MFM11	32.					
INFORMATION DENSITY	(										
Number of observation	points	points 1 1									
Distribution of observat	ion points	1	Single obse	ervation point in the	form of a	lineament.					
INTERPOLATION			•								
Geometry		1	Geometry s	supported by surface	e geophys	sical data.					
Geological indicators		1	Indirect sup	port by geophysical	data.						
EXTRAPOLATION				. , ,							
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m			gh e <					
Strike direction		3	Extrapolation based on surface geophysical data, Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
		FRA	CTURE CHA	RACTER							
	No data available										
INDIVIDUAL INTERCEPTS	3										
			No data avai	lable							

				U		12
GEOLOGICAL	CHARACTER	Property	155000 16000	) 16	5000 170000	
Deformation style:	Brittle	1	9			0
Deformation	No data available.		1000	_	~	000
description:			3	T	1 mm	67
Alteration:				Y	11/2	
- First order:	Oxidation	2	8 24		V 12	4 9
- Second order:	Not observed	-	~~ 38		NNN	2200
- I hird order:	Not observed		10 22			67
and type:	No data avallable.	-		X	AA No	
Fracture comment:	No data available.	4	2002	ARX		0000
Fracture fill	No data avallable.		67		MANY	6700
OB.IE				BATT	XX Y	
Strike/dip:	195°/80°			SV-	NY	
Length:	6278 m		9	M C	N	5000
Mean thickness:	40 m (15 - 64 m)		669	All	XI	699
Max depth:	-2100 m			H Y	A sure	
Geometrical	Topo 40m grid Max error 2	20m,			L / J man	
constraints:	ZFMNW0854, ZFMWNW3	3538.	000	$\langle \rangle$	Win	0000
			699	· \		699
			155000 160000	) 16!	5000 170000	30 mil
			100000			N
			Baseline DMS		S Contractioned Concile Contraction	A
	BASI	S FOR MOD				
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
Tourseles						
Lincoment and/or	- MEM1122					
seismic indications:	IVITIVITI 52.					3
	MODE	LLING PRO	CEDURE			
At the surface, corresponds	s to the low magnetic lineam	nent MFM113	33. Modelled to the b	base of th	e model volume with	n a dip of
80 degrees to the WNW ba	ased on comparison with hig	h confidence	e, steeply dipping zo	nes with I	NNE strike.	
			2000.0227	FMNNE1	133 T 2	1

NNE	ZFMNNE1			Version number	6	Total object CL	12	
OBJECT CONFIDENCE E	STIMATE							
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM1133					
Results of interpretatio	n	3	High confic	lence in lineament M	IFM1133.			
INFORMATION DENSIT	Y							
Number of observation	points	1	1					
Distribution of observa	1	Single observation point in the form of a lineament.						
INTERPOLATION			•					
Geometry		1	Geometry	supported by surface	e geophys	sical data.		
Geological indicators		1	Indirect support by geophysical data.					
EXTRAPOLATION								
Dip direction	Dip direction         No subsurface obs. point, supported only by surface data. H           1         uncertainty in dip-direction. Strike length of the modelled zor 2000 m				y by surface data. Hi of the modelled zon	gh e <		
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.					
FRACTURE CHARACTER								
	No data available							
INDIVIDUAL INTERCEPTS								
			No data avai	lable				

NNE	ZFMNNE1 <sup>4</sup>	134	Version number	3	Total object CL	12
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle	1	0			0
Deformation	No data available.		1000		~	000
description:			3	T	The server of I	671
Alteration:			{	Y	12	
- First order:	Oxidation	2	5		123/3	
- Second order:	Not observed	2	L~ 200		MPL	2000
- Third order:	Not observed		670	1 7	ANY	670
Fracture orientation and type:	No data available.		S 1	X	ALA Ve	100-14
Fracture comment:	No data available.		000	ZAX	×11/1 \5	000
Fracture fill	No data available.		5	XX	VI V	700
mineralogy:				AA	K Y	Q
OBJI				A	M/Y	
Strike/dip:	193°/80°		000	X	AX/	000
Length: Mean thickness:	7280 m		695(	N.		395C
Mean unickness:	40 m (15 - 64 m)		°	142	X	60
Max depth:	-2100 III ZEMNIM/0854 ZEMNINIM/0	906 Topo		1 DY	3 13	
Geometrical	40m grid Max arror 20m	606, TOPO	8	$\sim$	La Iman	8
constraints.	40m ghu Max error 20m.		0000		w	9000
			66	\ 		669
			155000 160000	) 165	5000 170000	30.50
			Madal valuma DMS			N
			Baseline		d Lastmate et Gerdia nerverkei	A
	BASI	S FOR MOD				
Zone based on surface line	eaments					
	sumento.					
Outcrops:	-					
Boreholes: -	•					
Tunnels:	-					
Lineament and/or	MFM1134.					3
seismic indications:			0551155			
	MODE	LLING PRO			a second a la seconda da seconda da	a d'a af
At the surface, correspond	s to the low magnetic linear	hent MFM11	34. Modelled to the t	base of th	e model volume with	a dip of
80 degrees to the WNW ba	ased on comparison with hig		e, steeply dipping zo	nes with I	NNE strike.	
· D / J			STATISCORDA	-		-
	3 23 1	No. of the second secon				
				251011151132		
	· ~ ~					
530						
			All and a second			
0 .					ZT MINE 1135	
D B				1		
· 0						
3	-			-		
SOMM		NINE113	4			
		ZEMININE				
					7EMINIE1135	
0	1 2		4	km 🖊		2
					V	

NNE	ZF	MNNE1	134	Version number	3	Total object CL	12		
OBJECT CONFIDENCE ESTIMATE									
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM1134						
Results of interpretatio	n	3	High confid	dence in lineament M	FM1134.				
INFORMATION DENSIT	Y								
Number of observation	points	1	1						
Distribution of observa	tion points	1	Single observation point in the form of a lineament.						
INTERPOLATION			·						
Geometry		1	Geometry	supported by surface	geophys	ical data.			
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction	1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.							
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.						
FRACTURE CHARACTER									
			No data ava	ilable					
INDIVIDUAL INTERCEPT	S								
			No data ava	ilable					

NNE	ZFMNNE1135		Version number	3	Total object CL	10		
GEOLOGICAL	CHARACTER	Property CI	155000 160000	0 16	5000 170000			
Deformation style:	Brittle	1	0			0		
Deformation description:	No data available.		671000		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	671000		
Alteration:			{	Y	12			
- First order:	Oxidation	2	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		1213			
- Second order:	Not observed	2	~~ 200	-1	MAN	2000		
- Third order:	Not observed		22 020		ANY	670		
Fracture orientation and type:	No data available.	-	Sold Here	X	ATA Va	N 014		
Fracture comment:	No data available.	-	2000	ABX		000		
mineralogy:			670		V V	6700		
OBJI Strike/dim			1 K CHA	A	NY			
Strike/dip:	190 / 60 4378 m		000	XX	AN	000		
Moan thickness:	4378111 30 m (15 - 64 m)		6632	A.	X	695(		
Max denth:	-2100 m		°	100	A the second	Q		
Geometrical	ZEMNNE1134 ZEMNW/08	854 Topo			173			
constraints:	40m grid Max error 20m.	, 1000	6650000	$\checkmark$	West .	669000		
			155000 160000	) 16	5000 170000	20.000 N		
			Model volume DMS     Baseline		0 2 4 8 Claiming of Gerdanservices	A		
	BASI	S FOR MOD	ELLING					
Zone based on surface line	eaments.							
Outcrops:	-							
Boreholes: -								
l unnels:	-							
seismic indications:	MFM1135.		CEDURE			1		
At the surface, correspond 80 degrees to the WNW ba	s to the low magnetic linear	hent MFM11	35. Modelled to the b e, steeply dipping zo	base of th nes with I	e model volume with NNE strike.	n a dip of		
ZFMNNE1135								
ZFMNNE0828								
0 100 200 300	500 m 1 km	2 km		.2				

NNE	ZF	MNNE1	135	Version number	3	Total object CL	10			
OBJECT CONFIDENCE E	OBJECT CONFIDENCE ESTIMATE									
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM1135							
Results of interpretatio	n	1	Low confid	lence in lineament M	FM1135.					
INFORMATION DENSIT	Y									
Number of observation	points	1	1							
Distribution of observa	1	Single observation point in the form of a lineament.								
INTERPOLATION										
Geometry		1	Geometry	supported by surface	geophys	sical data.				
Geological indicators		1	Indirect support by geophysical data.							
EXTRAPOLATION										
Dip direction	1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.								
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.							
FRACTURE CHARACTER										
	No data available									
INDIVIDUAL INTERCEPT	S									
			No data ava	lable						

NNE		ZFMNNE2008			Version I	number	5 <sup>Tota</sup>	l object CL	14
GEOLC	GICAL CH	IARACTER	F	Property CL	155000	160000	165000	170000	
Deformation style:	Brittle			3	8				Q
Deformation	No data	a available.			1000				000
description:					67	2		-	67
Alteration:						$\langle \vee$		2	
- First order:	Oxidati	ion		2		5	IVI	m li	3.
- Second order:	Not obs	served		3	2 200	7 -	VN	141	3000
- Third order:	Not obs	served			670	1 1	AII	$\mathcal{N} \cap \mathcal{N}$	620
Fracture	Few da	ata in each set. Si	teeply		5		N/TH	1 5	(Address)
orientation and	dipping	fractures that sti	rike		5	1100	XAH	7	3
type:	WSW a	as well as gently			8		XXII	$\left( \right)$	) 00
	dipping	fractures are			202		XIN		200
	conspi	cuous. Sealed an	nd		°		AX		9
	open fr	actures. Quantita	ative	2		XARRA	HAN I	$\checkmark$	
	estimat	te and span inclu	de a		8	ANK	=1X	/	8
Eracture commont	No dot	a available			1950	1 4 6 12	- V	$\langle$	950
Fracture fill		a avaliable.			99	1 11		1 A	66
mineralogy:	hemati	te/adularia_clav			1. 2.5		57	A more	
mineralogy.	minera	ls				//		5 Income	0
	OBJECT				0000		1 m		000
Strike/dip:	200°/84	200°/84°						S	666
Length:	328 m	328 m							
Mean thickness:	6 m (1	6 m (1 - 13 m)				160000	165000	170000	20.910
Max depth:	-330 m	,				1			N
Geometrical	ZFMW	NW0044, ZFMEN	NE0060B, 1	Горо	Baseline	e DMS		S Colonitaria Cardioneriveria	A
constraints:	40m gr	id Max error 20m	n, 1 Surface	e Planar					
	Cut(s),	1 UNIVERSE Pla	anar Cut(s)	).					
			BASIS F	OR MODE	ELLING				
Zone based on surfa	ace lineam	ents and borehol	e observati	ions.					
Outcrops:	-								
Boreholes:									
		Target in	ntercept	(	Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_lov [m]	W Sec	_up [m]	Sec_low [m]	Comme	nt	
KFM06C		283.00	306.00	2	82.41	303.53	283-306 DZ (cf. 1 Stephen recogniz	m inferred to able 3-2 in s et al. 2007 ed in SHI.	o be a ). Not
Tunnels:	-								
Lineament and/or seismic indications:	MFM2008G. 2						2		
			MODELLI	ING PROC	EDURE				
At the surface, corre estimated by conner plane placed at fixed	sponds to cting linean d point 293	the low magnetic nent MFM2008G m in KFM06C. Ir	c lineament with the bo nferred to b	MFM2008 prehole intor	BG. Modell ersection 2 zone.	ed down to 45 283-306 m in I	50 m depth, KFM06C. D	using the dip eformation zo	) one

NNE	ZFN	INNE20	08 Version number 5 Total object CL 14					
ZFMA2 401B	Zrunnezas Zrunnez Zrunnez Zrunnezas Zrunnez Zrunnez Zrunnez Zrunnez Zrunnez	MENEODOGOA MENEODOGOA						
		OBJECT						
Category		Object CL	Comment					
Data source		2	MEM2008G KEM06C					
Results of interpretation 2			KFM06C : 283–306 m inferred to be a DZ according to Table 3-2 in Stephens et al. (2007) (Confidence L=?, ) Not recognized in SHI, Intercept at c. 250 m.					
INFORMATION DENSITY			-					
Number of observ	ation points	2	2 Single observation point at depth and a surface lineament					
INTERPOLATION	servation points	I						
Geometry		1	Geometry supported by a lineament and a single intercept.					
Geological indicat	tors	1	Single observation point at depth. Zone modelled mainly based on surface geophysical data.					
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.					
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.					
		EDA						
Orientation:	Set WSW: 246.	2°/88.1°	ZEMNNF2008					
(strike/dip right-	Set G: 110.2°/5	.5°	N					
Frequency:	Boreholes: KFM	106C						
	FRACTURE	TERZAGHI-						
	TYPE	WEIGHED						
	Open and	2.6 m-1						
	partly open	07						
	Sealed	9.7 m-1	W-					
	network	intercept						
	Crush	0.4 % of DZ						
		mercept						
			Equal area Lower hemisphere					
			Unassigned (52)     S     Set WSW (17)     A     Mean pole Set WSW (155 3/1 0) Enter # = 13 5					
			<ul> <li>Set W3W (17) Δ Mean pole Set W3W (150.2/1.9) risher κ = 13.5</li> <li>Set G (34) Δ Mean pole Set G (20.2/84.5) Fisher κ = 58.2</li> </ul>					

NNE	ZFMNNE2008	Version number 5	Total object CL <b>14</b>
RQD:	min:82, max:100, mean:97	· ·	
Fracture fill mineralogy:	80 70 50 50	KFM06C(283.0-306.0)	Open and partly open
	20 10 10 10 10 10 10 10 10 10 1	Hendre Janone Human Orbite was	Whe good points



NNE	ZFMNNE2255			5		Ve	rsion r	numb	er	4	Tota	l object CL	14
GEOLOG	SICAL CH	ARACTER		Propert CL	ty	15	5000		60000	16	5000	170000	
Deformation style:	Brittle			3		0							Q
Deformation	No data	a available.				1000				_	$\sim$		000
description:						67			2	F	11	-	671
Alteration:									<	2	11	2	
- First order:	Oxidati	on		•				5	~	1	N	m li	2
- Second order:	Not obs	served		3		0009	-	. 7	1	-1	IN	141	5 00
- Third order:	Not obs	served				3705	1	M	1	-	K17		105 000
Fracture	Steeply	dipping fracture	es that			0	R	1		-1	TH	1 2	2 COMPANY
orientation and	strike N	INE are promine	ent.				1	1	t	XX	AH	A N	E
type:	Sealed	fractures domin	ates.			8	11		67	N S	$\gg$ ///	$  \wedge  $	5 8
51	Quantit	ative estimate a	nd			00	2	T	XX		X		5 000
	span in	clude a sealed f	racture	_		67	3	14	TARS		M		67(
	network	۲.		2				12		XID	N	$\langle / \rangle$	N
Fracture comment:	No data	a available.				_	11		M	X.	AV	7	
Fracture fill	Chlorite	e, calcite, quartz.				2000			H	K	JA.	/	000
mineralogy:	hematit	e/adularia, clay	·			9699			All C	~	X	}	9699
0,	mineral			Ű		1		10	~	2 million	Q		
	OBJECT	GEOMETRY							//		7 7	7	
Strike/dip:	203°/81	0				8			1	1	h	X	8
Length:	585 m					005			~		v		006
Mean thickness:	2 m (2 ·	- 36 m)				66							66
Max depth:	-580 m										1		
Geometrical	ZFMWI	NW0044, ZFME	NE0060A	, Topo		15	5000	1	60000	16	5000	170000	2030
constraints:	40m gri	id Max error 20n	n, 1 Surfa	ice Plana	r		Medalu	volume Di	16				N
	Cut(s).						Baseling	e	15			a Latiniterat, Geoderican-relay	A
			BASIS	FOR MC	DDE	LLI	NG						
Zone based on surface	ce lineame	ents and borehol	le observa	ations.									
	1												
Outcrops:	-												
Boreholes:													
		Target in	ntercept		G	ieoi	netric	; inte	rcept				
Borehole	PDZ	Sec up [m]	Sec_l	ow d	Sec	un	լայ	S	ec_low	C	omme	nt	
		oco_ab [iii]	[m]			_up	[]	-	[m]				
KFM06A	DZ5	619.00	624.0	00	61	9.1	5	6	24.58				
<u> </u>	1												
Tunnels:	-												
Lineament and/or	MFM22	255G.											
seismic													2
indications:	I		MODE				IDE			_			
		the level of a set	MODEL	LING PR				الم الم	una he l	-00	بالج بيد إل	under an Alexand	-
At the surface, correst estimated by connect zone plane placed at	ing linear fixed poin	the low magnetic nent MFM2255G It 622 m in KFM	c lineame with the 06A. This	borehole point is a	inte also	G. N erse situ	ction 6 ated a	ed do 519-6 along	own to 8 24 m ir an inte	KFM rval of	depth, 06A (D2 low rac	using the di Z5). Deform dar amplitud	p ation le (620-

NNE	ZFN	INNE22	55	Version number	4	Total object CL	14	
				ESTIMATE		ZEMIWINA		
Category INTERPRETATION Data source Results of interpre INFORMATION DEN Number of observ Distribution of obs INTERPOLATION Geometry Geological indicat EXTRAPOLATION Dip direction Strike direction	etation NSITY ation points servation points ors	Object CL           2           2           1           1           2           3	JECT CONFIDENCE ESTIMATE         t CL       Comment         MFM2255G, KFM06A         Medium confidence observation in KFM06A.         2         Single observation point at depth and a surface lineament.         Geometry supported by a lineament and a single intercept.         Single observation point at depth. Zone modelled mainly based of surface geophysical data.         Extrapolation in dip direction supported by subsurface obs. point.         Strike length of the modelled zone < 2000 m.					
		FRAC	CTURE CHAR	ACTER				
Orientation: (strike/dip right- hand-rule) Frequency:	Set NNE: 25.3°/ Boreholes: KFM FRACTURE TYPE Open and partly open Sealed Sealed network Crush	89.4° 106A TERZAGHI- WEIGHED P10 6.0 m-1 15.2 m-1 3.3 % of DZ intercept 0.0 % of DZ intercept	- Unass Set N	ZFMN igned (11) NE (41) Mean po	INE2255	Equal Lower hemisp	area ohere 17.0	
RQD:	min:53, max:10	), mean:86						





NNE		ZFMNNI	E2263		Version	number	Tota	I object CL	15
GEOLOG	SICAL CH	ARACTER	Pro	perty	155000	160000	165000	170000	
Deformation style:	Brittle			3	0				0
Deformation	No data	a available.		<u> </u>	1000				000
description:					67	NT.	21	1 mm	671
Alteration:						$\langle \vee$	11	2	
- First order:	Oxidatio	on		0	- Andrew	5	( A )	m / m	-
- Second order:	Quartz	dissolution		3	2000	5 -	VN	1 P L	2000
- Third order:	Not obs	served			1029		AI	A IN	5705
Fracture	Steeply	dipping fracture	s that		- the		1/TH	1 5	NRMON I
orientation and	strike S	W and dip steep	ly to		5	115	XAH	PA N	
type:	the NW	, are conspicuou	IS.		8 / /		XVII		000
	Steeply	dipping fracture	s that		202	VI. AND	KIN		7000
	strike S	SE as well as ge	ently to		°		XYX	JV	0
	modera	itely dipping fract	ures			X	PAC)	$\sim$	
	are also	o present. Sealed	2		8	UNITE	= X	/	0
	Ouantit	es dominates.	vd l		950	- ACK	~V	$\langle$	9500
	span in	alive estimate ai		2	66	1 11	5	2	66
	network			2		10		And service	
Fracture comment:	No data	available			0 )~			5 inneres	0
Fracture fill	Chlorite	a calcite.			0000		w	ri i	000
mineralogy:	hematit	e/adularia. clav			669			18 M	699
	mineral	s, quartz. High			1.10				
	frequen	cy of fractures th	nat dip		155000	160000	165000	170000	20.900
	gently t	o the NW with no			100000	110000	N		
	identifie	ed mineral			Baselin	volume DMS e		0 2 4 8	A
	coating	/filling.							
	OBJECT	GEOMETRY			-				
Strike/dip:	199°/83	8°							
Length:	449 m				-				
Mean thickness:	30 m (2	? - 30 m)			-				
Max depth:	-450 m				-				
Geometrical		IE0401A, ZEMIV	NVV0044,						
constraints:		EUUOUB, TOPO 4	oni gna wax e	enor					
	2011, 1	Surface Fidilar (	BASIS FOR	MOD					
Zone based on surfa	ce lineame	ents and borehold	e observations						
Outcrops:	-								
Boreholes:									
		Target in	toroont		Coomotric	intercent			
Borehole	PD7	Target II	Sec low		Geometric	Sec low	Comme	nt	
Derenoie		Sec_up [m]	[m]	Sec	:_up [m]	[m]	00111110		
KEM06C	D73	415.00	489.00	4	14.43	485.20			
	-				-				
Tunnels:	-								
Lineament and/or	MFM22	.63G.							
seismic									1
indications:									
			MODELLING	PROC	CEDURE				
At the surface, corres	sponds to I	the low magnetic	lineament MF	-M226	3G. Modell	ed down to 50	0 m depth,	using the dip	)
estimated by connect	ung iinean	t 467 m in KEM2	with the boreh		ersection 4	+15-489 m in K	LEIVIUGC (D	23). Deforma	
zone plane placed at	nxea poin	1 467 m in KFMU	юс. Decrease	a rada	r penetratio	on also along t	ne porenol	e interval 466	o-4/1 m.
meneu to be a mino									

NNE	ZFN	INNE22	63 Version number 5 Total object CL 15							
ZFMA2 ZFMA2	Zrunnezas Zrunnez Zrunnez Zrunnezas Zrunnez Zrunnez Zrunnez Zrunnez Zrunnez	ME2213 MENE0060A								
		OBJECT								
Category		Object CL	Comment							
Data source		2	MEM2263G KEM06C							
Results of interpre	etation	3	High confidence observation in KFM06C.							
INFORMATION DEM	NSITY		2							
Number of observ	ation points	2	2 Single observation point at depth and a surface lineament							
INTERPOLATION		•	Single observation point at depart and a sundee interment.							
Geometry		1	Geometry supported by a lineament and a single intercept.							
Geological indicat	tors	1	Single observation point at depth. Zone modelled mainly based on surface geophysical data.							
EXTRAPOLATION										
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone $< 2000$ m							
Strike direction		0	Conceptual understanding of the site and that the entire modelled							
		3	zone is supported by the lineament.							
		FRAC	TURE CHARACTER							
Orientation:	Set SW: 218.3°	/78.9°	ZFMNNE2263							
(strike/dip right- hand-rule)			N							
Frequency:	Boreholes: KFM	106C								
	FRACTURE	TERZAGHI-								
	TYPE	WEIGHED								
	Open and	P10								
	partly open	2.0 111-1								
	Sealed	8.5 m-1								
	Sealed	47.2 % of DZ	W-							
		intercept								
	Crush	0.0 % of DZ								
		intercept								
			Equal area Lower hemisphere							
			• Unassigned (291)							
			<ul> <li>Set SW (78) Δ Mean pole Set SW (128.3/11.1) Fisher κ = 44.5</li> </ul>							
RQD:	min:67, max:10	0, mean:98								







NNE		ZFMNN	E2273		Version r	number	6 <sup>Tot</sup>	al object CL	13
GEOLO	GICAL CH	IARACTER	Pro	perty CL	155000	160000	165000	170000	
Deformation style:	Brittle			3	8				9
Deformation	No data	a available.			1000		~		1000
description:					67	N		y many	67
Alteration:					1.00	5	1	1 1 4	1 -
- First order:	Oxidati	on		2	0	5	VV	1 m	3.
- Second order:	Not obs	served		5	2 200	2	VI	1111	5000
- Third order:	Not obs	served			S 670	/ /	A	AND	610 200
Fracture	Steeply	dipping fracture	s that		5	an los l	VIT	HA 5	0.000001
orientation and	dip to t	he SW are promi	inent.		5	1/to	XXTH	HA N	2
type:	Sealed	fractures domina	ates.		000		) 8		
	Quantit	ative estimate ar	nd		2020	W/ADD	XIM	$\gamma / \gamma$	2002
	span in	iciude sealed frac	cture	2			AV	$\langle Y \rangle$	G
Erecture comments	Ne det	KS.				X	HAN	$\sim$	
Fracture comment:		a avaliable.			8	1 XUX		$\langle \rangle$	8
mineralogy:	hematit	, chionte, to/adularia, quart	7		8950	1 Mille	X	$\langle$	3950
mineralogy.	nrehnit	e autiana, quan	.2,		99	1 11	X	- Ar	99
	OBJECT						5	And man	
Strike/dip:	210°/77	7°			8			J immed	Q
Length:	744 m				005	$\sim$	w	1. 10. 1	1006
Mean thickness:	10 m (2	2 - 36 m)			66			5 ×	66
Max depth:	-740 m	,							
Geometrical	ZFMW	NW2225, Topo 4	0m grid Max e	error	155000	160000	165000	170000	2030
constraints:	20m, 1	Surface Planar (	Cut(s), 1		Model v	olume DMS			N
	UNIVE	RSE Planar Cut(	s).		Baseling			& California event Geochese eventses	A
			BASIS FOR		ELLING				
Zone based on surfa	ice lineam	ents and borehol	e observation:	S.					
Outcrops:	-								
Boreholes:									
		Target in	ntercept	(	Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	Comm	ent	
KFM06A		518.00	545.00	5	17.07	544.97	518-54 DZ (cf. Stephe	5 inferred to b Table 3-2 in ens et al. 2007	be a ').
Tunnels	1.								
Lineament and/or	- MEM22	273G							
seismic		2750.							3
indications:									Ŭ
			MODELLING	PROC	EDURE				
At the surface, corre	sponds to	the low magnetic	c lineament MI	-M227	3G. Modell	ed down to 65	50 m depth	, using the dir	2
estimated by connect	ting linean	nent MFM2273G	with the bore	hole int	ersection 5	518-545 m in k	KFM06Å. [	Deformation z	one
plane placed at fixed	l point 530	m in KFM06A. Ir	nferred to be a	a minor	zone.				

NNE	ZFN	INNE22	Version number     6     Total object CL     13						
		ZFMN ANNE2255 MNNE2 FMENE0060, E2008							
Catagoria			Comment						
		Object CL	Comment						
Data source		2	MFM2273G, KFM06A						
Results of interpre	etation	1	Low confidence in KFM06A in 518-545, which is only inferred to be						
	NSITY		a DZ (cf. Table 3-2 in Stephens et al. 2007).						
Number of observ	ation points	2	2						
Distribution of obs	servation points	1	Single observation point at depth and a surface lineament.						
INTERPOLATION									
Geometry		1	Geometry supported by a lineament and a single intercept.						
Geological Indicat	ors	1	Single observation point at depth. Zone modelled mainly based on surface deophysical data.						
EXTRAPOLATION									
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.						
Otrilea dina stian		2	Strike length of the modelled zone < 2000 m.						
Strike direction		3	zone is supported by the lineament.						
Orientation:	Set NF: 37 9º/8	<b>FRA</b> ( 6.0°							
(strike/dip right-	000112.07.070		ALEMINICZZ75						
hand-rule)	<b>D</b>	1004							
Frequency:	Boreholes: KFM	106A							
	FRACTURE	TERZAGHI-							
	TYPE	WEIGHED							
	Open and	P10							
	partly open	1.0 111-1							
	Sealed	5.3 m-1							
	Sealed	1.0 % of DZ	WE						
	network	intercept							
	Crusn	0.0 % of DZ							
			4						
			Equal area						
			Linescipped (61)						
			<ul> <li>Onassigned (01)</li> <li>Set NE (44) Δ Mean pole Set NE (307.9/4.0) Fisher κ = 113.0</li> </ul>						
RQD:	min:26, max:10	0, mean:96							
	· · ·								





NNE		ZFMNN	E228	0		Version	number	12	Total object CL	15
GEO		CHARACTER		Prope	rty	155000	160000	) 16	5000 170000	
Deformation st	<b>de:</b> Brittle	2		3		0				0
Deformation description:	Stee Strike slip r dippi show move faults west move dextr subo comp	by dipping fault with oby dipping fault with abovement. Steeply ng fault with SW st is normal dip slip ement. Gently dipp with variable dips and south show ol ement with domina al strike slip and rdinate normal dip- ponents.	th NNE strike- trike ing to the blique nt -slip	3		670,000 670,000 671,000	La	5		570000 6705000 571000
Alteration:							X 2144	S.	NY	
- First order:	Oxid	ation		3		0000	1 fl	XX	M	000
- Second order	: Not o	bserved		3		2692		1	XI	695
- Third order:	Not o	bserved				Ψ.		147	A A A	9
Fracture orientation and type:	Stee NNE fractu fractu Quar span netw	bly dipping fracture strike and gently of ures dominates. Se ures dominates. ntitative estimate an include sealed fra orks.	es with lipping ealed nd cture	2		155000	160'000	16	5000 170000	0000699
Fracture comm	ent: No d	ata available.		2		Baselin	volume DMS		0 2 4 8	A
Fracture fill mineralogy:	Chlo hema quart fractu mode	rite, calcite, atite/adularia, laum z. Epidote along ures with gentle to erate dips to the SI dins with NW stril	iontite, E and				0. 			
			NC.							
Strike/dip:	208°									
Longth:	1033	m								
Moan thickness	1055 17 m	(3 - 50 m)								
Max denth	-105	<u>(3-3011)</u> ) m								
Geometrical	Topo	40m grid Max erro	or 20m. 1	Surface	÷.					
constraints:	Plan	ar Cut(s).	,		-					
			BASIS	FOR M	ODE	LLING				
Zone based on s	surface linea	ments and borehol	le observa	ations.						
Outcrops:	-									
Boreholes:										
		Target i	ntercept		(	Geometrie	c intercep	t		
Borehole	PDZ	Sec_up [m]	Sec_l [m]	ow	Sec	_up [m]	Sec_lo	ow C	Comment	
KFM06A	DZ11	950.00	990.0	00	9	49.55	990.0	7		
Tunnels:	-									
Lineament and/ seismic indications:	or MFN	2280G.	Mont							2
Acri			MODEL	LING P	ROC	EDURE		4070	1 4 1 4	
At the surface, c estimated by cor zone plane place	orresponds t nnecting line ed at fixed po	to the low magnetic ament MFM2280G pint 976 m in KFM	c lineame with the 06A.	nt MFM borehol	2280 le int	ersection	ied down t 950-990 m	:o 1050 r 1 in KFM	n depth, using the o 06A (DZ11). Deforr	מוג nation

NNE	ZFMNNE2280	Version number	<b>12</b>	otal object CL	15
		REPARTIENTS		Line of the second	
	OBJECT CONFIDENC				
Category	Object CL Comment				

Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM2280G, KFM06A
Results of interpretation	3	High confidence observation in KFM06A.
INFORMATION DENSITY		
Number of observation points	2	2
Distribution of observation points	1	Single observation point at depth and a surface lineament.
INTERPOLATION		
Geometry		One subsurface obs. point but the zone is extrapolated in horizontal
	1	direction mainly following interpreted surface lineament. Multiple
		zones with similar strike adding strong support.
Geological indicators	1	Single observation point at depth. Zone modelled mainly based on
	I	surface geophysical data.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point.
	2	Strike length of the modelled zone < 2000 m.
Strike direction	2	Conceptual understanding of the site and that the entire modelled
	3	zone is supported by the lineament.

	FRAC	<b>FURE CHARACTER</b>
Orientation: (strike/dip right- hand-rule) Frequency:	Set NNE: 18.9°/87.2° Set G: 166.7°/22.9° Boreholes: KFM06A	ZFMNNE2280
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open0.8 m-1Sealed10.3 m-1Sealed2.7 % of DZ interceptCrush0.0 % of DZ intercept	<ul> <li>Unassigned (75)</li> <li>Set NNE (75)</li> <li>Set G (62)</li> <li>Mean pole Set NNE (288.9/2.8) Fisher κ = 74.9</li> <li>Mean pole Set G (76.1) Fisher κ = 49.0</li> </ul>

		15
RQD: min:47, max:100, mean:99		
Fracture fill KFM06A(950.0-990.0)		
Minicipality.	Copen and partly open Sealed	



NNE		ZFMNN	E2293		Version r	number	4	Total object CL	14
GE	OLOGICAL	CHARACTER	Pro	perty	155000	160,000	165	5000 170000	
Deformation st	vle: Britt	9		<u>,∟</u> 3	9				9
Deformation	No c	ata available.		-	71000		-	~	1000
description:					67	5	5	N M	67
- First order:	Oxid	ation				$\sim$	1	1 L Z	-
- Second orde	r: Not	observed		3	2000	J F		/ M/ / /	2 000
- Third order:	Not	observed			670	~ `	$\langle \rangle$	ANN	6705
Fracture	Stee	ply dipping fracture	es that		5	1.1	X	ATHA S	ndren til
type:	pron	inent. Gently dippi	ing		8 { }	15	N		2 8
	fract	ures are also prese	ent.		2000	A A		AL IS	7000
	Qua	ntitative estimate a	nd	2	° /	1		V Y	0
	netw	orks.	loturo	2		SIN	S	NY	-
Fracture comm	nent: No c	ata available.			95000	A.C.	XX	VY	92000
Fracture fill	Calc	ite, chlorite, atite/adularia, quar	tz and		66	1	8		669
mineralogy.	othe	minerals.							
	OBJE	CT GEOMETRY			000		X	Wind	000
Strike/dip:	210	/80°			6660		~ \		0699
Mean thicknes	s: 8 m	(2 - 36 m)							
Max depth:	-950	m			155000	160000	165	000 170000	32.9
Geometrical	ZFM	WNW2225, ZFME	NE0061, Topo	40m	Model v	olume DMS		0 2 4 8	Å
constraints.	Cut(							d Laithniteini, Gasharkennikan	
Zone based on	surface lines	ments and boreho	BASIS FOR	MOD	ELLING				
				<b>.</b>					
Boreholes:	-								
		Target i	ntorcont	-	Goometric	intercent			
Borobolo	PD7		Sec_low	0		Sec_lo	w c	omment	
Dorenole					ec_up [m] [m]				
Borenoie		Sec_up [m]	[m]	Sec	:_up [m]	[m]			
KFM08D	DZ9	<b>Sec_up [m]</b> 737.00	<b>[m]</b> 749.00	<b>Sec</b>	<b>:_up [m]</b> /37.26	<b>[m]</b> 748.66	;		
KFM08D	DZ9	<b>Sec_up [m]</b> 737.00	<b>[m]</b> 749.00	<b>Sec</b>	<b>:_up [m]</b> /37.26	<b>[m]</b> 748.66	;		
KFM08D Tunnels: Lineament and	DZ9 - /or MFN	Sec_up [m] 737.00	<b>[m]</b> 749.00	7	<b>:_up [m]</b> /37.26	<b>[m]</b> 748.66	3		2
KFM08D Tunnels: Lineament and seismic indications:	DZ9 - /or MFN	Sec_up [m] 737.00	<b>[m]</b> 749.00	7	c_up [m] /37.26	[ <b>m]</b> 748.66	3		2
KFM08D Tunnels: Lineament and seismic indications:	DZ9	Sec_up [m] 737.00	[m] 749.00 MODELLING	PROC	237.26	[m] 748.66	3		2
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co.	DZ9 - /or MFN corresponds nnecting line	I2300G.	[m] 749.00 MODELLING c lineament MF	PROC	237.26 CEDURE 0G. Modell tersection 7	[m] 748.66 ed to a dep 737-749 m	oth of -98	50 m using the dip 18D (DZ9), Deforma	2
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place	DZ9 - /or MFM corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. to the low magnetic ament MFM2293G point 746 m in KFM0	[m] 749.00 MODELLING c lineament Mf S with the bore 08D.	PROC FM2300 hole int	CEDURE 0G. Modell tersection 7	[m] 748.66 ed to a dep 737-749 m	oth of -98	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, o estimated by co zone plane plac	DZ9 /or MFM corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. to the low magnetii ament MFM2293G pint 746 m in KFM0	[m] 749.00 MODELLING c lineament MI & with the borel 08D.	PROC M2300 mole int	CEDURE CEDURE OG. Modell tersection 7	[m] 748.66 ed to a dep 737-749 m	bth of -95	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, o estimated by co zone plane place	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00 MODELLING c lineament Mf S with the borel 08D.	PROC M230 hole inf	CEDURE OG. Modell tersection 7	[m] 748.66 ed to a dep 737-749 m	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place	DZ9 - /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. to the low magnetia ament MFM2293G pint 746 m in KFM0	[m] 749.00 MODELLING c lineament MR d with the borel 08D.	PROC FM2300 hole inf	CEDURE 0G. Modell tersection 7	[m] 748.66 ed to a dep '37-749 m	oth of -99	50 m using the dip 38D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place	DZ9 - /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. to the low magnetia ament MFM2293G point 746 m in KFM0 7598	[m] 749.00 MODELLING c lineament MI & with the borel 08D.	5 PROC FM230 hole int	CEDURE 0G. Modell tersection 7	[m] 748.66 ed to a dep 737-749 m	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, o estimated by co zone plane plac	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. to the low magnetic ament MFM2293G point 746 m in KFM0	[m] 749.00 MODELLING c lineament MF S with the borel 08D.	PROC PROC M2300 hole inf	CEDURE OG. Modell tersection 7	[m] 748.66	bth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00 MODELLING c lineament MF S with the borel 08D.	PROO FM2300 mole inf	CEDURE OG. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00 MODELLING c lineament MR b with the borel 08D.	PROC FM2300 FM2300 mole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99 in KFMC	50 m using the dip 38D (DZ9). Deformation	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. to the low magnetii ament MFM2293G point 746 m in KFM0	[m] 749.00 MODELLING c lineament MI b with the borel 08D.	PROOF FM2300 hole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99 in KFMC	50 m using the dip 38D (DZ9). Deformation	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G. 2300G.	[m] 749.00 MODELLING c lineament MF S with the borel 08D.	5 PROC 7 5 PROC TM2300 hole inf	CEDURE OG. Modell tersection 7	[m] 748.66	bth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place SB	DZ9 /or MFM corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROC FM2300 hole inf	CEDURE OG. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place SB SB SB SB SB SB SB SB SB SB	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PRO0 FM2300 mole inf	CEDURE OG. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58 58 58 58 58 58 58 58 58 58	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROC FM2300 hole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	pth of -99 in KFMC	50 m using the dip 08D (DZ9). Deformation	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58 58 58 58 58 58 58 58 58 58	DZ9 /or MFM corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROOF FM2300 hole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58 58 58 58 58 58 58 58 58 58	DZ9 /or MFM corresponds nnecting line ed at fixed p Comence Contemportation Contempo	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROC FM2300 hole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 08D (DZ9). Deformation	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, o estimated by co zone plane place 58 58 58 58 58 58 58 58 58 58	DZ9 /or MFN corresponds nnecting line ed at fixed p CFMENED CFMENED COG1	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROC PROC TM2300 mole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 08D (DZ9). Deforma	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58 58 58 58 58 58 58 58 58 58	DZ9 /or MFN corresponds nnecting line ed at fixed p	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROC FM230 mole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99 in KFMC	50 m using the dip 36D (DZ9). Deformation of the d	2 ation
KFM08D Tunnels: Lineament and seismic indications: At the surface, of estimated by co zone plane place 58 58 58 58 58 58 58 58 58 58	DZ9 DZ9 /or MFM corresponds nnecting line ed at fixed p Comence Contemportation Con	Sec_up [m] 737.00 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G. 12300G.	[m] 749.00	PROOF FM2300 hole inf	CEDURE 0G. Modell tersection 7	[m] 748.66	oth of -99	50 m using the dip 38D (DZ9). Deformation of the second s	2 ation

NNE	ZFMNNE22		93	Version number	4	Total object CL	14				
		OBJECT									
				-							
Category Object CL			Comment								
INTERPRETATION											
Data source		2	MFM2293G, KFM08D								
Results of interpretation		2	Medium confidence observation in KFM08D.								
INFORMATION DENSITY											
Number of observation points		2	2								
Distribution of obs	servation points	1	Single observation point at depth and a surface lineament.								
INTERPOLATION											
Geometry		1	Geometry supported by a lineament and a single intercept.								
Geological indicators		1	Single observation point at depth. Zone modelled mainly based on								
		•	surface geophysical data.								
EXTRAPOLATION											
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.								
Otvilue alianation			Strike length of the modelled zone < 2000 m.								
Strike direction		3	Conceptual understanding of the site and that the entire modelled								
			zone is supported by the lineament.								
		FRA	CTURE CHA	RACTER							
Orientation:				ZEMN	NE2203						
(strike/dip right-				211-114	N						
hand-rule)				1 miles	1						
Frequency:	Boreholes: KFM	108D				1					
	FRACTURE	TERZAGHI-		1		· · · /					
	TYPE	WEIGHED		6		•					
		P10									
	Open and	4.6 m-1	1	A		F					
	Socied	24.4 m 1				. 1					
	Sealed	24.4 III-1			21						
	network	intercent	W		• •	1	E				
	Crush	0.0 % of DZ		1.1							
	Ordon	intercept	1.			N N					
			1.			12					
				X		1					
			X		. :/						
				Equal	larea						
			• KFM08D (169)								
		0		1997 1997							
RQD: Fracture fill	min:46, max:10	0, mean:91									
mineralogy:	KFM08D(737.0-749.0)										
mineralogy.											
	80 -					Sealed	~ ]				
	ces										
	60 -										
	occi										
	· 전 40 -		and the second second								
	mbe										
	n2										
	20 -										
			22								
	0										
	latio	walls alote	Jone erals	ante otide	sure walls	dinite sight					
	Por	chee	C. Ast	Her Hyde June	inteo	See 0.					
	ale		C.	10.	OF.						



NNE		ZFMNNE2300			Version number		Total	Total object CL							
GEOLOGICAL CHARACTER			Proj	perty	155000	160000	165000	170000							
Deformation styl	e: Brittle			3	9				0						
Deformation	Gently t	o moderately so	outh		1000				000						
description:	dipping	dipping faults show reverse			67.	NT	21	strong	671						
	displace	displacement. A steeply				$\langle \vee$	1	2							
	dipping	fault with SSW	strike		- Andre	5	/ / l	~ 1 2	-						
	shows s	shows strike slip			0000	5 -	NN	FL	2 000						
	displace	displacement.			2206	~ /	AIA		5020						
Alteration:					- the	1	1/14	1	NEW I						
- First order:	Oxidatio	Oxidation			2	11	XAH	A NE	3						
- Second order:	Quartz	Quartz dissolution		5	8 ( )			$  \land    $	8						
- Third order:	Not obs	Not observed			00 ~	V. XW	KIA	1	000						
Fracture	Red-sta	Red-stained bedrock with fine-			6		2 HL		67						
orientation and	grained	grained hematite			< C.	XSSTA	423 7								
type:	dissemi	nation. Quartz			0	1 Mille	AV	7	0						
	dissolut	ion documented	lat		200										
	around	around 933 m. Quantitative			669										
	estimate	e and span inclu	ide	2	1	1 14	XX	S man							
Freedown commen	sealed I	racture network	s.				1	- Linnana	1						
Fracture comme	nt: No data	No data available.			0000		- hor		000						
Fracture fill	Chiorite	Uniorite, calcite, clay minerals,			0690	~			1						
mineralogy:	<i>i</i> : nematite/adularia, quartz and other minerals				U I				U						
OR IECT CEOMETRY								20-20-2							
OBJECT GEOMETRY					155000	160000	165000	170000	N						
Length:	942 m				Model V	volume DMS		0 2 4 8	A						
Mean thickness:	28 m (2	- 36 m)			baseiin			d Leidnike eit, Gridkonen-Hikes							
Max denth:	-940 m														
Geometrical	ZEMWN	ZEMWNW08094 Topo 40m arid													
constraints:	error 20	error 20m. 1 Surface Planar Cut(s) 1													
	UNIVERSE Planar Cut(s).														
BASIS FOR MODELLING															
Zone based on surface lineaments and borehole observations.															
Outcrops:	-														
Boreholes:															
		Torratio	ntoroont	-	Coomot-i-	intercent									
Boroholo		l arget interce			Seonetric intercept		Commont								
Borenole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	Commer	n							
KFM08D	DZ12	903.00	941.75	9	02.83	941.96									
Tunnals															
Tunnels: -															
Lineament and/or MFM2300G.									0						
Seising							2								
At the surface, corresponds to the low magnetic lineament MEM2300C, Modeled to a depth of 1000 musing the din															
estimated by connecting lineament MEM2308G with the borehole intersection 903 m to base of borehole (942 m) in KEM08D															
(DZ12). Deformation zone plane placed at fixed point 926 m in KFM08D. Borehole interval 924-929 m also corresponds to a															
prominent low am	plitude section	n in the radar da	ata.				are	prominent low amplitude section in the radar data.							

