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Boremap mapping of telescopic drilled borehole KFM08C

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Abstract

This report presents the results from the Boremap logging of telescopic drilled borehole KFM08C. The borehole is located at the western shore of Asphällsfjärden, SE of the Forsmark nuclear power plant, and plunges 60° towards NE. The main purpose for the location of this borehole was to provide geological data for the northeastern part of the potential repository. The borehole penetrates, moreover, rock domain 32, which largely coincides with the boundary of the site investigation area. The full length of KFM08C is 951.08 metres. The BIPS-image usable for mapping covers the interval 102.23–949.09 metres after length adjustment. All intersected structures and lithologies have been documented in detail by integrating information from the drill core and the BIPS-image. The lowermost metres of the drill core were mapped in Boremap without any complementary BIPS-image.

KFM08C is drilled in the northeastern part of the site investigation area, towards a belt of mainly aplitic material, which defines the northeastern margin rock domain 29. The predominant rock type in the borehole is a medium-grained metagranite, similar to that found in the previously drilled deep boreholes in the site investigation area. Extensive intervals variably affected by intense albitization occur at 342–547 and 603–617 metres length. The alteration has locally rendered the recognition of the protolith almost impossible, though the affected intervals are inferred to consist of medium-grained metagranite with subordinate occurrences of aplitic metagranite. The ferromagnesian phases in this interval are mostly dominated by hornblende instead of biotite, which predominates elsewhere in the borehole. Other frequent rock units within the borehole, none forming occurrences more than a few metres in length, include amphibolites, pegmatitic granites and fine- to medium-grained metagranitoids. Virtually all rocks in the borehole have experienced Svecofennian etamorphism under amphibolite facies conditions. Up to about three metres wide intervals of a vuggy, syenitic rock, formed as a result of selective quartz dissolution, sporadically occur in the length interval 455–532 metres.

Structurally, KFM08C is characterized by composite tectonic L-S fabrics, with a general predominance of the foliation component. Totally 27 narrow zones of more intense ductile and brittle-ductile deformation have been registered in the borehole. The majority is less than one decimetre wide and more or less parallel with the local tectonic foliation.

The total number of fractures registered *outside crush zones and sealed networks* during the Boremap-logging of KFM08C amounts to 4,204. Of these are 623 open, 56 partly open and 3,525 sealed. In addition, there are 49 sealed networks and four breccias (or brecciated intervals) registered in the mapped interval. The total length of all sealed networks in KFM08C amount to 7.8 metres. Chlorite and calcite are the most frequent fracture filling minerals found in KFM08C. A typical mineral assemblage, in fractures inferred to be sealed, consists of consists of adularia together with calcite, chlorite, hematite and locally quartz, epidote and/or pyrite. Laumontite occurs rather sparsely relative to other deep boreholes in the area. Minerals largely restricted to open fractures include clay minerals, as well as minor apophyllite, asphalt, Fe- hydroxide and analcime. Pyrite is spread rather equally between open and sealed fractures.

Sammanfattning

Föreliggande rapport redovisar resultaten från Boremapkarteringen av teleskopborrhål KFM08C. Borrhålet är beläget på västra stranden av Asphällsfjärden, SO om Forsmark kärnkraftverk, och stupar 60° mot NO. Det huvudsakliga syftet med borrhålets placering var att ge geologisk data för den nordöstra delen av det potentiella slutförvaret. Borrhålet penetrerar dessutom bergartsdomän 32, vilken i stora drag sammanfaller med begränsningen av undersökningsområdet. Den totala längden av KFM08C är 951,08 meter och den BIPS-bild som är användbar för kartering täcker intervallet 102,23–949,09 meter, efter längdjustering. Alla strukturer och litologier i det Boremap-karterade intervallet har dokumenterats i detalj genom att integrera information från borrkärnorna och BIPS-bilderna. De understa metrarna av borrhålet är dock karterade med Boremap utan kompletterande BIPS-bild.

KFM08C har borrats i nordöstra delen av undersökningsområdet, mot ett stråk av huvudsakligen aplitiskt material, som definierar nordöstra begränsningen av bergartsdomän 29. Den dominerande bergarten i borrhålet är en medelkornig metagranit, av samma typ som den som påträffats i övriga djupa kärnborrhål i undersökningsområdet. Betydande intervall som i varierande utsträckning genomgått albitisering förekommer på 342–547 och 603–617 meters längd. Ställvis är det i det nära nog omöjligt att urskilja ursprungsbergarten, men de påverkade intervallen består av vad som förefaller vara medelkornig metagranit med underordnade mängder aplitisk metagranit. De mafiska mineralen i dessa intervall utgörs huvudsakligen av hornblände istället för biotit, som i övrigt dominerar i borrhålet. Andra bergartsenheter i borrhålet, av vilka inga överskrider ett fåtal meter i borrhålslängd, omfattar amfiboliter, pegmatitiska graniter och fin- till medelkorniga metagranitoider. Största delen av berggrunden i området har genomgått Svekofennisk amfibolitfacies-metamorfos. Upp till ungefär tre meter breda sektioner av en porös, syenitisk bergart, som bildats genom selektiv kvartsupplösning, förekommer sporadiskt i längdintervallet 455–532 meter.

Strukturellt karaktäriseras KFM08C av en sammansatt L-S struktur, med en generellt dominerande tektonisk foliation. Totalt 27 mindre zoner med mer intensiv plastisk och spröd-plastisk deformation har registrerats i borrhålet. Flertalet är mindre än en decimeter breda och mer eller mindre parallella med den lokala tektoniska foliationen.

Det totala antalet sprickor som registrerats och *inte ingår i krosszoner eller läkta spricknätverk* vid Boremapkarteringen av KFM08C uppgår till 4 204. Av dessa är 623 öppna, 56 partiellt öppna och 3 525 läkta. Dessutom har 49 läkta spricknätverk och fyra breccior (eller breccierade intervall) registrerats i det karterade intervallet. Den totala längden av de läkta spricknätverken uppgår till 7,8 meter. Klorit och kalcit är de överlägset vanligaste sprickmineralen i KFM08C. En typisk mineralassociation, som vanligtvis uppträder i sprickor som bedömts vara läkta, utgörs av adularia tillsammans med kalcit, klorit, hematit, samt lokalt kvarts, epidot och/eller pyrit. Laumontit förekommer relativt sparsamt jämfört med andra djupa borrhål i området. Mineral som till största delen är begränsade till öppna sprickor är lermineral, samt mer sällan apofyllit, bergbeck, Fe-hydroxid och analcim. Förekomsten av pyrit är förhållandevis jämt fördelad mellan läkta och öppna sprickor.

Contents

1 Introduction

Since 2002, SKB investigates two potential sites at Forsmark and Oskarshamn, for a deep repository for spent nuclear fuel in the Swedish Precambrian basement. In order to characterise the bedrock down to a depth of about 1 km in the central part of the Forsmark site investigation area, three deep, sub-vertical boreholes were drilled. After completion of these initial drillings, SKB launched a more extensive, complementary drilling programme, aiming to solve more specific geological issues. An important aspect is to provide geological data for the northeastern area of the potential repository. To obtain such information, borehole KFM08C was drilled at the western shore of Asphällsfjärden, southeast of the Forsmark nuclear power plant, with 60° inclination towards northeast (036°) (Figure 1-1). The borehole has a total length of about 951 metres.

The drilling activities in KFM08C were finished 9 May 2006, and the geological logging of the borehole started 20 June and ended 31 August 2006.

A detailed geological logging of the drill cores obtained through the drilling programs is essential for subsequent sampling and borehole investigations, and consequently, for the three-dimensional modelling of the site geology. For this purpose, the so-called Boremap system has been developed. The system integrates results from geological drill core logging, or alternatively, the drill cuttings, when a core is not available, with information from BIPS-logging (Borehole Image Processing System) and calculates the absolute position and orientation of fractures and various planar lithological features (SKB MD 143.006 and 146.005).

This document reports the results gained by the geological logging of KFM08C, which is one of the activities performed within the site investigation at Forsmark. The work was carried out in accordance with activity plan AP PF 400-06-058. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Boremapkartering av teleskopborrhål KFM08C	AP PF 400-06-058	1.0
Method documents	**Number**	**Version**
Instruktion: Regler för bergarters benämningar vid platsundersökningen i Forsmark	SKB MD 132.005	1.0
Metodbeskrivning för Boremap-kartering	SKB MD 143.006	2.0
Nomenklatur vid Boremap-kartering	SKB MD 143.008	1.0
Mätsystembeskrivning för Boremapkartering, Boremap v. 3.0	SKB MD 146.005	1.0

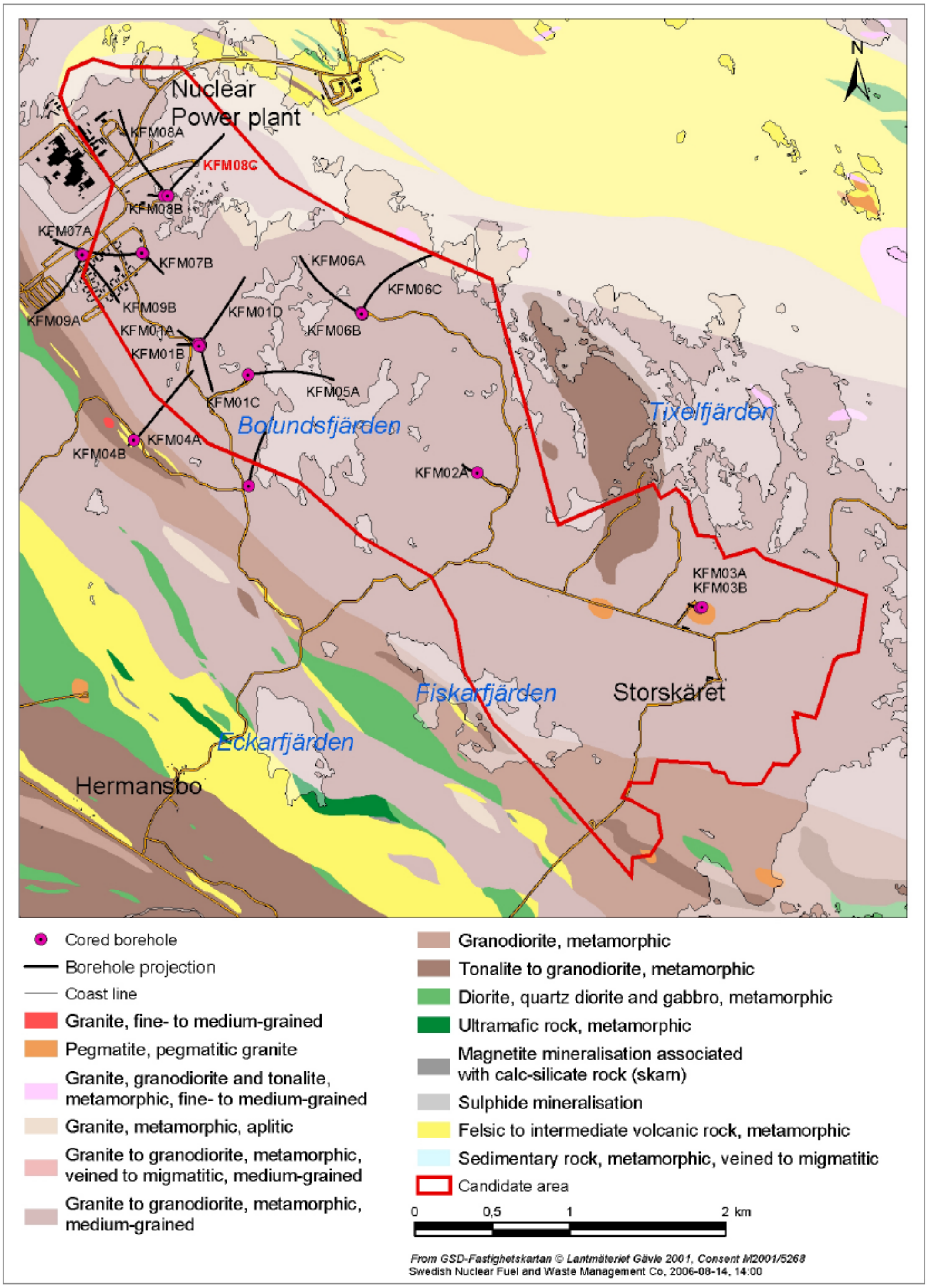

Figure 1-1. *Generalized geological map over Forsmark site investigation area and the projection of KFM08C in relation to other cored boreholes in the drilling programme.*

2 Objective and scope

The bedrock starts at 3.41 metres length in borehole KFM08C. The borehole starts with percussion drilling to a length of 100.48 metres, followed by core drilling at Ø = 86.0 mm to a length of 102.23 metres, and at Ø = 77.3 mm down to full its length at 951.08 metres. The diameters of the drill cores are 70 and 51 mm, respectively, under ideal conditions. Only the part drilled at Ø = 77.3 mm was included in the mapping engagement and the BIPS-image usable for geological logging covers the length interval 102.23–948.15 metres (after adjustment 102.23–949.09 metres). Thus, remaining part of the drill core, from 948.15 to 949.56 metres (after adjustment 949.09–950.50 metres), was mapped in Boremap without any complementary BIPS-image.

The aim of the geological borehole logging is to obtain a detailed documentation of *all* structures and lithologies in the interval that was core drilled at Ø = 77.3 mm. These data will serve as a platform for forthcoming analyses of the drill cores, aimed at investigating geological, petrophysical and mechanical aspects of the rock volume, as well as site descriptive three-dimensional modelling.

3 Equipment

3.1 Description of equipment/interpretation tools

All BIPS-based mapping was performed in Boremap v. 3.754. This software contains the bedrock and mineral standard used by the Geological Survey of Sweden (SGU) for geological mapping of the surface at the Forsmark site investigation area, to enable correlation with the surface geology. Additional software used during the course of the geological logging was BIPS Viewer v. 1.10 and Microsoft Access. The final data presentation was made by Geoplot and WellCAD v. 3.2.

The following equipment was used to facilitate the core logging: folding rule, concentrated hydrochloric acid diluted with three parts of water, unglazed porcelain plate, knife, hand lens, paintbrush and tap water.

4 Execution

4.1 General

During the core logging, the 850 metres drill core obtained from the interval 100.48–951.08 metres of KFM08C was available in its full length on roller tables in the core-mapping accommodation at Forsmark (the Llentab hall, near the SKB/SFR-office). The BIPS-based mapping of KFM08C was preceded by an overview mapping made by Kenneth Åkerström. No thin-sections were available from the drill cores, and all lithological descriptions are based on ocular inspection. Most of the mapping was done by two geologists at a time, forming a core logging team. One of the geologists did the core logging while the other registered the information in Boremap.