NNE	ZFN	INNE23	00	Version number	5	Total object CL	15		
	ZFMNNE The second secon					ZEMIVNINTO53			
		OBJECT	CONFIDENCE	EESTIMATE					
Category         INTERPRETATION         Data source         Results of interpretation         INFORMATION DENSITY         Number of observation points         Distribution of observation points         INTERPOLATION         Geological indicators         EXTRAPOLATION         Dip direction         Strike direction		Object CL           2           3           2           1           1           2           3	Comment         MFM2300G, KFM08D         High confidence observation in KFM08D.         2         Single observation point at depth and a surface lineament.         Geometry supported by a lineament and a single intercept.         Single observation point at depth. Zone modelled mainly based on surface geophysical data.         Extrapolation in dip direction supported by subsurface obs. point.         Strike length of the modelled zone < 2000 m.         Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.						
	I	FRAG	CTURE CHAR	ACTER					
(strike/dip right- hand-rule) Frequency:	Boreholes: KFN FRACTURE TYPE Open and partly open Sealed Sealed network Crush	A08D TERZAGHI- WEIGHED P10 5.1 m-1 11.2 m-1 8.2 % of DZ intercept 0.4 % of DZ intercept	W-	ZFMN	NE2300 N +	Equa	E I area ohere		
RQD:	min:78, max:10	0, mean:94							




NNE		ZFMNNE231			Version I	number	6	Total object CL	18
GEO	DLOGICAL CH	ARACTER	Pro	perty	155000	160000	16	5000 170000	
Deformation st	vle: Brittle			3	0				
Deformation	No data	a available.		•	1000		_	~	000
description:					67	2	T	1 mm	671
Alteration:					1.00	- {	Y	1 12	1 4
- First order:	Oxidatio	on		3	0	25	_ \	Ver	2. 0
- Second order	: Quartz	dissolution		0	200	w T	-1	INNY	200
- Third order:	Not obs	served			670	1		AM 12	670
Fracture orientation and type:	Steeply strike S fracture Steeply strike N Fracture has a d plunge, orientat fracture Quantit span in	dipping fracture SW and gently of so form prominen dipping fracture IW are also pres- es in HFM38, whi ifferent azimuth show a similar ion pattern. Sea so dominates. ative estimate are clude sealed fractor	is that dipping int sets. es that ent. inch and led ind cture	2	1000 6695000 670000				000 6695000 6700000
Erecture comm	network	(S.			0599		~ \		6900
Fracture comm	Fracture fill Calcite, chlorite,								9
mineralogy:	hematit epidote	e/adularia, quart	iz,		155000	160000	165	000 170000	20.93
	OBJECT	GEOMETRY			Baseline	olume DMS		0 Z 4 8	A
Strike/dip:	208°/87	70							
Length:	435 m								
Mean thickness	s: 19 m (2	2 - 20 m)							
Max depth:	-500 m								
constraints:	ZFMEN Surface Planar (	EIN GING MAX EIIC IE1061B, ZFMEI Planar Cut(s), 1 Cut(s).	NE1061A, 1 1 UNIVERSE						
Zono boood on a	urface lineamo	nto and horohol	BASIS FUR						
Zone based on s		ents and porenoi	e observations	5.					
Outcrops:	-								
Boreholes:	1								
		Toroot	torcont		Goometrie	intorcont			
Borehole	PD7	rarget ir	Sec low	-	Seometric	Sec los	" C	omment	
Derendre	1 52	Sec_up [m]	[m]	Sec	_up [m]	[m]			
HFM38	DZ1	149.00	164.00	1	04.82	130.49	)		
KFM08C	DZ2	419.00	542.00	4	23.69	540.44			
Tunnels:									
Lineament and	or MFM23	312G.							0
seismic									2
muications:									
MODELLING PROCEDURE At the surface, corresponds to the low magnetic lineament MFM2312G. Modelled using the dip estimated by connecting lineament MFM2312G with the borehole intersections 419-542 m in KFM08C (DZ2) and 149-164 m in HFM38 (DZ1). Truncated against ZFMENE1061A and ZFMENE1061B. Deformation zone plane placed at fixed points 518 m in KFM08C and 158 m in HFM38. Decreased radar penetration also along the borehole interval 518-535 m in KFM08C. Inferred to be a minor zone.									

NNE	ZFN	INNE23	12	Version number	6	Total object CL	18
		CFMNE2	S00 m	MENE1061B		C C RAMARI	
		Object CL	Comment				
Data source		2	MFM2312G, H	IFM38, KFM08C			
Results of interpre	etation	3	High confiden	ce observation in	KFM08C.		
INFORMATION DEP	INFORMATION DENSITY						
Distribution of obs	servation points	2	Two subsurfac	ce obs. point can	be conside	ered as a cluster and	d the
		2	surface linear	ent as an outlier.			
Geometry		0	The zone is bo	ound by ZFMENE	1061A an	d ZFMENE1061B bi	ut it
		2	has a blind en	d in SW/SSW dire	ection.		
	ors	2	Some discrep	ancies in the geol	logical data	a.	
Dip direction		2	Extrapolation	in dip direction su	pported by	y subsurface obs. po	oint.
Strike direction		2	Strike length o	of the modelled zo	one < 2000	) m.	allad
Strike direction		3	zone is suppo	rted by the linear	nent.		elleu
		FRAC	CTURE CHARA	CTER			
Orientation:	Set SSW: 210.3	°/68.0°		ZFM	NNE2312		
(strike/dip right- hand-rule)	Set G: 18.1%6.2	-		Land Land	N	~	
Frequency:	Boreholes: KFM	108C					
	FRACTURE	TERZAGHI-	]				
	TYPE	WEIGHED	4	1		fee	
	Open and	P10	1	P			
	partly open	4.1111-1	10°0	1.0			
	Sealed	17.5 m-1	10/ 53.			1	
	Sealed	1.3 % of DZ intercept	VV-	S		and a second sec	-
	Crush	0.0 % of DZ	Tes :		14	the second of	
		intercept	ton to	1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -	e 11 - 12 - 12		
			X	** *** ***			
				~		Equal	area
						Lower hemisph	here
			<ul> <li>Unassig</li> <li>Set SSV</li> </ul>	Ned (724) V (494) ▲ Mean p	oole Set SSW	(120.3/22.0) Fisher κ = 0	65.6
			• Set G (1	.88) 🛕 Mean p	oole Set G (2	88.1/83.8) Fisher κ = 11.	4
RQD:	min:54, max:10	0, mean:97					









NNE	ZFMNNE32	264	Version number	9	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle	2	0			0
Deformation	No data available.	_	1000	-	~	1000
description:			5	T	1 mm	67
Alteration:		-	$\sim$	X	1612	
- First order:	Not observed		8 7	1-	1212	1 8
- Second order:	Not observed		102 June 102	1 1	x / / / /	7050
Fracture orientation	No data available.		° R	1	THAN Z	0
and type:			3	X	AHA IS	
Fracture comment:	No data available.	-	600	20X	XII NS	000
Fracture fill	No data available.		620		VAI 12	6700
OB.I	FCT GEOMETRY			AN	XX Y	
Strike/dip:	10°/90°			S-	NY	-
Length:	678 m		1 / / / 2000	Mes	N	5000
Mean thickness:	10 m (2 - 36 m)		699	24	$\mathcal{A}$	699
Max depth:	-680 m			10X	- And man	
Geometrical	ZFMNW0805A, Topo 40m	grid Max	8		S man	Q
constraints:	Planar Cut(s)	Surface	0006	$\sim$	w	0006
			66	. · · · · · · · · · · · · · · · · · · ·		66
			Sec. 14			20.910
			155000 160000	) 16	5000 170000	N
			Model volume DMS		0 2 4 8	Ä
			Dasenie		S (altraitee), Gedeliner-wikes	
Zana haaad an aufaaa lin	BASI	S FOR MOD	DELLING			
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
Tourselas						
I unnels:	- MSED09001					
seismic indications:	WISFR00001.					2
	MODE	LLING PRO	CEDURE			
The position of the zone at	the ground surface is based	d on the mag	netic lineament MSF	R08001	in SFR model versio	n 1.0,
itself an update of lineame	nt MFM3264G in Forsmark s	stage 2.3 (Isa	aksson et al. 2007).	The stage	e 2.3 number in the z	one
name has been maintained	a long profile 36 (see Apper	between alm dix 6) week	erent versions of line	ed vertic	terpretation. Forward	1 7000
while profile 35 (see Apper	ndix 6. Cutis et al. 2011) give	es a weak ind	dication of a subverti	cal dip to	wards the west. The	20116,
modelled zone thickness is	s a default value.					
		1				
					27	
			$\sim$	s		6
						<b>~</b>
	2			<b>S</b>	S /	
		MAL.			X 447852 (M	
	2	WE3-				
	CMNN NO		64			
		265				
	SFM.					
100	NE320				A8057	
MNW09	006				MIN A	-
Zrun			H		M.	
						/
			Ä			
	ZFMNS21F		315		517	
	MINO3154	+	1×/Z-		XXXX	
0 100 200	300 500 m					
			///			

NNE	ZF	MNNE3	264	Version number	9	Total object CL	10			
<b>OBJECT CONFIDENCE E</b>	STIMATE									
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM3264G							
Results of interpretatio	n	2	Medium co	Medium confidence in lineament MFM3264G.						
INFORMATION DENSIT	Y									
Number of observation	points	1	1							
Distribution of observa	tion points	1	Single observation point in the form of a lineament.							
INTERPOLATION										
Geometry		1	Geometry	supported by surface	geophys	sical data.				
Geological indicators		1	Indirect su	pport by geophysical	data.					
EXTRAPOLATION										
Dip direction			No subsur	face obs. point, supp	orted only	y by surface data. Hi	gh			
		1	uncertainty	in dip-direction. Stri	ke length	of the modelled zon	e <			
			2000 m.		•					
Strike direction		2	Supported	by geological conce	ot and pa	irtly by surface linear	nent.			
FRACTURE CHARACTER										
			No data avai	lable						
INDIVIDUAL INTERCEPTS										
			No data avai	lable						

NNE	ZFMNNE32	265	Version number	9	Total object CL	11
GEOLOGICAL	CHARACTER	Property CI	155000 160000	) 165	5000 170000	
Deformation style:	Brittle	2	0			0
Deformation	No data available		000			000
description	no data avaliable.		0	5	~~	3710
Alteration:		-			N MZ	
Alteration:	Notobeenred	-	$\sim$		1 LIL	
- First order:	Not observed	-	8 7	1~	11213	1 8
- Second order:	Not observed	-	mr 620	1 1	X M M	300
- Inira order:	Not observed		10 22	17	XIV IX	67
Fracture orientation	No data avallable.		2 C	N	LITTA 3	
and type:	Nie dete eus lieble	-		T	XTHAN NE	
Fracture comment:	No data available.	-	6000	AAX	×11/1 12	0000
Fracture fill	No data available.		200		VITY I Y	3700
mineralogy:					X Y	U U
OBJ				All		
Strike/dip:	22°/90°		8	X	AX/	8
Length:	608 m		) // / / / / / / / / / / / / / / / / /	1 al and	VI	950
Mean thickness:	10 m (2 - 36 m)		89	11/10		66
Max depth:	-610 m			19X	All and	
Geometrical	ZFMNW0805A, Topo 40m	i grid Max			J / J manual	
constraints:	error 20m, ZFMNW0997, 1	1 Surface	000		how	000
	Planar Cut(s).		0000	~ \		690
			U A			9
					1	20.910
			155000 160000	) 165	5000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		St Dartmitteret, Gebildenserverkan	N
	BASI	S FOR MOD	ELLING			
Zone based on surface line	eaments					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MFM3265G.					C
seismic indications:						2
	MODE	LLING PRO	CEDURE			
The position of the zone at	the ground surface is based	d on the mag	netic lineament MFN	/3265G I	saksson et al. (2007	), itself
essentially the same as a l	inking of lineaments MSFR0	8002 and M	SFR08003 in the SF	R model	version 1.0 interpret	ation.
The forward modelling of n	nagnetic data along profiles	9, 35 and 36	(see Appendix 6, Cu	urtis et al.	. 2011) support the i	nferred
vertical dip of the zone. Ih	e modelled zone thickness is	s a default va	alue.			
		1				
					9	
			$\sim$	<		1
				• • • • • • • • • • • • • • • • • • •		5
	25.			$\rightarrow$ /	S /	
	S MI	VAL			🤰 🖊 🚽	
	<b>A</b>	E320				
	SENA.	-04		le I Alexandre I A		
		1-				
	~ ~	532				
	-FMAL	<65				
1007	15320				13 <sup>0</sup>	
NWOS	-06					
ZEDI			N		MIT /	
			I	V		
			· · · · · · · · · · · · · · · · · · ·			
				P		
	ZFMNS315	1	315	100	17	
	11135154	+	1-/2-		A K	
0 100 200	300 500 m					

NNE	ZF	MNNE3	265	Version number	9	Total object CL	11				
OBJECT CONFIDENCE E	STIMATE					•					
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM3265G								
Results of interpretation	n	2	Medium confidence in lineament MFM3265G.								
INFORMATION DENSIT	Y										
Number of observation	n points	1	1	1							
Distribution of observa	tion points	1	Single obs	Single observation point in the form of a lineament.							
INTERPOLATION											
Geometry		1	Geometry	supported by surface	geophys	sical data.					
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		1	No subsurf uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	y by surface data. Hi of the modelled zon	gh e <				
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.								
FRACTURE CHARACTER											
	-		No data avai	lable							
INDIVIDUAL INTERCEPTS											
			No data avai	lable							

NNE	ZFMNNE35	46A	Version number	5	Total object CL	11		
GEOLOGICA	L CHARACTER	Property	155000 160000	) 16	5000 170000			
Deformation style:	No data available		0			0		
Deformation	No data available Zone		000		~	000		
description:	hased on lineament		0		~~	671		
description.	mans in the catchment		{	V	1 TOL			
	area		$\sim$	1	July 6			
Alteration:			8 7	1-	111	2 8		
- First order:	Not observed		102		X X La	705(		
- Second order:	Not observed		° R	1	THAN Z	.9		
- Third order:	Not observed		7.1.1	X	ALLA Z			
Fracture orientation	No data available			T	XITT X 17	0		
and type:			2		XU/ 3	0000		
Fracture comment:	No data available.		20 2		HIV	67		
Fracture fill	No data available.			2XIV	XX /	-		
mineralogy:			- / K Olles	A.	AVY			
OBJ	ECT GEOMETRY	•	1 mg 2000	XX		0000		
Strike/dip:	214°/80°		1699	A	XI	9699		
Length:	4673 m			100	A more thank	Ű		
Mean thickness:	30 m (15 - 64 m)				1 12			
Max depth:	-2100 m		8		her	00		
Geometrical	Topo 40m grid Max error 2	Ωm	005		w.	006		
constraints:	7EMNW/0016_1 Surface Pl	anar	66			669		
constraints.	Cut(s) 1 UNIVERSE Plana	ar Cut(s)						
			155000 160000	) 165	5000 170000	20.910		
						N		
			Baseline Model volume DMS		0 2 4 6 21. autorate et Canche Representation	A		
	BASI	S FOR MOD	ELLING					
Zone based on surface lin	eaments.		-					
Outcrops:	-							
Boreholes: -	•							
Tunnels:	-							
Lineament and/or	MFM3546.					2		
seismic indications:								
	MODE	LLING PRO	CEDURE					
-								
Trunnesee e en								
						N		

NNE	ZFN	INNE35	546A	Version number	5	Total object CL	11			
<b>OBJECT CONFIDENCE</b>	ESTIMATE									
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM0806	merged						
Results of interpretation	on	2	Medium co	nfidence in lineamer	nt MFM08	06.				
INFORMATION DENSIT	Y									
Number of observatio	n points	1	1							
Distribution of observa	ation points	1	Single obse	Single observation point in the form of a lineament.						
INTERPOLATION										
Geometry		1	Geometry s	supported by surface	geophys	ical data.				
Geological indicators		1	Indirect sup	Indirect support by geophysical data.						
EXTRAPOLATION										
Dip direction		1	No subsurf uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	by surface data. Hi of the modelled zon	gh e <			
Strike direction Conceptual understanding of the site and zone is supported by the lineament.						I that the entire mod	lelled			
FRACTURE CHARACTER										
	No data available									
INDIVIDUAL INTERCEPT	INDIVIDUAL INTERCEPTS									
			No data avai	lable						

NNW		ZFMNNV	V010	)0		Version r	number	4	Total object CL	22
GEO	DLOGICAL CH	ARACTER		Prope	erty	155000	160,000	) 16	5000 170000	
Deformation st	vle: Brittle-[	Ductile		3		0				0
Deformation description:	Domina consist faults w strike-s sinistra Subord steeply ENE st displac faults w strike s slip or o Gently dip-slip displac	Dominant set of fault-slip data consists of steeply dipping faults with NNW-SSE strike, strike-slip displacement, both sinistral and dextral. Subordinate sets include steeply dipping faults with ENE strike shows strike-slip displacement. Steeply dipping faults with NNW and ENE strike shows highly oblique- slip or dip-slip displacement. Gently dipping faults shows dip-slip or strike-slip displacement.				195000 670000 671000 671000	5	5		séooo 670000 6705000 571000
Alteration:						9		14	At most	66
- First order:	Oxidati	on		3		1 1 man	-			
- Second order - Third order:	r: Not obs	served				0000		$\langle \times \rangle$	Word	0000
- Third order: Fracture orientation and	Variabl fracture	e orientation of s. Steeply dippin	na			6650		~ \	( <b>N</b> •	10699
type:	fracture WSW a dipping present fracture estimat several networl	fractures. Steepiy dipping fractures that strike NNW and WSW are conspicuous. Gently dipping fractures are also present. Dominance of sealed fractures. Quantitative estimate and span include several sealed fracture networks and a crush zone.				155000	160000	0 16	5000 170000	× z
Fracture comm	ent: No data	a available.								
Fracture fill	Chlorite	e, calcite,								
mineralogy:	hemati	e/adularia, laumo	ontite,							
		GEOMETRY	rais.							
Strike/dip:	174°/88	3°								
Length:	1423 m									
Mean thickness	s: 22 m (3	8 - 50 m)								
Max depth:	-1400 r	n								
Geometrical	ZFMNE	0810, ZFMENE2	2320, To	po 40m	l					
constraints:	Grid Ma	ix error 20m, 1 Si	unace Pi	lanar						
	Out(0).		BASIS	FOR N	IODE	LLING				
Zone based on s	surface lineame	ents and borehole	e observa	ations.						
Outcrops:	-									
Boreholes:										
		Target in	tercept		C	Geometric	intercep	t		
Borehole	PDZ	Sec_up [m]	Sec_l	ow	Sec	up [m]	Sec_lo	ow C	omment	
HEM23	D72	82.00	<u>[m</u> ]		F	- • • • •	105.2	0		
KFM07A	DZ4	920.00	999.2	22	9	44.41	986.8	0 D 2 0 T 2 b 2 2 2 2	ivided into three se ones at 803-840 m, 97 m and 920-999 r able 3-2 in Stephen 007). Fractured rocl etween these mode ones inferred to be ffected by DZ.	parate 857- n (cf. s et al. <s Illed</s 
KFM09A	DZ3	217.00	280.0	00	2	17.28	280.2	0		
Tunnalai										
Lineament and	- /or MFM01	00.								
seismic indications:										

NNW	ZFM	INNW01	00	Version number	4	Total object CL	22
MODELLING PROCE	DURE				I	L	
At the surface, corresp (Isaksson and Keisu, 2 connecting lineament I m in KFM09A (DZ3). Z zone ZFMENE0159A at KFM07A and 244 m in ZFMNNW0100 also in	oonds to the low r 2005, RSLV01 in MFM0100 at the Cone ZFMB8 also also modelled to KFM09A. Decre tersects horehole	nagnetic linear Figure 5-33 in surface with th modelled to in intersect DZ3 i ased radar per	nent MFM010 SKB, 2005). N e borehole inte tersect boreho n KFM09A. De netration also a m in HFM23	0 and low velocity so Modelled to a depth of ervals 920-999 m in ole interval 920-999 eformation zone plan along the borehole in (DZ2)	eismic refr of 1650 m KFM07A ( m along p ne placed nterval 960	action anomalies using dip estimated (part of DZ4) and 2 art of DZ4 in KFM0 at fixed points 970 )-972 m in KFM07/	d by 17-280 07A and m in A. Zone
	2500 m				ZEMANYROUGH 2 km		DECEMBRING 22
		OBJECT	CONFIDENCI	EESTIMATE			
Category		Object CL	Comment				
INTERPRETATION Data source Results of interpre	tation	<mark>2</mark> 3	MFM0100, H High confide	HFM23, KFM07A, Kl ence observation in I	FM09A KFM07A a	nd KFM09A.	
Number of observer	ation points	3	4 Even distribi	ution of obs. points.			
INTERPOLATION		Ŭ					
Geometry		3	Geometry su	upported by multiple	subsurfac	e obs. points.	
	ors	3	fracture orie	ntation pattern.	eological	parameters, foremo	DSt
Dip direction		2	Extrapolation Strike length	n in dip direction sup of the modelled zon	ported by ne < 2000	subsurface obs. po m.	oint.
Strike direction		3	Zone modell High confide understandir high conf. Zo	led length < 2000 m ence in this category ng of the site. Trace one ZFMENE2320.	Intersected based on length > 4	ed in multiple boreh conceptual 00 m. Truncated a	noles. gainst



Ν	INV	V		ZFN	/NN/	N01	00	V	ersion nun	<sup>hber</sup> <b>4</b>	Total ob	ject CL	2
						INDIVI	DUAL IN	ITERCE	EPTS				
IFM23	3 DZ2 (	82.0-95	.0 m)										
Length (m)	Elevation m.a.s.l. (m, RH2000)	Open fractures	Sealed fractures	Open total fractures	Sealed total fractures	Total fractures	Crushed zone	Sealed network	RQD reversed 100 = 0 low value = high value	Fracture open frac orientation	Fracture sealed frac orientation	Open aperture (mm)	Core loss
-		0 20	0 20	0 20	0 20	0 20			0 100	0 90 0	90 0	10	
83	-56			-							1 Mar		
84									83.5		-the		
85	-57 -		- C		-	1.000			82.9	Ast I	21		
86		- 1 C			24	32	1		84.5		24		
87	-58								95.5		3.5		
88				- C	and the second s				100.0		1 .		
89	-59								89.0	1.1	- 6		
90			1 1		4				97.7	× 1	8		
91	-60								02.6	1 1	TPC 1		
92					the second se				92.0				
93			-		-		3	-	100.0		- 14 -		
94	-61			100					100.0		1 2		
			-						90.5	~ • •	1	2	









NNW	ZFMNNWO	101	Version number	3	Total object CL	11
GEOLOGICAI	CHARACTER	Property CI	155000 160000	0 16	5000 170000	
Deformation style:	Brittle	1	0			0
Deformation description:	No data available.		671000	-F	m m	671000
Alteration:			5	Y	1 1 2	
- First order:	Oxidation	2	5	/	123	
- Second order:	Not observed	2	~~ 200	-1	MPN	2000
- Third order:	Not observed		670		ANN	670
Fracture orientation and type:	No data available.	_	S II	X	ATA So	8-00-14
Fracture comment:	No data available.	-	000	XAC	$\langle \rangle$	000
Fracture fill mineralogy:	No data available.		6700		V V	6700
OBJ				AL	M/	
Strike/dip:	171°/90°		00	X	AX/	8
Length:	1/26 m		3950	1 al and	$\mathbf{V}$	950
Mean thickness:	20 m (3 - 50 m)		30	112		66
wax deptn:		005 T		102		
Geometrical	ZFMENE0062A, ZFMNE00	065, 1000	•		S Inneres	0
constraints:	40m grid Max error 20m.		0000	$\bigvee$	w	000
			666	$\langle \rangle$		699
			155000 160000	) 16!	5000 170000	20.5
			100000 100000	, 10	110000	N
			Model volume DMS     Baseline		0 2 4 8	A
					a Cardinative, decardigmentary	
	BASI	S FOR MOD	DELLING			
Zone based on surface lin	eaments.					
	1					
Outcrops:	-					
Boreholes: -						
Tuppolo:						
Linoamont and/or	- MEM0101					
soismic indications:						2
	MODE		CEDURE			
At the surface, correspond	ts to the low magnetic linear	pent MFM01	1 Modelled to a de	nth of 17	50 m using an assur	ned din
of 90 degrees based on a	comparison with high confide	ence. vertica	and steeply dipping	zones w	ith NNW strike.	
	ZFMNNW010	ZFM866	S S		2F MENEDIO3B	An Ac
	0 100 200 300	500 m		z		

NNW	ZFN	MNNWO	101	Version number	3	Total object CL	11			
OBJECT CONFIDENCE	STIMATE									
Category		Object CL	Comment	Comment						
INTERPRETATION										
Data source		1	MFM0101,	MFM2469G						
Results of interpretation	n	2	Medium co	onfidence in lineamer	nt MFM01	01.				
INFORMATION DENSIT	Y									
Number of observation	n points	1	2							
Distribution of observation points		1	Single observation point in the form of a lineament.							
INTERPOLATION										
Geometry		1	Geometry supported by surface geophysical data.							
Geological indicators		1	Indirect support by geophysical data.							
EXTRAPOLATION										
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.							
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.							
		FRA	CTURE CHA	RACTER						
			No data avai	lable						
INDIVIDUAL INTERCEPT	S									
			No data avai	lable						

NNW		ZFMNNW0404			04		Version	number	4	Total object CL	22
GE	OLOG	ICAL CH	ARACTER		Prope	rty	155000	160000	)	165000 170000	
Deformation et	wlo:	Brittlo			2		0				
Deformation description:	.yie.	Steeply NNW s sometir epidote strike-s normal	r dipping faults w trike with chlorite nes accompanie striae, shows si lip or dip slip with and reverse ement	ith d by nistral n both	3		6705000 6710000	zz	5	6705000 571000	
Alteration:		uispiac	ement.				2	1. 1	D	VAITA >	Jon and and and and and and and and and an
- First order:		Oxidati	on		2		8 { \	- M	The	XITTX	200
- Second orde	r:	Not obs	served		3		200	X		$\Delta \mathcal{H} / \Lambda$	5 0000
- Third order:		Not obs	served				61			HIV	67
Fracture orientation and type: Fracture comm Fracture fill mineralogy: Strike/dip: Length: Mean thicknes: Max depth: Geometrical	nent:	Fracture set with NNW strike and steep dip to the east is dominant. A subordinate fracture set that is sub horizontal and fractures with steeper, more variable orientation are also present. Dominance of sealed fractures. Quantitative estimate and span include sealed fracture networks and crush zones. No data available. Chlorite, calcite, laumontite, prehnite, quartz, hematite/adularia, epidote. <b>OBJECT GEOMETRY</b> 152°/90° 946 m 10 m (2 - 36 m) -970 m ZEMENE0159A. ZEMENE0060/		2 		00005999 155000					
constraints:		40m gri Cut(s).	id Max error 20m	i, 1 Surfa	ace Plan	ar					
				BASIS	FOR M	ODE	LLING				
Zone based on	surfac	e lineame	ents and borehol	e observ	ations.						
Outcrops:		-									
Boreholes:											
			Target ir	tercept		G	eometric	; intercep	t		
Borehole	F	PDZ	Sec_up [m]	Sec_ [m	low ]	Sec_	_up [m]	Sec_lo [m]	w	Comment	
HFM27	[	DZ3	-	-		6	6.57	127.5	0		
KFM01B	[	DZ3	415.00	454.	00	41	4.87	453.2	20		
KFM07A	[	DZ1	108.00	185.	00	15	51.99	173.3	3	ZFM1203 also inte DZ1. 183-185 m a Table 3-2 in Steph 2007).	rsects dded (cf. ens et al.
Tunnels		-									
Lineament and/or MFM1196, 1196G. seismic indications:								2			
				MODEL	LING P	ROC	EDURE		1000	1 p	
At the surface, of connecting linea (DZ1) in KFM07 borehole interva DZ1. For this re KFM07A. Only t	corresp ament 7A, with al 150- ason, the low	ponds to f MFM119 h fixed po 170 m in there are ver part o	the low magnetic 6 at the surface v bints at 440 m in KFM07A. The ge difficulties to sep f DZ1 in KFM07A	ineame with the l KFM01B ently dipp parate th A is cons	ent MFM borehole 3 and 169 ping zon ie influen sidered to	in 196. e inter 5 m ir e ZFN nce of o belo	Modelle sections KFM07/ M1203 is zones Zl ong to this	d down to 415-454 n A. Decreas also mode FMNNWO s zone.	1000 m n (DZ3) sed rad elled to 404 and	n using dip estimate in KFM01B and 10 ar penetration also intersect KFM07A d ZFM1203 along D	ed by 08-185 m along the along 0Z1 in



Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM1196, HFM27, KFM01B, KFM07A
Results of interpretation	3	High confidence observation in KFM01B and KFM07A.
INFORMATION DENSITY		
Number of observation points	3	4
Distribution of observation points	3	Even distribution of obs. points.
INTERPOLATION		
Geometry	3	Geometry supported by SHI interpreted zones, one strong alternative.
Geological indicators	3	Interpolation supported by key geological parameters, foremost fracture orientation pattern.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.
Strike direction	3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.

	FRACI	URE CHARACTER
Orientation: (strike/dip right- hand-rule) Frequency:	Set NNW: 340.2°/85.3° Set G: 167.0°/1.0° Boreholes: KFM07A, KFM01B	ZFMNNW0404
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open2.6 m-1Sealed12.0 m-1Sealed9.9 % of DZ interceptCrush0.7 % of DZ intercept	<ul> <li>Unassigned (447)</li> <li>Set NNW (132)</li> <li>Set G (215)</li> <li>Mean pole Set G (77.0/89.0) Fisher κ = 45.4</li> </ul>
RQD:	min:62, max:100, mean:98	













NNW	ZFMNNW0	Version number	6	Total object CL	13		
GEOLOGICAL	GEOLOGICAL CHARACTER			) 16	5000 170000		
Deformation atula:	Prittle						
Deformation description:	No data available.		6710000	15	m m	6710000	
Alteration:				X	1112		
- First order:	Oxidation	2	e ~ (	- /	1213	1 0	
- Second order:	Not observed		~~ ~~ <sup>30</sup>	1	( M M )	20090	
- Third order:	Not observed		20 22	$\langle \rangle$	AN VY	67(	
and type:	No data available.	-		X	AHA No		
Fracture comment:	No data available.	-	5000	2 A A	XIII 3	0000	
mineralogy:			670		$\mathbb{W}$	670	
Strike/dip:			/ KOMM	S	NY		
Jength:	22000 m		000	X	AM	000	
Mean thickness	80 m (50 - 200 m)		1002	N	$\times 1$	695	
Max denth:	-2100 m			1410	and a second	9	
Geometrical	ZFMWNW0001 Topo 40m	n grid Max			1 To man		
constraints:	error 20m, 1 Surface Plana	ar Cut(s).	999	$\checkmark$	Went .	0000699	
			155000 160000	) 165	000 170000	N	
			Baseline		d Lastmatever Cardianeesseeines	A	
	BASI	S FOR MOD	ELLING				
Zone based on surface lin	eaments.						
Outcrops:	-						
Boreholes: -							
Tunnels:	-						
Lineament and/or	MFM0806 merged.					2	
seismic indications:						2	
	MODE	LLING PRO	CEDURE		<u> </u>		
At the surface, correspond assumed dip of 90 degree and NW strike.	is to the low magnetic linear	th high confic	D6. Modelled to the b dence, vertical and s	ase of the teeply dip	e model volume usin oping zones with WN	ng an IW strike	

NNW	ZFN	MNNWO	806	Version number	6	Total object CL	13		
OBJECT CONFIDENCE E	STIMATE					•			
			_						
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0806 merged						
Results of interpretatio	n	2 Medium confidence in lineament MFM0806.							
INFORMATION DENSIT	Y								
Number of observation	n points	1	1						
Distribution of observa	1	Single observation point in the form of a lineament.							
INTERPOLATION									
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect su	pport by geophysical	data.				
EXTRAPOLATION									
Dip direction		<u> </u>	Extrapolated to the base of the model volume. Strike length of the						
	Dip direction Extrapolated to the base of the model volume. Strike length modelled zone > 2000 m.				5				
Strike direction		0	Conceptual understanding of the site and that the entire modelled						
		3	zone is supported by the lineament.						
		FRA	CTURE CHA	ARACTER					
			No data ava	ilable					
INDIVIDUAL INTERCEPT	S								
			No data ava	ilable					

GEOLOGICAL CHARACTER         Property Property Internation style:         Britile         1           Deformation description:         Britile         1	NNW	ZFMNNW0823		Version number	3	Total object CL	14
Deformation style:       Britle         Deformation       No data available.         - First order:       Oxidation         - Second order:       No data available.         - Third order:       No data available.         Immeratogy:       Object GEOMETRY         Strikedip:       162*90°         Length:       3235 m         Mean thickness:       25 m (15: 64 m)         Max depth:       -2100 m         Geometrical       2FNWN00001, Topo         40m grid Max error 20m.       BASIS FOR MODELLING         Zone based on surface lineaments.       Outcrops:         Boreholes: -       -         Tunnels:       -         I.Insament and/or selemic lineaments.       MFM0823.         Basis FOR MODELLING       21         At the surface, corresponds to the low magnetic lineament MFM0823.       Modelled to the base of the model volume using an assumed dp of 90 degrees based on acomparison with high confidence, vertical and steeply diping zones with NIVY stike.         Total acount dip of 90 degrees based on acomparison with high confidence, vertical and s	GEOLOGICAL	CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation to be data available.	Deformation style:	Brittle	1	0			0
Alteration: - Second order: - Not observed - Third order: Not observed - Third order: No data available. - Interd order: - No data available. - Fracture fill Mo data available. - Interd order: - Striko/dp: - dota available. - Interd order: - Striko/dp: - dota available. - Interd order: - Striko/dp: - dota available. - Striko/dp: - Striko	Deformation description:	No data available.		671000	15	The star	671000
- First order: Not observed - Third order: Not observed Practure order: Not observed Fracture fill mineralogy: OBJECT GEOMETRY Striked(i): 1427/90° Length: 3225 m Max depth: 2210 m Geometrical ZFMNE0628, ZFMNW0001, Topo dom dia available. - Constraints: 40m grid Max error 20m. BASIS FOR MODELLING Zone based on surface lineaments. Outcrops: - Boreholes: - Tunnels: - Lineament and/or elsemic indications: MFM0823. elsemic indications: 32 MODELLING PROCEDURE At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on authing in ondiffere, vertical and steeply diping zones with NNW strike.	Alteration:		-	$\sim$	X	11/2	
Second order: Not observed Fracture orientation No data available. Fracture fill No data available. mineralogy: OBJECT GEOMETRY Strike/dip: 162'90° Length: 235 m (15 - 64 m) Max deptr: 40m grid Max eror 20m. BASIS FOR MODELLING Zone based on surface lineaments. Outcrops: Boreholes: - Tunnels: Lineament and/or selsmic indications: MEMODELLING PROCEDURE At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	- First order:	Oxidation	2	0 25	- /	V 12	1 0
- Infra druge: Fracture of instantation and type: Fracture comment: No data available. Fracture of instantation Max displtb: 3235 m Mean thickness: 25 m (15 - 64 m) Max depth: -2100 m Constraints: 27 MNNE0828, ZFMWNW0001, Topo 40m grid Max error 20m. BASIS FOR MODELLING Zone based on surface lineaments. Outcrops: Tunnels: Tunnels: Tunnels: Tunnels: At the surface, corresponds to the low magnetic lineament MFM0823. Seismic indications: MEMOBELLING PROCEDURE At the surface, corresponds to the low magnetic lineament with high confidence, vertical and steeply diping zones with NWV strike. 3 3 3 3 3 3 3 3 3 3 3 3 3	- Second order:	Not observed		~~ ~~ 30		INNY	500
Precture orientation No data available. Fracture fill No data available. Fracture fill No data available. Strike/dip: 162/90° Length: 3235 m Mean thickness: 25 m (15 - 64 m) Max depth: 2100 m Geometrical 2FMNNE0828, 2FMWNW0001, Topo 40m grid Max error 20m. BASIS FOR MODELLING Zone based on surface lineaments. Outcrops: Boreholes: - Tunnels: . Lineament and/or service lineaments. Outcrops: . Boreholes: - Tunnels: . Lineament and/or service lineaments. Outcrops: . Boreholes: . Tunnels: . Lineament and/or service lineament lineament RMM0823. seismic Indications: . MODELLING PROCEDURE . 3 The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface, corresponds to the low morparison with high confidence, vertical and steeply dipping zones with NNW strike. The surface dip of 90 degrees based on acomparison to the correspond dip dipping zones with NNW strike.	- Third order:	Not observed		20 22		AN IN	67(
Practure fills No data available. Practure fills No data available. Mean thickness: 25 m (15 - 64 m) Max depth: 2 constraints: 25 m (15 - 64 m) 40m grid Max error 20m. 40m grid Max error 20m. BASIS FOR MODELLING Constraints: 2 constraints: 2	Fracture orientation and type:	No data available.	-		X	ATA Ve	****
Practure numerical available. mineralogy: OBJECT GEOMETRY Strike/dip: 162/90" Length: 3235 m Max depth: -2100 m Geometrical Constraints: Dutcrops: Constraints: Dutcrops: Tunnels: Tunnels: - Tunnels: - MFM0823. setsmic indications: MODELLING PROCEDURE At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	Fracture comment:	No data available.	-	600	AAX	$\times$	0000
Strike/dip:       IG2/90°         Length:       3235 m         Max dipth:       2235 m         Geometrical       ZFMNNE0282, ZFMNNW0001, Topo         Geometrical       ZFMNNE0282, ZFMNNW0001, Topo         Geometrical       ZFMNNE0282, ZFMNNW0001, Topo         BASIS FOR MODELLING         Zone based on surface lineaments.         Outcrops:         Image: Indications:         Tunnels:         Image: Indications:         Model of 90 degrees based on acomparison with high confidence, vertical and steeply diping zones with NWW strike.	mineralogy:			670		Y X	6700
Survey of the su	UBJ Strike/dim				AP	NY	
Linguit.       325 m (15 - 64 m)         Max depth:       -2100 m         Geometrical       ZFMNNE0828, ZFMWNW0001, Topo         40m grid Max error 20m.       1000 m         40m grid Max error 20m.       1000 m         BASIS FOR MODELLING         Zone based on surface lineaments.         Outcrops:       -         Boreholes: -         Tunnels:       -         Lineament and/or selsmit indications:       MODELLING PROCEDURE         At the surface, corresponds to the low acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Outgrade       Basis corresponds to the low acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	Strike/dip:	102 /90 2225 m		000	XX	AN I	000
Max depit:       23 ml (19 - 04 ml)         Max depit:       22100 m         Geometrical constraints:       ZFMNNE0828, ZFMWNW0001, Topo 40m grid Max error 20m.       Image: Constraints of the state	Length:	3233 III		6956	N.		3950
Image: Description of the second s	Max depth:	25 III (15 - 64 III)		°	142	X	9
Constraints:       21 mm/rtd.0020, 21 mm/rtd0001, 10p0         40m grid Max error 20m.       1000000	Goometrical		0001 Topo		100	7 73	
10000       10000       170000         Basis FOR MODELLING         Zone based on surface lineaments.         Outcrops:         -       -         Boreholes: -         Turnels:         -         INDOELLING PROCEDURE         At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Output         Output         At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Output         Output </th <th>constraints:</th> <th>40m grid Max error 20m.</th> <th>0001, 1000</th> <th>eesocooc</th> <th></th> <th></th> <th>6690000</th>	constraints:	40m grid Max error 20m.	0001, 1000	eesocooc			6690000
Database         BASIS FOR MODELLING         Zone based on surface lineaments.         Outcrops:         orgeneration       -         Boreholes: -       -         Tunnels:						5000 170000	N
BASIS FOR MODELLING         Zone based on surface lineaments.         Outcrops:       -         Boreholes: -       -         Tunnels:       -         Lineament and/or seismic indications:       MODELLING PROCEDURE         At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Contract of the second				Baseline		D Cardinatered Gridal Approvedure	N
Zone based on surface lineaments.          Outcrops:       -         Boreholes: -       -         Tunnels:       -         Lineament and/or seismic indications:       3         MODELLING PROCEDURE       At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Correspond to the base of the model volume using an assumed dip of 90 degrees based on acomparison with model volume using an assumed dip of 90 degrees based on acomparison with model volume using an assumed dip of 90 degrees based on acomparison dup to the base of the model volume using an astrike to the base of the model volume using an		BASI	S FOR MOD	ELLING			
Outcrops: Boreholes: - Tunnels: Lineament and/or seismic indications: MODELLING PROCEDURE At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	Zone based on surface lin	eaments.					
Outcrops:       -         Boreholes: -       -         Lineament and/or seismic indications:       MFM0823.         At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface of the model volume using an assumed dip of 90 degrees based on acomparison degrees based on acomparison the surface of the model volume using an assumed dip of 90 degrees based on acomparison degrees based on acomparison degrees based on acomparison degrees based on acomparison degre		•					
Boreholes: -          Tunnels:       -         Lineament and/or seismic indications:       MFM0823.         At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: the surface in the surface intervence	Outcrops:	-					
Tunnels:       -         Lineament and/or seismic indications:       MFM0823.         At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.         Image: Contract of the strength of the strengt of the strength of the strengt of the strength of th	Boreholes: -						
Lineament and/or seismic indications: MFM0823. At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	Tunnels:	-					
seismic indications: MODELLING PROCEDURE At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	Lineament and/or	MFM0823.					•
At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.	seismic indications:						3
At the surface, corresponds to the low magnetic lineament MFM0823. Modelled to the base of the model volume using an assumed dip of 90 degrees based on acomparison with high confidence, vertical and steeply dipping zones with NNW strike.		MODE	LLING PRO	CEDURE			
Trinago Trinag	At the surface, correspond assumed dip of 90 degree	ls to the low magnetic lineam s based on acomparison with	hent MFM082 h high confid	<ol> <li>Modelled to the b ence, vertical and st</li> </ol>	base of th eeply dip	e model volume usir ping zones with NN	ng an N strike.