The core logging of KFM08C was performed in Boremap v. 3.754 according to activity plan AP PF 400-06-058 (SKB internal document) following the SKB method description/instruction for Boremap mapping, SKB MD 143.006 (v. 2.0) and 143.008 (v. 1.0). However, the generalised geophysical logs arrived after the geological mapping of the borehole was finished. The use of these logs was, therefore, limited to a few lithological ambiguities that remained after the mapping.

A WellCAD summary of the mapping is presented in Appendix 1.

4.2 Preparations

The length registered in the BIPS-image deviates from the true borehole length with increasing depth, and the difference at 950 metres borehole length of KFM08C is about 9 decimetres. It was, therefore, necessary to adjust the length in KFM08C with reference to groove millings cut into the borehole wall at every 50 metres. The deepest slot was cut at 900 metres length, though slots at 650, 700, 850 and 900 metres were not detected in the BIPS-image. The precise level of each reference mark can be found in SKB's database SICADA (Appendix 4). However, the adjusted length is still not completely identical with the one given in the drill core boxes, as the core recovery may yield erroneous lengths. The difference does never exceed 1 decimetre in the upper half and 3 decimetres in the lower half of the borehole. *All borehole lengths given in this report are adjusted with reference to the groove millings.*

Data necessary for calculations of absolute orientation of structures in the borehole includes borehole diameter, azimuth and inclination, and these data were imported directly from SKB's database SICADA (Appendices 2 and 3).

4.3 Data handling

To obtain the best possible data security, the mapping was performed on the SKB intranet, with regular back-ups on the local drives.

In order to avoid that some broken fractures had not been registered, the number of broken fractures in the drill core was regularly checked against the number of registered fractures. The quality routines include also daily controls of the mapping by detailed examination of Boremap generated variable/summary reports and WellCad log to match. The final quality check of the mapping was done by a routine in the Boremap software. The primary data were subsequently exported to the SKB database SICADA, where they are traceable by the activity plan number.

4.4 Analyses and interpretations

A problem with the Boremap system is that certain geological features (mainly fractures) only can be observed in the drill core. This problem usually arises from poor resolution in the BIPS-image, which in the present case often is caused by the occurrence of suspension from drilling and/or brownish black coating from the drilling rods on the borehole walls (see Section 4.5). However, even in the most perfect BIPS-image, it is sometimes difficult to distinguish a thin fracture, sealed by a low contrast mineral. All fractures observed in the drill core, but not recognized in the BIPS-image, have been registered as 'not visible in BIPS' in Boremap, to prevent them from being used in forthcoming fracture orientation analysis. If possible, they are still oriented relative to other structures with known orientations. Fractures supposed to be induced by the drilling activities fall within this category. Obviously drilling-induced fractures are not included in the mapping.

The resolution of the BIPS-image does generally make it possible to estimate the width of fractures with an error of ± 0.5 mm. Thus, reliable measurements of fracture widths/apertures less than 1 millimetre are possible to obtain in the drill core. The minimum width/aperture given is therefore 0.5 mm, in accordance with the nomenclature for Boremap mapping (SKB MD 143.008; v. 1.0).

The fracture mapping focuses on the division into broken and unbroken fractures, depending on whether they are parting the core or not. Broken fractures include both open fractures and originally sealed fractures, which were broken during the drilling or the following treatment of the core. To decide if a fracture was open, partly open or sealed in the rock volume (i.e. in situ), SKB has developed a confidence classification expressed at three levels, 'possible', 'probable' and 'certain', on the basis of the weathering of the fracture surface and fit of the fracture planes. The criteria for this classification are given in SKB method description for Boremap mapping, SKB MD 143.006 (v. 2.0).

Up to four infilling minerals can be registered in the database for each fracture. As far as possible, they are given in order of decreasing abundance in the fracture. Additional minerals (i.e. five or more), which occur in a few fractures, are noted in the attached comment. However, it must be emphasized that this provides no information of the volumetric amount of individual minerals. In a fracture with two minerals, the mineral registered as 'second mineral' may range from sub-microscopic staining up to amounts equal to that of the mineral registered as 'first mineral'. Hematite, for example, occur consistently as extremely thin coatings or impurities in other fracture minerals, such as adularia and laumontite.

Drill induced crushes have been registered at the following intervals in KFM08C: 431.87–432.00, 457.35457.69, 523.46–523.97 and 830.16–830.27 metres adjusted length. Furthermore, there are two intervals of core loss at 107.50–107.51 and 456.25–457.35 metres adjusted length.

4.5 Nonconformities

A few fractures within KFM08C are sealed by laumontite (Ca-zeolite). These fractures occur as both broken and unbroken, but dehydration of laumontite tends to produce volumetric changes, and the sealing will eventually crackle and break the drill core. Thus, laumontite-bearing fractures suspected to have been sealed originally are registered as unbroken.

Some fracture filling minerals are more conspicuous than other. For example, the distinct red tinting shown by sub-microscopic hematite reveals extremely low concentrations of the mineral. Also the use of diluted hydrochloric acid for identification of calcite makes it possible to detect amounts that are macroscopically invisible. The amount of fractures filled with other less conspicuous minerals may, on the other hand, be underestimated. Pyrite, which typically forms up to millimetre-sized, isolated crystals, might for example be underrepresented in unbroken fractures.

As in previous cored boreholes, the mapping of KFM08C was locally hampered by brownish black coatings on the borehole. However, suspended drill cuttings that may have a quality-reducing effect on the BIPS-images from some of the previous boreholes are virtually absent in KFM08C. The dark coating occurs throughout the borehole and forms typically a distinct spiral pattern or a single band along the borehole axis. The spiral pattern is more frequent in the upper parts of the borehole, whilst the axis parallel band predominates towards depth. Locally, it obscures more than half of the borehole wall. Orientations registered for geological structures (e.g. fractures) in these intervals may, consequently, differ greatly from the actual orientations. This coating phenomenon is obviously drill induced, and the explanation proposed is that the coatings originate from metal fragments abraded from the drill rods.

Both during the mapping and the subsequent work with mapping data from this and other boreholes in the drilling programme, we have noted a few inexplicable errors in the databases. These were all corrected, though there might still be unnoticed errors. We disclaim the responsibility for all errors caused by the shortcomings in the software.

5 Results

5.1 Lithology

5.1.1 General

Borehole KFM08C is located in the northeastern part of the site investigation area and plunges 60° northeastward, towards a belt of mainly aplitic material, which is equivalent to rock domain 32 and defines the northeastern margin of the tectonic lens that make up rock domain 29 /cf SKB 2005/. The predominant rock type in KFM08C is a medium-grained metagranite (rock code 101057), which also prevails in the previously drilled boreholes located in rock domain 29. An extensive interval that has been variably affected by intense albitization occurs at 342.2–546.5 metres adjusted length. The predominant rock in this interval is the medium-grained metagranite (rock code 101057), though some sections of the interval evidently consist of an aplitic metagranite (rock code 101058). However, the alteration has locally rendered the recognition of the protolith almost impossible and whether the precursor was aplitic or medium-grained is therefore uncertain. Interestingly, the ferromagnesian phases in this interval are mostly dominated by hornblende instead of biotite, which predominates elsewhere in the borehole. Another major interval affected by intense albitization is found between 603.5 and 616.8 metres adjusted length. Other frequent rock units in the borehole, none forming occurrences more than a few metres in length, include amphibolites (rock code 102017), pegmatitic granites (rock code 101061) and fine- to medium-grained metagranitoid (rock code 101051) of granodioritic to tonalitic composition. Except for a few minor late veins or dykes, all rocks have experienced Svecofennian metamorphism under amphibolite facies conditions.

5.1.2 Rock types

The medium-grained metagranite (rock code 101057) is typically granitic with a tendency to be slightly granodioritic. Texturally, the rock is rather equigranular with elongated quartz domains, alternating with feldspar-dominated domains and thin streaks of biotite. The colour of the rock ranges from greyish red to grey. Minor intervals speckled by fine-grained, whitish plagioclase occur sporadically along the borehole. The general impression is that the feature is related to static recrystallization. Microscopic examination of similar rocks from KFM01A and KFM03A suggests that it is a result of retrograde sericitization /Petersson et al. 2004/.

In some sections, especially in contact with amphibolite occurrences and within the two abovementioned intervals at 342.2–546.5 and 603.5–616.8 metres adjusted length, the medium-grained metagranite is variably bleached and characterised by flecks of biotite/hornblende aggregates. This bleaching has also affected virtually all major occurrences of aplitic metagranite. The overall appearance of this bleaching is highly reminiscent of the albitized rock in the lower part of KFM06A and outcrops along the northeastern margin of the investigation site /cf Petersson et al. 2005ab/. Bleached intervals were, therefore, mapped as 'albitized'. The distinction between the aplitic and medium-grained metagranite in the most intensely affected intervals is, in this interval generally based on the textural distribution of the ferromagnesian minerals. However, the original magmatic textures are normally masked or locally even obliterated in the intensely affected intervals. The separation of the two rock varieties is therefore more or less impossible in some intervals. However, intensely albitized rocks that fulfil *at least one* of the following criteria have been registered as medium-grained metagranite (rock code 101057): (1) the typical domain-like texture of alternating quartz and feldspar with thin streaks of ferromagnesian phases, (2) a content of ferromagnesian phases that broadly correspond to that of the apparently unaffected medium-grained metagranite, and (3) a grain-size ranging up to finely medium-grained. Otherwise, the rocks are registered as aplitic metagranite (rock code 101058). The relative intensity of the albitization is mainly based on the degree of whiteness of the feldspars for 'faint' to 'weak' intensities, and the textural changes for 'medium' to 'strong' intensities.

Dykes, veins and segregations of pegmatite and pegmatitic granite are frequent throughout KFM08C. Most occurrences are some decimetre or less, but several pegmatites/pegmatitic granites exceed a few metres in borehole length. The most extensive occurrences of pegmatitic granite occur at 333.8–340.3 and 731.4–736.5 metres adjusted length. The pegmatitic granites are generally texturally heterogeneous, often with a highly variable grain-size, and some occurrences include intervals of finely medium-grained, equigranular granite. Rather coarse magnetite and/or hornblende, up to about one centimetre in diameter, have been identified in some pegmatites. Various sulphides, primarily pyrite, are found more rarely. Despite the textural variability and temporal span within this unit, most of these rocks were grouped as 'pegmatite, pegmatitic granite' (rock code 101061).

Amphibolites (rock code 102017) occur sporadically throughout KFM08C. Except for a major occurrence at 304.3–311.4 metres adjusted length, individual occurrences range up to 2.6 metres in borehole length. Generally, the amphibolites are fine-grained, equigranular with a large proportion of biotite. A ca 3 centimetres wide occurrence of hornblendite (coded as 101004: 'metamorphic ultramafic rock') occurs at 545.35–545.38 metres adjusted length. Extensions and contacts of the amphibolites are more or less parallel with the tectonic fabric. Some occurrences are surrounded by up to one decimetre wide rims of bleached wall rock, inferred to be the result of albitization, as discussed above.

A few occurrences of fine- to medium-grained metagranitoids (rock code 101051) of mostly granodioritic to tonalitic composition occur sporadically below 355 metres length in KFM08C. Individual occurrences range up to 3.4 metres in borehole length. These rocks are equigranular, locally slightly porphyritic and ranges from grey to reddish grey in colour. The mineral fabric is commonly linear and external contacts are typically discordant to the tectonic foliation in the wall rock. A hornblende-rich, albitized rock inferred to belong to this group form several occurrences in the length interval 355.5–377.4 metres. This is noteworthy since another occurrence of the rock, at 472.6–474.9 metres adjusted length, appears to be unaffected by the alteration. Eleven minor occurrences (< 0.8 metre) of a fine- to medium-grained granite (rock code 111058), which locally is highly reminiscent of the fine-to medium-grained metagranitoid, are found in the borehole. A distinctive criterion apart from their granitic composition and late-tectonic character is their anomalously high natural gamma radiation relative to the granodioritic to tonalitic metagranitoids /cf Mattsson and Keisu 2006/. The most extensive occurrence occurs at 78.00–82.08 metres adjusted length. The other four occurrences are less than 5 decimetre in borehole-length.

The occurrence of skarn-like material (rock code 108019) is generally concentrated into three shorter intervals (116.84–117.17, 311.36–312.40 and 752.96–756.02 metres adjusted length), where it occurs in intimate association with metagranite that has been variably affected by albitization. Contacts toward the surrounding albitized metagranite are typically vaguely defined or gradual. Individual occurrences are distinguished by their visible content of epidote-mantled hornblende. Other frequent components are quartz, whitish feldspar and magnetite.

Intermediate rocks of inferred volcanic origin (rock code 103076) form as minor occurrences mainly restricted to three intervals: 703.66–704.46, 788.75–790.15 and 858.44–858.61 metres adjusted length. The rock is generally equigranular, dark grey in colour and all contacts are parallel with the tectonic fabric. Except for one of the occurrences, which exhibits a fine-scaled banding, they are all structureless and there are no textural or structural macroscopic feature that unambiguously points towards a volcanic origin of the rocks.

In addition, there are a few minor occurrences of granite, granodiorite, and quartz diorite in KFM08C. None of them appears to fit into the bedrock nomenclature defined by SKB MD 132.005. Instead they were coded as 1058 (unspecified granite), 1056 (unspecified granodiorite) and 1038 (unspecified quartz diorite). Quartz-dominated segregations or veins were coded as 8021. An aplite found at 269.61–269.64 metres adjusted length, which appears unaffected by the fabric development, was coded as 1062.

5.2 Ductile structures

Most rocks in KFM08C are characterized by composite tectonic L-S fabrics, with a general predominance of the foliation component. However, there are intervals with a more distinct mineral lineation. The most extensive occurs 325–430 and 547–604 metres length. Some of the pegmatitic granites, the fine- to medium-grained metagranitoid (rock code 101051) and the fine to medium-grained granite (rock code 111058) are post-tectonic with respect to the main tectonic foliation, and are hence massive or show only a weak mineral lineation.