NNW	ZFN	<b>MNNWO</b>	823	Version number	3	Total object CL	14		
<b>OBJECT CONFIDENCE E</b>	STIMATE								
Category Object CL Comment									
INTERPRETATION									
Data source		1	MFM0823						
Results of interpretation	n	3	High confic	lence in lineament M	FM0823.				
INFORMATION DENSIT	Y								
Number of observation	n points	1	1						
Distribution of observation points		1	Single observation point in the form of a lineament.						
INTERPOLATION	•								
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the						
		3	modelled zone > 2000 m.						
Strike direction		2	Conceptual understanding of the site and that the entire modelled						
		3	zone is supported by the lineament.						
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPT	S								
			No data avai	lable					

NNW	ZFMNNWO	Version number 9 Total object CL									
GEOLOGICA	L CHARACTER	Property	155000 160000	) 16	000 170000						
Deformation style:	Brittle	2	9			0					
Deformation	No data available.		1000		$\sim$	1000					
description:			5	T	1 mm	67					
Alteration:			~	Y	1 1 2	-					
- First order:	Not observed	_	8 24	1-	1213	1 8					
- Second order:	Not observed	_	my 38	1 1		0000					
- Third order: Fracture orientation	Not observed		10 22	1	HU S	67					
and type:			211		ALLA						
Fracture comment:	No data available.		8	XAX	5	00					
Fracture fill	No data available.		2002		ALIS	7000					
mineralogy:			° / I		K V	0					
OBJ											
Strike/dip:	172 <sup>-</sup> /90 <sup>-</sup>		000	X	1X/	000					
Mean thickness:	1005 III 15 m (3 - 50 m)		1995	A	XS	695(					
Max depth:	-1050 m			12V	and and a	9					
Geometrical	ZFMNW0805A, Topo 40m	grid Max			2 7 minut	1					
constraints:	error 20m, ZFMNW0997, 1	1 Surface	000	$\langle \times \rangle$	Went	000					
	Planar Cut(s).		0599	~ \		0690					
			Ű			Ű					
			155000 160000	) 165	000 170000	24.910					
			155000 100000	) 100	170000	N					
			Model volume DMS     Baseline		0 2 4 8 c (altraiteret, Gentlerserweiker,	A					
	BASI										
Zone based on surface lin	eaments										
Outcrops:	-										
Boreholes: -											
Turneler	1										
Tunnels:	- MEM0000G										
seismic indications:	WI W0999G.					2					
	MODE	ELLING PRO	CEDURE			1					
ZFMNNW0999 is based o	n the magnetic lineament MF	-M0999G in	the Forsmark stage	2.3 interp	retation (Isaksson et	t al.					
2007). The zone has a ler	igth of 692 m terminating at 2	ZFMNW0805	A in the south and e	extending	outside of the mode	l area to					
the north, where MFM099	9G terminates at lineament in 3149G in leakeson et al. (200	VISER08078	In the SFR model ve	rsion 1.0	(an update of Forsm	TARK					
SHI DZ2. However, this in	terval is inferred as being do	minated by Z	ZFMNW0805A and n	o exclusi	e evidence for the						
existence of ZFMNNW099	99 has been identified. For th	is reason, ZF	MNNW0999 has be	en classe	ed as medium confid	ence.					
The general thickness and	d vertical to subvertical dip ar	e supported	by the forward mode	elling of m	agnetic data along p	orofiles					
5 and 6 (see Appendix 6 i	n Curtis et al. 2011).										
				E.2.							
				02	6						
					F						
<u>8</u>					M.						
			7FMNs24		Ä						
			21 10110531	54	3						
					9						
						all and a					
	7	<b>FMNN</b>	W0999	-		-					
10997		-									
-EMNW02						21					
2											
ZFMNNW3TIS											
			45			,					
			.0805		>						
0 100	200 300	500 m	0 100 200 200 500 m M <sup>0</sup>								
0 100											
		500	TEMIL			$\checkmark$					
NNW	ZFN	<b>MNNW</b> 0	INW0999 Version number 9 Total object CL 10								
----------------------------	-------------	---------------	---	---------------------------	-------------	------------------------	-------	--	--		
<b>OBJECT CONFIDENCE E</b>	STIMATE						•				
			_								
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM09999	G							
Results of interpretation	n	2	Medium co	onfidence in lineamen	t MFM09	999G.					
INFORMATION DENSIT	Y										
Number of observation	n points	1	1								
Distribution of observa	tion points	1	Single obs	ervation point in the f	orm of a	lineament.					
INTERPOLATION											
Geometry	1	Geometry	supported by surface	geophys	sical data.						
Geological indicators		1	Indirect su	pport by geophysical	data.						
EXTRAPOLATION											
Dip direction			No subsur	face obs. point, supp	orted only	y by surface data. Hi	gh				
		1	uncertainty	/ in dip-direction. Stril	ke length	of the modelled zon	e <				
			2000 m.	•	U						
Strike direction		2	Supported	by geological concer	ot and pa	rtly by surface linear	nent.				
		FRA	CTURE CHA	ARACTER							
			No data avai	ilable							
INDIVIDUAL INTERCEPT	S										
			No data avai	ilable							

NNW		ZFMNN	W1034		Version I	number	6	Total object CL	20
GEOLO	OGICAL CH	IARACTER	Prop	perty	155000	160000	1	65000 170000	
Deformation style	Brittle			, <b>L</b> 3	0				0
Deformation	No data	a available.		0	1000		_	~	1000
description:					67	5	T	1 mm	67
Alteration:					100	~	X	11/2	
- First order:	Oxidati	on	;	3	8	25	-/-		& e
- Second order:	Argilliza	ation			7 050	4	1	XMM	0200
- Third order:	Epidoli	zalion o sots striking E	-W/ are		19 J	1		MIN 12	et9
orientation and	promin	ent followed by N	NNW		2	dik	V	AHDA Y	7
type:	set. Ge	ently dipping fract	tures		8		T)		5 8
	are als	o present. Occur	rence		2002			VAL 1	7000
	of seal	ed open and par	tly		°		SA.	X V	0
	open fr	acture. Dominan	ice of			X	H	XX	
Fracture comment	: Fractur	e apertures den	erally		000	11XV	J<	AN	000
	0.5 to 2	2 mm, with one	c.c.,		5695		1	XS	9695
	examp	le of 8 mm.					47	the same	9
Fracture fill	ure fill Open fractures, calcite, ralogy: chlorite, clay minerals, pyrite							2 7 inner	-
mineralogy:	chlorite	e, clay minerals, j	pyrite.		0000		X	how	0000
	Jaumor	itaciure, calcile,	, dote		6690		~ \		0699
	quartz.		uolo,		1.10				
	OBJECT	GEOMETRY			155000	160000	16	5000 170000	20.910
Strike/dip:	339°/78	3°			Model	oluma DMS		0 2 4 8	N
Length:	882 m				Baseline			S Lastmateret, Geldanterweiken	A
Mean thickness:	1/m(2	2 - 36 m)							
Geometrical	-660 m	N08054 Topo 4	Om arid Max er	ror					
constraints:	20m. 1	Surface Planar	Cut(s). 1	101					
	UNIVE	RSE Planar Cut	(s).						
			BASIS FOR	MOD	ELLING				
Zone based on surf	ace lineam	ents and borehol	le observations						
Outcrops:	-								
Boreholes:									
		Target i	ntercept		Geometric	intercept			
Borehole	PDZ	Coo un [m]	Sec_low	See	un Iml	Sec_lov	N C	Comment	
		Sec_up [m]	[m]	Sec	,_up [m]	[m]			
HFR106	DZ2	158.00	182.00	1	36.62	179.79			
HFR106	DZ3	158.00	182.00	1	36.62	179.79			
KFR101 KER106		256.00	266.00	2	10.56	79.86			
KEN 100	DLI	230.00	200.00	2	.00.09	271.05			
Tunnels:	-								
Lineament and/or	MSFR	08100, MSFR08 <sup>2</sup>	101.						
seismic									3
Indications:									
Based on magnetic	lineament	MFM1034G in F	orsmark stage	2.3 (19	aksson et :	al. 2007) th	at has	been adjusted slight	ly and
updated as lineame	ents MSFR0	8100 and MSFR	808101 in SFR	model	version 1.	0. Further r	nodifica	ation took place in th	ne
modelling work at th	ne north-we	st end, based or	n information fro	om KF	R101 DZ1	where the	zone p	asses through the	
magnetically disturb	ed pier are	a. The general th	hickness and st	teep d	ip to the no	orth-east are	e supp	orted by the forward	
modelling of magne	tic data alo	ng profile 2 (see	Appendix 6 in	Curtis	et al. 2011	). The zone	e is als	o intersected by KFF	<b>&lt;</b> 106
(200-200, DZ1), HF	-861) OUL 7	$r_{102}$ , $\nu_{22}$ and $\nu_{3}$	∠ວ).						

NNW	ZFM	NNW10	<b>34</b> Version number 6	Total object CL	20				
		B A A A A A A A A A A A A A	СЕМИЛИОВОSA СЕМИЛИИЗЗСВ2 ККИЧОВ СЕМИЛИИЗСВ3 ИМИЗССВ ККИЧОВ СЕМИЛИИЗСВ КСКИЧОВ СЕМИЛИИЗСВ СЕМИЛИИЗСВ СЕМИЛИИЗСВ						
		OBJECT	ONFIDENCE ESTIMATE						
Category		Object CL	Comment						
INTERPRETATION				20					
Data source Results of interpre	tation	2	MFM1034G, HFR106, KFR101, KFR10 High confidence observation in KFR10	06 6 HER106					
INFORMATION DEN	NSITY	5		0, 111 10100.					
Number of observ	ation points	3	4						
Distribution of obs	ervation points	3	Even distribution of obs. points.						
Geometry		3	Secmetry supported by multiple subsu	rface obs points					
Geological indicat	ors	2	Some discrepancies in the geological	data.					
EXTRAPOLATION									
Dip direction		2	Extrapolation in dip direction supported	by subsurface obs. p	oint.				
Strike direction		-	Strike length of the modelled zone < 20	<u>)00 m.</u>	aant				
		2	supported by geological concept and p	any by surface intean	nent.				
		FRAG	URE CHARACTER						
Orientation:	Set NNW: 342.3	3°/87.1°	ZFMNNW10	34					
(surke/dip right- hand-rule)	Set E: 94.3*/79. Set G: 55.4°/2 6	4 )°	N						
	Set G: 107.3°/3	1.8°	A						
Frequency:	Boreholes: KFR	101, KFR106							
	FRACTURE	TERZAGHI-							
	TYPE	WEIGHED		Sec. 1.					
	Operat	P10							
	open and	0.3 M-1	W	E	5				
	Sealed	18.6 m-1							
	Sealed	36.2 % of		···					
	network	DZ	Ver.	· · · · · · · · · · · · · · · · · · ·					
	Crush	0.7 % of D7	te.	1					
	Ciusii	intercept		/					
	<b>'</b>			Equal ar	'ea				
			Unassigned (344)     Set NNW (206)	Lower hemisphe	ere 45.6				
			Set E (447)     Mean pole Set	$E (4.3/10.6)$ Fisher $\kappa = 14.4$	43.0				
			Set G (158)     Mean pole Set	G (325.4/87.4) Fisher $\kappa = 30$	).2 6				
DOD:		0 moor:00	Set G (174) Mean pole Set	3(17.3)30.2 risner K = 33.1	0				
	,,,	u, iliedii.00							



Ν	INV	V				Ζ	F٨	ΛN	N٧	<b>N</b> 1	0	34	Ve	ersion num	<sup>ber</sup> 6	Tota	al object CL	20
				<u> </u>						IN	DIVI	DUAL IN	TERCE	PTS	•			
HFR10	6 DZ2	, D2	Z3 (1	58.0	-182	2.0 r	n)											
Length (m)	Elevation m.a.s.l. (m, RH2000)	Ofrae	pen	Sea	aled tures	Ope	n total ctures	Seale frac	d total tures	Tot fract	tal ures	Crushed zone	Sealed network	RQD reversed 100 = 0 low value = high value	Fracture open frac orientation	Fracture sealed fra orientation	Open c aperture n (mm)	Core loss
		0	20	0	20	0	20	0	20	0	20			0 100 0	90	0	90 0 10	)
1.000	-127 -		1 4		1		6- E				1				23	6 da	1	
159	-128 -							-						100.0	-	-+ 1	1	
160	-129							1.						100.0	-		2	
161	-130									F.				100.0				
163	101					ι.								100.0	4			
164	-131													100.0		1	1	
165	-132 -					1								100.0	-	-		
166	-133 -					2				22				100.0		-	*	
167	-134 -													92.2	~	1	10	
168	-135													100.0			A. C.	
169	176			1 C -				1		1.1				100.0			1	
170	-130													100.0		1		
171	-137							- C						100.0			~ «	
172	-138													100.0			6	
173	-139							6						100.0		1		
174	-140 -													100.0			-0-	
175	141			-				-						100.0			ALL ALL	
176	-141													99.7	100		- FL	
177	-142 -							1						95.0		1	1	
178	-143 -					E.		1						100.0	5 5		1	
179	-144	1						-		2	1	1.1.1		100.0	· · · ·			
180	-145 -			1		<b>r</b>		1	27	2	8			100.0	•			
181	1							-	-					100.0	1			







NNW		ZFMNN\	N120	4	Version	number	7	Fotal object CL	13
GEO	LOGICAL CH	ARACTER		Property	155000	160000	165000	0 170000	
Deformation sty	le: Brittle			3					0
Deformation description:	Steeply NNW st displace clay mir faults w strike-sl fault sho displace	dipping fault wit rikeshows strike ement and chlori erals Steeply di ith SW strike sh ip displacement ows sinistral stril ement.	th e-slip ite and ipping ows . One ke-slip	5	6705000 671000	Z	5	A Constant	6705000 6715000
Alteration:					8	No la	NA N		00
- First order:	Oxidatio	on .		3	2000	V. A		XI IS	2000
- Second order:	Not obs	erved			°			X Y	9
Fracture orientation and type:	Fracture conspic NE fract dipping	Not observed           Not observed           Fractures that strike NNW are conspicuous. Steeply dipping           NE fractures and some gently dipping fractures are also present. Sealed fractures			6695000				6695000
	dominat estimate some se network	dipping fractures and some gently dipping fractures are also present. Sealed fractures dominates. Quantitative estimate and span include some sealed fracture networks and a crush zone.			6690000		$\langle \rangle$		669000
Fracture comme	ent: No data	No data available.			155000	160000	165000	170000	
mineralogy:	hematite minerals fracture dipping	e/adularia. Clay s present in a fe s, both NNW ste and gently dipp	w eeply ing.		Baselin	volume DMS e		0 2 4 8 Vi Sturbense ki, Goodstarrender	Ă
	OBJECT	GEOMETRY							
Strike/dip:	347°/85	0			_				
Length:	-				_				
Mean thickness:	4 m (1 -	13 m)			-				
Max depth: Geometrical constraints:	-550 m ZFMEN grid Ma Cut(s).	E1061A, ZFME x error 20m, 1 S	NE2248, T Surface Pla	opo 40m Inar	FLUNG				
Zone based on a	borehole obse	ervation.	DAGIOI						
Outcrops:									
Boreholes:									
		Townet			Coorestri	Intercent			
Borehole	PDZ	Sec. up [m]	Sec_lo	w Se	Geometric	Sec_low	Con	nment	
KFM08A	DZ2	479.00	[m] 496.00		478.22	[m] 494.77			
Tunnels: Lineament and/o seismic indications:	or -								
			MODELL	ING PRO	CEDURE				
On the basis of the brittle deformation Deformation zone interval 476-483 r	Don the basis of the orientation of fractures, the borehole interval 479-496 m in borehole KFM08A (DZ2) is modelled as a prittle deformation zone with NNW strike and steep dip, which developed along the tectonic foliation in the bedrock. Deformation zone plane placed at fixed point 480 m in KFM08A. Decreased radar penetration also along the borehole Interval 476-483 m in KFM08A. Truncated against ZFMENE1061A and ZFMENE2248. Inferred to be a minor zone.								

NNW	ZFM	ZFMNNW1204		Version number	7	Total object CL	13
KFNIZE ZENIE	NE2248	ZFMA KFMORA FINENE1061A FINENE1061A FINENE1061A FINENE1061A FINENE1061A		ESTIMATE	T	AND THE OWNER OF THE OWNER OWNER OF THE OWNER OWNER OWNER OF THE OWNER	INTE
			•				
Category INTERPRETATION Data source Results of interpre INFORMATION DEN Number of observ Distribution of observ	etation NSITY ration points	Object CL           2           3           1           1	Comment No surface ir High confide	ntersection, modelle nce observation in	ed from z KFM08A.	-200 to -550 m, KFM	108A
INTERPOLATION Geometry Geological indicat EXTRAPOLATION	ors	1	Geometry su Single obser surface geop	pported by a linear vation point at dept hysical data.	nent and h. Zone n	a single intercept. nodelled mainly base	ed on
Strike direction		2	Extrapolation Strike length Supported by points.	o in dip direction su of the modelled zo y geological concep	pported b ne < 2000 ot and sub	y subsurface obs. po ) m. osurface observation	oint.
		FRAC	TURE CHAR	ACTER			
Orientation: (strike/dip right- hand-rule)	Set NNW: 354.0	D°/75.3°		ZFMN	NW1204 N	+	
	FRACTURE TYPE Open and partly open Sealed Sealed network Crush	• Unass • Set N	igned (67) vW (40) ▲ Mean po		Equal Lower hemisp	area here 20.6	
RQD:	min:79, max:10	0, mean:98					





NNW	Z	ZFMNNW12		Α	Version	number	5	Total object CL	20
GEO	LOGICAL CH	IARACTER	I	Property	155000	160000	165000	0 170000	
Deformation sty	/le: Brittle			<u>CL</u>					0
Deformation description:	Steeply SSE str sometir calcite : strike-s with ge shows reverse	/ dipping faults w rike have chlorite mes accompanie striae with sinisti lip displacement ntle dip to the St chlorite striae an e dip-slip displace	vith ed by ral t. Fault SE id ement.	3	6705000 671000	J.	S	A Constant	6705000 671000
Alteration:					8		X		00
- First order:	Oxidati	on		3	2002	VC See	XV	HIV IS	7000
- Second order	: Chioriti	zation			°		AY	X Y	0
Fracture orientation and type:	Fractur a consp dipping dipping present domina estimat	es that strike SS picuous set. Gen fractures and st NE fractures and t. Sealed fracture tes. Quantitative te and span inclu	E form htly teeply e also es ide	2	660000				r 690000 6695000
Eracturo comm	sealed	Tracture network	.s.		9			S	ō
Fracture fill mineralogy:	Calcite hematit	, chlorite, laumor te/adularia, quart clay minerals.	ntite, tz,		155000	160000 volume DMS	165000	) 170000	N
	OBJECT	GEOMETRY							
Strike/dip:	161°/77	7°			_				
Length: Mean thickness	366 M	12 m)			_				
Max denth:	-370 m	- 13 11)							
Geometrical constraints:	ZFMEN 20m, Z Cut(s),	NE0159A, Topo 4 FMENE1061A, 1 1 UNIVERSE PI	40m grid Ma 1 Surface P lanar Cut(s)	ax error Planar ).					
			BASIS F	OR MOD	ELLING				
Zone based on s ZFMNNW1205B	urface and bo , judged to cor	rehole observationstitute elements	ons. Zone 2 s of one and	ZFMNNW d the same	1205 consi e structure	sts of two seg	ments, 2	ZFMNNW1205A	and
Outcrops: Borobolos:	-								
		_					-		
Porchala	007	Target ir	ntercept		Geometric	intercept	-	mont	
Borenoie	PDZ	Sec_up [m]	Sec_iov [m]	N Sec	:_up [m]	Sec_low [m]	Com	iment	
KFM08B	DZ2	167.00	185.00	1	67.76	184.30			
KFM13	DZ1	37.00	49.00	;	34.78	42.56	DZ1 ZFM	also lies within NNW1205B.	
KFM21	DZ1	18.30	27.80		18.59	27.91			
Tunnala	ſ								
Lineament and/ seismic indications:	or MFM21	169G.							2
			MODELL	ING PRO	CEDURE				
On the basis of the DZ2, respectively tectonic foliation ZFMENE0159A	he orientation y) are modelle in the bedrock and ZFMENE1	ot fractures, the d as a brittle defe . Deformation zo 1061A. Inferred t	borehole in ormation zo one plane p o be a mino	ntervals 13 one with N placed at fi or zone.	3-140 m a NW strike xed point ?	nd 167-185 m and steep dip 176 m in KFM	, which o 08B. Tru	hole KFM08B (D developed along incated against	∠1 and the



	Sealed 7.5 % network interc Crush 1.1 % interc	6 of DZ 2ept 6 of DZ 2ept	Unassigned (27 Sct SSE (59)	76) ▲ Mean pole 5	Set SSE (68.8/10.2	Equal area Lower hemisphere
RQD:	min:51, max:100, mea	n:93				









NNW	Z	ZFMNNW12		3	Version number 5		Total object CL	21			
GEOI	LOGICAL CH	IARACTER	Pr	operty	155000	160000	165	000 170000			
Deformation styl	<b>b</b> : Brittle			3					0		
Deformation description:	Steeply SSE st sometin calcite slip dis	dipping faults w rike shows chlori mes accompanie striae with revers placement.	vith ite, ed by se dip-	5	000 6710000	R	5	J.J.	000 671000		
Alteration:					\$2205	w 1	1		1050		
- First order:	Oxidati	on		з	5			THAN 2	Colorenti-		
- Second order:	Not obs	served		5	5	11F	X	CHHAN NE	2		
- Third order: Fracture orientation and type:	Not obs Domina fracture W. Don fracture present fracture	served ated by NNV-SS as set that dips s ninance of seale as. Open fracture t. Occurrence of as networks pres	O teeply d es are sealed ent.	2	695000 6700000				395000 670000		
Fracture comme	nt: Apertur than 0.3 up to 5 Calcite	res are generally 5 mm. Few aper mm present. . chlorite. laumor	tures	L	9				0000 66		
mineralogy:	and he	matite.			669			1. 1. 1	699		
	OBJECT	GEOMETRY					1996				
Strike/dip:	155°/79	)°			155000	160000	165	000 170000	2250		
Length:	284 m	10			Model	volume DMS		0 2 4 8	Ň		
Max denth:	4 m (1	- 13 m)			Baselin	c		S Laitmitest, Gridenessies	~		
Geometrical constraints:	ZFMNN 40m gr 1 Surfa Planar	W1205A, ZFME id Max error 20n ce Planar Cut(s) Cut(s).	ENE0159A, T n, ZFMENE1 n, 1 UNIVERS	opo 061A, SE							
		• •	BASIS FO	R MOD	ELLING						
Zone based on su ZFMNNW1205A a	urface lineame and ZFMNNV	ents, outcrop and /1205B, judged	d borehole of to constitute	oservatio element	ons. Zone 2 s of one ar	ZFMNNW12 nd the same	205 cons structu	sists of two segmer re.	ıts,		
Outcrops:	AFM00	1393									
Boreholes:											
		Target in	ntercept		Geometric	intercept					
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	:_up [m]	Sec_lov [m]	v Co	omment			
KFM08B	DZ1	133.00	140.00	1	28.71	142.90					
KFM13	DZ1	37.00	49.00	4	45.28	51.45	DZ ZF	21 also lies within MNNW1205A.			
KFM21	DZ3	86.10	94.90	1	86.50	94.38					
Tunnoloi											
Lineament and/o seismic indications:	Tunnels:     -       Lineament and/or seismic indications:     MFM2168G, MFM2169G.										
	d on the basi	s of outcrop and	horehole da	ta from t	be investiv	nations of th	e shallo	w rock mass in the	drift		
Originally modelled on the basis of outcrop and borehole data from the investigations of the shallow rock mass in the drift area where the zone was named ZFMNNW2168. Later renamed to ZFMNNW1205B in the FPS-Access model (Follin 2019). ZFMNNW1205B is inferred to be a foliation parallel splay or sister to ZFMNNW1205A developed as second order structures due to displacements along ENE-trending zones. Projected towards depth based on three borehole intercepts, where KFM13 PDZ1 is shared with ZFMNNW1205A. Fix points are consequently used for KFM08B PDZ1 and KFM21 PDZ3. Cut-off depth based on the ground surface trace length.											













NNW		ZFMNNW1209				number	<b>4</b> Tota	l object CL	22		
GEOLC	GICAL CH	ARACTER	Prop C	erty L	155000	160000	165000	170000			
Deformation style:	Brittle			3 9	2				Q		
Deformation	Minor c	ohesive breccia	s and	200	00				000		
description:	catacla	sites present in I	KFR35	13	10	2	- C	· ·····	671		
	DZ1.					<		2	1.1		
Alteration:					- And A	5	IVI	m li	3		
- First order:	Oxidatio	on				1 -	VN	1 Pl	5 000		
- Second order:	Not obs	served		5		1 1	AIT		0200		
- Third order:	Not obs	served			the second	1	= / TH	$\Lambda \setminus \mathcal{Z}$	(real-mont)		
Fracture	No data	a available.			5	11	XAH	CA No			
orientation and				Ş	3 { /			$  \land    $	5 8		
type:				2 202	e C	17.70	KIA	1//	000		
Fracture comment	: No data	No data available.				i Z L L L L L L L L L L L L L L L L L L					
Fracture fill	Adularia	a, calcite, quartz	and		5	XSS	HANT				
mineralogy:	asphalt	ite.		9		1311.6	EAX	/	0		
	OBJECT	GEOMETRY			200	- 14 14 CV	~	$\langle \rangle$	500		
Strike/dip:	153°/83	°		200	00	1 11	$\sim$	2	666		
Length:	337 m				1.1	1 1	X	A summer			
Mean thickness:	18 m (2	: - 18 m)				//	1	5	-		
Max depth:	-340 m			000			/ hr	1	0000		
Geometrical	ZFMNN	IE0869, ZFMNE	0870, Topo 40	n g	1300	Ý		296 3	2690		
constraints:	grid Ma	x error 20m, 1 S	Surface Planar						Ū.		
	Cut(s).								20.001		
					155000	100000	105000	170000			
							165000	170000	N		
					155000 Model v Baseling	160000 Dlume DMS	165000		Å		
			BASIS FOR	MODELI	155000	160000 Dlume DMS	165000	170000	Å		
Zone based on surfa	ace observa	ations and tunne	BASIS FOR	MODELI	155000 Model v Baseline	160000 Dlume DMS	165000	170000	Ă		
Zone based on surfa	ace observa	ations and tunne	BASIS FOR	MODELI	155000 Model v Baseline	160000 Dlume DMS	165000	170000	Ň		
Zone based on surfa Outcrops: Boreholes:	ace observa	ations and tunne	BASIS FOR	MODELI	155000 Model v Baselino LING	160000 olume DMS	165000	170000	Ň		
Zone based on surfa Outcrops: Boreholes:	ace observa	ations and tunne	BASIS FOR	MODELI	155000 Model v Baseline	160000		170000	Ň		
Zone based on surfa Outcrops: Boreholes:	ace observa	ations and tunne Target in	BASIS FOR Is intersections	MODELL	155000 Model v Baseline	160000 Jume DMS		170000	Å		
Zone based on surfa Outcrops: Boreholes: Borehole	ace observa	ations and tunne Target in Sec_up [m]	BASIS FOR Is intersections ntercept Sec_low	MODELI Ge Sec_u	155000 Model v Baselinc LING ometric up [m]	160000 olume DMS	Comme	170000	Ň		
Zone based on surfa Outcrops: Boreholes: Borehole	ace observa	ations and tunne Target in Sec_up [m]	BASIS FOR Is intersections ntercept Sec_low [m]	Ge Sec_u	ISSOUD	intercept Sec_low [m]	Comme	nt	Ň		
Zone based on surfa Outcrops: Boreholes: Borehole KFR33	ace observa	Target in Sec_up [m]	BASIS FOR Is intersections ntercept Sec_low [m]	Gee Sec_u 46.	155000  Model v Baseline LING  ometric up [m] 09 88	160000 blume DMS intercept Sec_low [m] 114.55 74.01	Comme No SHI a	nt available.	Ň		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35	ace observa - PDZ DZ1	ations and tunne Target in Sec_up [m] - 32.70	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00	Ge           Sec_u           46.           32.	155000 Model v Baseline LING ometric up [m] 09 88	160000 blume DMS intercept Sec_low [m] 114.55 71.01	Comme No SHI a	nt available.	Ň		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels:	ace observa - PDZ DZ1	Target in Sec_up [m] - 32.70	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00	MODELI Gee Sec_u 46. 32.	ISSOUD	160000 Jume DMS intercept Sec_low [m] 114.55 71.01 t 0+920-0+94	Comme No SHI a	nt available.	0+893-		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels:	Ace observa - PDZ DZ1 DT targ 0+893 t	ations and tunne Target in Sec_up [m] - 32.70 et intercept 0+9 n. geometric intercept 0+9	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0	Georgenetics in the second sec	ISSOUO Model v Baseline LING ometric up [m] 09 88 intercep NBT tar	160000 Jume DMS intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 pet intercept	Comme No SHI a 5 m. BT targ	nt available.	0+893- -000-		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels:	- PDZ DZ1 DT targ 0+893 r 0+010 r	ations and tunne Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100	MODELI           .           .           Sec_u           46.           32.           eometric i           +907 m.           -0+100 m.	ISSOUD	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1	nt available. get intercept 0+ 17 m. 2BTF	0+893- -000- target		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels:	- PDZ DZ1 DT targ 0+893 r 0+010 r intercet	Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i ot: 0+078-0+080	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i	MODELI           .           .           Sec_u           46.           32.           cometric i           +907 m.           -0+100 m           netrecept 1	155000  Model v Baseline  ometric  p [m] 09 88  intercep NBT tarn n, geom 0+070-0	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1' target interg	nt evailable.	0+893- -000- target 0+060		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels:	DZ1 DT targ 0+893 r 0+010 r interceg m, geor	Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i ot: 0+078-0+080	BASIS FOR Is intersections Is intersections Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i 0+048-0+068 m	Ge     Ge     Sec_u     46.     32.     ometric i +907 m0+100 m htercept t . BMA ta	ISSOUD	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA ercept:0+030	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1' target intera -0+030 m. g	nt available. get intercept 0+ 17 m. 2BTF cept: 0+055- eometric inte	0+893- -000- target 0+060 prcept		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels:	DZ1 DT targ 0+893 r 0+010 r interceg m, geor 0+030-f	Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i ot: 0+078-0+080 metric intercept 0 0+055 m.	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i 0+048-0+068 m	Ge           Sec_u           46.           32.           cometric i           +907 m.           -0+100 m           ntercept ()           BMA tai	ISSOUD	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA ercept:0+030	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \ target interc -0+030 m, ge	nt available. get intercept 0+ 17 m. 2BTF cept: 0+055- eometric inter	0+893- -000- target 0+060 ercept		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels: Lineament and/or	DZ1 DT targ 0+893 r 0+010 r interceg m, geor 0+030-( MFM31	Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i ot: 0+078-0+080 metric intercept 0 0+055 m. 14G.	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i 0+048-0+068 m	Ge Sec_u 46. 32. eometric i +907 m. -0+100 m htercept i . BMA ta	ISSOUO Model v Baseline Description Desc	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept +090 m. BLA ercept:0+030-	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \ target interc -0+030 m, ge	nt available. cintercept 0+ 17 m. 2BTF cept: 0+055- eometric inte	0+893- -000- target 0+060 ercept		
Zone based on surfa Outcrops: Boreholes:  KFR33 KFR35 Tunnels: Lineament and/or seismic	DZ1 DT targ 0+893 r 0+010 r intercer m, geor 0+030-6 MFM31	ations and tunne Target in Sec_up [m] - 32.70 et intercept 0+9 m, geometric inter n, 1BTF target i ot: 0+078-0+080 metric intercept 0 2+055 m. 14G.	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i 0+048-0+068 m	Ge Sec_u 46. 32. cometric i +907 m. -0+100 m ntercept i 0. BMA ta	ISSOUO	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept +090 m. BLA ercept:0+030	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \ target interc -0+030 m, ge	nt available. get intercept 0+ 17 m. 2BTF cept: 0+055- eometric inte	0+893- 000- target 0+060 ercept		
Zone based on surfa Outcrops: Boreholes: KFR33 KFR35 Tunnels: Lineament and/or seismic indications:	DZ1 DT targ 0+893 r 0+010 r intercer m, geor 0+030-6 MFM31	ations and tunne Target in Sec_up [m] - 32.70 et intercept 0+9 m, geometric inter n. 1BTF target i ot: 0+078-0+080 metric intercept 0 0+055 m. 14G.	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i 0+048-0+068 m	Ge Sec_u 46. 32. cometric i +907 m. -0+100 m ntercept 0 . BMA ta	ISSOUO	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA ercept:0+030-	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \ target interc -0+030 m, ge	nt available. get intercept 0+ 17 m. 2BTF cept: 0+055- eometric inte	0+893- 00-target 0+000- target 0+060 ercept		
Zone based on surfa Outcrops: Boreholes: Borehole KFR33 KFR35 Tunnels: Lineament and/or seismic indications:	DZ1 DT targ 0+893 r 0+010 r intercep m, geor 0+030-0 MFM31	ations and tunne Target in Sec_up [m] - 32.70 et intercept 0+9 m, geometric inter n. 1BTF target i ot: 0+078-0+080 metric intercept 0 0+055 m. 14G.	BASIS FOR Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, ge ercept 0+885-0 ntercept 0+100 m, geometric i 0+048-0+068 m	Ge Sec_u 46. 32. oometric i +907 m. -0+100 m ntercept 0 . BMA ta	ISSOUO	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA ercept:0+030-	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \ target interc -0+030 m, ge	nt available. get intercept 0+ 17 m. 2BTF cept: 0+055- eometric inte	0+893- 00-target 0+000- target 0+060 ercept		
Zone based on surfa Outcrops: Boreholes: Borehole KFR33 KFR35 Tunnels: Lineament and/or seismic indications: Adopted from geolo	DZ1 DT targ 0+893 r 0+010 r intercep m, geor 0+030-0 MFM31 gical model	ations and tunne Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i ot: 0+078-0+080 metric intercept 0 0+055 m. 14G. for SFR (Axelss	BASIS FOR Is intersections Is intersections ntercept Sec_low [m] - 70.00 30 0+930 m, georetric i 0+048-0+068 m MODELLING son and Hansel	Ge           Sec_u           46.           32.           cometric i           +907 m.           -0+100 m           ntercept 0           n. BMA ta           PROCEI           n 199). E	155000 Model v Baseline LING ometric ometric op [m] 09 88 intercep NBT tarn, geomediate 0+070-0 arget intercep DURE xtended	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA ercept:0+030-	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \ target interc -0+030 m, geometric -0+030 m, geometric -0+040 m, geomet	nt available. get intercept 0+ 17 m. 2BTF cept: 0+055- eometric inte	0+893- 000- target 0+000- target 0+060 ercept 1		
Zone based on surfa Outcrops: Boreholes: Borehole KFR33 KFR35 Tunnels: Lineament and/or seismic indications: Adopted from geolo (zone 3 at SFR) and	DZ1 DT targ 0+893 r 0+010 r intercer m, geor 0+030-0 MFM31 gical model d ZFMNE08	Target in Sec_up [m] - 32.70 et intercept 0+9 n, geometric inter n. 1BTF target i ot: 0+078-0+080 netric intercept 0 0+055 m. 14G. for SFR (Axelsa 70 (zone 9 at SI	BASIS FOR Is intersections Is intersections Is intercept Sec_low [m] - 70.00 30 0+930 m, georetric in 0+048-0+068 m MODELLING son and Hansel FR). Modelled t	MODELI Sec_u 46. 32. cometric +907 m. -0+100 m ntercept a. BMA ta	Intercep     NBT tarn, geom.     O+070-0     arget intercep     Xtended     n of 350	intercept Sec_low [m] 114.55 71.01 t 0+920-0+94 get intercept etric intercept +090 m. BLA ercept:0+030 so as to be t m. Inferred to	Comme No SHI a 5 m. BT targ - , geometric t 0+090-0+1 \target interc -0+030 m, geometric t outper a state of the state -0+030 m, geometric -0+030	nt available. get intercept ; intercept 0+ 17 m. 2BTF cept: 0+055- eometric inte ainst ZFMNN zone. Interc	N           0+893-           000-           target           0+060           prcept           1           NE0869           epted by		



Category		Object CL	Comment
INTERPRETATION		-	
Data source		3	MFM3114G, KFR33, KFR35, and at least observed in four storage caverns in SFR facility (Axelsson and Hansen 1997).
Results of interpre	etation	3	High confidence observation in KFR35 and tunnels.
INFORMATION DENSITY			
Number of observ	ation points	3	>4
Distribution of obs	servation points	3	Even distribution of obs. points.
INTERPOLATION	•		
Geometry		3	One strong interpolation alternative due to observation of the zone from multiple tunnels.
Geological indicat	tors	3	Supported by key geological parameters.
EXTRAPOLATION			
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.
Strike direction		2	Supported by geological concept and partly by surface lineament.
		FRA	CTURE CHARACTER
Orientation:			
(strike/dip right-			
hand-rule)			
Frequency:	Boreholes: KFR	33, KFR35	
	FRACTURE	TERZAGHI-	
	TYPE	WEIGHED	

P10

9.1 m-1

0.0 m-1

intercept 0.8 % of DZ

intercept

0.0 % of DZ

Open and

partly open

min:10, max:77, mean:43

Sealed Sealed

network

Crush

RQD:

NNW	<b>ZFMNNW1209</b>	Version number <b>4</b>	Total object CL <b>22</b>	2
Fracture fill mineralogy:		KFR35(32.7-70.0)		
mineralogy.	400 - 400 -	POPTICIPAL AND ON ON OTO DATE OF	Open and partly open	



NNW	ZFMNNW3	113	Version number	11	Total object CL	9
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	No data available	CL				
Deformation	No data available.		10000		~	10000
description:			5	T	1 mm	67
Alteration:		_	$\sim$	X		
- First order:	Not observed	-	8 2	1-	121-5	1 8
- Second order:	Not observed	-	Juny 050	1 1		050
Fracture orientation	Not observed No data available		15 K	1	HU / S	67
and type:			2.11		ALLA	
Fracture comment:	No data available.		00 {	XX		00
Fracture fill	No data available.		2000		AL S	7000
mineralogy:			° ×		XX X	0
OBJ				A	M/	
Strike/dip:	172 <sup>-</sup> /90 <sup>-</sup>		000	X	AN .	000
Mean thickness:	1234 III 15 m (3 - 50 m)		1995	A	XI	695(
Max depth:	-1250 m		° I	M V	and and a summer	9
Geometrical	ZFMNW0805A. Topo 40m	n arid Max	1 121		2 7	
constraints:	error 20m, ZFMWNW357	1, 1 Surface	00	$\langle \times \rangle$	how	000
	Planar Cut(s).		2660	~ /		0690
			Ű l			e
			455000 40000	400	470000	120.5
			155000 160000	) 165	170000	N
			Model volume DMS     Baseline		0 2 4 8	A
	DAC					
Zone based on surface line	eaments.		JELLING			
Outcrops:	-					
Borenoies: -						
Tunnels:	-					
Lineament and/or	MSFR08079, MFM3581.					1
seismic indications:						
The position of the zone of	t the ground ourfood in bood	<u>LLING PRC</u>	ICEDURE	9070 in S	ED model version 1	0 hoing
a very minor revision of lin	eament MFM3113G in Forsi	mark stage 2	3 (Isaksson et al. 20	0079113 007) The	earlier number has	been
maintained for traceability	purposes in different lineam	ent interpreta	ations. The modelled	thicknes	s and dip are default	t values.
		•				~
				ZFAR	\$265	<u> </u>
				INNN N	15-	
					3266	
					A PAR	
	R				E	
10			ZFM	NS3154	E3	
	5			/	5	
ß	7				· · · · · · · · · · · · · · · · · · ·	
			ZEMNNW09	99		/
						1
	NIN0997					21
ZF	MILL					12
			ANININ/311	3		-
		ZF	VIIAIAAA			
						1
			45			
			0805.			
0 10	0 200 300 500	)m	MANNE	2~		
			LEW			

NNW	ZFI	MNNW3	5113	Version number	11	Total object CL	9		
OBJECT CONFIDENCE E	STIMATE			•					
			-						
Category		Object CL	Comment	Comment					
INTERPRETATION									
Data source		1	MFM31130	G, MSFR08079, MFN	//3581				
Results of interpretatio	n	1	Low confid	lence in lineament M	FM3113G	i.			
INFORMATION DENSIT	Y								
Number of observation	1	1							
Distribution of observation points 1 Single observation point in the form of lineaments.				eaments.					
INTERPOLATION			•						
Geometry	1	Geometry supported by surface geophysical data.							
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction			No subsur	face obs. point, supp	orted only	v by surface data. Hid	gh		
		1	uncertainty in dip-direction. Strike length of the modelled zone <				, e <		
			2000 m.						
Strike direction		2	Supported	by geological conce	ot and pa	rtly by surface lineam	ient.		
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPT	S								
			No data avai	lable					

NNW	ZFMNNW3	524	Version number	3	Total object CL	13
GEOLOGICAI	CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation style: Deformation description:	No data available No data available. Zone based on lineament maps in the catchment		6210000	S.	J R	6710000
	area.		8 2		V 1 3	
Alteration: - First order:	Not observed	-	670500		AND	670500
- Second order: - Third order:	Not observed Not observed		1.1	X	ALLA So	
Fracture orientation and type:	No data available.		100000		XI	00000
Fracture comment: Fracture fill	No data available. No data available.	-	ei		X//	67
mineralogy: OBJ	ECT GEOMETRY		0000	X	AX/	000
Strike/dip:	147°/90°		66995	A	$\times$	5695
Length:	7671 m			H Y	The second	U.
Mean thickness:	45 m (15 - 64 m)				2 7 man	1
Max depth:	-2100 m		0000	$\langle \times \rangle$	how	0000
Geometrical constraints:	Topo 40m grid Max error 2 ZFMWNW3519, 2 Surface Cut(s).	20m, Planar	8 155000 160000	) 165	5000 170000	2.
			Baseline Model volume DMS		0 2 4 8 Statistics of Grateriae and an	A
	BASI	S FOR MOD	ELLING			
Zone based on surface lin	eament.					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MFM3524.					2
seismic indications:	Mode					-
-	MODE	LLING PRO	CEDURE			
	Lennur Control	2	Contraction of the second seco	4 km		
				ver	m M ~	-

NNW	ZFN	MNNW3	524	Version number	3	Total object CL	13	
<b>OBJECT CONFIDENCE E</b>	STIMATE							
		•						
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM3524					
Results of interpretation	n	2	Medium co	onfidence in lineamer	t MFM35	524.		
INFORMATION DENSIT	Y							
Number of observation points		1	1					
Distribution of observa	1	Single observation point in the form of a lineament.						
INTERPOLATION			Ŭ	•				
Geometry		1	Geometry supported by surface geophysical data.					
Geological indicators		1	Indirect support by geophysical data.					
EXTRAPOLATION								
Dip direction		<u> </u>	Extrapolated to the base of the model volume. Strike length of the					
		3	modelled zone > 2000 m.					
Strike direction		0	Conceptual understanding of the site and that the entire modelled					
	3	zone is supported by the lineament.						
		FRA	CTURE CHA	RACTER				
			No data avai	lable				
INDIVIDUAL INTERCEPT	S							
	No data available							

NNW	ZFMNNW3	534	Version number	3	Total object CL	11
GEOLOGICAL	CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation style:	No data available	01	9			0
Deformation	No data available. Zone		000		m	000
description:	based on lineament		2 61	T	The man	671
• • • •	maps in the catchment		{	Y		
	area.		5	/	123/2	
Alteration:			2000	-1	MPL	5000
- First order:	Not observed		670	1	AM	670
- Second order:	Not observed		the last	W	111 5	moni
- Third order:	Not observed		5111	X	AHA IS	
Fracture orientation	No data available.		500		×11/15	0000
Eracture commont:	No data available	-	67	AN A	MAN Y	6700
Fracture fill	No data available.			AT)	XX /	
mineralogy:			1 K Chille	S	AVY	
OBJ	ECT GEOMETRY		000	XX	M	000
Strike/dip:	174°/90°		3698	N	XI	9695
Length:	9158 m			12/	A and a second	Ø
Mean thickness:	50 m (15 - 64 m)				2 7 2	
Max depth:	-2100 m		8		hard	00
Geometrical	Topo 40m grid Max error 2	20m.	0055		v	006
constraints:	ZFMNW3511. 1 Surface P	lanar	66			66
	Cut(s).		1 1 1 1 1 1			24.4
			155000 160000	) 16	5000 170000	1013
			Model volume DMS			N
			Baseline		d California port Geodecine sources	N
	BASI	S FOR MOD	ELLING			
Zone based on surface line	eament.					
	1					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MFM3534.					0
seismic indications:						2
	MODE	LLING PRO	CEDURE			
-						
Truny sett of	EFMNNW3534			5	, o o o	~
0_100	200 300 500 m	0	A Co	S z	$\triangleleft$	

NNW	ZFMNNW3		534	Version number	3	Total object CL	11				
OBJECT CONFIDENCE E	STIMATE										
Category		Object CL	Comment	Comment							
INTERPRETATION											
Data source		1	MFM3534. lineament.	MFM3534. The zone is partly based on the interpreted surface lineament.							
Results of interpretatio	n	2	Medium co	nfidence in lineamer	t MFM35	34.					
INFORMATION DENSIT											
Number of observation	n points	1	1								
Distribution of observa	1	Single observation point in the form of a lineament.									
INTERPOLATION				•							
Geometry		1	Geometry supported by surface geophysical data.								
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.				gh e <				
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.				elled				
		FRA	CTURE CHA	RACTER							
			No data avai	lable							
INDIVIDUAL INTERCEPT	S										
			No data avai	lable							

NNW	ZFMNNW3	550	Version number	3	Total object CL	10		
GEOLOGICAL	CHARACTER	Property CL	155000 160000	) 16	5000 170000			
Deformation style: Deformation description:	No data available No data available. Zone based on lineament maps in the catchment		6710000	Y.	D C	6710000		
	area.		e 2	/_	1 m 1 3	1 0		
Alteration:	Not also and	-	200		INN	5000		
- First order:	Not observed	_	5			67(		
- Second Order.	Not observed		1. 1.	- V	ATA Z			
Fracture orientation and type:	No data available.		00000		XIA 3	00000		
Fracture comment:	No data available.		67	AS .	WIV	67(		
Fracture fill	No data available.			2AIP	XX/			
mineralogy:			· / / ////	SE	-17	0		
OBJ	ECT GEOMETRY		4 1 1 200	Mrs .	X	500(		
Strike/dip:	159°/90°		666	211	X	669		
Length:	5041 m			14 Y	A sure			
Mean thickness:	35 m (15 - 64 m)		N NS	1	V / J man			
Max depth:	-2100 m		000	X	how	000		
Geometrical	Topo 40m grid Max error 2	20m,	660	~ /		0690		
constraints:	ZFMNW0854, ZFMNW351	11.	9			Ō		
						20.000		
			155000 160000	) 16	5000 170000			
			Model volume DMS			N		
			Baseline		Clastingent Deckenserverker	A		
	BASI	IS FOR MOD	ELLING					
Zone based on surface line	eament.							
Outcrops:	-							
Boreholes: -								
Tunnels:	-							
Lineament and/or	MFM3535.					2		
seismic indications:						5		
	MODE	ELLING PRO	CEDURE					
-								
e C ENNINSSTI								
	<u>0 100 200 100 500m 1</u> k ZE	= <u>MNNW3</u> 	2.2km					

NNW	ZFMNNW3			Version number	3	Total object CL	10	
<b>OBJECT CONFIDENCE E</b>	STIMATE							
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM3535					
Results of interpretation	n	1	Low confid	ence in lineament M	FM3535.			
INFORMATION DENSITY								
Number of observation	n points	1	1					
Distribution of observa	1	Single observation point in the form of a lineament.						
INTERPOLATION								
Geometry	1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.					
EXTRAPOLATION								
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.				.gh ⊧e <	
Strike direction 3			Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.					
		FRA	CTURE CHA	RACTER				
			No data avai	lable				
INDIVIDUAL INTERCEPT	S							
No data available								


NS	ZF	MNS3 <sup>2</sup>	Version number         12         Total object CL         9						
OBJECT CONFIDENCE ES	STIMATE								
			-						
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM31540	G					
Results of interpretation		1	Low confid	ence in lineament M	FM3154G				
INFORMATION DENSITY									
Number of observation	points	1	1						
Distribution of observati	on points	1	Single obs	ervation point in the f	form of a l	ineament.			
INTERPOLATION									
Geometry		1	Geometry	supported by surface	geophys	ical data.			
Geological indicators		1	Indirect su	port by geophysical	data.				
EXTRAPOLATION									
Dip direction			No subsurf	ace obs. point, supp	orted only	by surface data. High	gh		
		1	uncertainty	in dip-direction. Stri	ke length	of the modelled zone			
			2000 m.	•	Ū				
Strike direction		2	Supported	by geological conce	ot and par	tly by surface linear	nent.		
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPTS									
			No data avai	lable					

NW		ZFMNW0002 Version number 8 Total object CL				22						
GE	OLOG	SICAL CH	ARACTER		Prope	erty	155000	160000		165000	170000	
Deformation st Deformation description:	tyle:	Brittle-I Deform tempera facies) and late reactiva regime. texture promine along th within a of inten (amphil deforma tectonic Dextral of displa tempera deforma foliated segmen	3		650000 655000 670000 6710000	Je se	La		- Contraction of the second se	50000 6695000 6705000 571000		
Alteration: - First order: - Second orde	er:	Oxidatio Chloritiz	on zation		3		0 155000 Model	160'000		165000	170000	CO Read
Fracture orientation and type: Fracture comm	d nent:	Low fra tunnel 3 fracture from SF (percus Open fr	along data es are m, with	1		Baselir	nc			2 UNITARY SOLUTION	N	
Fracture fill mineralogy:		a few ra Chlorite	anging up to 3 m e, calcite.	ım.								
		OBJECT	GEOMETRY									
Strike/dip:		312°/90	)°									
Length:		3895 m										
Mean thicknes	s:	50 m (5	i0 - 200 m)									
Max depth:		-2100 n	n									
Geometrical constraints:		Topo 40 ZFMWI Cut(s).	0m grid Max err NW0001, 1 UNI	or 20m, VERSE P	lanar							
				BASIS	FOR	IODE	LLING					
Zone based on	surfac		ents, outcrop ob	servation	s, boreł	nole a	and tunnel	observatio	ons.			
Boreholes		PEIVI00	1037									
2010110163.												
			Target i	ntercept		C	Geometric	c intercept				
Borehole		PDZ	Sec_up [m]	Sec_l [m]	low ]	Sec	_up [m]	Sec_lo [m]	w	Commer	nt	
HFM35		DZ1	24.00	52.5	50	4	1.38	54.81		ZFMWN	NO001.	
HFM35		DZ2	24.00	52.5	50	4	1.38	54.81		ZFMWN	W0001.	
Tunnels:		DT targ 0+297 -	et intercept 0+3 0+347 m, geor	09 - 0+37 netric inte	72 m, ge ercept 0	eome +292	tric interce - 0+345 r	ept 0+310 - n.	0+36	65 m, BT ta	arget interce	pt
Lineament and seismic indications:	l/or	MFM08	04 merged.									2

NW	ZFN	/INW00	02	Version number	8	Total object CL	22
MODELLING PROCE	DURE				1		
At the surface, corresp that has been inferred significant Singö zone The position of the zon modified alignment at al. (2007) and lineame identified in tunnel 3 a SFR in Carlsson et al. fractured rock and par solely on the basis of Forsmark tunnel 3 the ZFMNW002 was ma described in terms of the	bonds to the low n from data along t , is itself a regiona he is based on the its south-east enc ent MFM0804 use t Forsmark (see F (1985) as 'zone 1 tly crushed rock. reference to the m zone thickness w inly based on info ow fracture froat	nagnetic linear he near-surface al deformation e magnetic line d, both in relatii d in the model fig. 5-9 in Carls ' described as The zone was napping in the vas reported as remaind from the rest of the model	nent MFM080 ce tunnel 3. Zo zone interpret ament MSFR( on to MFM080 ling work durir sson and Chris not being ver attributed a th SFR DT and E s 75 m. The pri- ne cooling wat	4. Modelled to the b ne ZFMNW0002, a ed as having a lengi 08085 in SFR model 4G in the stage 2.3 S stiansson (1987). Th y pronounced in the ickness of 7 to 10 m 8T tunnels. Outside of operty assessment l er tunnel of Forsma	ase of the splay of the splay of the th of 18 kr l version 1 lineament Stephens of e zone wa SFR tunr . The thic of the SFF oy Stephe rk reactor	model volume usin magor, regionally n Stephens et al. (2 .0, which has a slig interpretation Isaka et al. (2007). The zo as also reported ear el, consisting of sh kness has been mo regional model vo ns et al. (2007) for 3. In this, ZFMNW0	ng dip 2007). Jhtly sson et one was rlier at eet odified olume, in
0 100 200 300 500 m		ZFMNWO					
		OBJECT	CONFIDENCE	EESTIMATE			
Category		Object CL	Comment				
INTERPRETATION							
Data source	1-1:	3	MFM0804 m	erged, HFM35, PFN	<u>//001637,</u>	BI, DT	
		3	High confide	nce observation in r	HEIM35 an	a SFR tunnels.	
Number of observ	ation points	3	54				
Distribution of obs	ervation points	2	Supported b tunnels of th and HFM35.	y surface geophysic e SFR facility in add	al data ar lition to bo	d information from rehole intercepts H	IFM34
				www.ender.ll.			055
Geometry		3	Geometry su facility and d	upported by sub-sur Irill hole HFM34 and	Ace inforr	nation in tunnels of	SFR
Geological indicat	ors	2	observation	supported by surfaces.	ce geophy	sical data and outo	rop
EXTRAPOLATION			_				
Dip direction		3	Extrapolated modelled zo	to the base of the r ne > 2000 m.	nodel volu	ime. Strike length c	of the
Strike direction		3	Conceptual zone is supp	understanding of the orted by the lineam	e site and ent.	that the entire mod	elled

NW	ZFMNW000	2 Version number 8 Total object CL 22
FRACTURE CHARAG	CTER	
Orientation: (strike/dip right- hand-rule) Frequency:	Set SE: 139.7°/71.4° Set G: 72.2°/10.3° Boreholes: -	ZFMNW0002
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open0.0 m-1Sealed0.0 m-1Sealed0.0 % of DZ interceptCrush0.0 % of DZ intercept	$U_{nassigned (42)}$ $Set SE (85)$ $Set G (27)$ $M_{d}$ $M_{d$
RQD: Fracture fill	 No data available	
mineralogy:	INU UALA AVAIIADIE	



NW	ZFMNW000	3	Version number	5	Total object CL	22
		Property	155000 160000	) 165	5000 170000	
GEOLOG		ĊĹ			100	
Deformation style:	Brittle-Ductile	3	000			000
Deformation	Deformation zone with low-		2	5	$\sim$	57100
description:	facies) ductile deformation				VI ME	G
	and later, multiple-stage		$\sim$	1	1 W S	-
	reactivation in the brittle		00 7	-1	/ XI / C	2 00
	regime. Mylonite, cataclastic		6206	1 7		5705
	texture and fault breccia		- the last	N	THI S	1414011
	prominent at several outcrops		5	X	AHAN NE	2
	within a broad belt (c. 1200 m)		000	ARX		000
	of intense high-temperature		0026			3700
	amphibolite facies) ductile			ATT	XX Y	
	deformation south-west of the			S	NY	
	tectonic lens at Forsmark.		2000	MAC .	M	2000
	Steeply dipping faults with		699	211	$\times$	699
	shows sinistral strike slip			AX	The same	
	displacement. NW			Y	1 Junior	
	compression steeply dipping		0000	$\checkmark$	Went	0000
	faults with NW strike, epidote		699		1. 1. 1.	699
	striae shows dextral reverse			1.19		
	compression Epidote-filled		155000 160000	165	000 170000	20.910
	tension gashes along steeply		Model volume DMS		0 2 4 B	N
	dipping fractures with NS		Baseline		d Caldmatered Geolaticereevisio	A
	strike indicate EW extension.					
	A fault with gentle dip to SSE,					
	epidote and chlorite striae					
	Younger steeply displacement.					
	faults with ENE and NNE to					
	NE strike offset steep NW					
	structures. Inferred conjugate					
	set with sinistral strike-slip and					
	displacement respectively					
	shows NE compression.					
Alteration:						
- First order:	Oxidation	3				
- Second order:	Not observed	Ū				
- Third order:	Not observed					
Fracture	steeply dipping fractures that					
type:	dipping and NF steeply-					
	dipping fractures are also					
	present. Dominance of sealed					
	fractures followed by open	3				
	and partly open. Quantitative					
	sealed fracture networks					
Fracture comment:	No data available.					
Fracture fill	Surface geology: Epidote,					
mineralogy:	quartz, calcite, chlorite.					
	OBJECT GEOMETRY					
Strike/dip:	141°/85°					
Length:	16790 m					
Max depth:	-2100 m					
Geometrical	Topo 40m grid May error 20m					
constraints:	ZFMWNW0004, 2 Surface Plana	ar Cut(s).				

BASIS FOR MODELLING Zone based on surface linear	ZFIVINV	/0003	Version r	umber	5	Total obje	ect CL	22
Zone based on surface linear								
	nents, outcrop and	d borehole obs	ervations.					
Outcrops: PFM0	7086-PFM07095	1						
Boreholes:								
	Target i	ntercept	Geometric	intercer	ot			
Borehole PDZ		Sec_low	Sec. up [m]	Sec_l	ow	Comment		
		[m]	Sec_up [iii]	[m]				
HFM11 DZ1	83.00	160.00	87.23	161.9	90	170-179 m a	ded (cf	
HFM12 DZ1	91.00	179.00	98.54	183.9	98	Table 3-2 in \$ 2007).	Stephen	s et al.
Tunnels: -								
Lineament and/or MFM0 seismic indications:	0015 merged.							3
		MODELLING	PROCEDURE					
in HFM12 (DZ1 and extension upper part of DZ1 in HFM11 a	n). Deformation zo	art of DZ1 in H	d in the central p =M12, i.e. the sou	art of the th-weste	more rn part	highly fractured	d interva	als in the
ZFMNW0029 ZFMWNW002	ZEMNWO 24	2003 ZFMWN	N0004		A Star	4		
ZFMNW0029 ZFMWNW002 0 1	ZEMNWO 24	2 2	N0004		4	km		
ZFMNW0029 ZFMWNW002 0 1		2 2			4	km		· · · · · · · · · · · · · · · · · · ·
ZFMNW0029 ZFMWNW002 0 1		ZFMWN 2 BJECT CONFIL	N0004	E	4	km		
ZFMNW0029 ZFMWNW002 0 1		ZFMWN 2 BJECT CONFIL Ct CL Comm	DENCE ESTIMAT	E	4	km		
ZFMNW0029 ZFMWNW002 0 1 0 1 <u>Category</u> INTERPRETATION Data source		2 SJECT CONFIL 2 SJECT CONFIL 2 SJECT CONFIL 3 MFM0 3 MFM0	DENCE ESTIMAT	Е	4	km*	M00027	76,
ZFMNW0029 ZFMWNW002 0 1 0 1 Category INTERPRETATION Data source Results of interpretation	AFMNWO 4 OB Objec	2 3 3 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5	DENCE ESTIMAT Dent 015 merged, HFN 07095 oonfidence observ	E M11, HFN	4 4 112, P	Km FM001637, PF and HEM12	M00027	76,
ZFMNW0029 ZFMWNW002 0 1 0 1 0 1 0 0 1 0 1 0 1 0 1 0 1 0 1 0	OB Object	2 2 2 2 2 2 2 2 2 2 2 2 2 2	DENCE ESTIMAT Dent 015 merged, HFN 07095 onfidence observ	E M11, HFN ration in H	4 4 112, P	KM <sup>*</sup> FM001637, PF and HFM12.	M00027	76,
ZFMNW0029 ZFMWNW002 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	OB Objection oints	2 3 3 3 3 3 3 3 3 3 3 3 3 3	DENCE ESTIMAT Dent 015 merged, HFN 07095 confidence observ	Е M11, HFN ration in F	4 //12, P	FM001637, PF	M00027	76,
ZFMNW0029 ZFMWNW002 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	OB Object 3 oints 3 n points 2	2 3 3 3 3 3 4 3 5 4 3 5 4 3 5 4 3 5 4 3 5 4 3 5 5 5 5 5 5 5 5 5 5 5 5 5	DENCE ESTIMAT Dent 015 merged, HFN 07095 onfidence observ	E M11, HFN ation in F	A M12, P HFM11	FM001637, PF and HFM12.	M00027	76, ore
Category INTERPRETATION Data source Results of interpretation INFORMATION DENSITY Number of observation po Distribution of observation	AFMNWO 4 OB Object 3 oints 3 oints 3 n points 2	2 3 3 3 3 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5	DENCE ESTIMAT Dent 015 merged, HFN 07095 confidence observ up of clustered ob s.	E M11, HFN ation in H	A M12, P HFM11	FM001637, PF and HFM12.	M00027	76, 
Category INTERPRETATION Data source Results of interpretation INFORMATION DENSITY Number of observation po Distribution of observation INTERPOLATION Geometry	A COB A	2 SJECT CONFIL SJECT CONFIL CT CL Comm SMFM0 PFM0 PFM0 SMFM0 PFM0 SMFM0 PFM0 SMFM0 PFM0 SMFM0 PFM0 SMFM0 PFM0 SMFM0 PFM0 PFM0 SMFM0 PFM0 PFM0 SMFM0 PFM0 PFM0 SMFM0 PFM0	DENCE ESTIMAT Dence ESTIMAT Data Stranged, HFN 07095 confidence observ up of clustered ob s. le localities mapp ative.	E M11, HFM servation ed at sur	A A A A A A A A A A A A A A A A A A A	FM001637, PF and HFM12. and at least o	M00027	76, ore
ZFMNW0029 ZFMWNW002 0 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0	A SMNWO A OB Object 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 2 2 2 2 2 2 2 2 2 2 2 2 2	DENCE ESTIMAT Dence ESTIMAT 015 merged, HFN 07095 confidence observ up of clustered ob s. le localities mapp ative. plation supported vations.	E M11, HFN servation ed at sur by surface	A A A A A A A A A A A A A A A A A A A	FM001637, PF and HFM12. and at least o upporting one s physical data a	M00027	76, ore rop
ZFMNW0029 ZFMWNW002 0 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0	A SMNWO	2 SJECT CONFIL SJECT CONFIL CONFIL SJECT CONFIL SJECT	DENCE ESTIMAT Dence ESTIMAT Dent 015 merged, HFN 07095 confidence observ up of clustered ob s. le localities mapp ative. plation supported vations.	E M11, HFN ration in H servation ed at sur by surface	A A A A A A A A A A A A A A A A A A A	FM001637, PF and HFM12. and at least o upporting one s physical data a	M00027	76, ore
Category INTERPRETATION Data source Results of interpretation INFORMATION DENSITY Number of observation per Distribution of observation INTERPOLATION Geometry Geological indicators EXTRAPOLATION Dip direction	A SMNWO	2 2 2 2 2 2 2 2 2 2 2 2 2 2	DENCE ESTIMAT	E M11, HFN servation ed at sur by surface e of the r n.	A A A A A A A A A A A A A A A A A A A	FM001637, PF and HFM12. and at least o upporting one s physical data a volume. Strike	M00027	76, ore f the











NW	ZFMNW00	)16	Version number	6	Total object CL	13
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle-Ductile					0
Deformation	No data available.	1	000	-	~	0000
description:			2 61	VT	The more	671
Alteration:			~ {	X		-
- First order:	Oxidation	2	8 25		12	1 8
- Second order:	Not observed	_	~~ 020	11	( M M)	0500
- Inira order: Eracture orientation	Not observed		20 ×	1.1	HU K	67
and type:	NO Uata avaliable.		2	X	ALLA Z	
Fracture comment:	No data available.		8	XAX	VIIA 5	000
Fracture fill	No data available.		202		(HI) J	7000
mineralogy:			"			9
OBJ			1 K Clar	SI	NY	
Length:	10081 m		0000	X	M	000
Mean thickness:	50 m (50 - 200 m)		699	A	$\times$	5695
Max depth:	-2100 m			1 A	The same	
Geometrical	ZFMNW0003, Topo 40m	grid Max			C C man	
constraints:	error 20m, 1 Surface Plan	nar Cut(s).	0000	$\checkmark$	mon	0000
			669	-	N	699
			155000 160000	165	000 170000	120.000
			Model volume DMS		0 2 4 8	N
			Baseline		Clastinipet Soldaraneeven	N
	BAS	IS FOR MOD	ELLING			
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
Tunnels	-					
Lineament and/or	MFM0016 merged.					0
seismic indications:						2
	MODE	ELLING PRO	CEDURE			
At the surface, corresponds assumed dip of 90 degrees	s to the low magnetic linean s based on a comparison wi	th high confic	16. Modelled to the b dence, vertical and s	ase of the teeply dip	e model volume usir pping zones with WN	ig an IW and
NVV Strike.			200			
*						
					30	
	A BE ST					
WNW0023 WNW0123					3542	
ZEMM			UNIW0019	46A	MNE	
			ZEMWIN	IE35	ζł.	
~				NUT		
Printed (2		NNN A				
	10 10	S S				1
			0	2		
		ZEMI	Illaro			
			1/10016			
<fmnw0003< td=""><td></td><td></td><td></td><td>4</td><td></td><td></td></fmnw0003<>				4		
20	1	2	4 kn			
		12			6	
ZFMWNW0024		-	0	/		
	MWNW0004					
A						

NW	ZF	MNWO	0016 Version number 6 Total object CL 13								
OBJECT CONFIDENCE E	STIMATE										
			_								
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0016	merged							
Results of interpretation	า	2	Medium c	onfidence in lineamer	nt MFM00	016.					
INFORMATION DENSITY	/										
Number of observation	points	1	1								
Distribution of observat	ion points	1	Single obs	servation point in the f	form of a	lineament.					
INTERPOLATION		Ŭ	•								
Geometry		1	Geometry	supported by surface	geophy	sical data.					
Geological indicators		1	Indirect su	pport by geophysical	data.						
EXTRAPOLATION				, , , ,							
Dip direction		0	Extrapolat	ted to the base of the	model vo	olume. Strike length c	of the				
		3	modelled	zone > 2000 m.		Ŭ					
Strike direction		2	Conceptua	al understanding of th	e site an	d that the entire mod	elled				
		3	zone is supported by the lineament.								
		FRA	CTURE CH	ARACTER							
			No data ava	ailable							
INDIVIDUAL INTERCEPTS	5										
			No data ava	ailable							

NW		ZFMNW0017 Version number 4				4 Total	object CL	16	
GEOI	LOGICAL CH	ARACTER	Prop	perty	155000	160000	165000	170000	
Deformation styl	e Brittle-	Ductile		, <b>L</b>	0				0
Deformation	No data	a available			000		~		000
description:	No date				671	2	117		671
Alteration:						$\langle \cdot \rangle$		The	
- First order:	Oxidatio	on			Luis	$\sim$	/ / ľ	213	3
- Second order:	Not obs	served		1	000	5 -	1/1/	FR	2 8
- Third order:	Not obs	served			7 205	my )	XII	1//	1050
Fracture	Fracture	os that strike SF	and		o fr	1 1	- ITH		() ()
orientation and	din stee	enty to the SW			2	1,1	X AL	A	3
type:	domina	tes Gently dinn	ina		2 { \	A CONTRACTOR	SXIII	$7\lambda$ (	2 0
type.	fracture	es as well as ste	enly		200		XXI		000
	dinning	fractures that v	arv in		670	1000	S MY	/ //	670
	strike b	etween NE and	Fare		1	A COM	AN	$\langle \rangle \rangle$	
	also pro	minent Domin	ance of		1	(AR)		Y	
	sealed :	followed by one	n and		8	1 Alla	XPS	/	00
	partly o	nen fractures	in and		2956	1000	N.		9950
	Quantit	ative estimate a	nd		90	1 11	XX	X	99
	span in	clude sealed fra	cture				XY	S and	
	network	s and crush zor	nes		0			5 mare	0
Fracture comme	nt: No data	available	100.		000		1 mm		000
Fracture fill	No data	a from percussio	n		699				1699
mineralogy:	borehol		"						
inneralogy.	OBJECT	GEOMETRY	L		155000	100000	105'000	170000	20.0.0
Strike/din:	137º/85	5°			155000	160000	165000	170000	N
Length:	7913 m	,			Model v	olume DMS		0 2 4 8	A
Moan thickness	64 m (1	5 - 64 m			Baseling			C Latinite of Gridal Report for	
Max denth:	-2100 n	n							
Geometrical	-2100 H	NIN/0137 7EM/A							
constraints:	40m ari	id Max error 20n	n 1100013, 10pc	,					
constraints.	40m gi		BASIS FOR	MODE					
Zone based on su	urface lineame	onte and horeho	le observations	NODL					
Zone based on so				•					
Outcrops:	-								
Boreholes:									
		Target i	ntercept	0	Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_low	Sec	_up [m]	Sec_low	Comme	nt	
HFM30	DZ1	79.00	200.00	7	8.60	200.74			
Tunnels:	-								
Lineament and/o	or MFM00	)17.							_
seismic									3
indications:									
A	•		MODELLING	PROC	EDURE				
At the surface, co	rresponds to t	the low magneti	c lineament MF	M0017	. Modelled	to base of m	nodel volume	using the d	ıp
estimated by conr	necting linear	nent MFM0017 ∖	with the boreho	le inter	section 79	-200 m in HF	M30 (DZ1).	Deformation	zone
plane placed with	in core of zon	e that occurs alo	ong the borehol	le inter	val 158-16	7 m with a fix	ed point at 1	58 m. Decre	eased
radar penetration	along the bor	ehole interval 1 <sup>4</sup>	58-167 m						

NW	ZFN	/INW00 <sup>,</sup>	17 Version number 4 Total object CL 16						
		A ZEMAZ ZEMANINOPOLI ZEMANINOPOLI ZEMANINOPOLI ZEMANINOPOLI				THINKIDOGS	WWO PER		
		OBJECT	CONFIDENCE	ESTIMATE	- Ann				
Cotomore			Com						
		Object CL	Comment						
Data source		2	MFM0017G	merged, HFM30					
Results of interpre	etation	3	High confide	nce observation in I	HFM30.				
INFORMATION DEN	NSITY	0	0						
Distribution of observ	ation points	2	2 Single obser	vation point at dept	h and a si	urface lineament			
INTERPOLATION	servation points		Single Obser		ii anu a su	inace inteament.			
Geometry		1	Geometry su	pported by surface	geophysic	al data.			
Geological indicat	ors	1	Indirect supp	ort by geophysical	data.				
EXTRAPOLATION			<b>F</b>			01.11.1.11	6.41		
Dip direction		3	Extrapolated	to the base of the r $> 2000$ m	nodel volu	ime. Strike length o	of the		
Strike direction		0	Conceptual u	inderstanding of the	e site and	that the entire mod	lelled		
		3	zone is supp	orted by the lineam	ent.				
		FRAG	CTURE CHAR	ACTER					
Orientation:	Set SE: 128.0°/	77.3°		ZFMI	NW0017				
(strike/dip right-	Set G: 26.8°/2.0	)°			N				
hand-rule)	Set ENE: 56.4°/	72.8°			1**** * *	~			
Frequency:	Boreholes: -		_			5			
- 1				1	Sec.	1. The second			
	FRACTURE	TERZAGHI-		/	-				
	TYPE	P10	+			t i			
	Open and	0.0 m-1	f f		1 M				
	partly open								
	Sealed	0.0 m-1		1.			-		
	network	0.0 % of DZ	1						
	Crush	0.0 % of DZ	1		6 S.	1			
		intercept	]	here i i					
				X		/			
				See		1			
				12.00	1	Equal a	area		
			• Unass	igned (468)	5	Lower hemisph	nere		
			Set St     Set G	(425) 🔺 Mean p (245) 🔺 Mean p	ole Set SE (3 ole Set G (29	8.0/12.7) Fisher κ = 9.6 6.8/88.0) Fisher κ = 6	5		
			Set El	IE (83) A Mean p	ole Set ENE	(326.4/17.2) Fisher κ =	34.4		
RQD:									
Fracture fill	No data availab	le							
mineralogy:									





NW	ZFMNW00	)29	Version number	3	Total object CL	13
GEOLOGICAL	CHARACTER	Property	155000 160000	165	000 170000	
Deformation style:	Brittle-Ductile	1	0			0
Deformation	No data available.		1000		$\sim$	1000
description:			5	15	1 mm	67
Alteration:			~	X	112	
- First order:	Oxidation	- 1	8 2	1~	121-5	1 8
- Second order:	Not observed	-	Jun 1050	1 1	() ()	1050
Fracture orientation	No data available.		io R		THA 2	19 Kenti
and type:			200		AAA	
Fracture comment:	No data available.		8	XAX	VIIA S	000
Fracture fill	No data available.		00/10		STY / P	200
mineralogy:					VX Y	U
Strike/dip:	134°/90°			S	NY	
Length:	3793 m		1 1 2000	V-S	M	2000
Mean thickness:	30 m (15 - 64 m)		699	1	$\times$ {	699
Max depth:	-2100 m			WX M	the sum	
Geometrical	ZFMNW0036, ZFMNW00	03, Topo			L J manual	_
constraints:	40m grid Max error 20m,	1 Surface	0000		www	0000
	Planar Cul(s).		660	$\leq$	1. 1. 1. 1.	699
			3- 1-6			
			155000 160000	1650	000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		C Laithnatevet Geschenserweisen	~
	BASI	IS FOR MOD	DELLING			
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
	1					
Tunnels:	-					1
seismic indications	MF10029.					2
	MODE	ELLING PRO	CEDURE			
At the surface, corresponds	s to the low magnetic linear	nent MFM002	29. Modelled to base	of model	volume using an as	ssumed
dip of 90 degrees based or	n a comparison with high co	nfidence, ver	tical and steeply dipp	oing zone	s with WNW and N	N strike.
		ZEMI	VW0017	-		
ZFMJ1				-		
		-				
SMAN	1 mm					
MWV0036	Hing /					
1			Tr			
			-rmNW000	0		
				3		
	ZEM	NIWOOS	00			
	2. FTVI					
and the first of the second						
ZFMWNW0024						
ZFMWNW0004					4	2
0		2			4 KM	
						5
8					Ţ	
	Л					

NW	ZF	MNWO	029 Version number 3 Total object CL 13									
OBJECT CONFIDENCE E	STIMATE											
			•									
Category		Object CL	Comment									
INTERPRETATION												
Data source		1	MFM0029									
Results of interpretation	า	2	Medium c	onfidence in lineamer	nt MFM00	)29.						
INFORMATION DENSITY	/											
Number of observation	points	1	1									
Distribution of observat	ion points	1	Single obs	servation point in the f	form of a	lineament.						
INTERPOLATION		Ŭ	•									
Geometry		1	Geometry	supported by surface	e geophys	sical data.						
Geological indicators		1	Indirect su	pport by geophysical	data.							
EXTRAPOLATION												
Dip direction		<u> </u>	Extrapolat	ed to the base of the	model vo	lume. Strike length c	of the					
		3	modelled	zone > 2000 m.		0						
Strike direction		2	Conceptua	al understanding of th	e site an	d that the entire mod	elled					
		3	zone is supported by the lineament.									
		FRA	CTURE CH	ARACTER								
			No data ava	ilable								
INDIVIDUAL INTERCEPTS	3											
			No data ava	ilable								

NW	ZFMNW00	)36	Version number	8	Total object CL	14
GEOLOGICAL	CHARACTER	Property CL	155000 16000	0 16	5000 170000	
Deformation style:	Brittle-Ductile	1	Q			0
Deformation	No data available.	•	000		~	000
description:			3	1 F	Starting 1	671
Alteration:			{	Y		
- First order:	Oxidation	2	5		V M X	-
- Second order:	Not observed	2	L~ 200		MFL	5000
- Third order:	Not observed		670	1 )	ANY	670
Fracture orientation and type:	No data available.		2	X	ALLA So	A-0014
Fracture comment:	No data available.		8	XAX		00
Fracture fill	No data available.		2002		ALIS	2000
mineralogy:			io X		KU V	67
OBJE	ECT GEOMETRY			TAN		
Strike/dip:	127°/90°		8	X	AX/	00
Length:	10624 m		1	1 alas	$\sqrt{1}$	9501
Mean thickness:	50 m (50 - 200 m)		39	112	A to	66
Max depth:	-2100 m	and Mari		19 X	5 1 million	
Geometrical	ZFININVVUUU3, Topo 40m	grid Max	8		La mana	0
constraints:	enor zom, z Sunace Plan	iar Cut(s).	0006	$\bigvee$	w	9000
			660	$\langle \cdot \rangle$		666
			155000 160000	0 165	5000 170000	28.91
			Medel volume DMC			N
			Baseline		d Lastmitgent Grida raysocker	A
	BASI	S FOR MOD				
Zone based on surface line	aments.					
Outcrops:	-					
Boreholes: -						
Tunnole:						
Lineament and/or	MEM0036 merged					
seismic indications:	in neece merged.					3
	MODE	LLING PRO	CEDURE			
At the surface, corresponds	s to the low magnetic linear	nent MFM00	36. Modelled to base	of mode	l volume using an as	ssumed
dip of 90 degrees based or	n a comparison with high co	nfidence, ver	tical and steeply dip	ping zone	es with WNW and N	N strike.
					ZFMWNW012	3
			1 THERE			
						-
						-
				-		
					HEMA	
		-06			HFM12	
		W0030	12			
	7FM	21.	10035			
			FMWNW0033			
					ZFM	INWOC
			1 1/2	ZFMWNW0024		
				/NW0004	5	-
		a george	CHI CHI	and the second se	4	
			8	5		
0	1 5	2	4 ki	n 🔪		
			0			
		20414	. P		,	
	and and a					
	24					

NW	ZF	MNWO	036	Version number	8	Total object CL	14	
OBJECT CONFIDENCE E	STIMATE					·		
		•	-					
Category		Object CL	Commen	t				
INTERPRETATION								
Data source		1	MFM0036	merged				
Results of interpretation	า	3	High confi	dence in lineament M	FM0036			
INFORMATION DENSITY	/							
Number of observation	points	1	1					
Distribution of observat	ion points	1	Single obs	servation point in the f	form of a	lineament.		
INTERPOLATION	•			•				
Geometry		1	Geometry	supported by surface	geophys	sical data.		
Geological indicators		1	Indirect su	pport by geophysical	data.			
EXTRAPOLATION								
Dip direction		0	Extrapolated to the base of the model volume. Strike length or					
		3	modelled	zone > 2000 m.		Ģ		
Strike direction		2	Conceptu	al understanding of th	e site an	d that the entire mod	elled	
zone is supported by the lineament.								
		FRA	CTURE CH	ARACTER				
			No data ava	ailable				
INDIVIDUAL INTERCEPTS	6							
			No data ava	ailable				

NW	1	ZFMNW	0805	Α		Version r	number	12	Total object CL	22
GEC	DLOGICAL CH	ARACTER		Propert CL	ty	155000	160,000	16	5000 170000	
Deformation st	/le: Brittle-D	Ductile		3		8				Q
Deformation	No data	available.				1000		_	~	1000
description:						67	5	T	12 mm	67
Alteration:						1.00	- {	Y		1 1
- First order:	Oxidatio	on		З		0	27	_ /	V las 12	3. 0
- Second order	: Quartz	dissolution		0		2 200	w V		INN	200
- Third order:	Not obs	erved				200			AMIN	670
Fracture	Steeply	dipping fracture	es			5		H	THAN 5	3
orientation and	domina	te in the NVV-SE	_			. { }	11	T	STITT N	2
type.	WSW o	rientation as we	 ∥ 26			82	D a		XIII	000
	gently of	lipping fractures	ii as			670	1100	10	MAN /	670
Fracture comm	ent: No data	available.		2			LARD	AD.	XX /	
Fracture fill	Calcite,	chlorite,					C Slow	SI	NY	
mineralogy:	hematit	e/adularia, clay				2000	JA H.	J~	N	2000
	mineral	s, laumontite, qu	Jartz,			669	1	A.	XI	699
	epidote	•				51	1	W Y	h and	
	OBJECT	GEOMETRY					/		L / J manual	
Strike/dip:	316°/82					000	1		www	0000
Length:	11612 r	n 0000.m)				6661		-		3690
Mean thickness	5: 60 m (5	<u>0 - 200 m)</u>				1.10				
Geometrical	-2100 1	$\frac{1}{10001}$	10m arid M	Any orror	r	155000	160000	16	5000 170000	20.910
constraints:	20m 1	Surface Planar	Cut(s)			155000	100000	10.	170000	N
constraints.	2011, 1	oundeer land	Out(0).			Baseline	olume DMS		0 2 4 8	A
			DACIC							
Zone based on s	surface lineame	nte seismic dat	CIGAD ta and hou	rehole of		ations				
					J361V	allons.				
Outcrops:	-									
Boreholes:										
		Target i	ntercept		Ge	eometric	intercept			
Borehole	PDZ	Cas un Iml	Sec_lo	ow c	<b>•</b> •••	un final	Sec_lo	w C	omment	
		Sec_up [m]	[m]	2	Sec_	սք լmյ	[m]			
KFR08	DZ2	41.00	104.4	10	40	).74	101.4	4		
KFR101	DZ5	242.00	341.7	<b>'</b> 6	234	4.01	338.4	5		
KFR11	DZ1	41.45	95.6	5	32	2.64	98.07	,		
KFR23		-	-		10	.46	11.29	N	o SHI available.	
KFR24		-	-		49	.05	156.9	3 N	o SHI available.	
KFR25		-	-		50	0.74	196.5	) N	o SHI available.	
KFR56		-	-		57	.16	81.72		o SHI available.	
KED7A	D71	12.00	74 4	5	12	00	74 67		oudaivision of DZ1	054
	DZT	43.00	74.4	5	40	0.00	74.07	2	nd ZEMNW0805B	JJA
									13 21 WH W 0000D.	
Tunnels:	-									
Lineament and/	or MFM08	05 merged.								
seismic										2
indications:										
			MODEL	LING PR	ROCE		14 4 1			
At the surface, c	orresponds to t	ne low magnetic	c lineame	nt MFM0	1805.	Modelle	to the ba	se of the	model volume usir	ng dip
KFR11 Adopted	lin structural m	a along near-sui	velsson a	ind Hane	nun ta sen 10	997 Holr	vepis in K nén and S	tiasson (	.FRUO, RFRIUI ANG 2001)	L
TATA AUDIEU	in structural fr		ACISSOIT A					agooon		



Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM0805 merged, KFR7, KFR08, KFR11, KFR23, KFR24, KFR25, KFR56, KFR101.
Results of interpretation	3	High confidence observations in multiple boreholes.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	2	Observation points cover <600 m of the zone which is modelled along strike for c. 10000 m. Obs. points considered as a cluster and the lineament as an outlier.
INTERPOLATION		
Geometry	3	Zone intercepted with multiple drill holes and described by SHI in at least three drill cores with high confidence.
Geological indicators	3	Interpolation supported by key geological parameters, foremost fracture orientation pattern.
EXTRAPOLATION		
Dip direction	3	Extrapolated to the base of the model volume. Strike length of the modelled zone > 2000 m.
Strike direction	3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.