The intensity of the tectonic fabric in KFM08C is mostly weak to medium, and more rarely faint or strong. It must, however, be emphasized that the distinctness of a fabric does not necessarily reflect the intensity of the strain. The fact that a rock may appear massive not always implicate that they actually are unaffected by strain. It is, for example, often difficult to distinguish tectonic fabric visually in the pegmatitic granites and some of the fine-grained mafic rocks. Furthermore, most rocks have undergone varying degrees of static recrystallization. The structural orientation in KFM08C changes gradually towards depth, from a steep, SSE striking foliation in the upper 270 metres to more moderately dipping, VNV striking foliation, which predominates the lower 500 metres of the borehole (Figures 5-1 and 5-2). This is consistent with the location of the borehole in the hinge zone of a major fold structure. Linear fabrics have been impossible to register with the present methodology, but the general impression is that they are gently to moderately dipping.

Totally 27 narrow zones of more intense ductile and brittle-ductile deformation have been registered in KFM08C. Twenty of them are registered as ductile shear zones and seven as brittle-ductile shear zone. The zones occur sporadically throughout KFM08C, with a concentration in the length interval 792–892 metres. The borehole length of individual zones is typically less than one decimetre, though the maximal recorded length is 1.06 metre. The protolith in these, often highly deformed and grain-size reduced zones, seems mainly to be the medium-grained metagranite (rock code 101057), but also amphibolites (rock code 102017) and a fine- to finely medium-grained metagranitoid (rock code 101051) have been affected. Except for two ductile deformation zones at 854.3–854.5 metres adjusted length, near perpendicular to the general structural trend, all shear zones in KFM08C are more or less parallel with the local tectonic foliation (Figure 5-2).

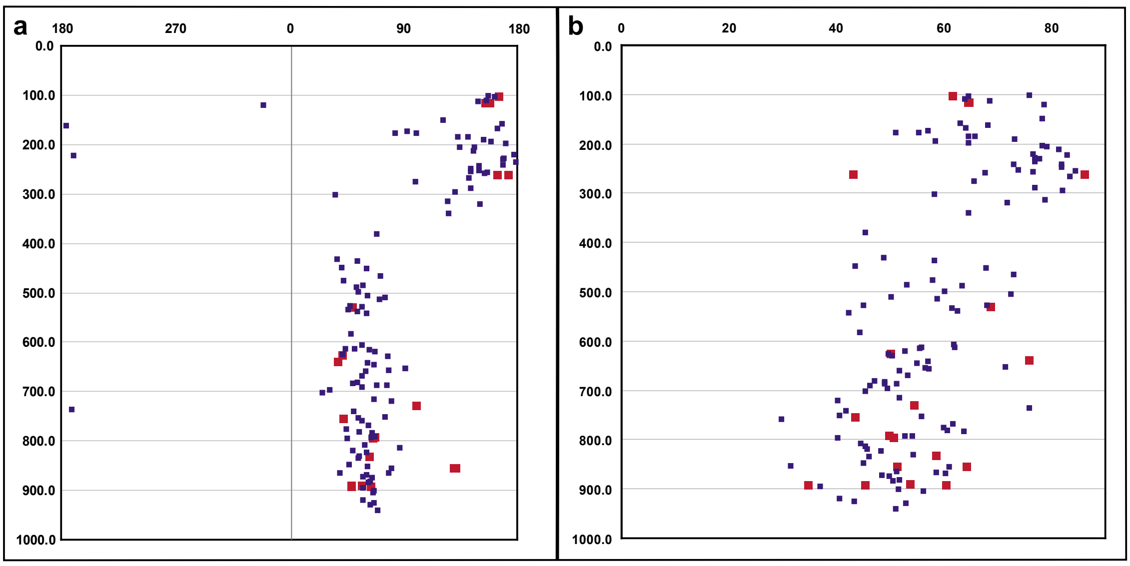

Figure 5-1. *Bivariate plots of (a) strike and (b) dip versus borehole length for foliation planes (blue symbols) as well as ductile and brittle-ductile shear zones (red symbols) mapped as "structural features" in KFM08C.*

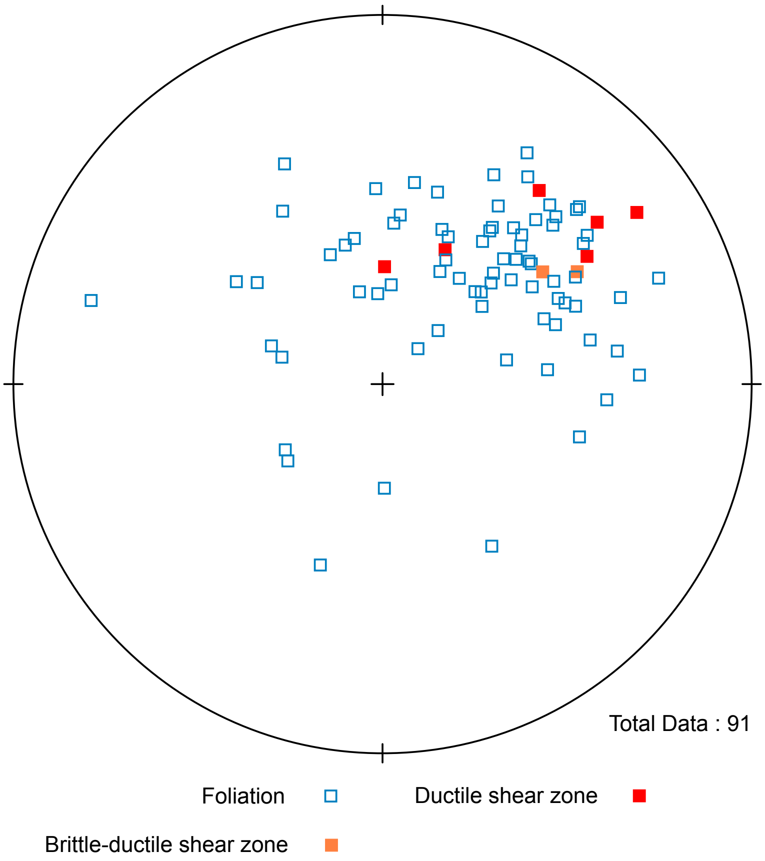

Figure 5-2. *Lower hemisphere, equal area stereographic projection showing poles to ductile structures in KFM08C.*

5.3 Alteration

Besides the albitization as discussed in Section 5.1, the most common alteration encountered in KFM08C is varying degrees of oxidation or red pigmentation of feldspars by sub-microscopic hematite. It is generally associated with more intensely fractured intervals and the most extensive intervals occur at 182–194, 438–467, 516–542 and 673–697 metres adjusted length. Totally, about 16% of the mapped interval of KFM08C has been affected by oxidation. Normally this oxidation is faint to weak in intensity, and more rarely medium. The most intense oxidation is associated with a conspicuous vuggy rock that occurs sporadically in the length interval 455–532 metres length. Individual occurrences are typically 2–3 decimetres in borehole length, though the widest reach up to 3.3 metres. An extensive occurrence of more or less identical rock occurs in KFM02A /Möller et al. 2003, Petersson et al. 2003/. According to the IUGS recommendations /Le Maitre 2002/ it should be denoted 'episyenite' as the rock apparently was formed by hydrothermal processes involving selective removal of quartz. The occurrences were, therefore, mapped as 'quartz dissolution'. The rock types affected by the alteration in KFM08C includes the medium-grained metagranite (rock code 101057), aplitic metagranite (101058) and pegmatitic metagranite (101061). The rock is typically highly porous with up to 20 vol.% vugs and the most frequent infilling minerals are calcite, quartz, adularia, chlorite and hematite. Calcite-rich intervals are marked as 'carbonatization'.

Other types of alterations within KFM08C include chloritization, epidotization and an alteration that gives the rock a slightly darker, blurry appearance (mapped as 'sassuritization' in Boremap). The chloritization is mainly restricted to amphibolites (rock code 102017), whilst the epidotization has affected three minor occurrences of pegmatitic granite (rock code 101061).

5.4 Fractures

5.4.1 Fracture frequencies and orientations

The total number of open (broken fractures with aperture > 0), partly open (unbroken fractures with aperture > 0) and sealed fractures (broken and unbroken fractures with aperture = 0) registered *outside crush zones and sealed networks* during the Boremap-logging of KFM08C amounts to 4,204, i.e. about 5.0 fractures/metres. Of these are 623 open, 56 partly open and 3,525 sealed. This separation in open, partly open or sealed fractures is made on the basis of the weathering of the fracture surface and fit of the fracture planes. It should be emphasized that there is a certain degree of uncertainty in these judgements.

In addition, there are 49 sealed networks and four breccias (or brecciated intervals) registered in the mapped interval. The distinction between breccia and sealed network is not straight forward, but normally zones with none or minor rotation of individual rock fragments has been mapped as sealed network. Significant fractures that differ markedly (e.g. in aperture or infilling mineralogy) from the majority of fractures within the sealed networks are mapped separately. The total length of all sealed networks in KFM08C amount to 7.8 metres (i.e. less than 1% of the mapped interval). The piece length (i.e. the distance between individual fractures) within these networks is typically about 1.4 cm, but ranges up to 4 cm. This makes slightly more than 500 additional sealed fractures in the mapped interval of the borehole. Breccias occur at the following lengths within KFM08C: 161.12–161.13, 330.04–330.06, 479.60–479.62 and 933.09–933.11 metres adjusted length. None of them exceed 3 centimetres in width. Except for the registered zones of breccia, there are four additional fractures with measurable displacements registered in KFM08C. This is noted in comments attached to each of these fracture.

One moderately dipping crush zone occurs at 829.94–830.02 metres adjusted length in KFM08C. The average piece length in this interval is 3 millimetres.

Throughout the borehole, the frequency of open and sealed fractures varies rather coherently, with an increased number of open fractures in intervals with concentrations of sealed fractures (Appendix 1). There are several intervals with anomalously high fracture frequencies throughout the borehole, though few of them are especially well-defined, and all are dominated by sealed fractures, some of which included in sealed fracture networks. Generally, there are five major intervals with increased fracture frequency relative to the remaining part of the borehole. The most extensive interval occurs between 419 and 542 metres adjusted length. However, the fracture frequency is highly variable within this interval. Other, less conspicuous intervals, occur at 161–191, 673–705, 829–832 and 946–949 metres adjusted length.

It is reasonable to expect that mechanical discontinuities, such as lithological contacts, should be the locus of fracture formation more frequently than within a homogeneous rock. For this reason we have noted the proportion of fractured amphibolite contacts. About 29% of the contacts in the mapped interval of KFM08C are fractured. This is in agreement with other cored boreholes in the Forsmark drilling programme, in which 22–42 % of the contacts are fractured /Petersson et al. 2006 and references therein/.

Inferred core discing occurs at the following lengths along KFM08C: 182.12, 693.60, 693.64, 694.03–694.44, 694.54, 694.60–694.79, 829.67–829.78 and 830.38–830.52 metres. Some of the core discing is initial and do not actually break the core. The maximum width of the intervals is 4 decimetres, and the typical dimension of individual discs range between 12 and 20 millimetres. The discs are all planar to slightly saddle-shaped.

5.4.2 Fracture mineralogy

Chlorite and/or calcite are found in about 70% of the total number of the registered fractures in KFM08C. Other infilling minerals, in order of decreasing abundance, include adularia, sub-microscopic hematite, quartz, epidote, laumontite, pyrite, clay minerals, and more rarely biotite, white feldspar, apophyllite (mapped as X2), unspecified sulphides, prehnite, Fe-hydroxide, asphalt, analcime (mapped as zeolite), pyrrhotite and allanite (mapped as X1). In addition, there are six fractures with unknown mineral filling. Analyses by XRD of similar material from the previously mapped cored boreholes in the area have revealed that most such filling are mineral mixtures, or in some cases, feldspars, apophyllite or analcime /Sandström et al. 2004/. There are also 140 fractures that are virtually free from visible mineral coatings. Sixty of them are sealed fractures with no *visible* mineral sealing.

The various clay minerals occur generally in open fractures. Fractures with clay minerals are found throughout the borehole, with a minor concentration in the length interval 670–694 metres. Clay minerals registered in fractures at greater depths are typically corrensite and illite, often intimately associated with chlorite. Other minerals preferably found in open and partly open fractures are apophyllite, asphalt, Fe- hydroxide and analcime. Asphalt is restricted to borehole lengths above 149 metres, whereas apophyllite and Fe-hydroxide occur more sporadically.

Sulphides are frequent in both sealed and open fractures. The presence of other sulphides than pyrite, such as pyrrhotite and 'unspecified sulphides', are rare and restricted to seven fractures.

All other minerals, as well as oxidized walls, are preferentially associated with fractures inferred to be sealed. A typical mineral assemblage, commonly found both in individual fractures and sealed fracture networks consists of adularia together with calcite, chlorite, hematite and locally quartz, epidote and/or pyrite. However, the exact assemblage is highly variable, and no fracture contains the full range of minerals. Fractures with epidote, for example, are often mono-mineralic and the majority occur in amphibolites.

Laumontite, typically associated with calcite, has only been recorded in 129 fractures, which is rather low compared to other deep boreholes in the area. Except for a few fractures around 945 metres length, they are all restricted to borehole lengths above 450 metres. A number of very thin (<< 1 mm), sealed fractures are typically only revealed by their oxidized walls. Several of these thin fractures are sealed by a mineral inferred to be hematite, but it might well be hematite-stained laumontite or adularia. This interpretation is based on the fact the hematite within KFM08C typically occurs in two main varieties: (1) thin, reddish coatings, preferentially found in flat lying fractures, and (2) staining of various silicates, such as adularia and laumontite.

White feldspar is registered in a few fractures in length interval 397–572 metres. The term is used for white or colourless adularia as well as suspected albite. Biotite is found in fractures inferred to be late-, rather than post-metamorphic throughout the borehole. These fractures are typically mono-mineralic or include minor amounts of pyrite, chlorite and/or quartz.

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SKB, 2005. Preliminary site description. Forsmark area– version 1.2. SKB R-05-18. Svensk Kärnbränslehantering AB.