	NW			ZFN	<b>INW</b>	0805	5A	Ve	ersion numbe	<sup>er</sup> 12	Total	object CL	22
			I			INDIVI	DUAL IN	TERCE	PTS				I
R08	DZ2 (	41.0-104	4.4 m)										
ength (m)	Elevation m.a.s.l. (m, BH2000)	Open	Sealed	Open total	Sealed total	Total	Crushed	Sealed	RQD reversed 100 = 0 low value	Fracture open frac	Fracture sealed frac	Open aperture	Core
,		0 20	0 20	0 20	0 20	0 20			0 100 0	90 0	9	0 0 10	
42		- <u>1</u> - 1	P	-	54	64		-	I control 1			1	
42 -					288	300	-		33.5				
44					115	119	- A		71.0				
45					439	203			95.0				
46					500	500			51.5				
47	-90				369	369			41.5				
40					334	334			66.0				
50				_	333	333			57.5				
51				55	250	305			37.5				
52					250	250			27.5				
53					209	217	-		24.0				
55					145	145			73.0				
56				-	59	59	_		30.0				
57					152	152			56.0				
58					111	128			30.3				
59	-91 -			25	111	136			29.6				
61				1.000	105	105			58.0				
62				-	65 86	65			70.5				
63					74	74			90.5				
64					84	88	-		35.5				
65				31	84	115			89.0				
67					79	81	1.1.1		77.5				
68					77	77			49.0				
69					66	79			41.5				
70	-92				76	83	· · · · · ·		28.0				
72									17.5				
73					70	70			29.0				
74 -					202	202			53.5				
75					70	70			77.0				
76				-	176	177			53.0				
78					189	205			62.0				
79					302	302			71.0				
80					58	58			45.0				
81					71	71			46.0				
82	-93				91	91			51.5				
84					66	66			43.5				
85					51	51			34.5				
86					40	46	J		48.5				
87			1.1.1.1		40	40			62.5				
88 .					40	40			79.5				
90					47	47			71.0				
91					33	33			53.5				
92	1				29	29			34.5				
93	-94								63.5				
94					59	59			44.0				
96						1000			31.5				
97									35.0				
98									84.5				
99									46.5				
100									53.0				
102									43.0				
									41.0				





	NW	1		ZFN	<b>INW</b>	0805	5A	V	ersion num	<sup>ber</sup> 1	2	Total o	bject CL	22
KFR11	DZ1	(41.45-9	5.65 m)											
No dat	a avail	able												
KFR23	3 (10.4	6-11.29	m)											
No dat	a avail	able												
KFR24	49.0	5-156.9	8 m)											
No dat	a avail	able												
KFR25	5 (50.7	4-196.5	m)											
No dat	a avail	able												
KFR56	6 (57.1	6-81.72	m)											
No dat	a avail	able	,											
KFR7/		(43.0-74	.45 m)											
Length (m)	Elevation m.a.s.l. (m, RH2000)	Open	Sealed	Open total	Sealed total	Total	Crushed	Sealed	RQD reversed 100 = 0 low value = high value	Fracture open frac		Fracture sealed frac	Open aperture (mm)	Core
		0 20	0 20	0 20	0 20	0 20			0 100 0	onentation		00	0 10	
-	-		1	1			1		100 0	<del>o por</del> ci				1
44	1	1.00							78.0					
45	1								26.0					
40	]					1.00			76.0					
48						1.1			81.0					
49				-					95.0					
50	{			23	- C	24			93.0					
51				25		25			100.0					
52				25		25			100.0					
53				23		23			99.0					
54	-134			1	(		1		32.0					
55	]					34			69.0					
57				21	31	52		1	74.0					
58					-	-			38.0					
59					56	66	n		78.0					
60							1.1.1		78.0					
61	1			1.00	31	31	1.00		94.0					
62	1					21			57.0					
63	]			The second	-				33.0					
65				-					80.0					
66				24	10.000	40		1	100.0					
67				26	22	43			100.0					
68				21	22	45			85.0					
69	-			34		34			100.0					
70	1			34		34		10	100.0					
71					-	100 C		1 C	58.0					
12	]			24		24			54.0					
13				51		51			100.0					

NW		<b>ZFMNW08</b>	305B	Version	number	4	Total object CL	22					
GEO		HARACTER	Prop	Derty 155000	160000	165	000 170000						
Deformation st	vle: Brittle	Ductile		·L				0					
Deformation	No dat	a available.		000			$\sim$	000					
description:				671	2	T	1 mm	671					
Alteration:		-		1.00	~	Y	1 1 4						
- First order:	Oxidat	ion		3 8	25	1-	V 1 1 3	2 0					
- Second order	r: Chlorit	ization		~ <u>.</u> 0500	rul 1	V	NN	0000					
Fracture	Steep	v dipping fractures w	/ith	10 K	1		HA CZ	67					
orientation and	I WNW-	ESE strike and gentl	ly	2	11h	X	ALA No	1					
type:	dippin	g fractures are prese	nt.	8	600	X		00					
Fracture comm	ent: No dat	a available.	2	2 00/2			STY / / /	1001					
Fracture fill	Calcite	e, chlorite, clay miner	als,			ATT	VX Y	U					
mineralogy.	quartz	epidote, laumontite.			AN CHE	X	NY						
	OBJEC	T GEOMETRY	- -	2000	1444	MAC N	M	2000					
Strike/dip:	317°/7	5°		669	1	1	$\times$	699					
Length:	1183 r	n 5 00 \				A X							
Mean thickness	s: <u>30 m (</u>	<u>5 - 30 m)</u> m		g			Jan Internet	Q					
Geometrical		W0805A Topo 40m	orid Max er	ror			w	0006					
constraints:	20m.		gria max or	99				66					
								20.510					
				155000	160000	1650	000 170000	N					
				C Mode Basel	l volume DMS		0 2 4 8	A					
		В	ASIS FOR	MODELLING									
Zone based on s	surface linearr	ents, tunnel and bore	ehole obser	vations.									
Outcrops:													
Boreholes:													
		Borenoles:											
		Target intercept Geometric intercept											
Borehole	PDZ	Target inter	cept Sec low	Geometric	c intercept Sec low	Co	mment						
Borehole	PDZ	Target inter       Sec_up [m]	cept Sec_low [m]	Geometric Sec_up [m]	c intercept Sec_low [m]	, Co	mment						
Borehole KFR08	PDZ	Target interest       Sec_up [m]     S       3.00     3.00	cept Sec_low [m] 19.00	Geometric Sec_up [m] 2.61	c intercept Sec_low [m] 32.44	Co	mment						
Borehole KFR08 KFR101	PDZ DZ1 DZ2	Target interd           Sec_up [m]         S           3.00         97.00	cept Sec_low [m] 19.00 116.00	Geometric Sec_up [m] 2.61 80.24	c intercept Sec_low [m] 32.44 131.56	Co	mment						
Borehole KFR08 KFR101	PDZ DZ1 DZ2	Target interd       Sec_up [m]       3.00       97.00	<u>cept</u> Sec_low [m] 19.00 116.00	Geometric Sec_up [m] 2.61 80.24	c intercept Sec_low [m] 32.44 131.56 18.71	Juc pho cor ind dig alo inte cor app inte with oxit 16	mment lging from the otographs of the dri es there is no obvid ication of a zone wi nity of ZFMNW080 ng the geometric ercept. The only spicuous feature is proximately 2 dm lo ensely fractured inte n moderate dation/laumontizati m length. No targe ercept is defined.	ill ous ith the 5B s an ong, erval on at t					
Borehole KFR08 KFR101 KFR11	PDZ DZ1 DZ2	Target interd       Sec_up [m]     S       3.00     97.00       97.00     -	<u>cept</u> Sec_low 19.00 116.00	Geometric Sec_up [m] 2.61 80.24 0.00 8.12	c intercept Sec_low [m] 32.44 131.56 18.71 40.88	Juc pho cor ind dig alo inte cor app inte witt oxi 16 inte No	Iging from the btographs of the dri es there is no obvid ication of a zone wi nity of ZFMNW080 ng the geometric ercept. The only ispicuous feature is proximately 2 dm lo insely fractured inten antoderate dation/laumontization m length. No targen ercept is defined. SHI available.	ill ous ith the 5B s an ong, erval on at t					
Borehole KFR08 KFR101 KFR11 KFR11	PDZ DZ1 DZ2	Target interview           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -	<u>cept</u> Sec_low <u>[m]</u> 19.00 116.00 -	Geometric Sec_up [m] 2.61 80.24 0.00 0.00	c intercept Sec_low [m] 32.44 131.56 18.71 18.71 40.88 50.61	Juc pho cor ind dig alo inte cor app inte witt oxi 16 inte No No	Iging from the btographs of the dri es there is no obvid ication of a zone wi nity of ZFMNW080 ng the geometric ercept. The only ispicuous feature is proximately 2 dm lo ensely fractured intre n moderate dation/laumontization m length. No target ercept is defined. SHI available.	ill ous ith the 5B s an ong, erval on at t					
Borehole KFR08 KFR101 KFR11 KFR11 KFR24 KFR25 KFR38 KFR38	PDZ DZ1 DZ2 DZ2	Target interd           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           153.60         -	<u>cept</u> Sec_low <u>[m]</u> 19.00 116.00 - - - - - - - - - - - - - - - - - -	Geometric Sec_up [m] 2.61 80.24 0.00 0.00 8.12 9.38 106.40 3.355	cintercept           Sec_low           [m]           32.44           131.56           18.71           40.88           50.61           185.40           44.68	Juce pho cor ind dig alo inte cor app inte with oxi 16 inte No No	Iging from the otographs of the dri es there is no obvic ication of a zone wi nity of ZFMNW080 ng the geometric ercept. The only ispicuous feature is proximately 2 dm lo ensely fractured inten n moderate dation/laumontization m length. No targe ercept is defined. SHI available.	ill ous ith the 5B s an ong, erval on at t					
Borehole KFR08 KFR101 KFR11 KFR11 KFR24 KFR25 KFR38 KFR38 KFR56	PDZ DZ1 DZ2 DZ2	Target interd           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           -         -           153.60         -	<u>cept</u> <u>Sec_low</u> <u>19.00</u> 116.00 - - - - 181.65 -	Geometric Sec_up [m] 2.61 80.24 0.00 0.00 8.12 9.38 106.40 3.55	c intercept Sec_low [m] 32.44 131.56 18.71 18.71 40.88 50.61 185.40 44.68	Z Co Juc pho cor ind dig aloo inte cor app inte with oxi 16 inte No No Sul	Iging from the otographs of the dri es there is no obvio ication of a zone wi nity of ZFMNW080 mg the geometric ercept. The only aspicuous feature is proximately 2 dm lo ensely fractured inten moderate dation/laumontizatii m length. No targe ercept is defined. SHI available. SHI available. odivision of DZ1 be	s an ong, erval on at t					
Borehole KFR08 KFR101 KFR11 KFR11 KFR24 KFR25 KFR38 KFR56 KFR7A	PDZ DZ1 DZ2 DZ1 DZ1	Target intern           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           153.60         -           3.50         -	<u>cept</u> <u>5ec_low</u> <u>19.00</u> 116.00 - - - - - - - - - - - - - - - - - -	Geometric Sec_up [m] 2.61 80.24 0.00 0.00 8.12 9.38 106.40 3.55 11.25	c intercept Sec_low [m] 32.44 131.56 18.71 18.71 40.88 50.61 185.40 44.68 43.20	Co Juc pho cor ind dig alo inte cor app inte with oxi 16 inte No No No Sul ZFI ZFI	Iging from the tographs of the dri es there is no obvid ication of a zone wi nity of ZFMNW080 ng the geometric ercept. The only ispicuous feature is proximately 2 dm lo ensely fractured intre in moderate dation/laumontization m length. No target ercept is defined. SHI available. SHI ava	ill ous ith the 5B s an ong, erval on at t					
Borehole KFR08 KFR101 KFR11 KFR11 KFR24 KFR25 KFR38 KFR56 KFR7A Tunnels:	PDZ DZ1 DZ2 DZ1 DZ1 DZ1 DZ1 BT tar 0+023	Target interview           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           -         -           153.60         -           3.50         -           3.50         -	<u>cept</u> <u>Sec_low</u> <u>19.00</u> 116.00 - - - - - - 43.00 1+185 m, g	Geometric           Sec_up [m]           2.61           80.24           0.00           0.00           8.12           9.38           106.40           3.55           11.25           eometric interces	cintercept           Sec_low           [m]           32.44           131.56           18.71           40.88           50.61           185.40           44.68           43.20	Cor Juc pho cor ind dig alo inte cor app inte with oxi 166 inte No No No ZFI ZFI	Iging from the otographs of the dri es there is no obvic ication of a zone wi nity of ZFMNW080 ng the geometric ercept. The only ispicuous feature is proximately 2 dm lo ensely fractured inten moderate dation/laumontization m length. No targe ercept is defined. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. Odivision of DZ1 be MNW0805A and MNW0805B.	ill ous ith the 5B s an ong, erval on at t t etween rcept					
Borehole         KFR08         KFR101         KFR101         KFR11         KFR11         KFR24         KFR25         KFR38         KFR56         KFR7A	PDZ DZ1 DZ2 DZ1 DZ1 DZ1 DZ1 Vor MFM0	Target interview           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           153.60         -           -         -           3.50         -           -         -           3.50         -           -         -           0+044 m.         805G1, MSFR08104	<u>cept</u> <u>Sec_low</u> <u>19.00</u> <u>116.00</u> - - - - - - - 43.00 - - 43.00	Geometric           Sec_up [m]           2.61           80.24           0.00           0.00           8.12           9.38           106.40           3.55           11.25           eometric interces           98.	cintercept           Sec_low           [m]           32.44           131.56           18.71           40.88           50.61           185.40           44.68           43.20	Cor Juc pho cor ind dig aloo inte cor app inte with OXi 16 inte No No Sul ZFI I+193 m	Iging from the otographs of the dri es there is no obvio ication of a zone wi nity of ZFMNW080 mg the geometric ercept. The only ispicuous feature is proximately 2 dm lo ensely fractured inten moderate dation/laumontizatii m length. No targe ercept is defined. SHI available. SHI available. SHI available. SHI available. SHI available. odivision of DZ1 be MNW0805A and MNW0805B.	ill ous ith the 5B s an ong, erval on at t stween rcept					
Borehole KFR08 KFR101 KFR111 KFR11 KFR11 KFR24 KFR25 KFR38 KFR56 KFR7A Tunnels: Lineament and seismic indications:	PDZ DZ1 DZ2 DZ1 DZ1 DZ1 DZ1 Vor MFM0	Target interv           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           153.60         -           -         -           3.50         -           3.50         -           -         -           0.55G1, MSFR08104	<u>cept</u> <u>Sec_low</u> <u>19.00</u> <u>116.00</u> - - - - - - - - - - - - - - - - - -	Geometric           Sec_up [m]           2.61           80.24           0.00           0.00           8.12           9.38           106.40           3.55           11.25           eometric intercer           98.	c intercept Sec_low [m] 32.44 131.56 18.71 18.71 40.88 50.61 185.40 44.68 43.20 ept 1+178 - 1	Co     Co     Juc     phe     cor     ind     dig     aloo     inte     cor     inte     viti     oxi     16     inte     No     No     Sul     ZFI     ZFI     I+193 m	Iging from the otographs of the dri es there is no obvio ication of a zone wi nity of ZFMNW080 mg the geometric ercept. The only aspicuous feature is proximately 2 dm lo ensely fractured inten moderate dation/laumontizatii m length. No targe ercept is defined. SHI available. SHI available. SHI available. SHI available. SHI available. odivision of DZ1 be MNW0805A and MNW0805B.	ill ous ith the 5B s an ong, erval on at t stween rcept					
Borehole KFR08 KFR101 KFR111 KFR11 KFR24 KFR25 KFR38 KFR56 KFR7A Tunnels: Lineament and seismic indications:	PDZ DZ1 DZ2 DZ1 DZ1 DZ1 DZ1 DZ1 Vor MFM0	Target interv           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           153.60         -           -         -           153.60         -           -         -           3.50         -           -         -           3.50         -           -         -           -         -           3.50         -	<u>cept</u> <u>Sec_low</u> <u>19.00</u> 116.00 	Geometric           Sec_up [m]           2.61           80.24           0.00           0.00           8.12           9.38           106.40           3.55           11.25           eometric interce           98.	c intercept Sec_low [m] 32.44 131.56 18.71 18.71 40.88 50.61 185.40 44.68 43.20 ept 1+178 - 1	Co     Co     Juc     pho     cor     ind     dig     alo     inte     cor     inte     vitl     oxi     16     inte     No     No     Sul     ZFI     ZFI     I+193 m	Iging from the otographs of the dri es there is no obvio ication of a zone wi nity of ZFMNW080 mg the geometric ercept. The only aspicuous feature is proximately 2 dm lo ensely fractured inten moderate dation/laumontizatii m length. No targe ercept is defined. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. Division of DZ1 be MNW0805A and MNW0805B.	ill ous ith the 5B s an ong, erval on at t					
Borehole         KFR08         KFR101         KFR11         KFR24         KFR25         KFR38         KFR56         KFR7A         Tunnels:         Lineament and, seismic indications:         At the surface, c	PDZ DZ1 DZ2 DZ1 DZ1 DZ1 DZ1 Vor MFM0 corresponds to	Target interd           Sec_up [m]         S           3.00         97.00           97.00         -           -         -           -         -           153.60         -           -         -           3.50         -           3.50         -           0+044 m.         805G1, MSFR08104           MC           MC           the low magnetic lin.	<u>cept</u> <u>Sec_low</u> <u>19.00</u> <u>116.00</u> - - - - - - - - - - - - - - - - - -	Geometric           Sec_up [m]           2.61           80.24           0.00           0.00           8.12           9.38           106.40           3.55           11.25           eometric interce           98.           PROCEDURE           M0805. Modelle	c intercept Sec_low [m] 32.44 131.56 18.71 18.71 40.88 50.61 185.40 44.68 43.20 ept 1+178 - 1	Co     Co     Juc     pho     cor     ind     dig     alo     inte     cor     app     inte     witl     oxi     16     inte     No     No     Sul     ZFI     ZFI     I+193 m     e of the	Iging from the tographs of the dri es there is no obvid ication of a zone wi inity of ZFMNW080 ng the geometric ercept. The only aspicuous feature is proximately 2 dm lo ensely fractured inten- n moderate dation/laumontizatii m length. No targei ercept is defined. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. SHI available. 1B geometric inte model volume usin	ill ous ith the 5B s an ong, erval on at t etween rcept 1					

and 1B tunnels in SFR. Adopted in structural model for SFR (Axelsson and Hansen 1997, Holmén and Stigsson 2001).

NW	ZFM	NW080	5B	Version number	4	Total object CL	22
E COLORIZACIÓN DE COLORIZACIÓN		ZFM 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	WINW0836 2FMN/N05 08058 ZFMWNW326 ZFMWNW326 ZFMWNW3267	2 2 2 2 7 1 1 1			
		OBJECT	CONFIDENCE	ESTIMATE			
Category		Object CL	Comment				
INTERPRETATION							
Data source		3	MFM0805G1, BT and 1B.	KFR08, KFR7A,	KFR24, KF	R25, KFR56, KFR	101,
Results of interpret	tation	3	High confiden tunnels.	ce observations ir	h KFR07A, ∣	KFR101 and SFR	
INFORMATION DEN	SITY						
Number of observa	ation points	3	>4				
Distribution of obse	ervation points	2	Cluster of bor	ehole intersection	s and a line	ament as an outlie	er.
INTERPOLATION							
Geometry		3	Modelled as a	splay to ZFMNW	0805A.	-	

			nactare chemater pattern and tariner obcervatione.
EXTRAPOLATION			
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.
Strike direction		3	Conceptual understanding of the site and that the entire modelled zone is supported by the lineament. Splay to ZFMNW0805A supported mainly by sub-surface obs. point KFR101 and BT in SFR facility. Truncated against ZFMNW0805A which is a high conf. Zone.
		FRA	CTURE CHARACTER
Orientation: (strike/dip right- hand-rule)	Set SE: 133.1°/8 Set G: 247.9°/6.	5.8° 1°	

3

Modelled as a splay to ZFMNW0805A. Interpolation supported by key geological parameters, foremost fracture orientation pattern and tunnel observations.

Geological indicators





	NW			ZFN	/NW	080	5B	Ve	ersion num	<sup>ber</sup> 4	Total o	bject CL	22
KFR11	(0.0-	18.71 m	)										
No dat	a avail	able											
KFR24	4 (8.12	-40.88 r	n)										
No dat	a avail	able	,										
KFR2	5 (9.38	-50.61 r	n)										
No dat	a avail	able	,										
KFR38	3 DZ1 (	153.6-1	81.65 m	1)									
No dat	a avail	able		-									
KFR56	6 (3.55	-44.68 r	n)										
No dat	a avail	able	,										
KFR7/		3.5-43.	) m)										
	Elevation		,						RQD reversed				
Length	m.a.s.l. (m,	Open	Sealed	Open tota	Sealed total	Total	Crushed	Sealed	100 = 0 low value	Fracture open frac	Fracture sealed frac	Open aperture	Core
(m)	RH2000)	fractures	fractures	fractures	fractures	fractures	zone	network	= high value	orientation	orientation	(mm)	loss
		0 20	0 20	0 0 20	0 20	0 20	,		0 100 0	90	0 90	0 10	
4									100				
5	1								80.0				
7	]					- C-		5 <sup>1</sup>	87.0				
8				26		26			100.0				
9						1.00			47.0				
10	1						-		66.5				
11									72.0				
12	-			-					59.5				
13	-					25			51.0				
14	-				10	25			40.5				
15						-			58.0				
16	1								38.0				
17									45.0				
18	1								60.0				
19	1								35.0				
20	]								41.0				
21					50	50			84.0				
23					49	49			77.5				
24									31.5				
25					29	29			34.5				
26	-133 -					27			46.0				
27				-					26.5				
28	1								36.0				
29	1								70.0				
30	1								66.0				
31	1					1.1	S		93.0				
32	]								53.0				
34							-		83.0				
35									78.0				
36									94.0				
37									81.0				
38	1				-				58.0				
39	-								38.0				
40					28	28			83.5				
41									50.0				
42	1			1					36.0				

NW	ZFMNW08	351	Version number	3	Total object CL	11		
GEOLOGICAL	CHARACTER	Property	155000 160000	) 165	000 170000			
Deformation style:	Brittle-Ductile	CL 3				0		
Deformation	No data available.	J	000		~	0000		
description:			621	, r	The second	671		
Alteration:			_{	Y	4			
- First order:	Oxidation	2	e s	_ \	V M 13	0		
- Second order:	Not observed	-	~~		(MM)	5000		
- I hird order:	Not observed		20 et	17	HU K	67		
and type:	no dala avaliable.	_	2	X	AAA No			
Fracture comment:	No data available.	-	000	XAX	VII / S	000		
Fracture fill	No data available.		6700		MANY //	3700		
mineralogy:				AT .	XX Y			
Strike/dip:	127°/90°			SI	NY			
Length:	3076 m		1	MAS -	M	2000		
Mean thickness:	25 m (15 - 64 m)		669	An	XI	699		
Max depth:	-2100 m			HAY	the sum			
Geometrical	ZFMNE0808A, ZFMNNE1	134, Topo			J / J man			
constraints:	40m grid Max error 20m.		0000	$\checkmark$	Went	2000		
			669		1 N	699		
			155000 160000	165	000 170000	10.00		
			Model volume DMS		0 2 4 8	N		
			Baseline		kn. Studtnipes (andersever) et	M		
Zone boood on outfood line	BASI	S FOR MOL	DELLING					
Zone based on surface line	aments.							
Outcrops:	-							
Boreholes: -								
Turneler	ſ							
Lineament and/or	- MEM0851							
seismic indications:	WIT W0051.					2		
	MODE	LLING PRO	CEDURE			<b></b>		
At the surface, corresponds	s to the low magnetic linear	nent MFM08	51. Modelled to the b	ase of the	e model volume usir	ng an		
assumed vertical dip based	I on a comparison with high	confidence,	vertical and steeply	dipping zo	ones with WNW and	INW		
Suike.								
		ZEWINE0020						
NW	ZF	MNWO	851	Version number	3	Total object CL	11	
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OBJECT CONFIDENCE E	STIMATE							
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM0851.					
Results of interpretation	า	2	Low confid	ence in lineament M	FM0851.			
INFORMATION DENSITY								
Number of observation	points	1	1					
Distribution of observation points 1 Single observation point in the form of a lineament.								
INTERPOLATION								
Geometry		1	Geometry	supported by surface	e geophys	sical data.		
Geological indicators		1	Indirect sup	oport by geophysical	data.			
EXTRAPOLATION								
Dip direction		1	No subsurface obs. point, supported only by surface data. Hi uncertainty in dip-direction. Strike length of the modelled zon 2000 m				gh e <	
Strike direction		3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.					
		FRA	CTURE CHA	RACTER				
			No data avai	lable				
INDIVIDUAL INTERCEPTS	5							
			No data avai	lable				

NW	ZFMNW08	354	Version number	5	Total object CL	11
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle Ductile					-
Deformation description:	No data available.	3	6710000	5	m m	6710000
Alteration:			5	Y		
- First order:	Oxidation	2	~~~~	/	VW 3	
- Second order:	Not observed	2	~~ 200			5000
- Third order:	Not observed		670		ANN	670
Fracture orientation and type:	No data available.	-	2	X	ALL Si	emona
Fracture comment:	No data available.	-	000	XAX	11/15	000
Fracture fill mineralogy:	No data available.		6200		QVV	6700
OBJE				Al		
Strike/dip:	142°/90°		8	X	AX/	00
Length:	29569 m		1	1 al and	$\bigvee$	950
Mean thickness:	95 m (50 - 200 m)		99	15	A to	66
Max depth:	-2100 m			19X	A man	
Geometrical	Topo 40m grid Max error	20m, 2			La James	0
constraints:	Surface Planar Cut(s).			16'	5000 170000	0000699
			Model volume DMS Baseline	100		X
	BASI	S FOR MOD				
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MFM0854 merged.					1
seismic indications:	_					I
	MODE	LLING PRO	CEDURE			
At the surface, corresponds assumed dip of 90 degrees NW strike.	s to the low magnetic linear based on a comparison wit	hent MFM08 th high confid	54. Modelled to the b dence, vertical and s	ase of th teeply dip	e model volume usir pping zones with WN	ng an IW and
			ZEMNW054			
			z tommet Z	Trans	ľ	× .

NW	ZF	MNWO	854	Version number	5	Total object CL	11		
OBJECT CONFIDENCE E	STIMATE								
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0854	merged.					
Results of interpretation	า	2	Medium co	onfidence in lineamer	nt MFM08	354.			
INFORMATION DENSITY	N DENSITY								
Number of observation	points	1	1						
Distribution of observat	ion points	1	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry	supported by surface	e geophys	sical data.			
Geological indicators		1	Indirect su	port by geophysical	data.				
EXTRAPOLATION									
Dip direction		1	No subsurf uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	y by surface data. Hi of the modelled zon	.gh ⊧e <		
Strike direction		3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.						
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPTS	3								
			No data avai	lable					

NW	ZFMNW09	74	Version number	3	Total object CL	11			
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000				
Deformation style:	Brittle-Ductile	1				0			
Deformation description:	No data available.		671000	1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	671000			
Alteration:				Y	114	-			
- First order:	Oxidation	2	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	/ _	V W JZ				
- Second order:	Not observed	2	m. 20		MM	2000			
- Third order:	Not observed		269	1 3	ANY	670			
Fracture orientation and type:	No data available.	-	2	X	ATTA No	and the second se			
Fracture comment:	No data available.		00	XAX	VIII S	000			
Fracture fill	No data available.		02		VITY / / /	200			
mineralogy: OBJE	CT GEOMETRY					U			
Strike/dip:	127°/90°		8 1010	AC	AX/	0			
Length:	4096 m		3 1 1 1 1 2 20	-	$\sqrt{7}$	9500			
Mean thickness:	<u>30 m (15 - 64 m)</u>		66	1000		66			
Max depth:	-2100 m			19X	And and				
Geometrical	ZFMNNW0806, ZFMNNE	1132,			La Stream	0			
constraints:	Topo 40m grid Max error 2	20m.	000	$\checkmark$	Were	000			
			660	$\langle \cdot \rangle$	1 N M 4	699			
			155000 160000	16	5000 170000	10.000			
						N			
			Baseline Model volume DMS		0 2 4 8 Standard Godenson Am	A			
	BASI	S FOR MOD	ELLING						
Zone based on surface line	aments.								
Outcrops:	-								
Boreholes: -									
Tunnels:	-								
Lineament and/or	MFM0974.					2			
seismic indications:						2			
	MODE	LLING PRO	CEDURE						
At the surface, corresponds assumed dip of 90 degrees NW strike.	s to the low magnetic lineam based on a comparison wit	ent MFM097 th high confic	74. Modelled to the b lence, vertical and s	ase of th teeply dip	e model volume usir pping zones with WN	ng an IW and			
W strike.									

NW	ZF	<b>MNW0</b>	974	Version number	3	Total object CL	11		
OBJECT CONFIDENCE E	STIMATE					•			
		-	-						
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0974	merged.					
Results of interpretation	า	2	Medium confidence in lineament MFM0974.						
INFORMATION DENSITY	/								
Number of observation	points	1	1						
Distribution of observat	ion points	1	Single observation point in the form of a lineament.						
INTERPOLATION	•			•					
Geometry		1	Geometry	supported by surface	e geophys	sical data.			
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		1	No subsurf uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	/ by surface data. Hi of the modelled zon	gh e <		
Strike direction	3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.							
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPTS	5								
			No data avai	lable					

NW	ZFMNW09	97	Version number	6	Total object CL	11				
GEOLOGICAL	CHARACTER	Property CL	155000 160000	) 16	5000 170000					
Deformation style:	No data available	~ -	8			0				
Deformation	No data available. Zone		100	-	~	100				
description:	based on lineament		6	VI	1 103	67				
	maps in the catchment		$\sim$	1						
Alteration:	alea anu bailiymeiry.		8 7		1/2/3	2 00				
- First order:	Not observed	1	202	1 -	A A A	705(				
- Second order:	Not observed		" Really "	1	THAN	9				
- Third order:	Not observed		11/1	XX	AHAA LE					
Fracture orientation and type:	No data available.	-	2000002		\$	700000				
Fracture comment:	No data available.	-	° / L		XV V	0				
Fracture fill	No data available.			A	XX					
OB II			000	X	AN	000				
Strike/dip:	143°/90°		5699	A	XI	695				
Length:	2240 m			141	the man	9				
Mean thickness:	20 m (3 - 50 m)		14		1 Junear	1				
Max depth:	-2100 m		00	X	how	000				
Geometrical	Topo 40m grid Max error 2	20m,	0.00	~ /		6900				
constraints:	ZFMWNW3571, ZFMWNW	N0836,	° /			0				
	ZFMNW0805A.					10.00				
			155000 160000	) 16	5000 170000	N				
			Model volume DMS Baseline		0 2 4 8	À				
	BASI	S FOR MOD	ELLING							
Zone based on surface line	eaments.									
Outcrops:	-									
Boreholes: -										
Tunnels:	-									
Lineament and/or	XFM0997A0, MFM3550, M	MFM3557.				2				
seismic indications:	MODE									
-	WODE		CEDURE							
で た た が の た の た の の の の の の の の の の の の の										
0 100 200 300 500 r	SFMNNN0999 SFMNNN09999 SFMNNNV3113 ZFMNW0805A LKm	NS37.84		2 km						

NW	ZF	MNWO	997	Version number	6	Total object CL	11		
OBJECT CONFIDENCE E	STIMATE			•		·			
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	XFM0997A0, MFM3550.						
Results of interpretation	า	2	Medium confidence in lineament XFM0997A0 and MFM3557.						
INFORMATION DENSITY									
Number of observation	points	1	2						
Distribution of observat	ion points	1	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry	supported by surface	geophys	sical data.			
Geological indicators		1	Indirect su	oport by geophysical	data.				
EXTRAPOLATION									
Dip direction	Dip direction 1			No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m.					
Strike direction	3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.							
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPTS	3								
			No data avai	lable					

NW	ZFMNW11	73	Version number	6	Total object CL	13
GEOLOGICAL	CHARACTER	Property CL	155000 16000	0 16	5000 170000	
Deformation style:	Brittle-Ductile	1	9			0
Deformation	No data available.		1000	_	$\sim$	0001
description:			3	V.F	The man	671
Alteration:			{	X	12	
- First order:	Oxidation	2	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		VM 13	
- Second order:	Not observed	2	L~ 200	- 1	MPL	5000
- Third order:	Not observed		670	1	AN	670
Fracture orientation	No data available.		5	W	THE ST	Kenota
and type:			5111	XX	AHA IE	
Fracture comment:	No data available.		000	ZAX	×11/1 5	000
Fracture fill mineralogy:	No data available.		02 5		VITY / / /	700
OBJE	ECT GEOMETRY				X Y	9
Strike/dip:	139°/90°			all'	M/	
Length:	14000 m		00	X	AXI	00
Mean thickness:	60 m (50 - 200 m)		1000	1 al and	$\mathbf{V}$	950
Max depth:	-2100 m		30	112	A to	66
Geometrical	ZFMWNW0853, Topo 40	m grid Max		R	- And second	
constraints:	error 20m, 1 Surface Plan	har Cut(s).			S Dimente	0
			00	$\bigvee$	wer	000
			990			699
			155000 16000	) 16	5000 170000	10-9-1
			155000 100000	0 10	3000 170000	N
			Model volume DMS			A
	BASI				TORNEY CONTRACTOR	
Zone based on surface line	paments					
	amenta.					
Outcrops:	-					
Boreholes: -	L					
Tunnels:	-					•
Lineament and/or	MFM1173 merged.					2
seismic indications:						2
	MODE	ELLING PRC				
At the surface, corresponds assumed dip of 90 degrees	s to the low magnetic linear	nent MEM11 th high confi	73. Modelled to the t dence vertical and s	base of th teeply di	e model volume usir pping zones with WN	ng an IW and
NW strike.				teepiy ui		
		,				
		-	ZFMNW0854			
					ta l	<b>X</b>
					AN IN	
					173	
			4470			-
			1173			
					600	
					TEMWINITUM	
					H	
				4	THE P	
0	2		4 km		Eog	
•					2	3A2

NW	ZF	FMNW1173 Version number 6 Total object CL 1						
OBJECT CONFIDENCE ES	STIMATE			•		·		
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM1173	merged.				
Results of interpretation	า	2	Medium c	onfidence in lineamer	t MFM11	173.		
INFORMATION DENSITY	, ,							
Number of observation points         1         1								
Distribution of observation points		1	1 Single observation point in the form of a lineament.					
INTERPOLATION	-							
Geometry		1	Geometry	supported by surface	geophys	sical data.		
Geological indicators		1	Indirect su	pport by geophysical	data.			
EXTRAPOLATION								
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the					
		3	modelled zone > 2000 m.					
Strike direction		2	Conceptua	al understanding of th	e site an	d that the entire region	onal	
		3	modelled zone is supported by the lineament.					
		FRA	CTURE CH	ARACTER				
			No data ava	ilable				
INDIVIDUAL INTERCEPTS	5							
			No data ava	ilable				

NW	ZFMNW120	0	Version nu	mber	5	Total object CL	23
GEOLOG		Property	155000	160000	1650	00 170000	
		CL					
Deformation style:	Brittle-Ductile	3	000				000
Deformation description:	Surface geology shows two different episodes of displacement along fault with NW-SE strike. Sinistral strike- slip displacement dominates. Oblique-slip shear with dextral normal displacement is also present in KFM09A (DZ4 and DZ5). Kinematic consistent with the surface data. Sinistral strike-slip faults with steep NW-SE strike dominate and dextral strike-slip along a fault with WSW strike is also present. Inferred conjugate set. One steeply dipping fault with a SE strike shows oblique slip with a strong dextral strike-slip component and subordinate normal displacement. One steeply dipping fault with a NE strike shows reverse dip-slip dipping fault with a SE strike			160000	16500		► E89000 685000 670000 670000 5710
Alteration:	displacement.		Baseline	me DMS		S California California California	A
- First order:	Oxidation						
- Second order:	Not observed	3					
- Third order:	Not observed	1					
Fracture orientation and type: Fracture comment:	Fractures that strike SE and dip steeply to the SW dominates. Gently dipping fractures as well as steeply dipping fractures with NE strike are also present. Sealed fractures dominate followed by open and partly open fractures. Quantitative estimate and span include sealed fracture networks. No data available.	2					
Fracture fill	Chlorite, calcite, laumontite,						
mineralogy:	prennite, hematite/adularia,						
	quartz and clay minerals.						
Strike/din:							
Jonath	3280 m						
Lengui. Moon thicknoss:	3200  III		1				
Max denth:	-2100 m						
Geometrical	Topo 40m grid Max error 20m 1						
constraints:	UNIVERSE Planar Cut(s).						

NW		ZFMNW	/1200	Version I	number	Total object CL	23
BASIS FOR MODE	ELLING						
Zone based on sur	face lineam	ents, outcrop and	borehole obs	ervations.			
Outcrops:	PFM00	7096, PFM0012	57				
Boreholes:							
		Target in	ntercept	Geometric	: intercept		
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	Comment	
KFM04A	DZ1	110.00	176.00	110.56	170.74	110-169 m added (c Table 3-2 in Stepher 2007).	f. ns et al.
KFM09A	DZ4	723.00	754.00	723.10	793.22	Fractured rock betw 754 and 770 m infer be affected by DZ ( Table 3-2 in Stepher 2007).	een red to cf. ns et al.
KFM09A	DZ5	770.00	790.00	723.10	793.22		
Tunnels							
Lineament and/or	MFM12	200.					
seismic indications:							1
			MODELLING	PROCEDURE			
observation point F MFM1200 at the su 723-754 m (DZ4) in affected by this zor Decreased radar p	PFM007096. Irface with t NKFM09A a ne. Deforma enetration a	Modelled to the he borehole inter and 770-790 m (E tion zone plane p lso along the bor	base of the mo sections 110-1 0Z5) in KFM09 basses through ehole interval	odel volume using 76 m in KFM04A A. Borehole inter n fixed points 159 731-754 m in KFI	g dip estimated (DZ1 and exterval 754-770 m m in KFM04A M09A.	I by connecting lineame ension in interval 110-1 in KFM09A also inferre and 731 m in KFM09A	ent 69 m), ed to be 
	ZFR	erenter MNV1200					

NW	ZFN	/NW12	00	Version number	5	Total object CL	23	
OBJECT CONFIDEN	CE ESTIMATE							
Category		Object Cl	Comment					
INTERPRETATION		Object CL	Comment					
Data source		3	MFM1200, H	KFM04A, KFM09A, F	PFM0070	96, PFM001257.		
Results of interpre	etation	3	High confide	nce observation in k	KFM09A.			
INFORMATION DE	NSITY							
Number of observ	ation points	3	>4	face observation no	int and th	o linoamont as an o	utlior	
INTERPOLATION	servation points	2	1 WO SUD-SUI	lace observation po	init and th		utiler.	
Geometry			In addition to outcrops/field localities, one oriented radar reflector in					
		3	KFM04A 169-176 m DZ1 provide support for current geometry and					
Geological indica	tors		linking the z	one to the surface lin	neament.	parameters foremo	oet	
Geological Indicators 3			fracture orie	ntation pattern.	eological	parameters, iorenic	51	
EXTRAPOLATION								
Dip direction		3	Extrapolated	I to the base of the n	nodel volu	ume. Strike length c	of the	
Strike direction			modelled zo	ne > 2000 m.	t and nart	ly by surface linear	nont	
Strike direction		3	Modelled zo	ne length > 2000 m.	i anu pan	ly by suitace inteat	ient.	
							I	
		FRA	CTURE CHAF	ACTER				
Orientation:	Set SE: 140.1%	82.0° 5°		ZFMM	W1200			
hand-rule)	Set 0. 207.2 /7	.0		hand the second				
Frequency:	Boreholes: KFM	104A, KFM09A						
		TEDZAOLI	1					
	TYPE	WEIGHED		1				
		P10		7				
	Open and	5.5 m-1	1.		1.	t i i		
	partly open	17.0 m 1	100			· · · · · · · · · · · · · · · · · · ·		
	Sealed	6.4 % of DZ	w-:		1		Ξ	
	network	intercept			Δ.	•		
	Crush	0.0 % of DZ	T.					
		intercept	1			· · · · · · · · · · · · · · · · · · ·		
				V2.		+		
				Z .				
				×				
				~.	••••••••	Equal a	area	
			• Unas	signed (503)	5	Loner nemisp.	iere .	
			Set S	E (255) 🔺 Mea	n pole Set S	SE (50.1/8.0) Fisher κ = ( (177.2/82.5) Fisher κ =	52.7	
DOD	50	0	• Set 0		in pole set (	5 (177.2/02.5) Histori K =	. 5.7	
RQD: Fracture fill	min:56, max:10	0, mean:94						
mineralogy:		KFM04A	(110.0-176.0), KF	M09A(723.0-754.0), KFM	09A(770.0-7	790.0)		
	400 -					Open and partly ope	en	
	100					Sealed	-	
	200 - 200 -							
	ourrei							
	500 d							
	200							
	5 100 -							
	100				-			
							1	
	Jane III	e dete ofte arals a	ore oute note tide	nue pat walt spat me	wite and at	at under neral spat offe		
	polin poorts	Co. Cur wice Bon	Hern Homble Hydro aut	the shind and shired pretty of	ou de feio	Sun un un tereso le		
		Q.	No. 160	bo. Ot. 5000	×.	Dutter when		
			NODEL					









NW	ZFMNW35	511	Version number	5	Total object CL	21
GEOLOGICAL	CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation style:	Brittle-Ductile	3	9			0
Deformation	No data available.		1000		~	000
description:			2 61	T	1 mm	67
Alteration:				Y		
- First order:	Oxidation	1	~~~~		A PY	
- Second order:	Quartz dissolution	1	L~ 200		MPL	5000
- Third order:	Not observed		670	1	AN	670
Fracture orientation	Dominance of NW and		5	N	141 5	cetona.
and type:	NNW striking fracture		5/1/	X	AHAA NE	
	set. Occurrence of		000	XAX	×11/1 \5	000
	sealed and open				VIT / / /	700
	fractures. Sealed		° ×		K V	0
	fracture networks are			TAH		
-	present.		8	X	AX/	8
Fracture comment:	No data available.		9 1 200	and		9500
Fracture fill mineralogy:	Calcite, laumontite and		99	112		660
				19X	- And more	
OBJE					L S man	
Strike/dip:	129 /90		000		win	0000
Length: Moon thicknooo	19614111					699
Max donth:	75 III (50 - 200 III)					
Geometrical	-2100 III ZEMW/NW/2512 Topo 40r	n arid Max	155000 160000	16	5000 170000	10-9-0
Geometrainte:	error 20m 2 Surface Plan	ar Cut(s)	155000 100000	, 10.	170000	N
constraints.		ar Cut(s).	Model volume DMS Baseline		0 2 4 8	A
					S CHEMISTER STREET, ST	
	BASI	S FOR MOD	DELLING			
Zone based on surface line	aments and outcrop observe	ations.				
Outcrops:	ABP20002 1ABP20005 /	BD20007 /		120		
Boreholes:	ABR20002-TABR20005, F	ADR20007, P	ADR20000, ADR200	JZU,		
Borenoica.						
Tunnels:	-					
Lineament and/or	MFM3511.					2
seismic indications:						3
	MODE	LLING PRO	CEDURE			
-						
		Tampoo Constanting South and a second				
	2FMNW3511 -2011000255 2740000551 2		4 km	w2		

NW	ZF	MNW3	511	Version number	5	Total object CL	21
OBJECT CONFIDENCE E	STIMATE						
Category		Object CL	Comment				
INTERPRETATION							
Data source		3	MFM3511, ABR20008	Field observations ( , ABR200020, ABR2	ABR2000 200021, A	2-ABR20005, ABR2 BR200034).	20007,
Results of interpretation	ר	3	High confic ABR20007	lence in outcrop obs , ABR20008, ABR20	ervations 00020, AB	(ABR20002-ABR20 R200021, ABR2000	005, )34).
INFORMATION DENSITY	/						
Number of observation	points	3	>4				
Distribution of observat	ion points	2	A cluster of based on g	f field observations ( eophysics.	outcrops)	and a surface linear	ment
INTERPOLATION							
Geometry		2	No subsurf arrangeme	ace observation poir nt of outcrops and fr	nts, but st acture ori	ill a supporting entations.	
Geological indicators		2	Interpolatio	n supported by data	from out	crops.	
EXTRAPOLATION							
Dip direction		3	Extrapolate modelled z	ed to the base of the one > 2000 m.	model vo	lume. Strike length	of the
Strike direction		3	Conceptua modelled z supported	I understanding of th one is supported by by outcrop observati	e site and the linear ons.	d that the entire regionent. Surface data	onal
		FRA					
	•		ino data aval	lable			
INDIVIDUAL INTERCEPTS	)		No doto ovoj	labla			
			inu uala aval	lable			

NW	ZFMNW35	552	Version number	3	Total object CL	12
GEOLOGICAL	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style: Deformation description:	No data available No data available. Zone based on lineament		2410000	5	Ch ro	6710000
	area.		~	1	1 L Z	-
Alteration:	Not shown a	-	J~ 0000	-1	APIS	2000
- First order: - Second order:	Not observed		67	17	HAVY.	67
- Third order:	Not observed		7	X	ALLA	
Fracture orientation and type:	No data available.		200000		XAJ	700000
Fracture comment: Fracture fill	No data available. No data available.	-	"			Ø
OBJI	ECT GEOMETRY		000	X	AM	000
Strike/dip:	131°/90°		699	An	$\times$	6695
Length:	13000 m			14X	The second	
Mean thickness:	60 m (50 - 200 m)				C S man	
Max depth:	-2100 m	00	0000	$\checkmark$	Win	0000
constraints:	ZFMWNW0001, 1 Surface Cut(s).	20m, e Planar	8 155000 160000	0 165	000 170000	099
			Baseline		0 2 4 8 Classification of the second	X
	BASI	S FOR MOD	ELLING			
Zone based on surface line	eaments.					
Outcrops:	-					
Borenoles						
Tunnels: Lineament and/or	- MFM0803A merge.					3
seismic indications:	MODE	LLING PRO	CEDURE			
-						
		8		Jos Co	2 2	
	ZFMWNW3552		2	Š		~
		-				c
	2					
	ZE WWWWOO				*	
0 100 200 300	500 m 1 km			2 kr	n 🕨	<
		$\bigcirc$	0			
		ZF	MNW0003			

NW	ZF	MNW3	552	Version number	3	Total object CL	12			
OBJECT CONFIDENCE E	STIMATE						•			
			_							
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM0803a	a merged.						
Results of interpretation	า	3	High confid	dence in lineament M	FM0803a	a.				
INFORMATION DENSITY	/									
Number of observation	points	1	1							
Distribution of observat	Distribution of observation points 1 Single observation point in the form of a lineament.									
INTERPOLATION										
Geometry		1	Geometry	supported by surface	geophys	ical data.				
Geological indicators		1	Indirect su	pport by geophysical	data.					
EXTRAPOLATION										
Dip direction		4	Extrapolate	lume. Strike length c	of the					
		1	modelled z	one > 2000 m.		Ū				
Strike direction		2	Conceptua	I understanding of th	e site and	d that the entire region	onal			
3 modelled zone is supported by the lineament.										
		FRA	CTURE CHA	RACTER						
			No data avai	lable						
INDIVIDUAL INTERCEPTS	3									
			No data avai	lable						

NW	ZFMNW80	)43	Version number	5	Total object CL	10
GEOLOGICAL	CHARACTER	Property	155000 160000	165	5000 170000	
Deformation style:	Brittle	2 2				0
Deformation	No data available.		1000		~	1000
description:			5	T	1 mm	67
Alteration:			~	X		-
- First order:	Not observed		8 1 4		1212	8
- Second order:	Not observed		1020 June 1020	1 1	A M Cha	1050
Fracture orientation	No data available.		° R		THAN Z	9
and type:			11/2	X	AHA Z	
Fracture comment:	No data available.		00	XAX	×11/15	000
Fracture fill	No data available.		0029		VAL 12	5700
mineralogy:					XX Y	
Strike/dip:	126°/90°			S	NY	
Length:	775 m		2000	MAC .	M	2000
Mean thickness:	10 m (2 - 36 m)		699	11	$\times$	699
Max depth:	-780 m			Id X	the man	
Geometrical	ZFMWNW3268, ZFMENE	3115,			J J man	-
constraints:	Topo 40m grid Max error 2	20m, 1	0000		war	000
	Sunace Planar Cul(s).		665	$\langle \rangle$	1 N M	669
			155000 160000	165	000 170000	10.400
			Model volume DMS		0 2 4 8	Ň
			Baseline		C Latitudge et Gescherseewerken	N
	BASI	IS FOR MOD	DELLING			
Zone based on surface line	eaments.					
Outcrops:	-					
Boreholes: -						
Tunnels	-					
Lineament and/or	MSFR10002.					
seismic indications:						1
	MODE	LLING PRC	CEDURE			
The position of the zone at	the ground surface is based	d on version	1.0 magnetic lineam	ent MSFF	R10002 that replaces	5
traceability between differe	nt model versions. The mod	lelled din and	thickness are defau	ut values	one name to assist	
traceability between differe				int values.		
•KFR13	ALE:102B					
200	To total					
	KFR1024	2FMA				
	anno.	Sou	VOBOR			
	FR27	U5B	224			
R S						
KFR79	KERIUS	ZEMWNW	1262			
	20		2.02			
	WWWW8042	KFR106				
KFR104	195			1		
2	-CMENE3135					
KER!	105					
S-FMAN		_				
S IV	8042 8	-MWNW3267				
AN A	13 1					
	ZEN	11/11/2000				
	ZFN ZFN	aviv 3268	N			
0 100 200	300 500 m					
		ZFMWNW0	001			

NW	ZF	MNW8	043	Version number	5	Total object CL	10		
OBJECT CONFIDENCE E	STIMATE				•				
			-						
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MSFR1000	)2.					
Results of interpretation	า	1	High confic	lence in lineament M	ISFR1000	)2.			
INFORMATION DENSITY	(								
Number of observation	points	1	1						
Distribution of observat	lineament.								
INTERPOLATION									
Geometry		1	Geometry	supported by surface	e geophys	sical data.			
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		1	No subsurf uncertainty 2000 m.	ace obs. point, supp in dip-direction. Stri	orted only ke length	y by surface data. Hi of the modelled zon	gh e <		
Strike direction Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.							onal		
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPTS	6								
			No data avai	lable					

WNW	ZFMWNW00	01	Version number	5	Total object CL	24
GEOLOG		Property	155000 160000	0 165	000 170000	
Deformation style:	Brittle-Ductile	CL 3	0			0
Deformation style: Deformation description:	Brittle-Ductile Steeply dipping faults with NW-SE or WNW-ESE strike shows dextral strike-slip, oblique-slip with a reverse dip- slip component, sinistral strike-slip or normal dip-slip displacement. Remainder faults exhibit strike-slip or oblique slip displacements. Steeply dipping faults with ENE-WSW or NE-SW strike shows strike-slip, oblique-slip with dominant strike- slip component in part dextral, oblique-slip with dominant reverse dip-slip component or normal dip-slip displacements. Steeply dipping faults with NNW strike shows sinistral strike-slip displacement. Gently dipping faults shows dextral strike- slip, oblique slip with dominant dextral strike- slip component or reverse dip- slip displacement. The larger part of the borehole interval 498-630 m in KFM11A (part of DZ1), which has been studied for the more detailed characterization and kinematics of zone ZFWNW0001, was classified as fault core; fault rocks (breccias and cataclasites) as well as crush zones were superimposed on rock affected by ductile deformation. Most fault slip data occur in the interval 510- 540 m and close to the bottom of the studied interval at 625-	3	0000129 0005029 0005099 155000 155000 160000 Baseline			
Alteration:						
- First order:	Oxidation	3				
- Third order:	Argillization					
Fracture orientation and type:	Steep sets with WNW-ESE to NW-SE and ENE strike are prominent. Fractures with other orientations, including gently dipping fractures, are also present. Dominance of sealed fractures. Quantitative estimate and span include sealed fracture networks and crush zones.	3				
Fracture comment:	No data available.					
Fracture fill mineralogy:	Chlorite, calcite, laumontite, hematite/adularia, clay minerals, guartz, epidote					
	OBJECT GEOMETRY					
Strike/dip:	119°/90°					
Length:	35551 m					
Mean thickness:	181 m (50 - 200 m)					
Max depth:	-2100 m					
Geometrical constraints:	Topo 40m grid Max error 20m, 3 Planar Cut(s).	3 Surface				

WNW		ZFMWN	W0001	Version	number	5	Total object CL	24
BASIS FOR MOD	ELLING						<b>I</b>	
Zone based on su	Inface lineame	ents, tunnel and	borehole obser	rvations.				
Outcrops:	-							
Boreholes:								
		Target in	ntercept	Geometric	intercept			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec_up [m]	Sec_low [m]	C	omment	
HFM34	DZ1	37.00	192.00	17.78	200.74			
HFM34	DZ2	37.00	192.00	17.78	200.74			
HFM34	DZ3	37.00	192.00	17.78	200.74			
HFM35	DZ1	24.00	33.00	8.13	41.38	Di Zi	Z1 also lies within MNW0002.	
HFM35	DZ2	47.20	52.50	8.13	41.38	D. ZF	Z2 also lies within MNW0002.	
HFR105	DZ1	21.12	31.00	14.12	77.41			
HFR105	DZ2	88.00	92.00	14.12	77.41			
KFM11A	DZ1	498.00	824.00	490.67	826.73	G be Zf Zf	eometrical split of D etween ZFMWNW0 FMWNW0813 and FMWNW3259.	)Z1 001,
KFR01	DZ1	0.00	62.30	0.00	62.29			
KFR61	DZ1	1.40	70.90	2.29	70.90			
KFR62	DZ1	45.64	82.80	4.65	82.80			
KFR64	DZ1	12.79	54.17	2.73	54.17			
KFR65	DZ1	17.63	39.68	1.77	39.68			
KFR66	DZ1	14.99	29.17	3.13	29.17			
KFR67	DZ1	13.74	48.95	4.12	48.95			
KFR71	DZ1	65.67	69.50	0.00	120.90			
KFR71	DZ2	72.14	120.90	0.00	120.90			
KFR84		-	-	0.00	29.50	N	o SHI available.	
KFR85		-	-	0.00	12.20	N	o SHI available.	
KFR86		-	-	0.00	14.70	N	o SHI available.	
Tunnels:	DT targ 0+189	get intercept 0+2 - 0+283 m, geom	12 - 0+295 m, g netric intercept	geometric interce 0+140 - 0+345 n	ept 0+155 - 0+ า.	-362 r	n. BT target interce	pt
soismic		505A merge, MF	1013300.					3
indications								5
indications.			MODELLING	PROCEDURE				
At the surface, co	rresponds to	the low magnetic	lineaments M	EM0803 and ME	M0803G0 70	no 76		s the
main structural co	mponent in a	system of sub-r	arallel deforma	ation zones with	NNW-FSF or	NW-	SE strike and vertic	alor
steep dip in the ce	entral part of t	the model volum	e. Modelling pr	ocedure and pro	perties inherit	ed fro	m updated geologi	cal
model for SFR pre	esented in Ap	pendix 11 in Cu	rtis et al. (2011	). The zone inter	sects the SFF	R DT t	unnel (tDZ7 0+212.	tDZ8
0+243, tDZ9 0+25	55, tDZ10 0+2	257, tDZ12 0+25	9, tDZ13 0+260	), tDZ14 0+258–	0+271, tDZ15	0+27	'5, tDZ16 0+278-0-	+295
and tDZ17 0+291	) and BT tunn	nel (tDZ7 0+189.	tDZ8 0+220, tl	DZ9 0+228, tDZ1	0 0+229, tDZ	11 0+	231, tDZ12 0+234,	tDZ13
0+238, tDZ14 0+2	238–0+249, tl	DZ15 0+248, tDZ	216 0+267-0+2	283, tDZ17 0+268	and tDZ18 0	)+280	), borehole KFM11/	A along
interval 498-824 n	n (part of DZ1	1) and several ol	der cored and	percussion boreh	oles at SFR.			-



Category	Object CL	Comment
INTERPRETATION		
Data source	3	MFM0803a merged, HFM34, HFM35, HFR105, KFM11, KFR01, KFR61, KFR62, KFR64, KFR65, KFR66, KFR67, KFR71, KFR84, KFR86, SFR DT and BT tunnels and older SFR boreholes along these tunnels.
Results of interpretation	3	High confidence observations in multiple boreholes and SFR tunnels.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	3	Multiple subsurface observations points suggesting one strong alternative.
INTERPOLATION		
Geometry	3	Geometry supported by multiple subsurface obs. points. One strong interpolation alternative.
Geological indicators	3	Interpolation supported by key geological parameters within the range of the obs. points.
EXTRAPOLATION		
Dip direction	3	Extrapolated to the base of the model volume. Strike length of the modelled zone > 2000 m. Dip based on data from intersections along tunnels 1-2, 3 and SFR, and boreholes along tunnels.
Strike direction	3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.

WNW	ZFMWNW000	Version number	5 Total object CL 24
FRACTURE CHARAG	CTER		
Orientation: (strike/dip right- hand-rule)	Set ESE: 122.7°/83.1° Set ENE: 63.7°/72.9°	ZFMWN	W0001 N
Frequency:	Boreholes: KFR67, KFR62, KFM11A, KFR61, KFR64, KFR65, KFR71, KFR85, KFR01, KFR84, KFR66, KFR86 FRACTURE TERZAGHI- TYPE WEIGHED P10 Open and 0.7 m-1 partly open Sealed 1.7 m-1 Sealed 1.7 m-1 Sealed 2.2 % of DZ network intercept Crush 0.2 % of DZ intercept	Unassigned (1239) Set ESE (1235) ▲ Mean pol Set ENE (487) ▲ Mean pol	Equal area Lower hemisphere e Set ESE (32.7/6.9) Fisher $\kappa = 10.3$ e Set ENE (333.7/17.1) Fisher $\kappa = 15.4$
RQD: Froaturo fill	min:28, max:100, mean:90		
Fracture fill mineralogy:		KFM11A(498.0-824.0)	
	1200 - 1000 - 800 - 600 - 200 - 200 - physics of the source of the	theore come over the content of the series o	Open and partly open Sealed

















V	VNV	N		ZFN	IWN	W00	01	Ve	ersion numb	ber E	5	Total o	bject CL	24
(FR01	DZ1 (	0.0-62.3	m)											
lo data	a availa	able	( ma )											
LLK01	DZI (	1.4-70.9	(m)						RQD reversed					
Length	m.a.s.l. (m,	Open	Sealed	Open total	Sealed total	Total	Crushed	Sealed	100 = 0 low value	Fracture open frac	Fr	acture led frac	Open aperture	Core
(m)	RH2000)	fractures	fractures	fractures	fractures	fractures	zone	network	= high value	orientation	orie	entation	(mm)	loss
2		0, 20	0, 20	0, 20	0 20	0, 20			0 100 0	91	T	90		_
3	0					1			100.0					
4	-1								100.0					
6	-2 :								100.0					
7	-3								100.0					
8	-4								100.0					
10	-5								100.0					
11	-6								100.0					
12	-7								100.0					
13	-8								100.0					
15	-9								100.0					
16	-10								100.0					
18	-11								100.0					
19	.12								100.0					
20	-12								100.0					
21	-13								100.0					
23	-14								100.0					
24	-15								100.0					
25	-16								100.0					
27	-17								100.0					
28	-18								100.0					
30	-19								100.0					
31	-20								100.0					
32	-21								100.0					
34	-22								100.0					
35	-23								100.0					
36 -	-74								100.0					
38	.25								100.0					
39	-25								100.0					
40	-20								100.0					
42	-27								100.0					
43	-28								100.0					
44	-29								100.0					
46	-30								100.0					
47 -	-31								100.0					
48	-32								100.0					
50	-33								100.0					
51 -	-34								100.0					
52	-35								100.0					
54	-36								100.0					-
55	-37								100.0					
56	.38								100.0					
58	-30								100.0					
59	-39								100.0					
60	-40								100.0					
62	-41								100.0					
63	-42								100.0					
64	-43								100.0					
66	-44								100.0					
67 -	-45								100.0					
68	-46								100.0					
69	1								100.0					

V	٧N٧	N		ZFN	IWN\	N00	01	V	ersion num	<sup>ber</sup> 5	, -	Fotal o	bject CL	24
KFR62	2 DZ1 ( Elevation m.a.s.l. (m, RH2000)	45.64-82	2.8 m)	Open total fractures	Sealed total	Total fractures	Crushed zone	Sealed	RQD reversed 100 = 0 low value = high value	Fracture open frac orientation	Frac	ture d frac tation	Open aperture (mm)	Core
		0 20	0 20	0 20	0 20	0 20			0 100 0	90	0	90	0 10	
1.00	-32										[			
47	.33								100.0					
48									100.0					
49	-34								100.0					
50	-35								100.0					
51									100.0					
52	-50								100.0					
54	-37								100.0					
55	-38								100.0					
56									100.0					
57	-39								100.0					
58	-40								100.0					
59	.41								100.0					
60									100.0					
61	-42								100.0					
62	-43 -	-							100.0					
63									100.0					
64	-44								100.0					
65	45	9							100.0					
66	.45								100.0					
67									100.0					
68	-47 -								100.0					
69	-48								100.0					
70									100.0					
71	-49								100.0					
72	-50								100.0					_
73	-51								100.0					
74									100.0					
75	-52								100.0					
76	-53								100.0					
77									100.0					
78	-54								100.0					
79	-55								100.0					
80	-56								100.0					
81									100.0					
82	-57								100.0					
V	٧N	N		ZFN		W00	01	Ve	ersion num	ber	5	Total	object CL	24
---------------	---	-------------------	---------------------	-------------------------	---------------------------	--------------------	-----------------	-------------------	--	-------------------------------------	------	--	--------------------------	--------------
KFR64	4 DZ1 (	12.79-54	4.17 m)											1
Length (m)	Elevation m.a.s.l. (m, RH2000)	Open fractures	Sealed fractures	Open total fractures	Sealed total fractures	Total fractures	Crushed zone	Sealed network	RQD reversed 100 = 0 low value = high value	Fracture open frac orientatio	n	Fracture sealed frac orientation	Open aperture (mm)	Core loss
		0 20	0 20	0 20	0 20	0 20		_	0 100 0		90 0		0 0 10	
14	-11													
14	-12								100.0					
16	-13	•							100.0					
17	-14								100.0					
18	-15								100.0					
19	-16								100.0					
20	-17								100.0					
22	-18								100.0					
23	-19								100.0					
24	-20								100.0					
25	-21								100.0					
26	-22								100.0					
27	-23								100.0					
28	-24								100.0					
30	-25								100.0					
31	-26								100.0					
32	-27								100.0					
33	-28								100.0					
34	-29								100.0					
35	-30								100.0					
30	-31								100.0					
38	-32	1							100.0					
39	-33								100.0					
40	-34								100.0					
41	-35								100.0					
42	-36								100.0					
43	-37								100.0					
44	-38								100.0					
45	-39								100.0					
47	-40								100.0					
48	-41								100.0					
49	-42	1							100.0					
50	-43								100.0					
51	-44								100.0					
53	-45	-							100.0					
	-46	1	_					_	100.0					
KFR6	5 DZ1 (	17.63-3	9.68 m)											
No da	ta avail 6 DZ1 /	able 14 99-20	9 17 m\											
No da	ta avail	ahle	0.17 111											
KFR6	7 D71 (	13 74-4	8 95 m)											
No dat	ta avail	able	0.00 mj											
KFR7		65 67-69	9.5 m)											
No da	ta avail	ahle	0.0 mj											
KER7	1 D72 /	72 14-1	20 9 m)											
No dat	ta avail	ahla	_0.0 m)											
KEDO		29 5 m												
No do	+ (U.U-	23.3 III) abla												
KED	a avali	12 2 m												
No dat	ta avail	able												
KFR8	6 (0.0-	14.7 m)												
No da	ta avail	able												

WNW	ZFMWNW00	04	Version number	7	7 Total object CL 24				
GEOLOG	ICAL CHARACTER	Property	155000 160000	0 165	000 170000				
Deformation style:	Brittle-Ductile	5 2	0			0			
Deformation style: Deformation description:	Brittle-Ductile Steeply dipping faults with NW-SE or WNW-ESE strike shows strike-slip with sinistral or dextral displacement. Oblique-slip including dominant sinistral or dextral strike-slip component, dextral strike-slip, sinistral strike-slip, reverse dip-slip or normal dip- slip displacement. Steeply dipping faults with ENE-WSW or NE-SW strike shows sinistral strike-slip or uncertain sense of shear. Steeply dipping faults with NNE-SSW strike shows reverse dip-slip or oblique slip displacement with dominant strike-slip component. Gently dipping faults shows reverse dip-slip, oblique-slip with dominant strike-slip component or strike-slip with dextral or sinistral displacement. Several intervals of fault core identified composed of cataclasite (see photograph below), ultra- cataclasite, fault breccia, sealed fracture networks including epidote-sealed networks, and crush zones (see photograph below). The interval between 312 and 338 m is most conspicuous. Vuggy rock with dissolution of quartz is also present along borehole interval 230–240 m.	3	0000L9 0000L9 000009 00009 00009 00009 00009 00009 000009 00009 00009 00009 00009 000009 000009 000009 000000			>> <u>6695000 6695000 670500 6705000 6705000</u>			
Alteration:									
- First order:	Oxidation	3							
- Second order:	Not observed								
Fracture orientation and type:	Steeply dipping fractures with NW-SE strike and dip predominantly to the southwest and more gently dipping fractures dipping to the south-east are prominent. Fractures with other orientations (e.g. steep ENE- WSW) are also present.	2							
Fracture comment:	Chlorite calcite laumontite								
mineralogy:	hematite/adularia, quartz, clay minerals, epidote, prehnite and pyrite. Note locally some asphaltite								
Striko/din:									
Strike/dip:	122 <sup>-</sup> /90 <sup>-</sup> 70000 m								
Mean thickness	143  m (50 - 200  m)								
Max denth	-2100 m								
Geometrical	Topo 40m grid Max error 20m 2	Surface							
constraints:	Planar Cut(s).								

WNW		ZFMWN	W0004	Version	number	7	Total object CL	24
BASIS FOR MC								
Zone based on	surface lineame	ents and borehol	le observatio	ns.				
Outononou	I							
Boreholes:	-							
Borenoies.								
Develop	867	Target i	ntercept	Geometri	c intercep	ot	<b>0</b>	
Borenole	PDZ	Sec_up [m]	Sec_low	Sec_up [m]	Sec_I	ow	Comment	
HFM37	D71	15.00	191 46	0.00	191	75		
HFM37	DZ2	15.00	191.46	0.00	191.7	75		
HFM37	DZ3	15.00	191.46	0.00	191.7	75		
KFM12A	DZ1	125.00	402.00	122.79	400.6	63		
KFM12A	DZ2	125.00	402.00	122.79	400.6	63		
I unnels:	-	14						
seismic		J14.						з
indications:								Ŭ
			MODELLIN	IG PROCEDURE				<u> </u>
At the surface, o	corresponds to	the low magnetic	c lineament l	MFM0014. Modelle	d to the b	ase of th	e model volume usir	ng an
assumed dip of	90 degrees by	comparison with		001. Intersects KF	M12 at 12	25-402 m	n (DZ1 and 2) as well	as the
whole HFM37 (I	JZ1-3).							
							6	
						-	CORE BONN	
			AL		1	1		
			AN MA		WWWW0023	NWNW0123		
					v			
				(2 Mind Hand 12)	-	-		
				F	alle alle	-		1
		-	~ .					
				HEWIT		-		
		ZFM.12		ZEMNW0036				
		ZEMWNW0035	1 1		ZFMNWO	003	The second secon	
				ZEMNW0029	_			
		1	-	ZFMWNW0024				and the
		X	ZFMV	NW0004				
	1 10		P M	- (				
5-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1					4			
		0 1	2	4 km				
		-			•		9	
1 Common and				2		2		100
				A	0 -			
		94 57		A				
					TC			
		UE		IDENCE ESTIMA	IE			
Category		Obied	t CL Cor	nment				
INTERPRETA	TION							
Data source	9	3	B MFI	M0014a, HFM37, K	(FM12A.			
Results of ir	nterpretation	3	B Hig	n confidence obser	vations in	KFM12	۹.	_
INFORMATIO	N DENSITY							
Number of c	observation poi	nts 3	3 3					
Distribution	of observation	points	3 Cor	isidering the two bo	oreholes a	as a clust	ter and the lineamen	t as an
			out	ier.				
Geometry			00	strong alternativo	hasod on	availahl	e sub-surface obsor	vation
Geometry		3	3 Doir	its.	Jaseu Uli	avaliaU	C Sub-Sundue UDSEN	
Geological i	ndicators	3	3 Inte	rpolation supported	d by kev a	eoloaica	l parameters.	
EXTRAPOLAT	ΓΙΟΝ			,	.,,9	3.00		
Dip direction	Ì		Ext	apolated to the bas	se of the r	nodel vo	lume. Strike length c	of the
			, moo	delled zone > 2000	m.		-	
Strike directi	on		3 Cor	ceptual understan	ding of the	e site and	d that the entire regio	onal
11			mod	aeilea zone is supp	orred by t	ne linear	nent.	



















WNW	ZFMWNW0	019	Version number	9	Total object CL	13
GEOLOGICAI	L CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation style:	Brittle-Ductile	1	8			0
Deformation description:	No data available.		671000	15	The most	671000
Alteration:		-	$\sim$	X	1112	
- First order:	Oxidation	1	8 24		112	1 8
- Second order:	Not observed	-	~~ 020	1	X M MI	200
- Third order:	Not observed		20 2V		AN VY	67
and type:	No data available.	-		X	ATTA Nor	
Fracture comment:	No data available.	-	5000		XIII	0000
mineralogy:			670		W/Y	670
OBJ Strike/din:			1 Kalle	AU	NY	
Longth:	114 /85 8605 m		000	X	AN	000
Moon thicknoss:	45 m (15 64 m)		695	1	X	695(
Max donth:	-2100 m		°	100	A R	Q
Geometrical	Topo 40m grid Max error 2	0m 1		100	1 77	
constraints:	Surface Planar Cut(s), 1 U Planar Cut(s).	NIVERSE	0000000000000000000000000000000000000	0 163	5000 170000	0000699 Z
		0 505 M05	ELL IN C			
Zana hana dan aufara l'a	BASI	S FOR MOL	DELLING			
Zone based on surface lin	eaments.					
Outcrops:	_					
Boreholes' -	-					
Tunnels:	-					
Lineament and/or	MFM0019 merged.					0
seismic indications:	MODE		CEDURE			2
At the surface, correspond assumed dip of 85 degree	ds to the low magnetic linear s to the southwest based on	nent MFM00 a compariso	19. Modelled to the b on with high confiden	base of th	e model volume usir ZFMNW0017.	ig an
	2011/11/10/23 2011/11/10/23 2011/11/10/23 2011/11/10/23 2011/11/10/23 2011/11/10/23 2011/11/10/23	2	ZEMMININ	0019 4 km	YOPSERNMAZ	ZFMNE9542
ZFMWNW0024	ZFMWNW0004	0	2			

WNW	ZFN	/WNWC	O019         Version number         9         Total object CL         13							
OBJECT CONFIDENCE E	STIMATE					•				
			-							
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM0019.							
Results of interpretation	n	2	Medium co	nfidence in lineamen	t MFM00	)19.				
INFORMATION DENSIT	Y									
Number of observation points 1 1										
Distribution of observa	1	Single observation point in the form of a lineament.								
INTERPOLATION										
Geometry	Geometry			supported by surface	geophys	sical data.				
Geological indicators	1	Indirect sur	port by geophysical	data.						
EXTRAPOLATION			•							
Dip direction			Extrapolate	ed to the base of the	model vo	lume. Strike lenath c	of the			
·		3	modelled zone > 2000 m.							
Strike direction		0	Conceptua	l understanding of th	e site an	d that the entire region	onal			
		3	modelled z	one is supported by	the linear	ment.				
		•	•							
		FRA	CTURE CHA	RACTER						
			No data avai	lable						
INDIVIDUAL INTERCEPT	S									
			No data avai	lable						

WNW	ZFN	/WNWC	Version number         8         Total object CL         13								
OBJECT CONFIDENCE E	STIMATE			•		•					
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0023.								
Results of interpretation	n	2	Medium co	nfidence in lineamen	t MFM00	)23.					
INFORMATION DENSIT	Y										
Number of observation	n points	1	1								
Distribution of observa	1	Single observation point in the form of a lineament.									
INTERPOLATION	•			•							
Geometry	Geometry			supported by surface	geophys	sical data.					
Geological indicators	1	Indirect sup	oport by geophysical	data.							
EXTRAPOLATION											
Dip direction		0	Extrapolate	ed to the base of the	model vo	lume. Strike length c	of the				
		3	modelled z	one > 2000 m.		Ū					
Strike direction		0	Conceptua	I understanding of th	e site an	d that the entire region	onal				
		3	modelled z	one is supported by	the linear	ment.					
	FRACTURE CHARACTER										
			No data avai	lable							
INDIVIDUAL INTERCEPT	S										
			No data avai	lable							

WNW	ZFMWNW0	024	Version number	3	Total object CL	12
GEOLOGICAI	CHARACTER	Property	155000 160000	165	000 170000	
Deformation style:	Brittle-Ductile					0
Deformation description:	No data available.		671000	, r	~ ~	671000
Alteration:			5	Y	12	
- First order:	Oxidation	2	S		V 12 13	
- Second order:	Not observed	2			MPL	3000
- Third order:	Not observed		670		VA VV	610
Fracture orientation and type:	No data available.	_	S I	X	AHA Si	kenona
Fracture comment:	No data available.	_	8	XAC	11/15	000
Fracture fill mineralogy:	No data available.		e700		QUV	6700
OBJ	ECT GEOMETRY			AL	M/	
Strike/dip:	125°/90°		8	A	AX/	00
Length:	/980 m		3950	al and	$\mathbf{X}$	950
Mean thickness:	45 m (15 - 64 m)		8	20		66
Max depth:	-2100 m	000 <b>T</b>		1 L	- A man	
Geometrical	ZEMVVNVV0004, ZEMNVV0	003, Topo	8		S Inner	0
constraints:	40m grid Max error 20m.		0000		war	0000
			66		1 N 1	666
			155000 160000	165	000 170000	10.00
						N
			Baseline Model volume DMS		0 2 4 8 km	A
	BASI					
Zone based on surface lin	eaments.					
Outcrops:	-					
Boreholes: -	-					
Borenoles.						
Tunnels:	-					
Lineament and/or	MFM0023 merged.					4
seismic indications:	5					1
	MODE	LLING PRO	CEDURE			
At the surface, correspond assumed dip of 90 degree WNW and NW strike.	Is to the low magnetic linear s degrees based on a compa	nent MFM002 arison with hi	24. Modelled to the bag gh confidence, vertic	ase of the al and st	e model volume usir eeply dipping zones	ng an with
			ZFMWNW0123			,
					· ·	
				27 Minuted IV		-
						1
			HEAL	-		
		HEMÍZ	1			
			10036			
	ZEMOL	ZEMIN			ZFMAN	
	ZFMWNW0035				WV0003	
			ZFMNW0029	-		
	ZENAM	N0024				~
		N0024	-			
An Ob	ZEMWNWO	004				
	77	5				
1 11 1					<b>`</b>	
					1	
0			4 km			
6 W 7						

WNW	ZFN	/WNW0	W0024Version number3Total object CL12								
OBJECT CONFIDENCE	STIMATE			·		•					
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0024.								
Results of interpretation	on	1	Low confid	lence in lineament M	FM0024.						
INFORMATION DENSIT	Y										
Number of observation	n points	1	1								
Distribution of observa	1	Single observation point in the form of a lineament.									
INTERPOLATION											
Geometry	Geometry			supported by surface	geophys	sical data.					
Geological indicators	1	Indirect su	pport by geophysical	data.							
EXTRAPOLATION											
Dip direction		0	Extrapolate	ed to the base of the	model vo	lume. Strike length c	of the				
		3	modelled z	one > 2000 m.		Ū					
Strike direction		2	Conceptua	I understanding of th	e site an	d that the entire region	onal				
		3	modelled z	one is supported by	the linear	nent.					
		FRA	CTURE CHA	RACTER							
No data available											
INDIVIDUAL INTERCEPTS											
			No data avai	lable							

WNW	ZFMWNW0	035	Version number	4	Total object CL	12
GEOLOGICA	CHARACTER	Property CI	155000 160000	) 16	5000 170000	
Deformation style:	Brittle-Ductile	1	0			0
Deformation description:	No data available.	I	6710000	~~	The most	5710000
Alteration:				X		
- First order:	Oxidation	2	0 ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	/ _	1213	1 0
- Second order:	Not observed	_	~~ 200	1	MM	Soc
- Third order:	Not observed		6	1)	AN IX	67(
and type:	No data available.	_		X	ATA No	
Fracture comment:	No data available.		2000	XAR	XIII	0000
mineralogy:	No data available.		6700		X V	6700
OBJ Obrika (dina				A	NY	
Strike/dip:	122°/90°		00	X	AX/	000
Length:	3506 m		2950	K	$\mathbf{X}$	3950
wean thickness:	∠o m (15 - 64 m)		io /	14/2	A Real Provide	66
wax deptn:		rid Mari		1 1 X	and a second	
constraints:	error 20m, 1 UNIVERSE P Cut(s).	lanar	155000 160000 Model volume DMS	165	0000 170000	0000699 2
	BASI		Baseline		in contractives Conductives and	~
Zone based on surface lin	eaments.					
Outcrops:	-					
Boreholes: -	I					
Tunnels:	-					
Lineament and/or	MFM0023 merged.					4
seismic indications:			CEDURE			1
At the surface, correspond assumed dip of 90 degree NW strike.	ts to the low magnetic linear is based on a comparison wit	th high confic	35. Modelled to the b dence, vertical and st	ase of the teeply dip	e model volume usin ping zones with WN	ng an IW and
	gast			Z	FMNW0017	2943
		ZFMJ	2		WW0036	
		ZFMV	NNW0035	4		
	ZFMK1					
	0 200 300 500 m 1 km		2 km		ZFMWNW002	4

WNW	ZFN	/WNW0	Version number         4         Total object CL         12								
<b>OBJECT CONFIDENCE E</b>	STIMATE			•		•					
		•									
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM0035.								
Results of interpretation	on	1	Low confid	ence in lineament M	FM0035.						
INFORMATION DENSIT	Υ										
Number of observation	n points	1 1									
Distribution of observa	1	Single observation point in the form of a lineament.									
INTERPOLATION											
Geometry	1	Geometry	supported by surface	geophys	sical data.						
Geological indicators	1	Indirect su	oport by geophysical	data.							
EXTRAPOLATION											
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the								
		3	modelled zone > 2000 m.								
Strike direction		0	Conceptua	I understanding of th	e site an	d that the entire region	onal				
		3	modelled z	one is supported by	the linear	nent.					
		FRA	CTURE CHA	RACTER							
			No data avai	lable							
INDIVIDUAL INTERCEPT	S										
			No data avai	lable							

WNW		ZFMWNW0044 Version number 5						object CL	14
GEOLOG	SICAL CH	ARACTER	Prop	perty	155000	160000	165000	170000	
Deformation style:	Brittle	-		<b>L</b>	0				0
Deformation description:	Steep fa NNE sti displace sinistral dipping displace	aults with N, SSW rike show strike-sl ement, one of whi . A moderately S- fault shows dip-sl ement.	/ or lip ch is lip	,	705000 671000	s of	T	June -	705000 6710200
Alteration:					° R	1 1	JTH		0
- First order:	- First order: Oxidation					11th	XAHE	AN	2
- Second order:			000		XXIII	1	000		
- Third order:     Fracture     orientation and     type:      Fracture comment:     Fracture fill     mineralogy:      Strike/dip:     Length:     Mean thickness:	Not obs Fracture SE and SSW to vertical NNE-SS fracture sealed partly o Quantit span in- network No data Chlorite hematit mineral <b>OBJECT</b> 115°/77 1178 m 40 m (3	erved es that strike ESE dip steeply to the SW as well as su fractures that stril SW form conspicu- sets. Dominance followed by open pen fractures. ative estimate and clude sealed fract and crush zone available. calcite, e/adularia, quartz s, epidote. GEOMETRY	to b b b c b c c c c c c c c c c c c c	2	000000000000000000000000000000000000				
Max depth: Geometrical constraints:	-1200 n ZFMW1 40m gri	n NW2225, ZFMENI d Max error 20m,	E0062A, Topo 1 Surface Pla	o anar					
	Out(3).		BASIS FOR	MODE					
Zone based on surfac	ce lineame	ents and borehole	observations	•					
Boreholes:	1								
		Towned !	araant	-	<b>`~~</b> ***'-	interect			
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	Commen	t	
KFM06C	DZ4	502.00	555.00	5	02.39	554.68			
Tunnels:	-								
Lineament and/or	MFM00	44, MFM0044G0.							
seismic		,							2
indications:									
At the surface, correst eastern part of the low belong to the north-w ZFMWNW2225. On the interpretation and the connecting the linear placed at fixed point 6	ponds to t w magneti esterly co he basis co geometric nent segm 536 m whe	the low magnetic l c lineament MFM ntinuation of linea f this revised inter c model for zone 2 ents with the bore ere both a crush z	MODELLING lineament MF 0044G0. The ment MFM22. protection, the ZFMWNW004 shole intersect one and a sea	M0044 north-v 25G ai ere is a 4. Moo tion 50 aled fra	A and its co western pa nd has bee discrepan delled dow 02-555 m in acture network	ontinuation to th int of lineament on used in the r cy between the n to 850 m dep n KFM06C (DZ work are preser	ne north-wes MFM0044G nodelling of original line oth, using the 4). Deforma nt. Decrease	at along the 50 is judged zone eament e dip estima tion zone pl ed radar per	south- I to ated by lane netration

WNW	ZFMWNW0044	Version number 5	Total object CL	14
Real Provide Arriver Arriv	THE THE TRANSPORTED FOR TH	California de la construcción de la constru	Eveness S	

OBJECT CONFIDENCE ESTIMATE								
Category	Object CL	Comment						
INTERPRETATION								
Data source	2	MFM0044G, MFM0044G0, KFM06C.						
Results of interpretation	3	High confidence observations in KFM06C.						
INFORMATION DENSITY								
Number of observation points	2	2						
Distribution of observation points	1	Single observation point at depth and surface lineaments.						
INTERPOLATION								
Geometry	1	Geometry supported by a lineament and a single intercept.						
Geological indicators	1	Indirect support by geophysical data.						
EXTRAPOLATION								
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point.						
	2	Strike length of the modelled zone < 2000 m.						
Strike direction	2	Conceptual understanding of the site and that the entire regional						
	2	modelled zone is supported by the lineament.						

FRACTURE CHARACTER									
Orientation: (strike/dip right- hand-rule) Frequency:	Set SE: 127.7°/77.9° Set NNE: 27.6°/88.8° Boreholes: KFM06C	ZFMWNW0044							
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open3.2 m-1Sealed14.8 m-1Sealed11.8 % of networkDZ intercept1.0 % of DZ intercept	<ul> <li>Unassigned (156)</li> <li>Set SE (132)</li> <li>Set NNE (103)</li> <li>Mean pole Set SE (37.7/12.1) Fisher κ = 6.0 Mean pole Set NNE (297.6/1.2) Fisher κ = 23.2</li> </ul>							
RQD:	min:41, max:100, mean:97								





WNW	1	ZFMWNW01		W012	23		Version r	number	7	Total object	<sup>CL</sup> <b>2</b>	)
GE	OLOGI	CAL CH	ARACTER		Prope	erty	155000	160000	0 1	65000 1700	00	
Deformation st	vle:	Brittle-D	Juctile		CL 3	-	Q					
Deformation description:	<i>y</i> .o.	Strue-Ductule Steep faults with SE, ESE and WNW strike show strike-slip displacement, eight of which have distinctive sinistral strike- slip displacement. One steeply fracture with SSE strike also shows strike-slip displacement. Two gently dipping faults show dip-slip displacement, one of which					00000 6705000 671000	2 and a second	A A	0000 670500 571000		
Alteration:		with rev	erse dip-slip.				10			HI.	67(	
- First order:		Oxidatio	on		2			XXX	S			
- Second orde	r:	Epidotiz	ation		3		5000	- Ale	X	M	5000	
Fracture comm Fracture comm Fracture comm Fracture fill mineralogy: Strike/dip: Length: Mean thickness Max depth: Geometrical	t nent: C s:	Oxidation         Epidotization         Quartz dissolution         Fractures that strike SE and dip steeply to the SW dominates. Gently dipping fractures and steeply dipping fractures that strike NE are also conspicuous along DZ1 in KFM10A. Open fractures that both dip steeply to the SW and are gently dipping are prominent along DZ1 in KFM10A. Crush zones also present. Dominance of sealed fractures along DZ5 in KFM04A. Quantitative estimate and span include sealed fracture networks and crush zones.         No data available.         Calcite, hematite/adularia, chlorite, clay minerals, quartz, prehnite, epidote.         OBJECT GEOMETRY         119°/82°         5078 m         52 m (15 - 64 m)		2 Max er	TOT	155000 Model V Baselin	00000000000000000000000000000000000000					
constraints:		20m, ZF	MWNW0023, 1	Surface	Planar	-						
				BASIS	FOR	<i>l</i> ode	ELLING					
Zone based on a Outcrops: Boreholes:	surface	lineame -	ents and borehol	e observ	ations.							
			Target ir	ntercept		(	Geometric	intercep	ot			ר
Borehole	PI	DZ	Sec_up [m]	Sec_l [m]	low ]	Sec	_up [m]	Sec_lo [m]	ow (	Comment		
HFM24	D	Z1	18.00	32.0	00	1	2.48	111.8	39			_
		ZZ 73	42.00	102	00	1	2.48	111.8	20			-
	ם די	∠3 71	19.00	25.0	00	1	12.40 32.00	120.2	38			-
HFM29	מ	72	62.00	81 0	00		32.00	120.0	38			-
HFM29	מ	Z3	146.00	150	00		32.00	120.0	38			$\exists$
KFM04A KFM10A	Di	Z5 Z1	654.00 62.85	661. 145.	00 00	6	22.02 62.84	688.3 144.4	39 12			
Tunnels: Lineament and seismic indications:	l/or	- MFM01	23.								3	

WNW	ZFM	WNW0 <sup>-</sup>	123	Version number	7	Total object CL	20
MODELLING PROCE	DURE						
At the surface, corresp estimated by connectir and 67-103 m in HFM2 m in KFM04A (DZ5). D KFM04A. Decreased r	oonds to the low n ng lineament MFN 24 (DZ1, DZ2 and Deformation zone adar penetration	nagnetic linear 10123 with the I DZ3), 19-25 r plane passes along the bore	ment MFM0123 borehole inters m, 62-81 m and through fixed p hole interval 85	. Modelled to base sections 63-145 m 146-150 m in FM2 bints 108 m in KFM	of the mod in KFM104 29 (DZ1, D 110A, 69 m A.	del volume using th A (DZ1), 18-32 m, Z2 and DZ3), and a in HFM29 and 65	ne dip 42-63 m 654-661 5 m in
The most decision fails percention along the bole merval of 120 mm mont.							
		OBJECT	CONFIDENCE	ESTIMATE			
Category		Object CL	Comment				
INTERPRETATION							
Data source		2	MFM0123G0	, HFM24, HFM29,	KFM04A, I	KFM10A.	
Results of interpre	tation	3	High confider	ce observations in	KFM10A.		
INFORMATION DEN	ISITY						
Number of observation	ation points	3	>4				
Distribution of obs	ervation points	2	Cluster of bor	ehole intersections	and a line	ament as an outlie	er.
INTERPOLATION							
Geometry		3	Geometry sup strong support	oported by informative to react the second sec	tion from n e.	nultiple drill hole (S	iHI),
Geological indicate	ors	2	Some discrep	ancies in the geolo	ogical data	•	
EXTRAPOLATION			_				
Dip direction		3	Extrapolated modelled zon	to the base of the r e > 2000 m.	nodel volu	me. Strike length c	of the
Strike direction		2	Conceptual u modelled zon	nderstanding of the e is supported by t	e site and t he lineame	hat the entire regionent.	onal













WNW	ZFMWNW0137		Version number	5	Total object CL	14
GEOLOGICA	L CHARACTER	Property CL	155000 160000	) 16	5000 170000	
Deformation style:	Brittle-Ductile	1	g			0
Deformation description:	No data available.		671000	-F	m m	671000
Alteration:			~ {	Y	1 1 4	
- First order:	Oxidation	2	0 25	/	V 12	. 0
- Second order:	Not observed	-	m. 200	-1	MNN	200
- Third order:	Not observed		20 24	$\langle \rangle$	AN NY	670
Fracture orientation and type:	No data available.	-	S 1	X	AHA Ve	*****
Fracture comment:	No data available.	-	2000	XAC	×11/1 12	000
Fracture fill mineralogy:	No data available.		6700		V V	6700
OBJ				A	M M	
Strike/dip:	100°/90°		00	X	AX/	00
Length:	4373 m		2950	1 al	$\times$	950
Mean thickness:	30 m (15 - 64 m)		ö	1000	A straight of the straight of	96
Max depth:	-2100 m			1 A	- An man	
constraints:	error 20m, ZFMNW0003.	i griu iviax	0000	$\mathbf{X}$	Ward manual	0000
			693	• \	1. 1. 1. 1.	699
			155000 160000	) 165	000 170000	12:50
			Model volume DMS Baseline		0 2 4 8	Ň
Zone based on surface lin	eaments.	S FOR MOL	DELLING			
Outcrops:	1					
Boreholes: -						
Tunnels:	-					
Lineament and/or	MFM0137 merged.					•
seismic indications:	MODE					3
At the surface, correspond	ds to the low magnetic linear	nent MFM01	37A0. Modelled to th	e base of	the model volume u	using an
assumed dip of 90 degree	s based on comparison with	nign confide	nce, vertical and ste	epiy dippi	ng zones.	
			P	W0007		
	0	MEN .		M		
	yen?	No 5		Lo.		
Et.	- has	1230				
ANU	ZFMWN	W0137			ZFMM	
63			8	-	WW1053	10
		ZFMID				
	IT				THE SHEET A	
	ANA BO			P		1
	E A		ENNERS	Ņ		
	0 100 200 300 500 m	km				hor
			2 101		CT SE//	