Appendix 1

WellCAD image

Title	LEGEND FOR FORSMARK	KFM08C	Appendix 1

Site	FORSMARK
Borehole	KFM08C
Plot Date	2006-10-03 21:13:31
Signed data	

ROCKTYPE FORSMARK

- Granite, fine- to medium-grained
- Pegmatite, pegmatitic granite
- Granitoid, metamorphic
- Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained
- Granite, metamorphic, aplitic
- Granite to granodiorite, metamorphic, medium-grained
- Granodiorite, metamorphic
- Tonalite to granodiorite, metamorphic
- Diorite, quarts diorite and gabbro, metamorphic
- Ultramafic rock, metamorphic
- Amphibolite
- Calc-silicate rock (skarn)
- Magnetite mineralization associated with calc-silicate rock (skarn)
- Sulphide mineralization
- Felsic to intermediate volcanic rock, metamorphic
- Mafic volcanic rock, metamorphic
- Sedimentary rock, metamorphic

ROCK ALTERATION TYPE

- Oxidized
- Chloritisized
- Epidotisized
- Weathered
- Tectonized
- Sericitisized
- Quartz dissolution
- Silicification
- Argillization
- Albitization
- Carbonatization
- Saussuritization
- Steatitization
- Uralitization
- Laumontitization
- Fract zone alteration

MINERAL

- Biotite
- Epidote
- Hematite
- Calcite
- Chlorite
- Quartz
- Unknown
- Pyrite
- Sulfides
- Clay Minerals
- Laumontite
- Iron Hydroxide

STRUCTURE

- Cataclastic
- Schistose
- Gneissic
- Mylonitic
- Ductile Shear Zone
- Brittle-Ductile Zone
- Veined
- Banded
- Massive
- Foliated
- Brecciated
- Lineated

TEXTURE

- Hornfelsed
- Porphyritic
- Ophitic
- Equigranular
- Augen-Bearing
- Unequigranular
- Metamorphic

GRAINSIZE

- Aphanitic
- Fine-grained
- Fine to medium grained
- Medium to coarse grained
- Coarse-grained
- Medium-grained

STRUCTURE ORIENTATION

- Cataclastic
- Bedded
- Gneissic
- Schistose
- Brittle-Ductile Shear Zone
- Ductile Shear Zone
- Lineated
- Banded
- Veined
- Brecciated
- Foliated
- Mylonitic

ROCK ALTERATION INTENSITY

- No intensity
- Faint
- Weak
- Medium
- Strong

ROUGHNESS

- Planar
- Undulating
- Stepped
- Irregular

SURFACE

- Rough
- Smooth
- Slickensided

CRUSH ALTERATION

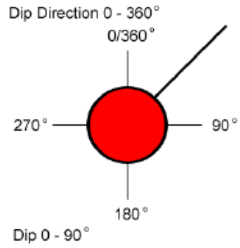
- Slightly Altered
- Moderately Altered
- Highly Altered
- Completley Altered
- Gouge
- Fresh

FRACTURE ALTERATION

- Slightly Altered
- Moderately Altered
- Highly Altered
- Completely Altered
- Gouge
- Fresh

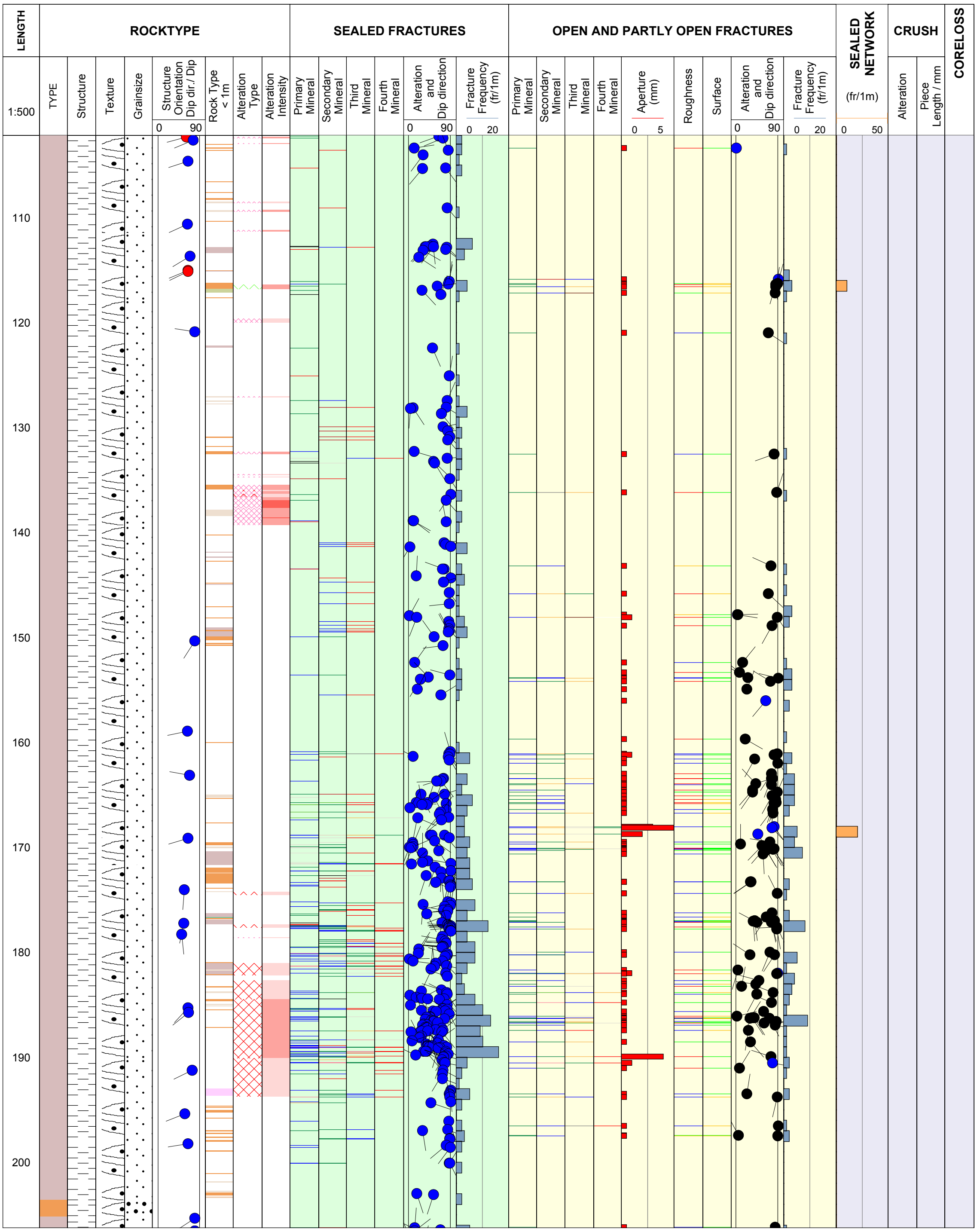
FRACTURE DIRECTION

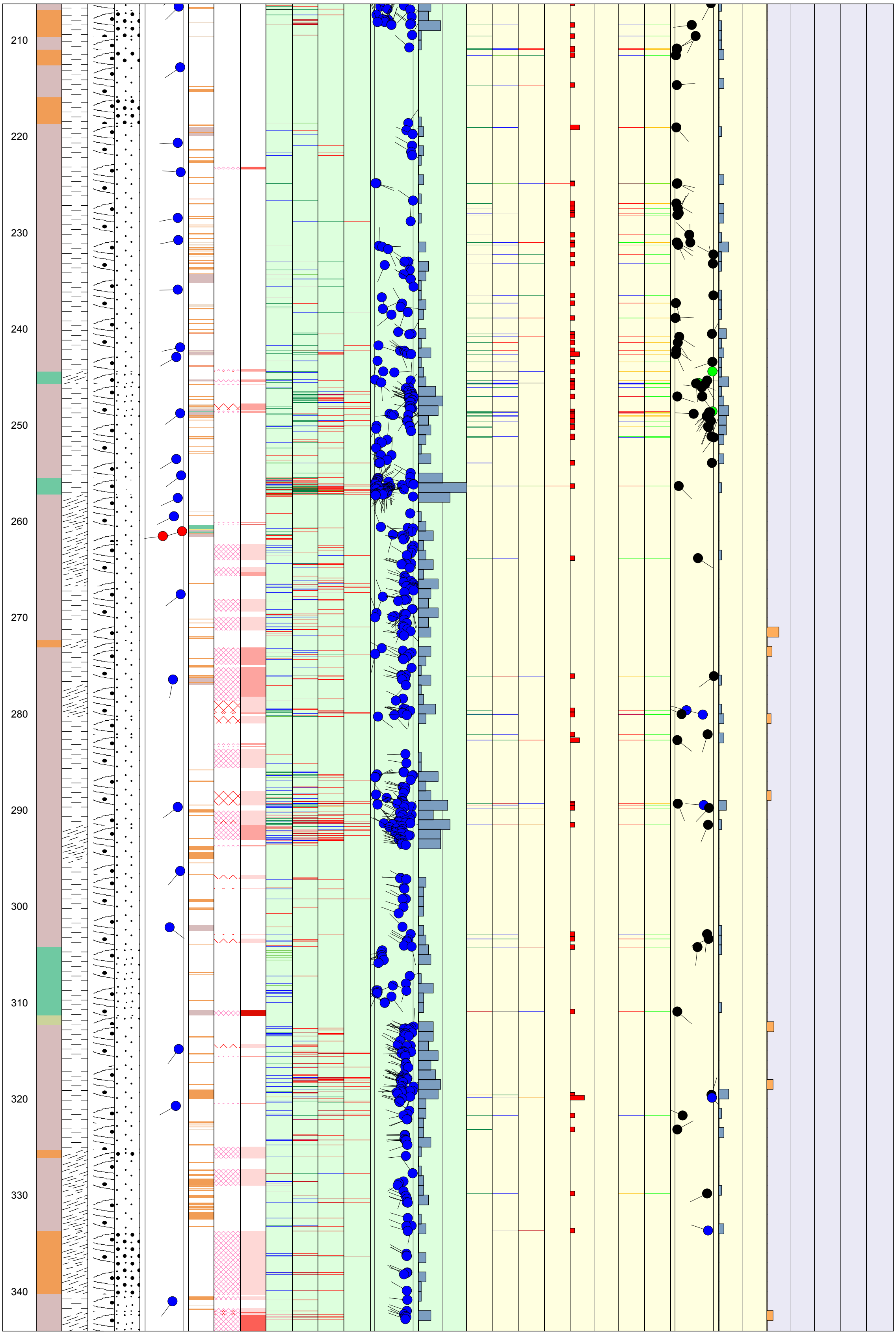
STRUKTURE ORIENTATION



Title **GEOLOGY IN KFM08C** **Appendix: 1**

Site	FORSMARK	**Coordinate System**	RT90-RHB70
Borehole	KFM08C	**Northing [m]**	6700495.88
Diameter [mm]	77	**Easting [m]**	1631187.57
Length [m]	950.500	**Elevation [m.a.s.l.]**	2.47
Bearing [°]	35.88	**Drilling Start Date**	2005-04-13 09:00:00
Inclination [°]	-60.45	**Drilling Stop Date**	2005-04-26 15:00:00
Date of coremapping	2006-06-20 15:25:00	**Plot Date**	2006-11-15 22:12:48
Rocktype data from	p_rock	**Signed data + Unsigned data**	

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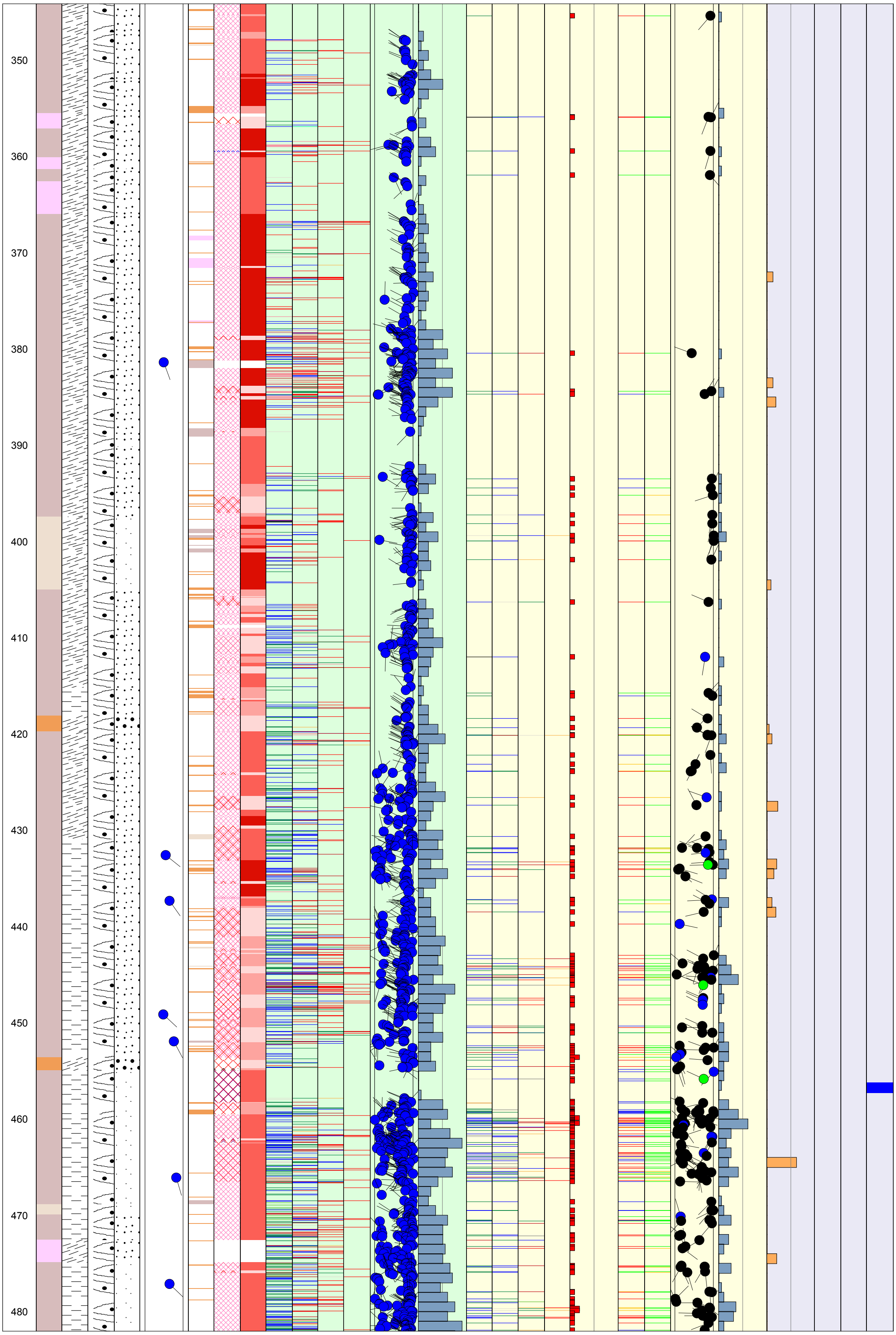
320
330
340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400
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420
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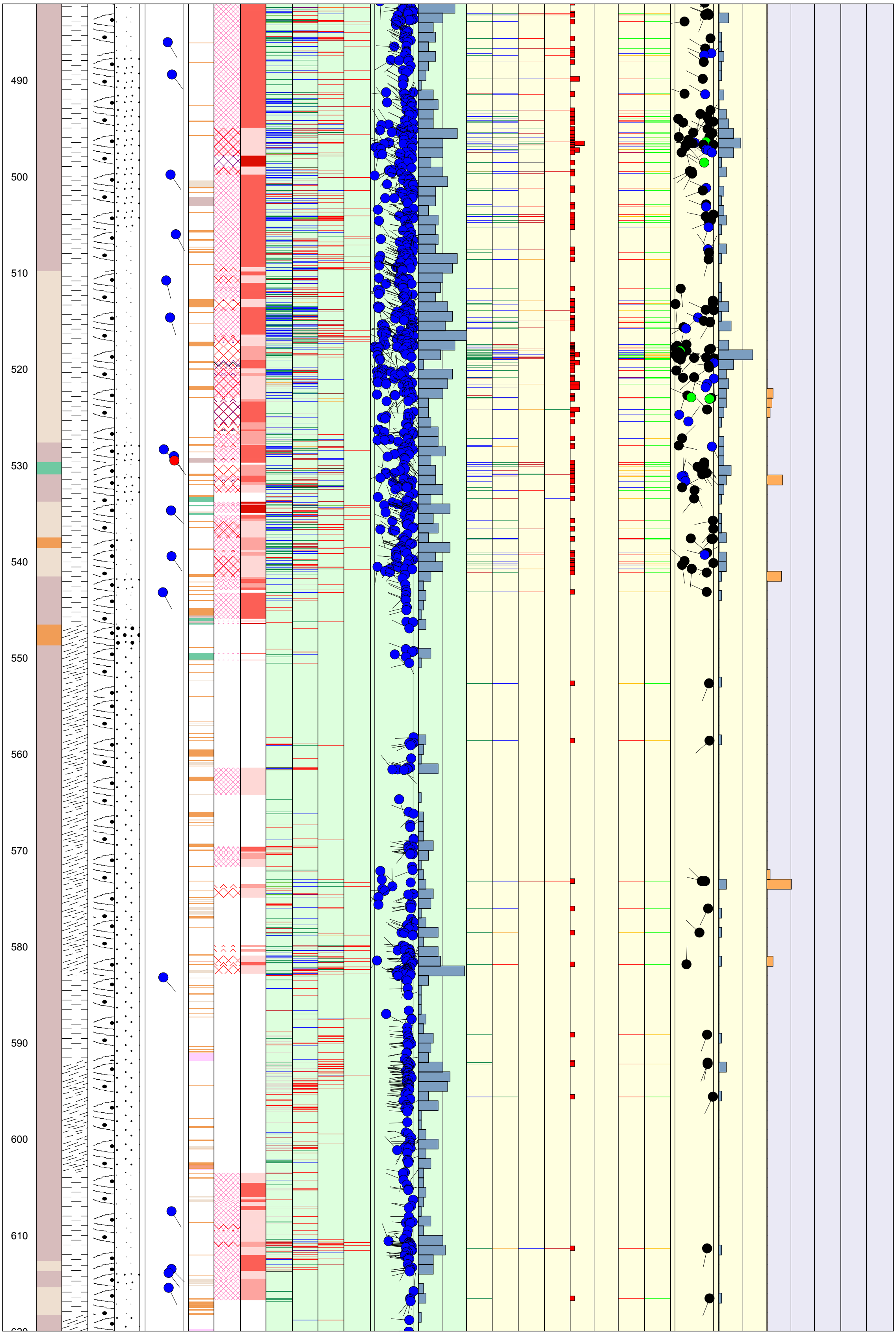
440
450
460
470
480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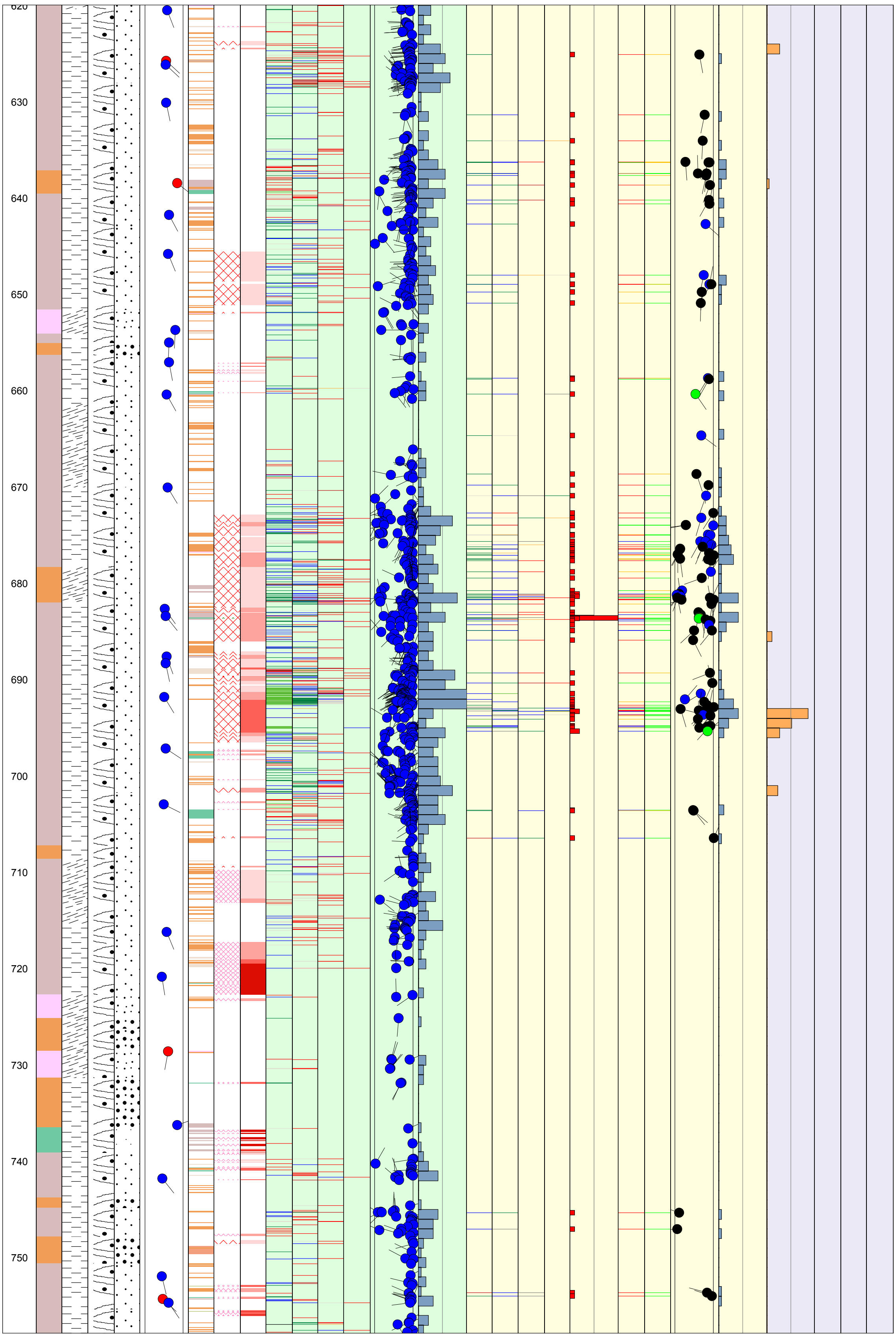
560
570
580
590
600
610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730
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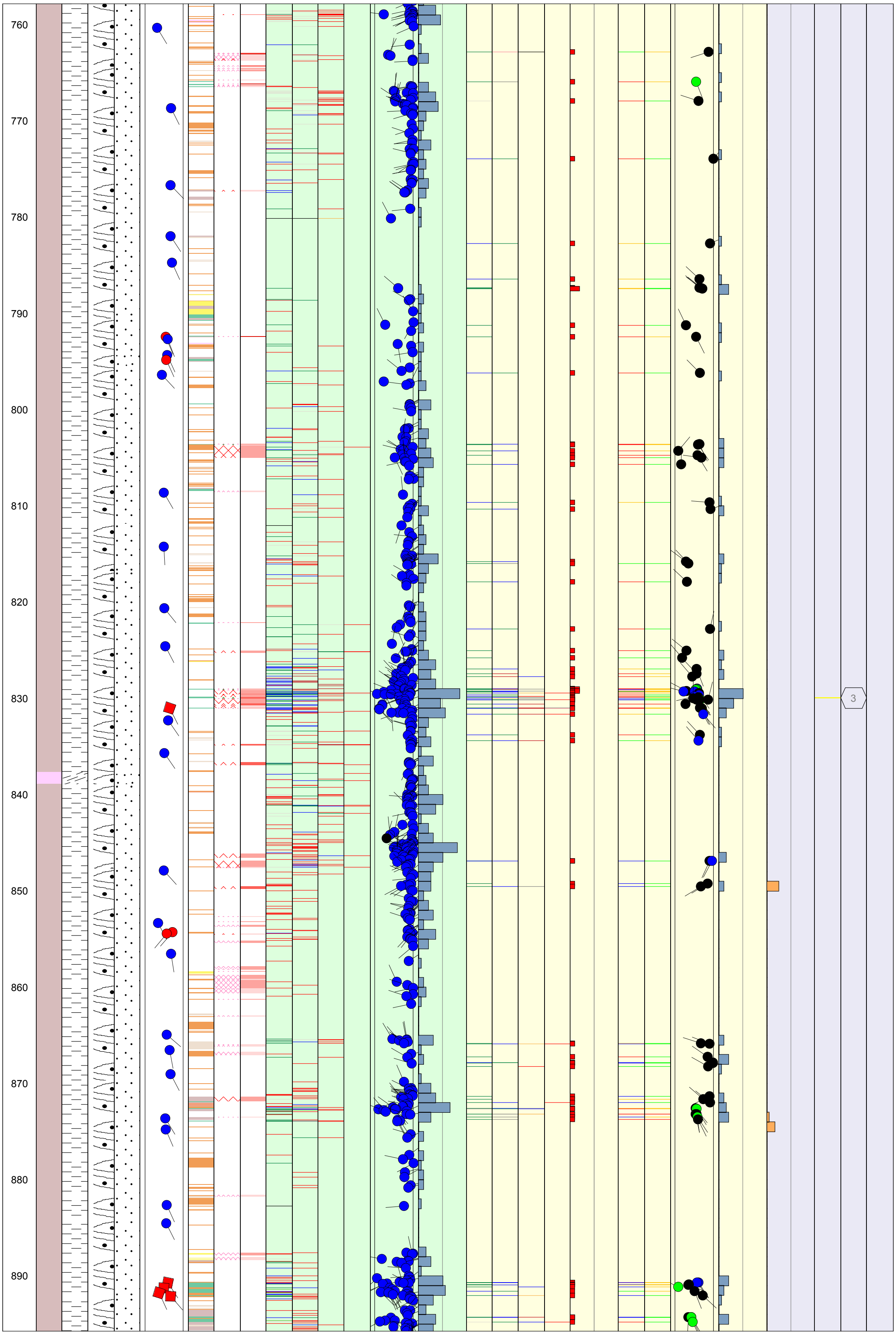
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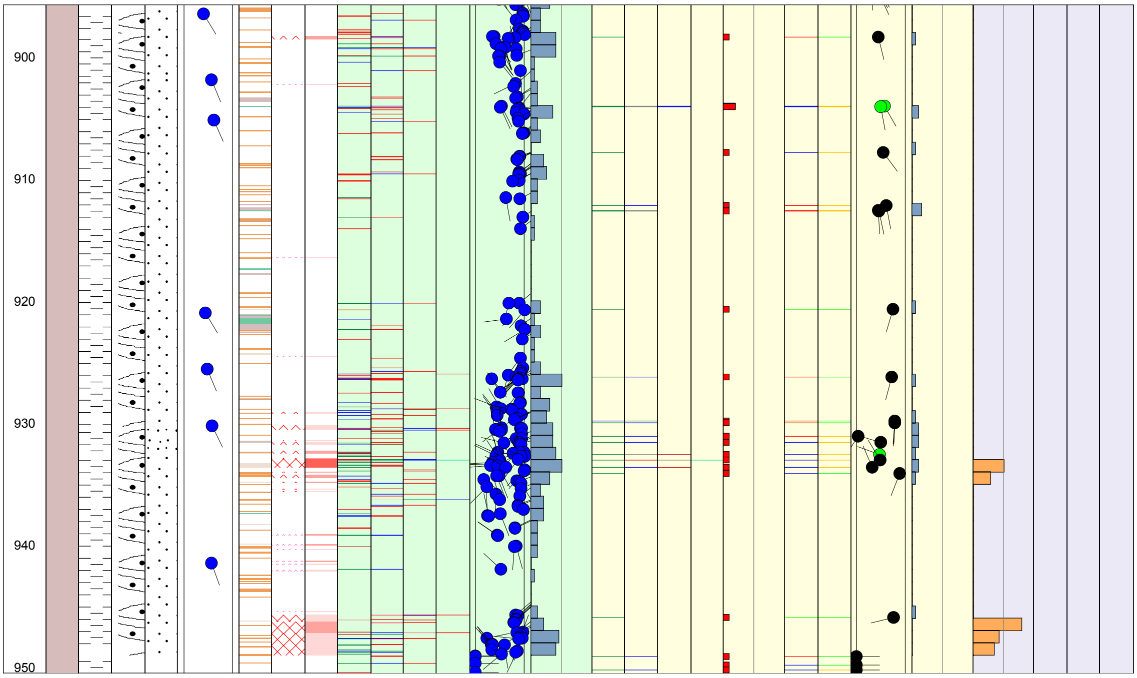
900
910
920
930
940
950

Appendix 2

Borehole diameters

Hole Diam T – Drilling: Borehole diameter

KFM08C, 2005-04-13 09:00:00 – 2005-04-26 15:00:00 (0.000–951.080 m).

Sub secup (m)	Sub seclow (m)	Hole diam (m)	Comment
0.190	12.060	0.3390	
12.060	100.300	0.1913	Krona vid start
100.300	100.480	0.1607	Krona vid borrslut
100.480	102.230	0.0860	
102.230	951.080	0.0773	

Printout from SICADA 2006-08-28 16:26:46.

Appendix 3

Downhole deviation measurements

Maxibor T – Borehole deviation: Maxibor

KFM08C, 2006-05-08 08:00:00 – 2006-05-08 16:00:00 (0.000–945.000 m).