WNW	ZFN	/WNW0	)137	Version number	5	Total object CL	14		
OBJECT CONFIDENCE E	STIMATE			•					
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM0137.						
Results of interpretation	n	3	High confic	dence in lineament M	FM0137.				
INFORMATION DENSIT	Y								
Number of observation points		1	1						
Distribution of observation points		1	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.						
EXTRAPOLATION									
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the						
		3	modelled zone > 2000 m.						
Strike direction		2	Conceptual understanding of the site and that the entire regional						
		3	modelled zone is supported by the lineament.						
		FRA	CTURE CHA	RACTER					
			No data avai	lable					
INDIVIDUAL INTERCEPT	S								
No data available									

WNW	ZFMWNW08	09A	Version number <b>3</b> Total object CL				
GEOLOGICA	L CHARACTER	Property	155000 160000	) 16	5000 170000		
Deformation style:	Brittle	1 1	0			0	
Deformation	No data available.		000	-	~	0000	
description:			0	VF	The more	671	
Alteration:				Y			
- First order:	Oxidation	2	e pr	_ \	V 1 3	0	
- Second order:	Not observed	-	~~ 0200		ANN	2000	
- Third order:	Not observed		5 2		AN VY	67(	
and type:	No data avallable.		7. 1.	X	ATTA 2		
Fracture comment:	No data available.		8	AN C	ATTA S	0	
Fracture fill	No data available.		500		XU/ 3	0000	
mineralogy:			67		HLI V	67	
OB	JECT GEOMETRY			2AH			
Strike/dip:	118°/90°		8	X	AX/	8	
Length:	3349 m		2000	the	$\sqrt{1}$	9501	
Mean thickness:	25 m (15 - 64 m)		39	11	A the second sec	66	
Max depth:	-2100 m ZEMNE0810 ZEMENE006				3		
constraints.	40m grid Max error 20m	2A, TOPO	8	$\sim$	Wat man	8	
oonotrainto.	For gird max on or 2011.		005600		v	0069	
			8			80	
					1	20.910	
			155000 160000	) 16	5000 170000	N	
			Model volume DMS		0 2 4 8	Â	
			baseline		S Latitudgest Gridal scenesises		
	BASI	S FOR MOD	ELLING			(0000D	
Judged to constitute element	ents of one and the same stru	09 consists ( icture.	of two segments, ZF	MVVNVVO	809A and ZFMWNW	/0809B,	
Outcrops:	-						
Boreholes: -							
	1						
Tunnels:	-						
Lineament and/or	MFM0809, MFM0809G.					3	
Seisine indications.	MODE	LLING PRO	CEDURE				
Zone ZFMWNW0809 con	sists of two segments, the mo	ost prominen	t of which is denoted	ZFMWN	W0809A. These two	)	
segments are judged to c	onstitute elements of one and	the same st	ructure. At the surfa	ce, zone	ZFMWNW0809A		
corresponds to the low ma	agnetic lineaments MFM0809	and MFM08	809G. Lineament MF	M0809 is	inferred to continue	east of	
ZONE ZEMIENEUU62A as t	at as ZFMWWNWU001, with a s	slightly differ	ent trend, and is inte		e the surface expres	SION OF	
on a comparison with high	n confidence, vertical and stee	eply dipping	zones with WNW an	d NW stri	ke.	Jaseu	
en a companeen maring.		opiy aipping					
	25MWNW1035		TENENIN TELEVISION	2			
34					1		
		12	<i>d</i> we				
		10				-	
		21	ww/hW3259				
		-	ZFMW1W0813				
5		SEC		\$			
		TEMPIN				1	
		ZEMWNW0	809A		0	1	
					1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
						Ve	
					<th>-0</th>	-0	
					-A way		
			1 Put			8	
	A MARKE		Valle		1 A A		
				1.		5	
			M				
					8	h-	
0 100 200 300 500 m	1/km	<i>§</i> // 1 2 ki	n Aller and a second se	- 1			
		8/1000					

WNW	ZFM	WNW08	309A	Version number	3	Total object CL	14		
<b>OBJECT CONFIDENCE</b>	ESTIMATE								
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM2215C	).					
Results of interpretati	on	3	High confid	ence in lineament M	FM22150	<b>.</b>			
INFORMATION DENSI	ΓY								
Number of observation	n points	1	1						
Distribution of observation points		1	Single observation point in the form of a lineament.						
INTERPOLATION									
Geometry		1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect sup	port by geophysical	data.				
EXTRAPOLATION									
Dip direction		2	Extrapolated to the base of the model volume. Strike length of the						
		3	modelled zone > 2000 m.						
Strike direction		2	Conceptual understanding of the site and that the entire regional						
		3	modelled zone is supported by the lineament.						
		FRA	CTURE CHA	RACTER					
	No data available								
INDIVIDUAL INTERCEP	rs								
No data available									
WNW	ZFMWNW08	09B	Version number	3	Total object CL	13			
------------------------------	--	--	------------------------------	-------------	---	----------			
GEOLOGICA	L CHARACTER	Property	155000 160000	) 16	5000 170000				
Deformation style:	Brittle	1	Q			0			
Deformation	No data available.		1000	_	$\sim$	1000			
description:			5	VF	1 mm	67			
Alteration:		_	$\sim$	X					
- First order:	Oxidation	2	8 5	1-	1615	1 8			
- Third order:	Not observed		1020	1 - 1	A M Cla	7050			
Fracture orientation	No data available.		° R	1	THANK	Kenna CO			
and type:			5	X	AHA LE				
Fracture comment:	No data available.	-	000	X	XIINS	0000			
Fracture fill	No data available.		670		VCY / Y	6700			
OB.		l			XX /				
Strike/dip:	111°/90°		. / / )///	SE	AVY .	0			
Length:	1254 m		900	Mrs .	VY	9500			
Mean thickness:	15 m (3 - 50 m)		99	10/2		665			
Max depth:	-2100 m	10001		(C)					
constraints	ZEIVIEINEUUOZA, ZEIVIVVNVV Topo 40m grid Max error 20	) Dm	8	1	hard harden	00			
constraints.	Topo form grid Max error 20		0059		w.	10065			
			0			86			
			155000 10000		170000	10.01			
			155000 160000	) 165	170000	N			
			Model volume DM5 Baseline		0 2 4 8 A Lateral per Conductor when	A			
	BASI		FLUNG						
Zone based on surface lir	neaments. Zone ZFMWNW08	09 consists o	of two seaments. ZF	MWNW0	809A and ZFMWNW	/0809B.			
judged to constitute element	ents of one and the same stru	icture.	,,			,			
Outcrops:	-								
Boreholes: -									
Tunnels:	-								
Lineament and/or	MFM1056.					0			
seismic indications:						2			
7 751 010 010 000	MODE	LLING PRO	CEDURE						
Zone ZFMVVNVV0809 con	isists of two segments, the mo	ost prominen I the same st	t of which is denoted		1770809A. These two 75M///N/08094	)			
corresponds to the low m	agnetic lineaments MFM0809	and MFM08	809G. Lineament MF	M0809 is	inferred to continue	east of			
zone ZFMENE0062A as f	far as ZFMWNW0001, with a	slightly differ	ent trend, and is infe	erred to be	e the surface expres	sion of			
zone ZFMWNW0809B. B	oth segments modelled to bas	se of the mod	del volume using an	assumed	dip of 90 degrees, I	based			
on a comparison with hig	h confidence, vertical and stee	eply dipping a	zones with WNW an	d NW stri	ke.				
						01			
		20.							
	A THENEOOG2C	MN	1.						
006	ZEMIENT		WNOO						
ENED			°007						
TEMP									
		/							
1	ZEMM		RUOR						
	4///	~				X			
				4		1			
where a		M			Ņ				
	- b	$\left( \begin{array}{c} \mathbf{v} \\ \mathbf{v} \end{array} \right)$							
	0 100 200 300	500 m		<b>S</b>	$\setminus$				
	6 hr								

WNW	ZFM	WNWO	809B	Version number	3	Total object CL	13				
OBJECT CONFIDENCE ESTIMATE											
-											
Category		Object CL	Comment								
INTERPRETATION	INTERPRETATION										
Data source		1	MFM10560	).							
Results of interpretati	on	2	Medium co	nfidence in lineamen	t MFM10	56G.					
INFORMATION DENSI	ΓY										
Number of observatio	n points	1	1								
Distribution of observe	1	Single observation point in the form of a lineament.									
INTERPOLATION	•										
Geometry		1	Geometry s	supported by surface	geophys	ical data.					
Geological indicators		1	Indirect sup	port by geophysical	data.						
EXTRAPOLATION											
Dip direction		2	Extrapolate	d to the base of the	model vo	lume. Strike length c	of the				
		3	modelled z	one > 2000 m.		-					
Strike direction		2	Conceptual	understanding of th	e site and	d that the entire region	onal				
		3	modelled zone is supported by the lineament.								
		FRA	CTURE CHA	RACTER							
			No data avail	able							
INDIVIDUAL INTERCEPT	ſS										
			No data avail	able							

WNW			ZFMWN	W08	13		Version	number	3	Total object Cl	20
GE	OLOG	ICAL CH	ARACTER		Prope	erty	155000	160,000	1	65000 170000	
Deformation st	wlo:	Brittlo-	Ductile			-	0				
Deformation	Lyie.	No data	available		5		000			~	0000
description:		no date					671	2	F	TT m	671
Alteration:								{	V	11 11-	2
- First order:		Oxidatio	on				a horis	52	/	1 mg	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
- Second orde	r:	Chloritiz	zation		3		2000			VNE	5000
- Third order:		Sericitiz	zation				670			AN	8106 man
Fracture		Steep s	ets with WNW-I	ESE			5	an Vera	K	1/ THEN V	
orientation and	k	and SS	E strike as well	as a			5	NF	N	XTHH7	E.
type:		set con	sisting of gently				2000	1 de la	All Call		2 000
		aipping	fractures are	ith			6700	1		SUM 1	2200
		other or	rientations are a	lso					8AA	XXX	
		present	. Dominance of	sealed			X	KCHA	A.	AVY	
		, fracture	s. Quantitative				0000	14 Sec.	Y	1M	000
		estimat	e and span inclu	ude	2		699	1 1	N	XI	9695
		several	sealed fracture				-+	1	2)	the same	-
		network	is and some cru	ish						~ 7 -	**
Erecture comm	onti	Zones.	availabla		-		0000		X	War	000
Fracture fill	ient.	Chlorite			-		9999		~		3690
mineralogy:		hematit	e/adularia, epid	ote.							0
linioralogyi		quartz.	laumontite and	clav			155000	160000	1	65000 170000	30.900
		mineral	S.	,			155000	100000		00000 170000	N
		OBJECT	GEOMETRY				Baselin	volume DMS e		0 2 4	Α
Strike/dip:		117°/90	)°								
Length:		2788 m	<u> </u>								
Mean thicknes	s:	76 m (4	0 - 76 m)								
Max depth:		-2100 n		40.00 autial	Max						
Geometrical		20m		40m gna	iviax en	IOI					
constraints.		2011.		BASIS	FOR N	MODE					
Zone based on	surfac	e lineame	ents, tunnel and	borehole	observ	ation	S.				
Outcrops:		-									
Boreholes:											
			Target i	ntorcont		0	Comotric	intercent			
Borehole	F	PDZ		Sec	low			Sec lov	v	Comment	
			Sec_up [m]	[m	]	Sec	_up [m]	[m]	-		
									(	Geometrical split o	f DZ1
KFM11A	1	DZ1	245.00	400.	00	24	44.48	391.14		petween ZFMWNV	V0001,
	-					_			4	ZFMWNW0813 an	d
									4	ZFIVIVVINVV3259.	
Tunnels:		DT targ	et intercept 0+0	65 - 0+12	28 m. a	eome	tric interce	ept 0+062 -	0+138	m. BT target inter	cept
		0+042 -	- 0+082 m, geor	netric inte	ercept 0	)+042	- 0+082 r	n.	000		0001
Lineament and	l/or	MFM08	13G.								
seismic											2
indications:											
A + + h =			the law of	MODEL	LING F	PROC			-	1000	
At the surface, of the surface	corres	ponds to f	ine low magneti	c lineame	ent M⊢N fidoroc	VIU813	su1.Mode	elled to a de	epth of	1600 m using an	assumed
The original line	amont	eu on a C	e trace diverge	in the are	nuence,	, venti tunn	el with the	e zone evte	nded 1	o cross the SEP	INVV SIFIKE.
construction and	d oper	ation tunr	els before term	inating at	ZFMW	/NW0	001. The r	modification	n was h	ased on the exist	ence of
deformation see	en in th	ne upper l	evel of KFM11A	A DZ1 and	d signifi	cant o	deformatio	n seen in th	ne BT	and DT detailed tu	nnel
mapping results	. Forw	ard mode	elling of magnet	ic data al	ong pro	files 2	24, 25 and	26 (see Ap	pendi	x 6, Curtis et al. 20	)11)
supports a verti	cal to s	steep din	to the south-we	st.							



modelled zone > 2000 m.

Extrapolated to the base of the model volume. Strike length of the

Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.

2

3

3

EXTRAPOLATION

Strike direction

Dip direction









WNW		ZFMWN	W0835		Version I	number	8	Total object CL	16
GEOLO	GICAL CH	IARACTER	Prop C	berty L	155000	160000	165	000 170000	
Deformation style:	Brittle-I	Ductile	1	1	8				0
Deformation	No data	a available.			1000			~	1000
description:					67	2	T	1 mm	67
Alteration:					1. 20	- 5	~	1 1 2	
- First order:	Oxidati	on		,	0	5	1	VW	
- Second order:	Not obs	served		-	2 200	1 -	-1	MPL	200
- Third order:	Not obs	served			S 670	/ /	7	VA V	670
Fracture	No data	a available.			5		N	THAN 5	(national)
orientation and					5	110	XX	ATTA NE	2
type:	N. 1.4				200	N D	b×		) 000
Fracture comment	No data	No data available.				11 AN	$\sim$		2000
Fracture fill	No data available.					LEAR	ATT	XX Y	
mineralogy:		CEOMETRY				XAMM	X	MY	
Strike/din:	120%/89				000	11/10	K	AN .	000
Longth:	1065 m				695	1 11		X	695(
Mean thickness	10 m (?	- 			9	1	5	A CAR	Q
Max denth:	-1050 r	n					X	1 79	
Geometrical	Topo 4	0m grid Max erro	or 20m		8		/	Not the second s	8
constraints:	ZFMEN	VE3115. 1 Surfac	e Planar Cut(s	).	00500	$\sim$	1	v	006
		,,		/-	96			1. C	66
									20.000
					155000	160000	165	000 170000	
					Model v	olume DMS			Ň
					Baseline	2		S Calificational Candidatesevenian	N
			BASIS FOR	MOD	ELLING				
Zone based on surfa	ace lineam	ents and intersed	tions with KFR	121 a	nd KFR27.	Zone ZFMW	NWO	335 consists of two	
segments, ZFMWN	N0835A ar	nd ZFMWNW083	5B, judged to a	constit	ute elemer	nts of one an	d the s	ame structure.	
Outcrops:	-								
Boreholes:									
		Target in	ntercept		Geometric	intercept			
Borehole	PDZ		Sec low	-		Sec low	C	omment	
		Sec_up [m]	[m]	Sec	:_up [m]	[m]			
KFR121	DZ3	225.00	233.00	2	21.75	238.90			
KFR27		-	-		9.83	33.05			
KFR27	DZ2	323.00	469.00	3	300.87	476.53			
KFR27	DZ3	323.00	469.00	3	800.87	476.53			
KFR27	DZ4	323.00	469.00	3	800.87	476.53			
Tunnels:	-								
Lineament and/or	MSFR	08107, MSFR081	106.						0
seismic									2
indications:									
Zono ZEM/M/N/M/092	5 consists	of two soamonto	the most prop	ninont		donoted 75		1/08254 Those tw	<u>```</u>
segments are judge	d to constit	ute elements of	, the most profi	me sti		the surface	COLLEG	ond to the low may	anetic
lineaments MFM083	SA0 and M	IFM0835B0, resi	pectively. Both	seam	ents model	led to base of	of the r	nodel volume using	an
assumed dip of 90 c	legrees. ba	ised on a compa	rison with high	confic	lence. verti	cal and steel	ply din	ping zones with WN	W and
NW strike supported	by SHI in	KFR121 and KF	R27.				, "p		















WNW		ZFMWN	W0836		Version	number 2	Total object CL	13
GEOLO	GICAL CH	IARACTER	Prop	perty	155000	160000	165000 170000	
Deformation style:	Brittle		C	;L 1	0			0
Deformation	No dat	a available.			1000		$\sim$	1000(
description:					67	55	1 mm	67
Alteration:	Ovidati	ion			-	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	1 L C S	~
- First order:	Not ob	served	2	2	000	7 5	VVIEV	2 8
- Third order:	Not ob	served			5705	m 1	XXX	21050000
Fracture	No dat	a available.			- the			Law and
orientation and					. {	1/2	A KHHAY	52
Fracture comment:	No dat	a available			2000	The state	$X \times I / $	3 0000
Fracture fill	No dat	a available.			67			67(
mineralogy:						XIIIA		
<u>Strike/din</u>					000	O MIS		00
Strike/dip:	4866 m	<u>)</u>			6950	LANK	XY I	6950
Mean thickness:	35 m (	15 - 64 m)			9	1 11	the same	Q
Max depth:	-2100 ו	m						-
Geometrical	ZFMN	N0805A, ZFMNI	NE1134, Topo 4	40m	0000		Went	0000
constraints:	grid Ma	ax error 20m.			693	, i i		1699
					155000	160000	165000 170000	1074
					Baselin	volume DMS e	0 2 4 8	Ă.
			BASIS FOR	MODE				
Zone based on surfa	ice lineam	ents.						
Outcrops:	-							
Boreholes:								
		Target in	ntercept	0	Geometric	intercept		
Borehole	PDZ	Sec up [m]	Sec_low	Sec	up [m]	Sec_low	Comment	
KFR24			[m] -	1	56.98	 159.20	No SHI available	
Tunnels:	-	220						
seismic		530.						2
indications:								_
			MODELLING	PROC	EDURE			
At the surface, corre assumed dip of 90 d	sponds to earees bas	the low magnetic sed on a compar	c lineament MF	M0836 confide	6. Modelleo ence. vertio	d to base of the cal and steeply	e model volume using a dipping zones with WN	n IW and
NW strike.	09.000 54			Jonnae				
			\$	$\mathcal{O}$	er er	5	ZE-MNW0851	
		2EMMINW0574			•0 <sup>°°</sup>	S		
			. <	52	30			
E TROVETSA E ANGELSA E ANG		Construction of the second			o	0 v <sub>0</sub> 0	Tananatas	
		0 100 200 300	2FM			2 km	33° <b>2</b> 0 0 0 0 0	

WNW	ZFM	WNW0	836	Version number	4	Total object CL	13			
	OBJECT CONFIDENCE ESTIMATE									
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM0836G,	KFR24 (No SHI ava	ilable).					
Results of interpre	tation	2	Medium cont	fidence in lineament	MFM083	6G.				
INFORMATION DEM	ISITY									
Number of observ	ation points	1	2							
Distribution of obs	ervation points	1	Single obser	vation point in the for	rm of a lir	neament.				
INTERPOLATION										
Geometry		1	Geometry su	pported by surface of	eophysic	al data.				
Geological indicate	ors	1	Indirect supp	ort by geophysical d	ata. (No	SHI available for KI	FR24).			
EXTRAPOLATION										
Dip direction		3	Extrapolated modelled zor	to the base of the m ne > 2000 m.	odel volu	me. Strike length o	f the			
Strike direction		3	Conceptual u modelled zor	understanding of the ne is supported by th	site and e lineam	that the entire regic ent.	nal			
		FRA	CTURE CHAR	ACTER						
			No data availa	ble						
INDIVIDUAL INTERC	EPTS									
KFR24 (156.98-159.2	m)									
No data available										

WNW	ZFMWNW0	853	Version number	5	Total object CL	13			
GEOLOGICAI	CHARACTER	Property	155000 160000	) 16	5000 170000				
Deformation style:	Brittle Ductile					-			
Deformation description:	No data available.		6710000	15	m m	6710000			
Alteration:				X	11/2				
- First order:	Oxidation	2	8 ~ ~ ~	- \	V 12	1 0			
- Second order:	Not observed		~~ 020		( M M	20090			
- Third order:	Not observed		5 2			67(			
and type:	No data available.	-		X	AT A				
Fracture comment:	No data available.	-	2000	ABX	XIII	0000			
mineralogy:			670		W/Y	670			
Strike/dip:			1 K Chille	S	NY				
Length:	10543 m		000	X	1M	000			
Mean thickness:	60 m (50 - 200 m)		1002	1	$\times 1$	695			
Max denth:	-2100 m		° ()	M V	and and a second	9			
Geometrical	ZFMNW0854 Topo 40m g	rid Max			1 TH man				
constraints:	error 20m, ZFMNNW0806.		6650000	$\checkmark$	Went	669000			
			155000 160000	165	5000 170000				
			Baseline Model volume DMS		0 2 4 8 Commission Conditioners of Am	Ă			
	BASI	S FOR MOD	ELLING						
Zone based on surface lin	eaments.								
Outcrops: Boreholes: -	-								
Tunnels:	-								
Lineament and/or	MFM0853 merged.					0			
seismic indications:	5					Z			
	MODE	LLING PRO	CEDURE						
At the surface, correspond assumed dip of 90 degree NW strike.	Is to the low magnetic linear s based on a comparison wit	hent MFM085 th high confic	53. Modelled to base dence, vertical and s	of the m teeply dip	odel volume using a oping zones with WN	n IW and			

WNW	ZFN	/WNW0	853	Version number	5	Total object CL	13					
OBJECT CONFIDENCE ESTIMATE												
		•										
Category		Object CL	Comment									
INTERPRETATION												
Data source		1	MFM0853.									
Results of interpretation	n	2	Medium co	onfidence in lineamer	t MFM08	53.						
INFORMATION DENSIT	Υ											
Number of observation	n points	1	1									
Distribution of observation points		1	Single observation point in the form of a lineament.									
INTERPOLATION	INTERPOLATION											
Geometry		1	Geometry	supported by surface	geophys	sical data.						
Geological indicators		1	Indirect su	port by geophysical	data.							
EXTRAPOLATION												
Dip direction		0	Extrapolate	ed to the base of the	model vo	lume. Strike length c	of the					
		3	modelled z	one > 2000 m.		Ū						
Strike direction		2	Conceptua	I understanding of th	e site and	d that the entire region	onal					
		3	modelled z	one is supported by	the linear	ment.						
	FRACTURE CHARACTER											
			No data avai	lable								
INDIVIDUAL INTERCEPT	S											
			No data avai	lable								

WNW			ZFMWN	W103	5	Version number 6 Total object CL 19				
GE	OLOG	GICAL CHARACTER			Property	155000	160000	) 1	65000 170000	
Deformation of	hylo:	Brittlo [	Nuctilo		2					
Deformation description:	lyle.	No data	a available.		5	6710000	5		~~ ~	6710000
Alteration:							<	V	1 The	1
- First order:		Oxidati	on		_	a harden	$\sim$		12313	2
- Second orde	r:	Not obs	served		3	000	5 5	-	/ M / V	2 8
- Third order:		Not obs	served			1 105	w	1 -	XININ	102
Fracture		Steep f	ractures with WN	NW-		° R		1	17HA S	CONTROL OF
orientation and	k	ESE sti	ike and gently d	ipping		2	111		CAHER NO	3
type:		fracture	s are prominent			8 { /		XAN	$\gg      \land \land \land$	8
		Steeply	dipping fracture	es with		200	X		VAN 1	000
		a SE st	rike are also pre	sent.		19	IKE		V V	67
Fracture comm	nent:	No data	a available.				X	2AH		
Fracture fill		No data	a available.			8	1310	X	AX/	9
mineralogy:						9500	114	the	VY	9500
		OBJECT	GEOMETRY			66	1	214		666
Strike/dip:		124°/81	0				/	1ª	And man	
Length:		2078 m	00			. )<		Y	2 S Vincent	
Mex depth:	S:	15 m (5	- 20 m)			0000	1	$\checkmark$	went	000
Geometrical		-070 III	om grid Max erro	or 20m		665				699
constraints:		ZFMWI	W0001. ZEMN	W0002		1.1				
			,			155000	160000	) 1	65000 170000	20.91
						Model	volume DMS		0 2 4 8	N
						Baseline	e		d Cardinateret, Gatzlatererweikun	A
		L		BASIS F	OR MOD	ELLING				
Zone based on	surfac	e lineame	ents, tunnel and	borehole o	bservatior	IS.				
Outcrops:		-								
Boreholes:										
Dembed		202	Target ir	ntercept		Geometric	intercep	t	<b>N</b>	
Borenoie		PDZ	Sec_up [m]	Sec_lo	W Sec	:_up [m]	Sec_ic	bw l	Jomment	
				[111]			[111]	1	DZ3 in HFR105 rathe	er than n
		220				00.00	100.0	。 (	given a higher priority	/ for
		DZS	-	-		00.02	199.0	° (	defining the ZFMWN	W1035
								2	cone geometry. No s	pecific
		220	440.00	4.47.00		10.01	1 1 0 0	1	arget intercept is def	ined.
HFR105		DZ3	119.00	147.00	) 1	19.24	146.3	8		
Tunnels:		DT targ 0+398	et intercept 0+42	20 - 0+433 netric interc	m, geome	etric interce 3 – 0+412 r	pt 0+420 n.	- 0+435	m. BT target interce	pt
Lineament and	l/or	MFM10	35G, MSFR081	12, MSFRO	08110, MS	FR08123.				
seismic										2
indications:										
The second second			(4005 is here all	MODELL	ING PRO	CEDURE	440050		0440 MOED00440 -	
I ne surface pos	Sition C	n ot ol 20		on the mag	netic linea	aments IVIFI	VI1035G, onte basa	MSFR0	8112, MSFR08110 a	na
manning and he	arssu	informat	ion There are a	number of	f structure	s manned i	n the tunr	als with	strikes parallel to th	a trands
of the lineament	ts and	with a ste	en din to the so	uth-west w	ith target	intercent in	the DT tu	innel de	fined by tD72 and tD	727 and
in the BT tunnel	l at tD2	Z26 (see a	appendix 11. Cu	rtis et al. 2	011). A th	ickness of	15 m has	been de	fined by the thicknes	sof
HFR105 DZ3, a	s well	as to refl	ect the spread of	f the inferre	ed related	structures	seen in th	e tunne	mapping. In a simila	ar
manner as othe	r para	llel oriente	ed zones in the v	vicinity of S	FR, tunne	I mapping	suggests	that the	zone consists of an	
associated grou	p of s	ubparalle	smaller structur	res and the	different	zones toge	ther, in the	e area a	round SFR, define th	ne
complex Singö	tecton	ic belt. Th	e forward mode	lling of mag	gnetic data	a along pro	file 1 (see	Appen	dix 6, Curtis et al. 20	11) data
suggests a sub-	vertica		alp to the north	1-east but th	ne lateral	continuity c		naly and	a, as a result, how	al stoop
dip to the south	west. a	as inferre	d by linking the li	ineaments	to boreho	le and tunn	s (∠4, ∠3, el interse	ctions ir	the modelling proce	ai sieep dure.

WNW	ZFMWNW1035	Version number 6	Total object CL <b>19</b>
		E ESTIMATE	AT A A A A A A A A A A A A A A A A A A
	OBJECT CONFIDENC	EESIIWAIE	

Category	Object CL	Comment
INTERPRETATION		
Data source	3	MFM1035G (MFM1035G, MSFR08112, MSFR08110, MSFR08123), HFM35, HFR105, DT, BT.
Results of interpretation	3	High confidence observations in HFM35 and tunnels of the SFR facility.
INFORMATION DENSITY		
Number of observation points	3	>4
Distribution of observation points	2	Tunnel and a borehole intercept considered as a cluster with support from another borhole intecept and lineament gives a medium in this category. A group of clustered observation points and at least one or more outliers (Hermanson and Petersson 2022)
INTERPOLATION		
Geometry	2	Splay to Singö zone. Several sub-surface obs. points from drill holes and SFR tunnels in SE available. Combined and linked with surface lineament, perhaps one strong alternative for interpolation in SE, however, the distance to next sub-surface obs. point HFM35 in horizontal space is c. 450 m.
Geological indicators	2	Some discrepancies in the geological data.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m. Zone exposed in several tunnels. Truncated against ZFMWNW0001.
Strike direction	2	Supported by geological concept and partly by surface lineament.





WNW		ZFMWN	W1053		Version r	number	<b>B</b> Tota	l object CL	14
GEO	LOGICAL CH	ARACTER	Prop C	berty L	155000	160000	165000	170000	
Deformation sty	/le: Brittle-D	Ductile		1	8				8
Deformation	No data	a available.			100				1000
description:					67	NT.	11	themas .	67
Alteration:					1.00	5 4	1 1	4	1
- First order:	Oxidatio	on		2	0	5	$\langle \rangle$		3.
- Second order	: Not obs	served		2	500	2	VN	141	5000
- Third order:	Not obs	served			670	1 1	AII		010
Fracture	No data	a available.			5	· · · ·	1/TH	1 5	(contract)
orientation and					5	11	XAHH	A K	2 C
type:					8 / /	- AV	- VII	101	5 8
Fracture comme	ent: No data	a available.			200		XIA		000
Fracture fill	No data	a available.			6		2 HX	IV	67
mineralogy:					5	XSEA	4 A T		
	OBJECT	GEOMETRY			0	1 Miles	AV	1	0
Strike/dip:	121°/90	)°			9500	AN HOL		$\langle \rangle$	500
Length:	2680 m	l			669	1 116	X	2	699
Mean thickness	: 25 m (3	3 - 50 m)				1 14	X	Sharmer .	
Max depth:	-2100 m	n			C C		~ /	2 mars	-
Geometrical	Topo 40	0m grid Max erro	or 20m,		000		1 mm	1	000
constraints:	ZFMWN	NW0809A, ZFM	WNW0137.		059	~			069
					9				ø
							1		20.910
					155000	160000	165000	170000	
					Baseling	olume DMS			Ä
			BASIS FOR	MODE	LLING				
Zone based on s	urface lineame	ents.							
Outcrops:	-								
Boreholes:									
		Target ir	tercent		Seometric	intercent			
Borehole	PD7	Target I	Sec low	· ·	Seometric	Sec low	Comme	nt	
Borenoie	T DE	Sec_up [m]	[m]	Sec	_up [m]	[m]	Comme		
HFM33		-	-		9.42	49.87			
Tunnels:	-								
Lineament and/	or MEM10	)94G							
seismic									3
indications:									Ŭ
	1		MODELLING	PROC	EDURE				1
At the surface, corresponds to the low magnetic lineaments MEM1053 MEM1053G and MEM1094. Modelled to base of the									
model volume us	sing an assume	ed dip of 90 dear	ees based on	a com	parison wit	h high confide	nce. vertica	and steeply	v dippina
zones with WNW	/ and NW strike	e.				5	-,	· · · · · · · · · · · · · · · · · · ·	

	∽₋   14									
<image/>										
OBJECT CONFIDENCE ESTIMATE										
Category Object CL Comment										
Data source 1 MEM1094G										
Results of interpretation 3 High confidence in lineament MEM1094G										
INFORMATION DENSITY										
Number of observation points 1 1										
Distribution of observation points 1 Single observation point in the form of a lineament.										
INTERPOLATION										
Geometry 1 Geometry supported by surface geophysical data.										
Geological indicators 1 Indirect support by geophysical data.										
EXTRAPOLATION										
Dip direction     3     Extrapolated to the base of the model volume. Strike len modelled zone > 2000 m.	gth of the									
Strike direction Conceptual understanding of the site and that the entire modelled zone is supported by the lineament.	regional									
FRACTURE CHARACTER										



WNW	ZFMWNW1	Version number 5 Total object CL 1'										
GEOLOGICA	CHARACTER	Property CI	155000 160000	0 165	000 170000							
Deformation atula:	Prittle					12						
Deformation style:	Dillie Na data available	2	0000			000						
Deformation	No data avallable.		6	5	$\sim$	710						
description:			° )	15	17 103	0						
Alteration:			~)	Z	112							
- First order:	Not observed		0 2	_ \	1213							
- Second order:	Not observed		200	1	MAN	5000						
- Third order:	Not observed		220	1 7	V/ V/	5705						
Fracture orientation	No data available.		a the		THIN Z	-						
and type:			1.1.1		ALLA S							
Fracture comment:	No data available	-		T		0						
Fracture fill	No data available.	-	82	A A	XIIIS	000						
minoralogy	No data avallable.		67	1 Stort	MY/ //	670						
Initieratogy.	ECT CEOMETRY			17	XX /							
UBJ			1 Martin	A	MY							
Strike/dip:	121°/90°		8	Mar -	AX/	8						
Length:	1002 m		3 100 - 20	12mm	VI	950						
Mean thickness:	15 m (3 - 50 m)		99	114		66						
Max depth:	-1000 m			AX	the same							
Geometrical	ZFMNE0810, ZFMNNW01	00, Topo			L I man	-						
constraints:	40m grid Max error 20m, 1	Surface	8	$\langle \times \rangle$	how	000						
	Planar Cut(s).		0050	V		006						
			8		1. A. A. A.	66						
			155000 160000	) 165	000 170000	18-00						
						N						
			Model volume DMS		0 2 4 8	A						
			Descrine									
	BAS	IS FOR MOD	ELLING									
Zone based on surface lin	eaments and seismic refract	ion data.										
Outons	1											
Outcrops:	-											
Boreholes: -												
Tunnels:	-											
Lineament and/or	MFM1068.					2						
seismic indications:						2						
	MODE	ELLING PRC	CEDURE									
At the surface, correspond	to the lineament MFM1068	<ol><li>This linear</li></ol>	nent is defined by a	depressio	n in the bedrock sur	face,						
the form of which has bee	n recognised on the basis of	an analysis	of old refraction seis	mic data (	Isaksson and Keisu	, 2005).						
Possible correlation also v	vith a low velocity seismic ref	fraction anor	naly (Isaksson and K	(eisu, 200	5), RSLV02 in Figur	e 5-33						
in SKB (2005). Modelled t	o a depth of 1000 m using ar	n assumed d	ip of 90 degrees, bas	sed on a c	omparison with high	۱						
confidence, vertical and st	eeply dipping zones with WN	W and NW	strike.									
,			Nonexa 1									
10000			Et.									
( States of the second s												
	1810		17MM	WHO.								
	E0810		1 AMA	NNO TOD								
	INE0810		17111	MNO TOO		2						
	mNE0810		1.111	WM0100								
	WNE0810			WA10100								
	mNE0810			MADIDO MAR		N.						
	mNE0810		17111	MADIOD MARKE		N. N						
	mintE0810		14068	NNO10D								
	MINEO810		W1068	WW0100		10						
	INVEG810	ZEMW	VW1068	Magingo Henry		- Marine Contraction						
	MINEO810	ZFMW	VW1068	WW0100		Ch.						
	MINEO810	ZFMW	W1068	MN0100		C.						
	MINEGO 810	ZFMWN	VW1068	MN0100								
	MINEGO 810	ZFMW	VW1068	MN0100	1200-Y							
	MINE D810	ZFMW	JW1068	ANDIDO .	IE 12084							
	Meestood and a second and a s	ZFMW	W1068	AMBI BO	ENET2084							
	OTBOJINI	ZFMW	W1068	AMBO BO	meNE12084							
	01803WII ZFMNW1200	ZFMW	VW1068	Magage Hard	Ever-1-2005							
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ZFMW	WN1068	Maging Hard	Parent Lange							
	0 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	ZFMW	WN1068	Maging Hener	Tenner Tenner							
	0100 200 300	ZFMW	WN1068	Maging Hener	Remer							

WNW	ZFN	/WNW1	068	Version number	5	Total object CL	11		
<b>OBJECT CONFIDENCE E</b>	STIMATE			•					
			_						
Category		Object CL	Comment						
INTERPRETATION									
Data source		1	MFM1068.						
Results of interpretation	n	2	Medium co	nfidence in lineamer	nt MFM10	68.			
INFORMATION DENSIT	Y								
Number of observation	n points	1	1						
Distribution of observa	tion points	1	Single obse	ervation point in the f	form of a l	ineament.			
INTERPOLATION									
Geometry		1	Geometry s	supported by surface	e geophys	ical data.			
Geological indicators		1	Indirect sup	oport by geophysical	data.				
EXTRAPOLATION									
Dip direction		1	No subsurface obs. point, supported only by surface data. High uncertainty in dip-direction. Strike length of the modelled zone < 2000 m. Modelled to base of the model volume using an assumed dip of 90 degrees based on a comparison with high confidence, vertical and steeply dipping zones with WNW or NW strike (Stephens and Simeonov 2015).						
Strike direction		3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.						
		FRA	CTURE CHA	RACTER					
No data available									
INDIVIDUAL INTERCEPT	5								
			No data avai	lable					

WNW	ZFMWNW1	Version number	3	Total object CL	12				
GEOLOGICA	155000 160000	0 16	5000 170000						
Deformation style:	Brittle	1	0			0			
Deformation description:	No data available.		621000	15	The man	671000			
Alteration:			~ {	X	11/2				
- First order:	Oxidation	2	0 25	/ _	V 12	0			
- Second order:	Not observed	-	~~ 220	())	MMM	2000			
- Third order:	Not observed	_	20 20		AUV	67(			
Fracture orientation and type:	No data available.	-		X	AT A				
Fracture comment:	No data available.	-	200	AAX	$\times$	0000			
mineralogy:	No data available.		6700		Y V	6700			
OBJ				CH C	MM				
Strike/dip:	97°/90°		000	X	AX	000			
Length:	3021 m		695(	N.	$\times$	3950			
Max donth:	20 m (10 - 04 m)		°	14/2	A T	6			
Geometrical		125 Tono		103	2 13				
Geometrical	2FIVINEU808A, 2FIVINNET	135, 1000	8		La Inner	8			
constraints:	40m gha wax error 20m.		0000	$\bigvee$	w	000			
			99			666			
			155000 160000	) 16	5000 170000	12.410			
						N			
			Baseline Model volume DMS		Contratevet Gride newsyles	A			
	PASI								
Zono boood on ourfood lin	BASI	5 FOR MOL	PELLING						
Zone based on surface in	leaments.								
Outcrops:	I _								
Boreholes: -									
Borenoico.									
Tunnels:	-								
Lineament and/or	MFM1156.					4			
seismic indications:						I			
	MODE	LLING PRO	CEDURE						
At the surface, correspond	ds to the low magnetic linear	nent MFM11	<ol><li>Modelled to base</li></ol>	e of the m	odel volume using a	n			
assumed dip of 90 degree	s, based on a comparison w	ith high confi	dence, vertical and s	steeply di	pping zones.				
assumed dip of 90 degrees, based on a comparison with high confidence, vertical and steeply dipping zones.									

WNW	ZFN	/WNW1	156	Version number	3	Total object CL	12						
<b>OBJECT CONFIDENCE ES</b>	TIMATE												
		-	_										
Category		Object CL	Comment										
INTERPRETATION													
Data source		1	MFM1156.										
Results of interpretation		1	Low confide	ence in lineament M	FM1156.								
INFORMATION DENSITY													
Number of observation p	points	1	1										
Distribution of observation	on points	1	Single obse	ervation point in the f	orm of a	lineament.							
INTERPOLATION													
Geometry		1	Geometry s	supported by surface	geophys	ical data.							
Geological indicators		1	Indirect sup	port by geophysical	data.								
EXTRAPOLATION													
Dip direction		3	Extrapolate modelled z	ed to the base of the one > 2000 m.	model vo	lume. Strike length o	of the						
Strike direction	3	Extrapolation in strike direction mainly based on the trend of linked surface lineament. Terminated against ZFMWNW1156 and ZFMNNE1135., Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.											
		FRA	CTURE CHA	RACTER									
No data available													
INDIVIDUAL INTERCEPTS													
			No data avail	able									

WNW		ZFMWN	W2225		Version r	number	6	Total object CL	15
GEO		CHARACTER	Prop	perty	155000	160000	16	5000 170000	
Deformation at		 -	C	L					
Deformation st Deformation description:	yle: Britin Verti strike displ dippi strike	cal fault with WNW show sinistral stri acement. Gently S ng fault show dexti slip displacement	/-ESE ke-slip - ral						000 6710000
Alteration:					6029	m 1		A A N	5705
- First order:	Oxid	ation		2	S		N	THE S	(All second
- Second order	r: Not o	bserved		,	5	IL	XX	AHAN NE	2
- Third order:	Not o	bserved			00 }	JUL J	X	VII A L	000
Fracture orientation and type:	I Stee domi othe genti also seale open fracti estin seale	Steeply dipping fractures that strike in NW and SE sectors dominates. Fractures with other orientations, including gently dipping fractures, are also present. Dominance of sealed fractures followed by open and partly open fractures. Quantitative estimate and span include		2	6650000 6700 6700		1 6690000 6695000 6700		
Fracture comm	ent: No d	ata available.			1.1.1				
Fracture fill mineralogy:	Chlo hema quar	Chlorite, calcite, hematite/adularia, epidote, quartz, clay minerals.			155000 Model v Baseling	160000 olume DMS	165	000 170000	224 A
Strike/din:	1220	78°							
Length:	1531	m							
Mean thickness	s: 26 m	(3 - 50 m)							
Max depth:	-155	) m							
Geometrical	ZFM	ENE0060A. Topo 4	40m arid Max e	rror					
constraints:	20m	1 Surface Planar	Cut(s).	-					
Zone based on s	surface linea	ments and a boreh	BASIS FOR nole observation	MODE 1.	ELLING				
Boreholes:									
Borehole	PDZ	Target in	ntercept Sec low	(	Geometric	intercept Sec lov	v c	omment	
		Sec_up [m]	[m]	Sec	:_up [m]	[m]			
KFM08C	DZ3	673.00	705.00	6	73.22	705.32			
Tunnels:	-								
Lineament and	or MFM	2225G. MFM0044	G0.						
seismic		, 10044							2
indications:									
			MODELLING	PROC	CEDURE				
At the surface, c lineament MFM0 these lineament fixed point 693 r 692-696 m.	corresponds 2044G0, whi segments w n where a se	to the low magnetic ch have been com ith the borehole int caled fracture netw	c lineament MF bined. Modelled tersection 673-7 ork is present. I	M2225 d dowr 705 m Decrea	5G and the n to 1600 m in KFM080 ased radar	north-west depth usir C (DZ3). De penetratior	tern par ng the d eformati n also a	t of the low magnet ip estimated by cor on zone plane plac long the borehole ir	ic inecting ed at hterval

WNW ZFMWNW2225		Version number	6	Total object CL	15
ZFMENE 200	CFMWNV2225	CTHORA	ZFMNNE2255 ZFMNNE2273	Z-HEREROOD	

Category	Object CL	Comment
INTERPRETATION		
Data source	2	MFM2225G0, MFM2225G1, KFM08C.
Results of interpretation	3	High confidence observation in KFM08C.
INFORMATION DENSITY		
Number of observation points	2	2
Distribution of observation points	1	Single observation point at depth and surface lineaments.
INTERPOLATION		
Geometry	1	Geometry supported by surface geophysical data.
Geological indicators	1	Indirect support by geophysical data.
EXTRAPOLATION		
Dip direction	2	Extrapolation in dip direction supported by subsurface obs. point.
Strike direction	3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament. Extrapolation in strike direction mainly based on the trend of linked surface lineament. Terminated against ZFMENE0060A in SE and limited by ZFMNNE2312 and ZFMENE1061A in NW.