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
0.00	6700495.88	1631187.57	–2.47	RT90-RHB70	–60.46	35.88				
3.00	6700497.07	1631188.43	0.14	RT90-RHB70	–60.46	35.88	0.0000	0.0000	0.0000	
6.00	6700498.27	1631189.30	2.75	RT90-RHB70	–60.48	35.82	1.4800	0.0000	0.0000	
9.00	6700499.47	1631190.16	5.36	RT90-RHB70	–60.42	35.73	2.9600	0.0000	0.0000	
12.00	6700500.67	1631191.03	7.97	RT90-RHB70	–60.40	35.67	4.4400	–0.0100	0.0000	
15.00	6700501.87	1631191.89	10.58	RT90-RHB70	–60.41	35.62	5.9200	–0.0100	0.0000	
18.00	6700503.08	1631192.75	13.19	RT90-RHB70	–60.41	35.55	7.4000	–0.0200	0.0100	
21.00	6700504.28	1631193.62	15.80	RT90-RHB70	–60.45	35.48	8.8800	–0.0300	0.0100	
24.00	6700505.49	1631194.47	18.41	RT90-RHB70	–60.47	35.41	10.3600	–0.0400	0.0100	
27.00	6700506.69	1631195.33	21.02	RT90-RHB70	–60.50	35.37	11.8400	–0.0500	0.0100	
30.00	6700507.90	1631196.19	23.63	RT90-RHB70	–60.49	35.32	13.3200	–0.0600	0.0100	
33.00	6700509.10	1631197.04	26.24	RT90-RHB70	–60.45	35.24	14.8000	–0.0800	0.0100	
36.00	6700510.31	1631197.89	28.85	RT90-RHB70	–60.51	35.19	16.2800	–0.0900	0.0100	
39.00	6700511.52	1631198.74	31.46	RT90-RHB70	–60.58	35.18	17.7500	–0.1100	0.0000	
42.00	6700512.72	1631199.59	34.07	RT90-RHB70	–60.61	35.12	19.2300	–0.1300	0.0000	
45.00	6700513.93	1631200.44	36.69	RT90-RHB70	–60.56	35.01	20.7000	–0.1500	–0.0100	
48.00	6700515.13	1631201.29	39.30	RT90-RHB70	–60.54	34.93	22.1700	–0.1700	–0.0200	
51.00	6700516.34	1631202.13	41.91	RT90-RHB70	–60.61	34.88	23.6500	–0.1900	–0.0200	
54.00	6700517.55	1631202.97	44.52	RT90-RHB70	–60.62	34.81	25.1200	–0.2200	–0.0300	
57.00	6700518.76	1631203.81	47.14	RT90-RHB70	–60.66	34.74	26.5900	–0.2500	–0.0400	
60.00	6700519.97	1631204.65	49.75	RT90-RHB70	–60.68	34.67	28.0600	–0.2800	–0.0500	
63.00	6700521.18	1631205.49	52.37	RT90-RHB70	–60.61	34.63	29.5300	–0.3100	–0.0600	
66.00	6700522.39	1631206.32	54.98	RT90-RHB70	–60.59	34.63	31.0000	–0.3400	–0.0700	
69.00	6700523.60	1631207.16	57.60	RT90-RHB70	–60.53	34.68	32.4700	–0.3700	–0.0700	
72.00	6700524.81	1631208.00	60.21	RT90-RHB70	–60.41	34.73	33.9500	–0.4000	–0.0800	
75.00	6700526.03	1631208.84	62.82	RT90-RHB70	–60.39	34.82	35.4300	–0.4300	–0.0800	
78.00	6700527.25	1631209.69	65.43	RT90-RHB70	–60.36	34.88	36.9100	–0.4600	–0.0700	
81.00	6700528.47	1631210.54	68.03	RT90-RHB70	–60.27	34.96	38.4000	–0.4900	–0.0700	
84.00	6700529.68	1631211.39	70.64	RT90-RHB70	–60.20	35.09	39.8800	–0.5100	–0.0600	
87.00	6700530.90	1631212.25	73.24	RT90-RHB70	–60.15	35.22	41.3700	–0.5300	–0.0400	
90.00	6700532.12	1631213.11	75.84	RT90-RHB70	–60.09	35.34	42.8700	–0.5500	–0.0300	
93.00	6700533.35	1631213.98	78.44	RT90-RHB70	–60.01	35.45	44.3600	–0.5600	–0.0100	
96.00	6700534.57	1631214.85	81.04	RT90-RHB70	–59.94	35.56	45.8600	–0.5700	0.0100	
99.00	6700535.79	1631215.72	83.64	RT90-RHB70	–59.88	35.68	47.3700	–0.5800	0.0400	
102.00	6700537.01	1631216.60	86.23	RT90-RHB70	–59.81	35.79	48.8700	–0.5900	0.0700	
105.00	6700538.24	1631217.48	88.83	RT90-RHB70	–59.72	35.87	50.3800	–0.5900	0.1100	
108.00	6700539.46	1631218.37	91.42	RT90-RHB70	–59.63	35.96	51.8900	–0.5900	0.1400	
111.00	6700540.69	1631219.26	94.01	RT90-RHB70	–59.56	36.07	53.4100	–0.5900	0.1900	
114.00	6700541.92	1631220.15	96.59	RT90-RHB70	–59.51	36.18	54.9300	–0.5800	0.2400	
117.00	6700543.15	1631221.05	99.18	RT90-RHB70	–59.45	36.27	56.4500	–0.5700	0.2800	
120.00	6700544.38	1631221.95	101.76	RT90-RHB70	–59.37	36.37	57.9800	–0.5600	0.3400	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
123.00	6700545.61	1631222.86	104.34	RT90-RHB70	–59.29	36.47	59.5000	–0.5500	0.3900	
126.00	6700546.84	1631223.77	106.92	RT90-RHB70	–59.22	36.58	61.0400	–0.5400	0.4600	
129.00	6700548.07	1631224.68	109.50	RT90-RHB70	–59.17	36.69	62.5700	–0.5200	0.5200	
132.00	6700549.30	1631225.60	112.07	RT90-RHB70	–59.12	36.80	64.1100	–0.5000	0.5900	
135.00	6700550.54	1631226.52	114.65	RT90-RHB70	–59.09	36.93	65.6500	–0.4700	0.6600	
138.00	6700551.77	1631227.45	117.22	RT90-RHB70	–59.04	37.05	67.1900	–0.4400	0.7300	
141.00	6700553.00	1631228.38	119.80	RT90-RHB70	–58.99	37.17	68.7300	–0.4100	0.8000	
144.00	6700554.23	1631229.31	122.37	RT90-RHB70	–58.94	37.27	70.2800	–0.3800	0.8800	
147.00	6700555.46	1631230.25	124.94	RT90-RHB70	–58.93	37.32	71.8200	–0.3400	0.9600	
150.00	6700556.69	1631231.19	127.51	RT90-RHB70	–58.90	37.35	73.3700	–0.3000	1.0400	
153.00	6700557.93	1631232.13	130.08	RT90-RHB70	–58.88	37.40	74.9200	–0.2600	1.1200	
156.00	6700559.16	1631233.07	132.64	RT90-RHB70	–58.90	37.48	76.4700	–0.2200	1.2000	
159.00	6700560.39	1631234.01	135.21	RT90-RHB70	–58.92	37.56	78.0200	–0.1800	1.2800	
162.00	6700561.62	1631234.96	137.78	RT90-RHB70	–58.94	37.65	79.5700	–0.1300	1.3600	
165.00	6700562.84	1631235.90	140.35	RT90-RHB70	–58.96	37.73	81.1200	–0.0800	1.4400	
168.00	6700564.07	1631236.85	142.92	RT90-RHB70	–58.97	37.81	82.6600	–0.0300	1.5200	
171.00	6700565.29	1631237.80	145.49	RT90-RHB70	–58.99	37.88	84.2100	0.0200	1.6000	
174.00	6700566.51	1631238.75	148.06	RT90-RHB70	–58.99	37.94	85.7500	0.0700	1.6700	
177.00	6700567.73	1631239.70	150.64	RT90-RHB70	–58.98	38.01	87.3000	0.1300	1.7500	
180.00	6700568.94	1631240.65	153.21	RT90-RHB70	–58.96	38.09	88.8400	0.1900	1.8300	
183.00	6700570.16	1631241.61	155.78	RT90-RHB70	–58.95	38.18	90.3900	0.2500	1.9000	
186.00	6700571.38	1631242.56	158.35	RT90-RHB70	–58.95	38.26	91.9300	0.3100	1.9800	
189.00	6700572.59	1631243.52	160.92	RT90-RHB70	–58.94	38.34	93.4800	0.3700	2.0600	
192.00	6700573.81	1631244.48	163.49	RT90-RHB70	–58.93	38.43	95.0300	0.4400	2.1400	
195.00	6700575.02	1631245.44	166.06	RT90-RHB70	–58.91	38.52	96.5700	0.5100	2.2200	
198.00	6700576.23	1631246.41	168.63	RT90-RHB70	–58.90	38.60	98.1200	0.5800	2.3000	
201.00	6700577.44	1631247.37	171.19	RT90-RHB70	–58.90	38.68	99.6700	0.6500	2.3800	
204.00	6700578.65	1631248.34	173.76	RT90-RHB70	–58.90	38.78	101.2200	0.7300	2.4600	
207.00	6700579.86	1631249.31	176.33	RT90-RHB70	–58.89	38.90	102.7600	0.8100	2.5400	
210.00	6700581.07	1631250.29	178.90	RT90-RHB70	–58.86	39.02	104.3100	0.8900	2.6200	
213.00	6700582.27	1631251.26	181.47	RT90-RHB70	–58.83	39.13	105.8600	0.9700	2.7000	
216.00	6700583.48	1631252.24	184.03	RT90-RHB70	–58.83	39.22	107.4100	1.0600	2.7800	
219.00	6700584.68	1631253.22	186.60	RT90-RHB70	–58.85	39.30	108.9600	1.1500	2.8700	
222.00	6700585.88	1631254.21	189.17	RT90-RHB70	–58.85	39.39	110.5100	1.2400	2.9500	
225.00	6700587.08	1631255.19	191.74	RT90-RHB70	–58.84	39.47	112.0600	1.3400	3.0300	
228.00	6700588.28	1631256.18	194.30	RT90-RHB70	–58.83	39.53	113.6100	1.4400	3.1100	
231.00	6700589.48	1631257.17	196.87	RT90-RHB70	–58.84	39.60	115.1600	1.5400	3.1900	
234.00	6700590.67	1631258.16	199.44	RT90-RHB70	–58.87	39.69	116.7100	1.6400	3.2800	
237.00	6700591.87	1631259.15	202.01	RT90-RHB70	–58.90	39.76	118.2500	1.7400	3.3600	
240.00	6700593.06	1631260.14	204.57	RT90-RHB70	–58.94	39.83	119.8000	1.8400	3.4300	
243.00	6700594.25	1631261.13	207.14	RT90-RHB70	–58.95	39.91	121.3400	1.9500	3.5100	
246.00	6700595.43	1631262.12	209.71	RT90-RHB70	–58.93	39.99	122.8900	2.0600	3.5900	
249.00	6700596.62	1631263.12	212.28	RT90-RHB70	–58.92	40.08	124.4300	2.1700	3.6600	
252.00	6700597.80	1631264.11	214.85	RT90-RHB70	–58.93	40.17	125.9800	2.2800	3.7400	
255.00	6700598.99	1631265.11	217.42	RT90-RHB70	–58.94	40.24	127.5200	2.4000	3.8200	
258.00	6700600.17	1631266.11	219.99	RT90-RHB70	–58.92	40.28	129.0600	2.5200	3.8900	
261.00	6700601.35	1631267.11	222.56	RT90-RHB70	–58.90	40.33	130.6100	2.6400	3.9700	
264.00	6700602.53	1631268.12	225.13	RT90-RHB70	–58.86	40.39	132.1500	2.7600	4.0500	
267.00	6700603.71	1631269.12	227.70	RT90-RHB70	–58.81	40.46	133.7000	2.8800	4.1300	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
270.00	6700604.89	1631270.13	230.27	RT90-RHB70	–58.78	40.54	135.2500	3.0000	4.2100	
273.00	6700606.08	1631271.14	232.83	RT90-RHB70	–58.75	40.64	136.8000	3.1300	4.2900	
276.00	6700607.26	1631272.15	235.40	RT90-RHB70	–58.72	40.73	138.3500	3.2600	4.3800	
279.00	6700608.44	1631273.17	237.96	RT90-RHB70	–58.74	40.80	139.9000	3.3900	4.4600	
282.00	6700609.62	1631274.19	240.52	RT90-RHB70	–58.81	40.86	141.4500	3.5200	4.5500	
285.00	6700610.79	1631275.20	243.09	RT90-RHB70	–58.89	40.92	143.0000	3.6600	4.6300	
288.00	6700611.96	1631276.22	245.66	RT90-RHB70	–58.93	40.98	144.5400	3.8000	4.7100	
291.00	6700613.13	1631277.24	248.23	RT90-RHB70	–58.94	41.07	146.0900	3.9300	4.7800	
294.00	6700614.30	1631278.25	250.80	RT90-RHB70	–58.92	41.17	147.6300	4.0700	4.8500	
297.00	6700615.46	1631279.27	253.37	RT90-RHB70	–58.90	41.26	149.1700	4.2200	4.9300	
300.00	6700616.63	1631280.29	255.94	RT90-RHB70	–58.90	41.34	150.7100	4.3600	5.0100	
303.00	6700617.79	1631281.32	258.51	RT90-RHB70	–58.92	41.41	152.2500	4.5100	5.0800	
306.00	6700618.95	1631282.34	261.07	RT90-RHB70	–58.94	41.47	153.8000	4.6600	5.1600	
309.00	6700620.11	1631283.37	263.64	RT90-RHB70	–58.93	41.54	155.3400	4.8100	5.2300	
312.00	6700621.27	1631284.39	266.21	RT90-RHB70	–58.92	41.61	156.8800	4.9600	5.3000	
315.00	6700622.43	1631285.42	268.78	RT90-RHB70	–58.91	41.69	158.4200	5.1200	5.3800	
318.00	6700623.59	1631286.45	271.35	RT90-RHB70	–58.91	41.75	159.9600	5.2700	5.4500	
321.00	6700624.74	1631287.48	273.92	RT90-RHB70	–58.91	41.81	161.5000	5.4300	5.5200	
324.00	6700625.90	1631288.52	276.49	RT90-RHB70	–58.90	41.86	163.0400	5.5900	5.6000	
327.00	6700627.05	1631289.55	279.06	RT90-RHB70	–58.90	41.91	164.5800	5.7500	5.6700	
330.00	6700628.20	1631290.59	281.63	RT90-RHB70	–58.93	41.97	166.1200	5.9200	5.7500	
333.00	6700629.36	1631291.62	284.20	RT90-RHB70	–58.96	42.05	167.6600	6.0800	5.8200	
336.00	6700630.50	1631292.66	286.77	RT90-RHB70	–58.99	42.13	169.2000	6.2500	5.8900	
339.00	6700631.65	1631293.69	289.34	RT90-RHB70	–59.01	42.21	170.7400	6.4100	5.9600	
342.00	6700632.79	1631294.73	291.91	RT90-RHB70	–59.02	42.30	172.2700	6.5800	6.0300	
345.00	6700633.94	1631295.77	294.48	RT90-RHB70	–59.04	42.39	173.8100	6.7600	6.0900	
348.00	6700635.08	1631296.81	297.06	RT90-RHB70	–59.06	42.48	175.3400	6.9300	6.1600	
351.00	6700636.21	1631297.85	299.63	RT90-RHB70	–59.09	42.58	176.8700	7.1100	6.2200	
354.00	6700637.35	1631298.90	302.20	RT90-RHB70	–59.12	42.68	178.4000	7.2900	6.2900	
357.00	6700638.48	1631299.94	304.78	RT90-RHB70	–59.13	42.76	179.9300	7.4700	6.3500	
360.00	6700639.61	1631300.99	307.35	RT90-RHB70	–59.14	42.82	181.4600	7.6600	6.4100	
363.00	6700640.74	1631302.03	309.93	RT90-RHB70	–59.16	42.89	182.9900	7.8400	6.4700	
366.00	6700641.87	1631303.08	312.50	RT90-RHB70	–59.20	42.96	184.5100	8.0300	6.5200	
369.00	6700642.99	1631304.12	315.08	RT90-RHB70	–59.23	43.04	186.0400	8.2200	6.5800	
372.00	6700644.11	1631305.17	317.66	RT90-RHB70	–59.26	43.11	187.5600	8.4100	6.6300	
375.00	6700645.23	1631306.22	320.24	RT90-RHB70	–59.29	43.19	189.0800	8.6000	6.6900	
378.00	6700646.35	1631307.27	322.82	RT90-RHB70	–59.31	43.24	190.6000	8.8000	6.7400	
381.00	6700647.46	1631308.32	325.40	RT90-RHB70	–59.33	43.31	192.1200	8.9900	6.7900	
384.00	6700648.58	1631309.37	327.98	RT90-RHB70	–59.35	43.39	193.6400	9.1900	6.8300	
387.00	6700649.69	1631310.42	330.56	RT90-RHB70	–59.36	43.47	195.1600	9.3900	6.8800	
390.00	6700650.80	1631311.47	333.14	RT90-RHB70	–59.39	43.51	196.6700	9.5900	6.9300	
393.00	6700651.91	1631312.52	335.72	RT90-RHB70	–59.42	43.54	198.1800	9.8000	6.9700	
396.00	6700653.01	1631313.57	338.30	RT90-RHB70	–59.45	43.56	199.7000	10.0000	7.0100	
399.00	6700654.12	1631314.62	340.89	RT90-RHB70	–59.47	43.59	201.2100	10.2000	7.0500	
402.00	6700655.22	1631315.67	343.47	RT90-RHB70	–59.49	43.62	202.7200	10.4100	7.0900	
405.00	6700656.32	1631316.73	346.06	RT90-RHB70	–59.51	43.65	204.2300	10.6100	7.1300	
408.00	6700657.43	1631317.78	348.64	RT90-RHB70	–59.52	43.68	205.7400	10.8200	7.1700	
411.00	6700658.53	1631318.83	351.23	RT90-RHB70	–59.54	43.70	207.2400	11.0300	7.2100	
414.00	6700659.63	1631319.88	353.81	RT90-RHB70	–59.56	43.72	208.7500	11.2300	7.2400	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
417.00	6700660.72	1631320.93	356.40	RT90-RHB70	–59.57	43.74	210.2600	11.4400	7.2800	
420.00	6700661.82	1631321.98	358.99	RT90-RHB70	–59.58	43.74	211.7600	11.6500	7.3100	
423.00	6700662.92	1631323.03	361.57	RT90-RHB70	–59.57	43.74	213.2700	11.8600	7.3500	
426.00	6700664.02	1631324.08	364.16	RT90-RHB70	–59.57	43.73	214.7700	12.0600	7.3800	
429.00	6700665.12	1631325.13	366.75	RT90-RHB70	–59.55	43.73	216.2800	12.2700	7.4100	
432.00	6700666.21	1631326.18	369.33	RT90-RHB70	–59.52	43.75	217.7800	12.4800	7.4500	
435.00	6700667.31	1631327.23	371.92	RT90-RHB70	–59.51	43.77	219.2900	12.6900	7.4900	
438.00	6700668.41	1631328.29	374.50	RT90-RHB70	–59.52	43.80	220.8000	12.9000	7.5200	
441.00	6700669.51	1631329.34	377.09	RT90-RHB70	–59.54	43.84	222.3000	13.1100	7.5600	
444.00	6700670.61	1631330.39	379.67	RT90-RHB70	–59.58	43.88	223.8100	13.3200	7.6000	
447.00	6700671.70	1631331.45	382.26	RT90-RHB70	–59.60	43.92	225.3100	13.5300	7.6300	
450.00	6700672.80	1631332.50	384.85	RT90-RHB70	–59.62	43.96	226.8200	13.7400	7.6600	
453.00	6700673.89	1631333.55	387.44	RT90-RHB70	–59.61	44.00	228.3200	13.9500	7.6900	
456.00	6700674.98	1631334.61	390.02	RT90-RHB70	–59.61	44.03	229.8200	14.1700	7.7200	
459.00	6700676.07	1631335.66	392.61	RT90-RHB70	–59.60	44.08	231.3200	14.3800	7.7500	
462.00	6700677.16	1631336.72	395.20	RT90-RHB70	–59.60	44.12	232.8300	14.6000	7.7900	
465.00	6700678.25	1631337.77	397.79	RT90-RHB70	–59.61	44.18	234.3300	14.8200	7.8200	
468.00	6700679.34	1631338.83	400.38	RT90-RHB70	–59.63	44.24	235.8300	15.0400	7.8500	
471.00	6700680.43	1631339.89	402.96	RT90-RHB70	–59.64	44.30	237.3300	15.2600	7.8800	
474.00	6700681.51	1631340.95	405.55	RT90-RHB70	–59.64	44.34	238.8300	15.4800	7.9100	
477.00	6700682.60	1631342.01	408.14	RT90-RHB70	–59.64	44.38	240.3300	15.7000	7.9300	
480.00	6700683.68	1631343.07	410.73	RT90-RHB70	–59.63	44.41	241.8300	15.9300	7.9600	
483.00	6700684.76	1631344.13	413.32	RT90-RHB70	–59.62	44.43	243.3300	16.1500	7.9900	
486.00	6700685.85	1631345.19	415.91	RT90-RHB70	–59.63	44.46	244.8300	16.3800	8.0200	
489.00	6700686.93	1631346.25	418.49	RT90-RHB70	–59.64	44.49	246.3300	16.6000	8.0500	
492.00	6700688.01	1631347.32	421.08	RT90-RHB70	–59.64	44.52	247.8300	16.8300	8.0800	
495.00	6700689.09	1631348.38	423.67	RT90-RHB70	–59.63	44.55	249.3300	17.0600	8.1100	
498.00	6700690.17	1631349.44	426.26	RT90-RHB70	–59.62	44.59	250.8300	17.2900	8.1300	
501.00	6700691.25	1631350.51	428.85	RT90-RHB70	–59.63	44.63	252.3300	17.5100	8.1600	
504.00	6700692.33	1631351.57	431.44	RT90-RHB70	–59.64	44.66	253.8300	17.7500	8.1900	
507.00	6700693.41	1631352.64	434.02	RT90-RHB70	–59.64	44.71	255.3300	17.9800	8.2200	
510.00	6700694.49	1631353.71	436.61	RT90-RHB70	–59.63	44.75	256.8300	18.2100	8.2500	
513.00	6700695.57	1631354.77	439.20	RT90-RHB70	–59.64	44.78	258.3200	18.4400	8.2700	
516.00	6700696.64	1631355.84	441.79	RT90-RHB70	–59.63	44.82	259.8200	18.6800	8.3000	
519.00	6700697.72	1631356.91	444.38	RT90-RHB70	–59.62	44.86	261.3200	18.9100	8.3300	
522.00	6700698.79	1631357.98	446.97	RT90-RHB70	–59.60	44.90	262.8200	19.1500	8.3600	
525.00	6700699.87	1631359.05	449.55	RT90-RHB70	–59.60	44.93	264.3200	19.3900	8.3800	
528.00	6700700.94	1631360.13	452.14	RT90-RHB70	–59.61	44.96	265.8200	19.6300	8.4100	
531.00	6700702.02	1631361.20	454.73	RT90-RHB70	–59.62	44.98	267.3200	19.8700	8.4400	
534.00	6700703.09	1631362.27	457.32	RT90-RHB70	–59.62	44.99	268.8100	20.1100	8.4700	
537.00	6700704.16	1631363.34	459.91	RT90-RHB70	–59.61	44.99	270.3100	20.3500	8.5000	
540.00	6700705.24	1631364.42	462.49	RT90-RHB70	–59.61	44.99	271.8100	20.5900	8.5200	
543.00	6700706.31	1631365.49	465.08	RT90-RHB70	–59.63	44.99	273.3100	20.8300	8.5500	
546.00	6700707.38	1631366.56	467.67	RT90-RHB70	–59.66	45.00	274.8100	21.0700	8.5800	
549.00	6700708.46	1631367.63	470.26	RT90-RHB70	–59.66	45.03	276.3000	21.3100	8.6000	
552.00	6700709.53	1631368.71	472.85	RT90-RHB70	–59.64	45.09	277.8000	21.5500	8.6300	
555.00	6700710.60	1631369.78	475.44	RT90-RHB70	–59.64	45.14	279.3000	21.7900	8.6600	
558.00	6700711.67	1631370.85	478.02	RT90-RHB70	–59.65	45.19	280.7900	22.0400	8.6800	
561.00	6700712.73	1631371.93	480.61	RT90-RHB70	–59.64	45.24	282.2900	22.2800	8.7100	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
564.00	6700713.80	1631373.01	483.20	RT90-RHB70	–59.62	45.28	283.7900	22.5300	8.7300	
567.00	6700714.87	1631374.08	485.79	RT90-RHB70	–59.62	45.32	285.2800	22.7800	8.7600	
570.00	6700715.94	1631375.16	488.38	RT90-RHB70	–59.62	45.37	286.7800	23.0200	8.7800	
573.00	6700717.00	1631376.24	490.97	RT90-RHB70	–59.62	45.41	288.2700	23.2700	8.8100	
576.00	6700718.07	1631377.32	493.55	RT90-RHB70	–59.63	45.45	289.7700	23.5300	8.8400	
579.00	6700719.13	1631378.40	496.14	RT90-RHB70	–59.63	45.48	291.2700	23.7800	8.8600	
582.00	6700720.20	1631379.49	498.73	RT90-RHB70	–59.63	45.52	292.7600	24.0300	8.8900	
585.00	6700721.26	1631380.57	501.32	RT90-RHB70	–59.61	45.57	294.2600	24.2800	8.9100	
588.00	6700722.32	1631381.65	503.91	RT90-RHB70	–59.60	45.61	295.7500	24.5400	8.9400	
591.00	6700723.38	1631382.74	506.49	RT90-RHB70	–59.60	45.66	297.2500	24.8000	8.9600	
594.00	6700724.44	1631383.82	509.08	RT90-RHB70	–59.59	45.70	298.7500	25.0500	8.9900	
597.00	6700725.50	1631384.91	511.67	RT90-RHB70	–59.59	45.75	300.2400	25.3100	9.0100	
600.00	6700726.56	1631386.00	514.26	RT90-RHB70	–59.59	45.79	301.7400	25.5700	9.0400	
603.00	6700727.62	1631387.08	516.84	RT90-RHB70	–59.60	45.82	303.2300	25.8400	9.0700	
606.00	6700728.68	1631388.17	519.43	RT90-RHB70	–59.61	45.85	304.7300	26.1000	9.0900	
609.00	6700729.74	1631389.26	522.02	RT90-RHB70	–59.61	45.90	306.2200	26.3600	9.1200	
612.00	6700730.79	1631390.35	524.61	RT90-RHB70	–59.61	45.94	307.7200	26.6200	9.1400	
615.00	6700731.85	1631391.44	527.20	RT90-RHB70	–59.61	45.99	309.2100	26.8900	9.1600	
618.00	6700732.90	1631392.53	529.78	RT90-RHB70	–59.61	46.03	310.7100	27.1600	9.1900	
621.00	6700733.96	1631393.63	532.37	RT90-RHB70	–59.62	46.07	312.2000	27.4200	9.2100	
624.00	6700735.01	1631394.72	534.96	RT90-RHB70	–59.64	46.09	313.6900	27.6900	9.2300	
627.00	6700736.06	1631395.81	537.55	RT90-RHB70	–59.65	46.13	315.1900	27.9600	9.2600	
630.00	6700737.11	1631396.90	540.14	RT90-RHB70	–59.66	46.17	316.6800	28.2300	9.2800	
633.00	6700738.16	1631398.00	542.73	RT90-RHB70	–59.66	46.20	318.1700	28.5000	9.3000	
636.00	6700739.21	1631399.09	545.32	RT90-RHB70	–59.66	46.23	319.6600	28.7700	9.3200	
639.00	6700740.26	1631400.19	547.90	RT90-RHB70	–59.66	46.26	321.1500	29.0400	9.3400	
642.00	6700741.31	1631401.28	550.49	RT90-RHB70	–59.66	46.30	322.6400	29.3200	9.3600	
645.00	6700742.35	1631402.38	553.08	RT90-RHB70	–59.66	46.33	324.1300	29.5900	9.3800	
648.00	6700743.40	1631403.47	555.67	RT90-RHB70	–59.66	46.36	325.6200	29.8700	9.4000	
651.00	6700744.44	1631404.57	558.26	RT90-RHB70	–59.64	46.37	327.1100	30.1400	9.4200	
654.00	6700745.49	1631405.67	560.85	RT90-RHB70	–59.61	46.39	328.6000	30.4200	9.4400	
657.00	6700746.54	1631406.77	563.44	RT90-RHB70	–59.58	46.41	330.0900	30.6900	9.4600	
660.00	6700747.59	1631407.87	566.02	RT90-RHB70	–59.57	46.43	331.5900	30.9700	9.4900	
663.00	6700748.63	1631408.97	568.61	RT90-RHB70	–59.58	46.45	333.0800	31.2500	9.5100	
666.00	6700749.68	1631410.07	571.20	RT90-RHB70	–59.60	46.48	334.5800	31.5300	9.5400	
669.00	6700750.73	1631411.17	573.79	RT90-RHB70	–59.63	46.53	336.0700	31.8100	9.5600	
672.00	6700751.77	1631412.27	576.37	RT90-RHB70	–59.64	46.59	337.5600	32.0900	9.5800	
675.00	6700752.81	1631413.37	578.96	RT90-RHB70	–59.63	46.65	339.0500	32.3700	9.6000	
678.00	6700753.85	1631414.47	581.55	RT90-RHB70	–59.62	46.71	340.5400	32.6500	9.6200	
681.00	6700754.89	1631415.58	584.14	RT90-RHB70	–59.61	46.74	342.0300	32.9400	9.6400	
684.00	6700755.93	1631416.68	586.73	RT90-RHB70	–59.62	46.76	343.5200	33.2200	9.6600	
687.00	6700756.97	1631417.79	589.31	RT90-RHB70	–59.64	46.78	345.0100	33.5100	9.6800	
690.00	6700758.01	1631418.89	591.90	RT90-RHB70	–59.65	46.80	346.5000	33.8000	9.7000	
693.00	6700759.05	1631420.00	594.49	RT90-RHB70	–59.67	46.82	347.9900	34.0800	9.7200	
696.00	6700760.08	1631421.10	597.08	RT90-RHB70	–59.68	46.85	349.4700	34.3700	9.7400	
699.00	6700761.12	1631422.21	599.67	RT90-RHB70	–59.70	46.89	350.9600	34.6600	9.7500	
702.00	6700762.15	1631423.31	602.26	RT90-RHB70	–59.72	46.92	352.4500	34.9500	9.7700	
705.00	6700763.19	1631424.42	604.85	RT90-RHB70	–59.75	46.93	353.9300	35.2400	9.7800	
708.00	6700764.22	1631425.52	607.44	RT90-RHB70	–59.77	46.95	355.4100	35.5300	9.7900	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
711.00	6700765.25	1631426.63	610.04	RT90-RHB70	–59.77	46.98	356.9000	35.8200	9.8100	
714.00	6700766.28	1631427.73	612.63	RT90-RHB70	–59.75	47.02	358.3800	36.1100	9.8200	
717.00	6700767.31	1631428.83	615.22	RT90-RHB70	–59.74	47.06	359.8600	36.4000	9.8300	
720.00	6700768.34	1631429.94	617.81	RT90-RHB70	–59.72	47.11	361.3400	36.6900	9.8400	
723.00	6700769.37	1631431.05	620.40	RT90-RHB70	–59.67	47.16	362.8300	36.9900	9.8600	
726.00	6700770.40	1631432.16	622.99	RT90-RHB70	–59.64	47.20	364.3100	37.2900	9.8700	
729.00	6700771.43	1631433.27	625.58	RT90-RHB70	–59.61	47.23	365.8000	37.5800	9.8900	
732.00	6700772.46	1631434.39	628.17	RT90-RHB70	–59.57	47.25	367.2900	37.8800	9.9100	
735.00	6700773.49	1631435.50	630.75	RT90-RHB70	–59.54	47.26	368.7800	38.1800	9.9300	
738.00	6700774.53	1631436.62	633.34	RT90-RHB70	–59.53	47.26	370.2700	38.4800	9.9500	
741.00	6700775.56	1631437.74	635.93	RT90-RHB70	–59.51	47.27	371.7600	38.7800	9.9700	
744.00	6700776.59	1631438.86	638.51	RT90-RHB70	–59.52	47.30	373.2500	39.0800	10.0000	
747.00	6700777.62	1631439.97	641.10	RT90-RHB70	–59.52	47.32	374.7400	39.3800	10.0200	
750.00	6700778.65	1631441.09	643.68	RT90-RHB70	–59.53	47.31	376.2400	39.6900	10.0400	
753.00	6700779.69	1631442.21	646.27	RT90-RHB70	–59.54	47.29	377.7300	39.9900	10.0700	
756.00	6700780.72	1631443.33	648.85	RT90-RHB70	–59.55	47.29	379.2200	40.2900	10.0900	
759.00	6700781.75	1631444.45	651.44	RT90-RHB70	–59.57	47.31	380.7100	40.5900	10.1100	
762.00	6700782.78	1631445.56	654.03	RT90-RHB70	–59.59	47.33	382.2000	40.8900	10.1300	
765.00	6700783.81	1631446.68	656.61	RT90-RHB70	–59.61	47.34	383.6900	41.1900	10.1500	
768.00	6700784.84	1631447.79	659.20	RT90-RHB70	–59.64	47.35	385.1700	41.4900	10.1700	
771.00	6700785.86	1631448.91	661.79	RT90-RHB70	–59.66	47.37	386.6600	41.7900	10.1800	
774.00	6700786.89	1631450.02	664.38	RT90-RHB70	–59.68	47.39	388.1400	42.1000	10.2000	
777.00	6700787.92	1631451.14	666.97	RT90-RHB70	–59.70	47.40	389.6300	42.4000	10.2100	
780.00	6700788.94	1631452.25	669.56	RT90-RHB70	–59.72	47.42	391.1100	42.7000	10.2300	
783.00	6700789.96	1631453.37	672.15	RT90-RHB70	–59.74	47.44	392.5900	43.0000	10.2400	
786.00	6700790.99	1631454.48	674.74	RT90-RHB70	–59.75	47.46	394.0700	43.3100	10.2500	
789.00	6700792.01	1631455.59	677.33	RT90-RHB70	–59.77	47.47	395.5500	43.6100	10.2600	
792.00	6700793.03	1631456.71	679.92	RT90-RHB70	–59.77	47.48	397.0300	43.9100	10.2700	
795.00	6700794.05	1631457.82	682.52	RT90-RHB70	–59.77	47.49	398.5100	44.2200	10.2800	
798.00	6700795.07	1631458.93	685.11	RT90-RHB70	–59.78	47.52	399.9900	44.5200	10.2900	
801.00	6700796.09	1631460.05	687.70	RT90-RHB70	–59.80	47.53	401.4700	44.8200	10.3000	
804.00	6700797.11	1631461.16	690.29	RT90-RHB70	–59.81	47.54	402.9500	45.1300	10.3000	
807.00	6700798.13	1631462.27	692.89	RT90-RHB70	–59.82	47.54	404.4300	45.4300	10.3100	
810.00	6700799.15	1631463.39	695.48	RT90-RHB70	–59.83	47.54	405.9000	45.7400	10.3200	
813.00	6700800.16	1631464.50	698.07	RT90-RHB70	–59.85	47.56	407.3800	46.0400	10.3200	
816.00	6700801.18	1631465.61	700.67	RT90-RHB70	–59.85	47.56	408.8600	46.3500	10.3300	
819.00	6700802.20	1631466.72	703.26	RT90-RHB70	–59.85	47.54	410.3300	46.6500	10.3300	
822.00	6700803.21	1631467.83	705.86	RT90-RHB70	–59.86	47.53	411.8100	46.9600	10.3400	
825.00	6700804.23	1631468.94	708.45	RT90-RHB70	–59.87	47.52	413.2800	47.2600	10.3400	
828.00	6700805.25	1631470.06	711.05	RT90-RHB70	–59.88	47.51	414.7600	47.5700	10.3500	
831.00	6700806.26	1631471.17	713.64	RT90-RHB70	–59.91	47.49	416.2300	47.8700	10.3500	
834.00	6700807.28	1631472.27	716.24	RT90-RHB70	–59.92	47.46	417.7100	48.1700	10.3500	
837.00	6700808.30	1631473.38	718.83	RT90-RHB70	–59.93	47.44	419.1800	48.4700	10.3500	
840.00	6700809.31	1631474.49	721.43	RT90-RHB70	–59.93	47.42	420.6500	48.7800	10.3500	
843.00	6700810.33	1631475.60	724.02	RT90-RHB70	–59.92	47.42	422.1200	49.0800	10.3500	
846.00	6700811.35	1631476.70	726.62	RT90-RHB70	–59.92	47.44	423.6000	49.3800	10.3600	
849.00	6700812.37	1631477.81	729.22	RT90-RHB70	–59.91	47.44	425.0700	49.6800	10.3600	
852.00	6700813.38	1631478.92	731.81	RT90-RHB70	–59.90	47.43	426.5400	49.9800	10.3600	
855.00	6700814.40	1631480.03	734.41	RT90-RHB70	–59.88	47.42	428.0200	50.2800	10.3600	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord system	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
858.00	6700815.42	1631481.13	737.00	RT90-RHB70	–59.87	47.42	429.4900	50.5800	10.3700	
861.00	6700816.44	1631482.24	739.60	RT90-RHB70	–59.87	47.46	430.9700	50.8800	10.3700	
864.00	6700817.46	1631483.35	742.19	RT90-RHB70	–59.87	47.48	432.4400	51.1900	10.3800	
867.00	6700818.47	1631484.46	744.79	RT90-RHB70	–59.86	47.48	433.9200	51.4900	10.3800	
870.00	6700819.49	1631485.57	747.38	RT90-RHB70	–59.85	47.46	435.3900	51.7900	10.3900	
873.00	6700820.51	1631486.68	749.97	RT90-RHB70	–59.81	47.42	436.8700	52.0900	10.3900	
876.00	6700821.53	1631487.79	752.57	RT90-RHB70	–59.79	47.39	438.3500	52.4000	10.4000	
879.00	6700822.55	1631488.91	755.16	RT90-RHB70	–59.81	47.31	439.8300	52.7000	10.4100	
882.00	6700823.58	1631490.01	757.75	RT90-RHB70	–59.82	47.21	441.3100	53.0000	10.4100	
885.00	6700824.60	1631491.12	760.35	RT90-RHB70	–59.82	47.14	442.7900	53.2900	10.4200	
888.00	6700825.63	1631492.23	762.94	RT90-RHB70	–59.82	47.11	444.2600	53.5900	10.4300	
891.00	6700826.65	1631493.33	765.53	RT90-RHB70	–59.81	47.08	445.7400	53.8800	10.4400	
894.00	6700827.68	1631494.44	768.13	RT90-RHB70	–59.80	47.08	447.2200	54.1700	10.4500	
897.00	6700828.71	1631495.54	770.72	RT90-RHB70	–59.80	47.09	448.7000	54.4700	10.4600	
900.00	6700829.74	1631496.65	773.31	RT90-RHB70	–59.81	47.12	450.1800	54.7600	10.4700	
903.00	6700830.76	1631497.75	775.91	RT90-RHB70	–59.82	47.14	451.6600	55.0500	10.4800	
906.00	6700831.79	1631498.86	778.50	RT90-RHB70	–59.82	47.16	453.1400	55.3500	10.4900	
909.00	6700832.81	1631499.96	781.09	RT90-RHB70	–59.82	47.16	454.6200	55.6400	10.4900	
912.00	6700833.84	1631501.07	783.69	RT90-RHB70	–59.81	47.16	456.1000	55.9400	10.5000	
915.00	6700834.87	1631502.18	786.28	RT90-RHB70	–59.80	47.15	457.5800	56.2300	10.5100	
918.00	6700835.89	1631503.28	788.87	RT90-RHB70	–59.78	47.13	459.0600	56.5300	10.5200	
921.00	6700836.92	1631504.39	791.46	RT90-RHB70	–59.75	47.11	460.5400	56.8200	10.5300	
924.00	6700837.95	1631505.50	794.06	RT90-RHB70	–59.73	47.11	462.0200	57.1200	10.5400	
927.00	6700838.98	1631506.60	796.65	RT90-RHB70	–59.72	47.11	463.5100	57.4100	10.5500	
930.00	6700840.01	1631507.71	799.24	RT90-RHB70	–59.71	47.11	464.9900	57.7100	10.5700	
933.00	6700841.04	1631508.82	801.83	RT90-RHB70	–59.70	47.10	466.4800	58.0000	10.5800	
936.00	6700842.07	1631509.93	804.42	RT90-RHB70	–59.71	47.09	467.9600	58.2900	10.6000	
939.00	6700843.10	1631511.04	807.01	RT90-RHB70	–59.72	47.08	469.4400	58.5900	10.6100	
945.00	6700845.16	1631513.25	812.19	RT90-RHB70	–59.72	47.12	472.4100	59.1800	10.6400	