**OBJECT CONFIDENCE ESTIMATE** 

	FRAC	TURE CHARACTER
Orientation: (strike/dip right- hand-rule)	Set SSE: 149.9°/88.8°	ZFMWNW2225
Frequency:	Boreholes: KFM08C	
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open4.1 m-1Sealed18.4 m-1Sealed5.4 % of DZnetworkinterceptCrush0.0 % of DZintercept	Unassigned (142) Set SSE (141) Mean pole Set SSE (59.9/1.2) Eisher K = 10.6

WNW	ZFMWNW2225 Version number 6 Total object CL 15
RQD:	min:68, max:100, mean:97
RQD: Fracture fill mineralogy:	Min:68, max:100, mean:97   KFM08C(673,0-705.0)   Image: Sealed   Image: Sealed   Image: Sealed   Image: Sealed
	2 40 - 20 - 20 - 20 - 20 - 20 - 20 - 20 - 2



WNW	1		ZFMWN	W32	59		Version	number	3	Total ob	ject CL	22
GEOLOGICAL CHARACTER			Prop C	erty L	155000	160000	)	165000	170000			
Deformation st	vle:	Brittle-D	Ductile		3		0					9
Deformation	<b>,</b>	No data	a available.				371000	0	5	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		71000
Alteration:							Ŷ	1	$\checkmark$		12	Ű
- First order:		Ovidati	20					$\sim$	1	1 the	3 5	-
- First order.	r.	Chloriti	zation		3		000	5 5	-	1/1/		1 8
- Third order:		Sericitia	zation				2050	w		KIX	11	1050
Fracture		Steen s		and F			0 22 O	1		THA	12	9
orientation and	ł	strike a	s well as a set				2	1,1		KANDA	2	
type:	•	consisti	na of aently dipr	oina			8	1 h	The			2 0
		fracture	s are prominent				200	XV		1 KUI	3	0000
		Fractur	es with other				67	IKE		M/		671
		orientat	ions are also pre	esent.				KIE	ZAL	XX	/	
		Domina	ince of sealed					0016	A	AV I	/	0
		fracture	s. Quantitative				500	A fr	2×	SVY		500
		estimat	e and span inclu	ide	2		665	1	214	X		699
		several	sealed fracture	ah			1	-/	1d	1 Az	Junders	
			s and some cru	511				1		11	Tanonsken	
Fracture comm	ent.	No data	available				0000	1	V	how		0000
Fracture fill		Chlorite	calcite				669					6690
mineralogy:		hematit	e/adularia. epido	ote.			1.10					
		quartz,	laumontite and o	clay			155000	160000		165000 1	70000	20.9
		mineral	S.				100000	100000		100000 1	10000	N
		OBJECT	GEOMETRY				Baselin	olume DMS c		0 3 Let	miteret Grideroeverken	A
Strike/dip:		119°/90	)°									
Length:		2173 m										
Mean thicknes	s:	50 m (2	0 - 60 m)									
Max depth:		-2100 n			Topo							
constraints		40m ari	d Max error 20m	1 0 0 0 0 0 1 1	, торо							
		, ioni gri		BASIS	FOR I	MODE	LLING					
Zone based on	surfac	e lineame	ents, tunnel and	borehole	obser	vation	S.					
Outcrops:		-										
Boreholes:												
			Target ir	ntercept		0	Geometric	intercep	t			
Borehole	F	PDZ	Sec un [m]	Sec_l	low	Sac	սո [m]	Sec_low		Comment		
			occ_up [m]	[m]	]	000	_սթ [ույ	[m]				
										Geometrical	split of D	Z1
KFM11A	[	DZ1	400.00	498.	00	4	01.73	490.6	7		VIVVINVVUU 213 and	JUT,
										ZFMWNW32	259.	
	·		I			·	ı					
Tunnels:		DT targ	et intercept 0+14	42 – 0+1	70 m, g	geome	etric interce	ept 0+128	- 0+1	80 m.		
		BT targ	et intercept 0+12	20 – 0+1	50 m, g	geome	etric interce	ept 0+108	- 0+1	58 m.		
Lineament and	/or	MFM32	59G.									4
indications												1
indications.				MODEL	LING	PROC	EDURE					
The position of t	the zo	ne at the	ground surface i	s based	on mad	gnetic	lineament	MFM325	9G (Isa	aksson et al.	2007), wi	th a
slight lateral adj	ustme	nt in posi	tion as it traverse	es KFM1	1A and	d a fur	ther exten	sion to the	e north	west coupled	d to a re-l	inking
of the connection with MFM0813G. MFM3259G is take					to be t	the ec	uivalent of	f linking th	e serie	es of much sh	orter SFF	ર
version 1.0 lineaments MSFR08073, MSFR08074 and					/ISFR0	8075	in SFR mo	del versio	on 1.0 a	and is conside	ered to be	ea
more suitable length of trace to use in the model area.					orward	I mod	elling of m	agnetic da	ata aloi	ng profiles 24	, 25 and 2	26 (see
Appendix 6, Cu	rtis et	al. 2011)	suggests a verti	cal to ste	ep dip	to the	south-we	st. Due to	the un	certainty of th	ne modell	ing
The target inter		the turne	ons, a vertical d	ip, based	a on the		er and KFI	marked in	a, nas l a tha t	uppel mapping	a in the m	udel.
and Bolvede 1	987)	No specif	ic evidence is ta	ken to de	fine th	e bou	ndaries of	this zone	in the	tunnel hut sin	nilar to in	a 155011
KFM11A there is	s clea	r evidenc	e of deformation	and the	modell	ed zo	ne represe	ents a mor	e gene	eral subdivisio	on of defo	rmation
seen in the tunn	el bet	ween this	zone, ZFMWNW	W0813, Z	FMWN	1W00	01 and ZFI	MNW0002	2.			-
WNW	ZFMWNW32		259 Version number 3 Total object CL 22									
------------------------------------	--	---	--									
	рир ни на ни ни ни ни ни ни ни ни ни ни ни ни ни	remains remain	received a second a s									
		OBJECT	CONFIDENCE ESTIMATE									
Opto marga												
		Object CL	Comment									
Data source		3	MFM3259G, KFM11A, DT/BT.									
Results of interpretation		3	High confidence observations in KFM11A and tunnels of the SFR									
INFORMATION DENSITY												
Number of observation points		3	4									
Distribution of observation points		2	Supported by sub-surface information in tunnels of SFR facility and drill hole KEM11A									
INTERPOLATION												
Geometry		3	Geometry supported by drill hole and two tunnel observations.									
Geological Indical	IOIS	3	Supported by key geological parameters from two tunnel observations.									
EXTRAPOLATION												
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point. Strike length of the modelled zone < 2000 m.									
Strike direction		3	Conceptual understanding of the site and that the entire regional modelled zone is supported by the lineament.									
		FRAC										
Orientation:	Set NW: 314.7°	/86.2°	ZEMWNW3259									
(strike/dip right-	Set G: 7.7°/8.0°	E0	N									
nanu-rule)	Set L. 92.0 /30.	5										
Frequency:	Boreholes: KFM	111A										
	FRACTURE	TERZAGHI-										
	TYPE	WEIGHED										
	Open and	7.5 m-1										
	partly open	-										
	Sealed	27.1 m-1	<b>4</b>									
	network	DZ										
	Omist	intercept										
	Crusn	0.3 % of DZ										
	· · · · · · · · · · · · · · · · · · ·											
			Equal area									
			Unassigned (564)  Lower hemisphere									
			<ul> <li>Set NW (327) Δ Mean pole Set NW (224.7/3.8) Fisher κ = 37.6</li> <li>Set G (322) Δ Mean pole Set G (277.7/82.0) Fisher κ = 18.5</li> </ul>									
			• Set E (294) Δ Mean pole Set E (2.8/31.5) Fisher κ = 12.7									

WNW	ZFMWNW3259	Version number 3	Total object CL <b>22</b>
RQD:	min:52, max:100, mean:91		
Fracture fill mineralogy:		KFM11A(400.0-498.0)	
	700 - 600 - 500 - 50	par persone under under vorse v	Open and partly open Sealed





WNW	ZFMWNW3262			Version r	number	8	Total obj	ect CL	20	
GEOLOG	GICAL CH	ARACTER	Prop	perty	155000	160000	16	5000 1	70000	
Deformation style:	Brittlo [	Nuctilo		L 2	0					
Deformation	No data			<b>)</b>	000					000
description:	NU Uala	a avaliable.			671	2	5	~~		6710
Alteration:						( )	)		The second	
- First order:	Oxidatio	on				$\sim$	1	1 the	5/5	-
- Second order:	Not obs	served	3	3	000	5 -	1-	1 11	- 1.	2 00
- Third order:	Not obs	served			105	m 1	1	XIX	111	70507
Fracture	Fracture	e set with WNW	strike		° R	1	_/	THIN	3	(Contraction)
orientation and	domina	tina. Gently dipp	ina		1	11	XX	AHDA	5	3
type:	fracture	set also presen	t.		8 { }		Y	V////		8
Fracture comment:	Fracture	e apertures gene	erally		82	XX		AV1	5	000
	betwee	n 0.5 and 1.5mm	n.		67	INSAS	S.	H/		67
Fracture fill	Calcite,	chlorite are				X	(IV)	XX	/	-
mineralogy:	domina	ting open and se	aled			SILL	¥	AV 7	/	0
	fracture	s. Laumontite in			200	14 HB	Rec.	N		2000
	sealed	and clay mineral	s in		699	1 111	~	XI		699
	open fra	actures are				1 1	X	h		
	conspic	uous.			R	11		2 7	himmedian	-
	OBJECT	GEOMETRY			000		X	how		000
Strike/dip:	118°/86	50			0690	~				690
Length:	618 m	22 \			w la					U
Mean thickness:	2 m (2 ·	- 36 m)						1		10.000
Max depth:	-610 m		0054		155000	160000	165	5000 1	70000	N
Geometrical		3137, ZEMINWU	805A, Des arid Max ar		Model v	olume DMS		0 2	4 8	Â
constraints:	20m 1	Surface Planar (	ni gilu wax eli	101	Baseling			a Cale	niterel Griddoner-erkes	
	2011, 1			MODE						
Zone based on surface	ce lineame	ents and three bo	prehole observa	ations.						
Outcrops:	-									
Boreholes:										
		Target ir	ntercept	G	Geometric	intercept				
Borehole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	С	omment		
KFR103	DZ3	180.00	182.50	17	78.30	183.57				
KFR106	DZ3	67.00	73.00	6	6.95	75.17				
KFR121	DZ1	89.00	100.00	9	2.77	96.42				
Tunnels	-									
Lineament and/or	MSERO	8105								
seismic		0100.								1
indications:										
			MODELLING	PROC	EDURE					
The position of the zo	one on the	ground surface	is based on ma	agnetic	lineament	MSFR0810	5 in Sl	FR model v	version 1	.0, itself
a modification of lines	ament MFI	M3262G from (Is	aksson et al. 2	007). 1	he earlier	number has	been	retained in	the zon	e name
to assist traceability.	There has	been an extens	ion to the WNV	V, throi	igh an are	a where the	magn	etic field is	disturbe	d, to
allow termination at z	one ZFMN	NE3137. Thickne	ss is based on	the SH	II PDZ boi	ehole interc	epts. F	Forward mo	delling c	of
magnetic data along	profile 2 (A	Appendix 6, Curt	is et al. 2011) i	ndicate	s a very s	teep dip to th	ne nor	th-east whe	ereas inv	rersion
modelling indicates a	vertical to	sub-vertical dip	towards the so	outh-we	est that co	responds to	the m	odelled ge	ometry.	

WNW	ZFM	WNW32	262	62 Version number 8 Total object CL						
HERE AND CONTRACT OF CONTRACT	REFELIDA REF	Truewerstand	SISSE STEMMUN CENTRAL CENTR	100054 W3262 ZFMWNW00335						
0 100 20	0 300	500 m	ZFMWNWOC	101						
		OBJECT	CONFIDENC	E ESTIMATE						
Category		Object CL	Comment							
INTERPRETATION										
Data source	tation	2	MSFR0810	5 (MFM3262G in RV	S), KFR1	<u>03, KFR106, KFR1</u>	21.			
		3	righ comachec observations in multiple boreholes.							
Number of observ	vation points	3	4							
Distribution of obs	servation points	2	Lineament,	three boreholes clos	e to each	other and one outli	ier.			
INTERPOLATION										
Geometry	Geometry		Three boreholes, somewhat spread out, and one lineament. Appears to truncate against ZFMNE3137, ZFMNW0805A an ZFMNW0805B.				d			
Geological indicat	ors	2	Interpolation	n supported by data	from bore	holes.				
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.							
Strike direction		2	Strike length of the modelled zone < 2000 m. Conceptual understanding of the site and that the entire regional							
		ు	modelled zo	modelled zone is supported by the lineament.						
		FRA	CTURE CHAI	RACTER						
Orientation:	Set WNW: 283.	4°/86.0°		ZFMW	NW3262	2				
(strike/dip right-	Set G: 142.3°/8	.0°		-	Ņ					
nand-rule)	ENE: 16.0780.0	)-		La	•					
Frequency:	Boreholes: KFR KFR121	106, KFR103,			•					
	FRACTURE TYPETERZAGHI- WEIGHED P10Open and partly open14.1 m-1Sealed14.9 m-1Sealed16.6 % of DZ interceptCrush2.2 % of DZ intercept					Equal a	area			
RQD:	min:40, max-10	0. mean:81	• Unas • Set V • Set C • ENE	signed (94) VNW (57) A Mean pr 5 (59) A Mean pr (28) A Mean pr	S ole Set WNV ole Set G (5 ole ENE (28	Lower nemispr N (193.4/4.0) Fisher $\kappa = 2.3/82.0$ ) Fisher $\kappa = 27.2$ 6.0/10.0) Fisher $\kappa = 8.0$	22.4 2			
100U.	11111+0, 111ax.10	o, moan.o i								







WNW		ZFMWNW3267		67		Version r	number	6	Total object CL	17	
GE	OLOGI	ICAL CH	ARACTER		Proper Cl	rty	155000	160000	1	55000 170000	
Deformation st	tvle:	Brittle			3		9				0
Deformation	. <b>.</b>	No data	a available.		•		1000		_	~	000
description:							67	2	T	The month	671
Alteration:							1. 1.	_ {	Y		
- First order:		Oxidatio	on		З		0	5	/	V M V	3. 0
- Second orde	r:	Argilliza	ation		5		2 200	ul T	-	VNPL	200
- Third order:		Lamont	ization				67 67	1			670
Fracture		Steeply	dipping ESE fra	icture			2	1.1	X	ATTA 3	5
type.		by stee	nly dinning SSW	l sets			2 { \	12	N	XIIITA N	3 0
type.		Domina	ince of sealed	5010.			200	the state		XIIIS	0000
		fractures. Open and partly		rtly			67	IKER	A	WI V	670
		open fra	actures are also		3			XXXX	RH/		
		present					0	13/16	X	AV7	0
Fracture comm	nent:	Fracture	e apertures up to	52			9500	Al 40	1×2	VY	9500
Encoderate City		mm.	ala la séta cara d				669	1 1	22		665
Fracture fill		Calcite,	tite dominate					/	()	and the second second	
mineralogy.		OB.IECT	GEOMETRY				0		$\checkmark$	S inner	0
Strike/dip:		124°/90	)°				0008	$\langle \cdot \rangle$		w	0006
Length:		702 m	·				669				665
Mean thicknes	s:	18 m (2	: - 36 m)								
Max depth:	th: -700 m						155000	160000	16	5000 170000	22.54
Geometrical		ZFMNE	3137, ZFMNNW	/1034, To	opo 40m		Model v	olume DMS		0 2 4 8	N
constraints:		grid Ma	x error 20m, 1 S	urface Pl	lanar		Baseline			S Leitmateret, Gridal networkers	N
		Cut(s).		DACIC							
Zone based on	surface	a lineame	ants and borehol	A observa	ations	UDEI	LLING				
	Sunace			0030176	210113.						
Outcrops:		-									
Boreholes:											
			Target ir	ntercept		G	Geometric intercept				
Borehole	P	DZ	Sec up [m]	Sec_l	ow	Sec	սո [m]	Sec_lov	v (	Comment	
			occ_ab [iii]	[m]	1	000_	սելու	[m]			
KED404		775	200,00	4545		20	0.05	454 50	1	lo geometrical Sec_	up as
KFR104		JZ5	396.00	454.3	57	38	6.65	454.53	t +	he porenole not pen	trates
									L	lo geometrical Sec	5. UD 26
KFR104	Г	076	396.00	454.5	57	38	8.65	454.53	t	he borehole not pen	trates
									t	he modelled surface	S.
KFR105	C	DZ4	258.00	283.0	00	25	7.76	282.88			
Tunnels:		-									
Lineament and	l/or	MFM32	67G.								
indications:											I
indications.				MODEL	LING PF	ROCI	EDURE				
In the current SI	FR mo	del versio	on 1.0, this zone	is based	on a mo	odifica	ation of th	e Forsmar	k stage	2.3 lineament MFM	3267G
(Isaksson et al.	2007).	In the SI	R model versio	n 0.1 line	ament in	nterpr	retation, th	nis lineame	nt was	replaced by MSFR0	8121
and MSFR0811	5. The	dip of th	e zone is based	on a link	with the	bore	hole inter	ceptions in	KFR10	)4 and KFR105. The	9
forward modellin	ng of m	nagnetic	data along profile	e 1 (see A	Appendix	x 6 in	Curtis et	al. 2011) d	ata su	gests a sub-vertical	to a
verv steep dip to	o the n	orth-east	, while profile 39	modellin	ng sugge	ests a	vertical d	ip.			

WNW	ZFM	WNW32	267	Total object CL	17					
	Le reuza Le	A CANADA		020054 27FMWNW00030 67 14						
0 100 20	00 300	500 m	ZFMWNW00	01						
		OBJECT	CONFIDENC	ESTIMATE						
Category		Object CL	Comment							
INTERPRETATION		-								
Data source		2	MFM3267G	, KFR104, KFR105.						
	3	High confide	nce observations in	multiple I	ooreholes.					
Number of observ	2	3								
Distribution of obs	servation points	2	Two subsurf	ace observation poir	nts, even	v distributed, and o	ne			
		2	lineament.	ace obcorration poin		y alothoutou, and e				
INTERPOLATION										
Geometry	Geometry		The lineame where the ze the lineame	I he lineament that this zone follows, deviates around the area where the zone is seen in the boreholes, i.e. it could follow either the lineament, or the boreholes.						
Geological indicat	tors	2	Interpolation	supported by miner	al fillings	within fractures from	m			
EXTRAPOLATION			borenoies.							
Dip direction		2	Extrapolation in dip direction supported by subsurface obs. point.							
0.1		2	Strike length	of the modelled zor	ne < 2000	) m.				
Strike direction		2	Supported b	y geological concept	t and part	ily by surface linear	nent.			
		FRA	CTURE CHAP	ACTER						
Orientation: (strike/dip right- band-rule)	Set WNW: 122. Set SSW: 193.0	3°/89.7° )°/83.9°		ZFMW	NW3267 N					
Frequency:	Boreholes: KFR	104, KFR105	_							
	FRACTURE TYPE Open and partly open Sealed Sealed network Crush	TERZAGHI- WEIGHED P10 8.1 m-1 12.9 m-1 23.7 % of DZ intercept 0.1 % of DZ intercept	W			Equal Lower hemisp	E area ihere			
			<ul> <li>Set W</li> <li>Set S</li> </ul>	/NW (223) ▲ Mean p SW (92) ▲ Mean p	ole Set WN	W (32.3/0.3) Fisher κ = V (103.0/6.1) Fisher κ =	7.6 30.9			

WNW	ZFMWNW3267 Version number 6 Total object CL 17	
RQD:	min:60, max:100, mean:93	
Fracture fill mineralogy:	KFR104(396.0-454.57), KFR105(258.0-283.0)	
	250 200 50 50 50 50 50 50 50 50 50 50 50 50 5	







WNW	ZFMWNW3	268	Version number	6	Total object CL	9
GEOLOGICAI	CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation style:	Brittle-Ductile					0
Deformation	No data available	2	000		~ ~	0000
description:	No data avaliable.		2	5		6710
Alteration:			{	V	V The	
- First order:	Not observed		$\sim$		1 W Z	- 1
- Second order:	Not observed		000	-1	/ / / / s	2 00
- Third order:	Not observed		202	/ ~	A M M	705
Fracture orientation	No data available.			-/	THILE	(C)
and type:			211	$ \bigvee $	AHAN LE	
Fracture comment:	No data available.		00	X	VIIA 15	8
Fracture fill	No data available.				AVI S	000
mineralogy:			io X		K V	61
OBJ	ECT GEOMETRY			THE		
Strike/dip:	111°/90°		8 1 1 1	X	AX/	0
Length:	862 m		3 1 1 2 200	1 mas	VI	9500
Mean thickness:	5 m (2 - 36 m)		99	112		666
Max depth:	-860 m			W X	And some	
Geometrical	ZFMNE3137, ZFMWNW10	)35, Topo			L J haven	0
constraints:	40m grid Max error 20m, 1	Surface	000	$\bigvee$	www	000
	Planar Cut(s).		999			699
			155000 160000	) 16	5000 170000	10.910
						N
			Model volume DMS     Baseline		0 2 4 8	A
	BASI					
Zone based on surface lin	eaments.					
Outcrops:	-					
Boreholes: -	I					
Tunnels:	-					
Lineament and/or	MSFR80006.					1
seismic indications:						1
	MODE	LLING PRO	CEDURE		<b>D</b>	
The position of the zone a	t the ground surface is based	d on magneti	c lineament MSFR80	0006 (SF	R model version 1.0)	), itself
ZEMNE2127 and ZEMW/N	W1025 The vertical din is a	defeult volue	The medalled thick			al Dood on
the traceable zone length	of 709 m However in the m	odel the zon	e geometry has beer	n extende	d to terminate at	
ZFMWNW1035 to ensure	connectivity giving an rys mo	odelled lengt	h of 861 m.	I OXIONUC		
	, j	g				
•KFR13	A-RI02B					
	KFR102A FFR	ZFM				
FR34	A Starting	""INI	Voor			
	KFR27	058	SUSA			
KERTS V	KER103	ZEMANARA				
		111111111111	202			
	ZEMWNINGS	P106				
	10042	Khu.				
	10135		ZFMWMMM			
	ZEMENES		0035			
KFI	allos					
A 11/80	43					
Â.		WWWWW3267				
A	le l					
	ZF	MWNW	3268			
			0200			
0 100 200	300 500 m	ZEMMAN	A			
			001			

WNW	ZFN	/WNW3	8268	Version number	6	Total object CL	9				
<b>OBJECT CONFIDENCE E</b>	STIMATE				•						
Category		Object CL	Comment								
INTERPRETATION											
Data source			MSFR8000	MSFR80006. Modified. Earlier represented by MFM3268G							
		1	(Isaksson et al. 2007). Further extension to the WNW to allow								
			termination	n at ZFMNE3137 and	IZFMWN	IW1035.					
Results of interpretation	1	Low confid	ence in lineament M	FM32680	G.						
INFORMATION DENSIT											
Number of observation points		1	1								
Distribution of observation points		1	Single obs	ervation point in the	form of lir	neaments.					
INTERPOLATION	INTERPOLATION										
Geometry		1	Geometry supported by surface geophysical data.								
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction			No subsurface obs. point, supported only by surface data. High								
		1	uncertainty	in dip-direction. Stri	ke length	of the modelled zone	e <				
			2000 m.		-						
Strike direction		2	Supported	by geological conce	pt and pa	rtly by surface linean	nent.				
		FRA	CTURE CHA	RACTER							
			No data avai	lable							
INDIVIDUAL INTERCEPT	S										
			No data avai	lable							

WNW	ZFMWNW3	512	2 Version number 4 Total object CL			13
GEOLOGICAI	CHARACTER	Property CL	155000 16000	0 16	5000 170000	
Deformation style: Deformation description:	No data available No data available. Zone based on lineament maps in the catchment		6710000	×		6710000
Alteration	area.		8	1-	V 1-2	1 8
- First order:	Not observed	_	1050	1 - 1		70501
- Second order:	Not observed		° R	N	THA LE	ig is a second s
- Third order:	Not observed		11/3	X	AHA RE	
Fracture orientation and type:	No data available.		200000		XIN 3	700000
Fracture comment:	No data available.	_	° A		XX Y	0
mineralogy:	No data avaliable.		1 Kalle	X	NY	
OBJ	ECT GEOMETRY		1 1 2000	X	M	0000
Strike/dip:	96°/90°		699	214	XI	6695
Length:	15262 m			HAY	As where	
Mean thickness:	65 m (50 - 200 m)				2/2	
Max depth:	-2100 m		0000	$\langle \times \rangle$	War	000
Geometrical constraints:	Topo 40m grid Max error 2 Surface Planar Cut(s).	20m, 2	6660			2699
			155000 160000 Model volume DMS Baseline	0 165	000 170000	Å
	BASI	IS FOR MOD	ELLING			
Zone based on surface lin	eaments.					
Outcrops:	-					
Boreholes: -						
Tunnels:	-					
Lineament and/or seismic indications:	MFM3508, MFM3512.					3
	MODE	ELLING PRO	CEDURE			
0 100 200 300	ZFMW 500 m	<b>NW351</b>	2		2 km	

WNW	ZFN	/WNW3	3512	Version number	4	Total object CL	13			
OBJECT CONFIDENCE E	STIMATE									
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM3508							
Results of interpretation 3 Hid				dence in lineament M	IFM3508					
INFORMATION DENSIT	Y									
Number of observation	n points	1	1							
Distribution of observa	1	Single obs	ervation point in the	form of a	lineament.					
INTERPOLATION			<u> </u>							
Geometry		1	Geometry supported by surface geophysical data.							
Geological indicators		1	Indirect su	pport by geophysical	data.					
EXTRAPOLATION										
Dip direction		2	Extrapolat	Extrapolated to the base of the model volume. Strike length of the						
		3	modelled zone > 2000 m.							
Strike direction		2	Supported	by geological conce	pt and pa	rtly by surface linear	nent.			
		FRA	CTURE CHA	ARACTER						
			No data ava	ilable						
INDIVIDUAL INTERCEPT	S									
			No data ava	ilable						

WNW	ZFMWNW3	ZFMWNW3519 Version number 4 Total object CL		13					
GEOLOGICAI	CHARACTER	Property CL	155000 160000	0 165	000 170000				
Deformation style:	No data available		8			0			
Deformation	No data available. Zone		1000	-	$\sim$	1000			
description:	based on lineament		2 61	T	more if	67			
	maps in the catchment		5	Y	12				
	area.		5		V 12 12	- 10			
Alteration:			2000		/ M L C	2000			
- First order:	Not observed		2200	1 3		5705			
- Second order:	Not observed		a the		141 2	invite U			
- Third order:	Not observed		2.11	X	AHA LE				
Fracture orientation	No data available.		8 {	XAX		8			
and type:			2		AUS	000			
Fracture comment:	No data available.		6		HIV	67			
Fracture fill	No data available.			2RID	XX/	-			
mineralogy:			· / / ///	A	AV7	0			
OBJ	ECT GEOMETRY		1 / / / / /	West .	N	500(			
Strike/dip:	121°/90°		6669	214	XI	699			
Length:	16455 m			14V	the more				
Mean thickness:	70 m (50 - 200 m)				1 7				
Max depth:	-2100 m		8		had a	8			
Geometrical	ZFMNW3511, Topo 40m o	rid Max	005	V	•••	006			
constraints:	error 20m, 1 Surface Plana	ar Cut(s).	8		10 B C C C	66			
			155000 160000	) 165	000 170000	12.44			
						N			
			Baseline		C Cartenie et Grichel region ken	A			
	BASI	IS FOR MOD	ELLING						
Zone based on surface lin	eaments.		-						
Outcrops:	-								
Boreholes: -									
Tunnels:	-								
Lineament and/or	MFM3519.								
seismic indications:						3			
	MODE	ELLING PRO	CEDURE						
-									
ZEMNW3519 ZEMNW3511									
0	1 :	2		);	4 km	462			

WNW	ZFN	/WNW3	3519	Version number	4	Total object CL	13			
OBJECT CONFIDENCE ESTIMATE										
Category		Object CL	Comment							
INTERPRETATION										
Data source		1	MFM3519.							
Results of interpretation	n	3	High confid	dence in lineament M	IFM3519					
INFORMATION DENSIT	Y									
Number of observation	1 points	1	1							
Distribution of observation points		1	Single observation point in the form of a lineament.							
INTERPOLATION			•							
Geometry		1	Geometry supported by surface geophysical data.							
Geological indicators		1	Indirect support by geophysical data.							
EXTRAPOLATION										
Dip direction		2	Extrapolated to the base of the model volume. Strike length of the							
		3	modelled zone > 2000 m.							
Strike direction			Supported by geological concept and partly by surface lineament.							
FRACTURE CHARACTER										
No data available										
INDIVIDUAL INTERCEPT	S									
No data available										

WNW	ZFMWNW3520		Version number	4	Total object CL	13		
GEOLOGICAI	CHARACTER	Property CL	155000 160000	) 16	5000 170,000			
Deformation style: Deformation description:	No data available No data available. Zone based on lineament maps in the catchment		6710000	×	P	6710000		
	area.		8 22	/	V ~ 12			
Alteration:	Not choosed	-	~~~ es	1	(MM)	2000		
- First order:	Not observed	-	5	1 7	HU IX	67(		
- Second order:	Not observed	-	1. 1.	- V	ATTA 3			
Fracture orientation	No data available.		00000	X	XIN 3	00000		
Fracture comment:	No data available.		67	1 All	W/ V/	670		
Fracture fill	No data available.			AD	XX /	_		
mineralogy:				A	NY			
OBJ	ECT GEOMETRY		1 here 2000	WXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	M	2000		
Strike/dip:	121°/90°		699	111	XI	9699		
Length:	14739 m			14V	the man	U U		
Mean thickness:	65 m (50 - 200 m)		24		2 12			
Max depth:	-2100 m		8	1	how	000		
Geometrical	Topo 40m grid Max error 2	0m. 2	0055	V	•V-	006		
constraints:	Surface Planar Cut(s).		8			66		
			155000 160000	) 165	000 170000	1991		
			Model volume DMS Baseline		0 2 4 8	X		
	DAG							
Zone based on surface lin	eaments.		ELLING					
	1							
Outcrops:	-							
Boreholes: -								
Tunnels:	-							
Lineament and/or	MFM3520.					2		
seismic indications:						_		
-	MODE	LLING PRO	CEDURE					
5000	~~>				- M			
85	$\sim$							
0								
in the second								
ZFMWNW3520								
100,200,300 500 m 1 km 2 km								
D. Color C.								

WNW	ZFN	/WNW3	3520	Version number	4	Total object CL	13	
OBJECT CONFIDENCE ESTIMATE								
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM3520.					
Results of interpretation	on	2	Medium co	onfidence in lineamer	nt MFM35	520.		
INFORMATION DENSIT	Υ							
Number of observation	n points	1	1					
Distribution of observe	1	Single observation point in the form of a lineament.						
INTERPOLATION								
Geometry		1	Geometry supported by surface geophysical data.					
Geological indicators		1	Indirect support by geophysical data.					
EXTRAPOLATION								
Dip direction		0	Extrapolated to the base of the model volume. Strike length of the					
		3	modelled zone > 2000 m.					
Strike direction		2	Conceptual understanding of the site and that the entire regional				onal	
	3	modelled zone is supported by the lineament.						
	FRACTURE CHARACTER							
			No data avai	lable				
INDIVIDUAL INTERCEPT	S							
No data available								

WNW	ZFMWNW3538		Version number	4	Total object CL	13
GEOLOGICA	CHARACTER	Property CL	155000 16000	0 16	5000 170000	
Deformation style:	No data available		8			0
Deformation	No data available. Zone		1000		~	000
description:	based on lineament		2	T	man 17	671
••••	maps in the catchment		{	Y	1 12	
	area.		$\sim$		1 hull 2	-
Alteration:			000		/ / / / 2	2 8
- First order:	Not observed		2200	1 -	SIN NA	105
- Second order:	Not observed		a the	1	THIN S	include C
- Third order:	Not observed		2.11	$\checkmark$	AHA NE	
Fracture orientation	No data available.		00	XAX	VII 1 15	00
and type:					AVI S	000
Fracture comment:	No data available.		6	ASA)	K V	67
Fracture fill	No data available.			TALL		
mineralogy:			· / / //	AL	AV7	0
OBJ	ECT GEOMETRY		9	and	VY	500
Strike/dip:	114°/90°		66	2016		669
Length:	6587 m			19X	An man	
Mean thickness:	40 m (15 - 64 m)			/	I I inner	
Max depth:	-2100 m		000	X	War	0000
Geometrical	Topo 40m grid Max error 2	20m,	2690	~ \		10690
constraints:	ZFMNNW0806, 1 Surface	Planar	Ű			U
	Cut(s).				1	10.00
			155000 160000	0 16	5000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		AT Last textpoor Constant spoor was	<u>N</u>
	BASI	IS FOR MOD	DELLING			
Zone based on surface lin	eaments.					
Outenance						
Outcrops:	-					
Borenoles						
Tunnels:	-					
Lineament and/or	MFM3538					
seismic indications:						2
	MODE	ELLING PRO	CEDURE			
-						
TEMMINEIDS TEMINEIDS TEMINE						
ZFM	MAN ALSO				V	

WNW	ZFN	/WNW3	3538	Version number	4	Total object CL	13	
OBJECT CONFIDENCE	STIMATE					•		
		-	-					
Category		Object CL	Comment					
INTERPRETATION								
Data source		1	MFM3538.					
Results of interpretation	on	2	Medium co	nfidence in lineamen	t MFM35	538.		
INFORMATION DENSIT	Υ							
Number of observation	n points	1	1					
Distribution of observa	1	Single observation point in the form of a lineament.						
INTERPOLATION								
Geometry	1	Geometry supported by surface geophysical data.						
Geological indicators		1	Indirect support by geophysical data.					
EXTRAPOLATION								
Dip direction			Extrapolated to the base of the model volume. Strike length of the					
·		3	modelled zone > 2000 m.					
Strike direction		0	Conceptual understanding of the site and that the entire regional					
	3	modelled zone is supported by the lineament.						
		•	•					
FRACTURE CHARACTER								
No data available								
INDIVIDUAL INTERCEPT	S							
No data available								

WNW	ZFMWNW3	571	Version number	6	Total object CL	13
GEOLOGICAI	L CHARACTER	Property	155000 160000	) 16	5000 170000	
Deformation atula:	No data available	UL UL				
Deformation	No data available Zone		0000		~	0000
description:	hased on lineament		0	. 5	~~	5710
description.	maps in the catchment		- [		VI M	
	area		$\sim$	1	1 LJ E	_
Alteration:			8 5	1-	11/ 12	1 8
- First order:	Not observed		mr 2050	1 1	XXXX	1050
- Second order:	Not observed		io R	1-1	THU IS	67
- Third order:	Not observed		2	X	ALLA SA	
Fracture orientation	No data available.		8	AN C		0
and type:			82		KU/ S	0000
Fracture comment:	No data available.		60 2 60	ASA -	WI VI	671
Fracture fill	No data available.			2RIV	XXI	-
mineralogy:			· / KOlles	SE	AV Y	-
OBJ	ECT GEOMETRY		1 1 200	Mrs<	N	200(
Strike/dip:	109°/90°		669	211	X	699
Length:	4879 m			14 Y	As where	
Mean thickness:	35 m (15 - 64 m)		St V		2 / J manue	1
Max depth:	-2100 m		000	X	how	000
Geometrical	Topo 40m grid Max error 2	20m,	059	~ /		069
constraints:	ZFMNE0808A, ZFMNW08	05A, 1	°			9
	UNIVERSE Planar Cut(s).				1	10.000
			155000 160000	) 16	5000 170000	
			Model volume DMS		0 2 4 8	Ň
			Baseline		Constructions Constructions for	N
	BASI	IS FOR MOD	ELLING			
Zone based on surface lin	eaments.					
Outcrops:	-					
Boreholes: -						
Tunnels	-					
Lineament and/or	MEM3571 MEM3551					
seismic indications:						2
	MODE	ELLING PRO	CEDURE			
-						
		ő				10
						12
a			Sai			
0			2			
•						
80						
	0					
he some	<ul> <li></li></ul>				The second se	06
58 11 2 .			TENANA/NINA/2571			
5			FINIANIAASSI			
× ×	SI					
In //	C					
125	31					
				٥	957	
201	2 <sup>ZEMNW0805A</sup>	EF	ANNUAL STREET	th.		
e r	1 200			11112000	88 mm	
			V ) Marine V			
Sel los						2
0	1) ( 2			- 4	km/	
						7
				1		
	a o m		AX D	1		

WNW	ZFN	/WNW3	8571	Version number	6	Total object CL	13				
<b>OBJECT CONFIDENCE E</b>	STIMATE			•							
			-								
Category		Object CL	Comment								
INTERPRETATION											
Data source		1	MFM3571,	MFM3551, Northern	most par	t of MFM3551.					
Results of interpretation	on	2	Medium co	onfidence in lineamer	t MFM35	71 and MFM3551.					
INFORMATION DENSIT	Υ										
Number of observation	n points	1	2	2							
Distribution of observe	1	Single observation point in the form of a lineament.									
INTERPOLATION											
Geometry	1	Geometry supported by surface geophysical data.									
Geological indicators		1	Indirect support by geophysical data.								
EXTRAPOLATION											
Dip direction		-	Extrapolated to the base of the model volume. Strike length of the								
		3	modelled zone > 2000 m.								
Strike direction		0	Conceptua	I understanding of th	e site and	d that the entire region	onal				
	3	modelled zone is supported by the lineament.									
FRACTURE CHARACTER											
No data available											
INDIVIDUAL INTERCEPT	S										
No data available											

WNW		ZFMWNW8042				number	7 <sup>Tota</sup>	I object CL	17
GEO	LOGICAL CH	ARACTER	Pro	perty	155000	160000	165000	170000	
Deformation sty	le: Brittle			<u>→∟</u> ੨	0				0
Deformation Sty	No data	available		5	000		~		0000
description:	No date				671	2	2	, seened	671
Alteration:						$\langle \cdot \rangle$		The second	1
- First order:	Oxidatio	on		-	and the second s	$\sim$		MI	2
- Second order:	Chloritiz	zation		3	0000	5 -	11	1 F L	5 000
- Third order:	Not obs	served			2029	~ /	A	N IN	3705
Fracture	Steeply	dipping WNW f	racture		- the	1	-//H	1 2	10.00.00.00
orientation and	set. Do	minance of oper	า		5	11	XAH	PA No	
type:	fracture	s. Sealed fractu	res		8 1		X	$  \land  $	5 00
	and sea	aled fracture net	works		200	V. Ale	XIA		000
	are pres	sent.			°		XYX	JY	9
Fracture comme	ent: No data	a available.				XSAM	HAN	$\sim$	
Fracture fill	Predom	ninant fracture m	inerals		8	1 All		/	0
mineralogy:	in open	fractures are ch	llorite,		950	-464		{	9500
	OXIDIZE	d walls, laumont	ite,		66	1 11	50	2	66
		and clay mineral	s anu			1 19	1	And services	
	calcite		ionine,		0			J Harrison	0
	OBJECT								
Strike/dip:	298°/88								699
Length:	524 m	524 m							
Mean thickness	: 8 m (2 -	8 m (2 - 36 m) 155000 165000							20.5
Max depth:	-520 m	,							N
Geometrical	Topo 40	Om grid Max erro	or 20m,		Baseling	olume DMS		0 2 4 km	A
constraints:	ZFMEN	IE3135, ZFMEN	E3115,						
	ZFMWN	NW0835, 1 Surfa	ace Planar Cut	t(s).					
			BASIS FOR	MODE	ELLING				
Zone based on s	urface lineame	ents and borehol	e observations	S.					
Outcrops:	-								
Boreholes:	·								
		Target i	ntercept	(	Geometric	intercept			
Borenole	PDZ	Sec_up [m]	Sec_low [m]	Sec	_up [m]	Sec_low [m]	Comme	ent	
KFR105	DZ3	170.80	176.00	1	68.63	177.71	_		
KFR121	DZ4	289.80	303.00	2	90.74	302.88			
I UNNEIS:	-	0040							
seismic	Dr MSFRU	MSFR08042. 2							
The position of th	e zone at the	around surface	is based on ma		lineament	MSER08042	(SER mode	l version 1 0	) with a
further extension	to the WNW to	o allow terminati	on at ZFMFNF	E3115	The zone	thickness is b	ased on the	borehole int	ercepts
of KFR105 and K	FR121 and th	e dip is based o	n linkina the lir	neamer	nt to the bo	rehole interce	epts. Forwar	d modelling	of
magnetic data alo	ong profiles 12	and 44 support	s the vertical c	lip and	limited thic	kness of the	zone, while	inversion mo	delling
suggests a very steep dip to the north-east (see Appendix 6 in Curtis et al. 2011).									

WNW	ZFM	WNW80	Version number 7 Total object CL 17					
		в кение кение 8042 26менена 30 стр	251111108054 251111108054 4670 7570 7570 7570 7570 7570 7570 7570 7					
		OBJECT						
Category		Object CL	Comment					
INTERPRETATION								
Data source		2	MSFR08042, Inferred continuation to the WNW to allow termination					
		_	at ZFMENE3115 and intersections in KFR121, KFR105.					
Results of interpre	etation	3	High confidence observation in KFR121 and KFR105.					
INFORMATION DENSITY		0						
Number of observation points		2	3 Two subsurface abconvetion points, swanly distributed					
Distribution of observation points		2	Two subsurface observation points, eveniy distributed.					
Geometry			Geometry supported by two subsurface observation points and					
Geometry		2	partly surface lineament					
Geological indicators		2	Some discrepancies in the geological data.					
EXTRAPOLATION		_						
Dip direction		0	Extrapolation in dip direction supported by two subsurface obs.					
		2	point. Strike length of the modelled zone < 2000 m.					
Strike direction		2	Partly support by surface lineament. Supported by geological					
		_	concept and subsurface observation points.					
		FRAC						
Orientation:	Set WNW: 302	0°/89.4°						
(strike/dip right-	Set ENE: 264.3	°/78.4°	N					
hand-rule)			the task					
Frequency:	Boreholes: KFR	105, KFR121						
		TEDZACU						
	TYPE							
		P10	/ •. • *					
	Open and	11.0 m-1						
	partly open							
	Sealed	7.3 m-1						
	Sealed	65.7 % of	W E					
	network	DZ intereent						
	Crush	1 1 % of D7						
	Ciusii	intercept						
		interoopt						
			Equal area					
			Lower hemisphere					
			<ul> <li>Unassigned (60)</li> <li>Set WNW (53)</li> <li>▲ Mean pole Set WNW (212 0/0 6) Fisher к = 11.0</li> </ul>					
			<ul> <li>Set ENE (66) Δ Mean pole Set ENE (174.3/11.6) Fisher κ = 15.0</li> </ul>					
RQD:	min:29, max:10	0, mean:83						





SKB is responsible for managing spent nuclear fuel and radioactive waste produced by the Swedish nuclear power plants such that man and the environment are protected in the near and distant future.

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