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Length reference marks

Reference Mark T – Reference mark in drillhole

KFM08C, 2006-05-10 10:00:00 – 2006-05-10 17:30:00 (150.000–900.000 m).

Bhlen (m)	Rotation speed (rpm)	Start flow (l/min)	Stop flow (l/min)	Stop pressure (bar)	Cutter time (s)	Trace detectable	Cutter diameter (mm)	Comment
150.00	400.00	500	300	32.0	1	Ja		150.10/150.20
200.00	400.00	500	300	32.0	1	Ja		200.30/200.40
250.00	400.00	500	300	32.0	1	Ja		250.46/250.56
300.00	400.00	500	300	32.0	1	Ja		300.61/300.71
350.00	400.00	500	300	32.0	1	Ja		350.79/350.89
398.00	400.00	500	300	32.0	1	Ja		398.93/399.03
450.00	400.00	500	300	32.0	1	Nej		
500.00	400.00	500	300	26.0	1	Nej		Upprepade indikationer vid 500 m
550.00	400.00	600	400	24.0	1	Nej		
600.00	400.00	600	400	22.0	1	Nej		Sämre sluttryck
650.00	400.00	800	600	18.0	1	Nej		Lågt sluttryck =>Tveksam fräsverkan
700.00	400.00	800	600	16.0	2	Nej		Lågt sluttryck =>Tveksam fräsverkan
750.00	400.00	800	1,680	30.0	1	Nej		Byte till pump och styrning från Onram 200 för att få bättre tryck
800.00	400.00	800	1,440	32.0	1	Nej		
850.00	400.00	900	1,260	28.0	1	Nej		
900.00	400.00	1,020	1,560	32.0	1	Nej		

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