P-06-207

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September 2006

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Abstract

This report presents geological single-hole interpretations of the cored boreholes KFM08C and KFM10A and the percussion boreholes HFM23, HFM28, HFM30, HFM31, HFM32 and HFM38 at Forsmark. The interpretation combines the geological core mapping, generalized geophysical logs and borehole radar measurements to identify where rock units and possible deformation zones occur in the boreholes. A brief description of the character of each rock unit and possible deformation zone is provided.

The geological single-hole interpretation shows that three rock units (RU1–RU3) occur in KFM08C. However, the borehole can be divided into seven separate sections due to the repetition of RU1 (RU1a, RU1b, RU1c and RU1d) and RU2 (RU2a and RU2b). Medium-grained metagranite-granodiorite (101057) dominates the borehole. Subordinate rock types are pegmatitic granite (101061), amphibolite (102017), aplitic metagranite (101058), fine- to medium-grained metagranitoid (101051) and minor occurrence of felsic to intermediate metavolcanic rock (103076). Albitization is a prominent feature in especially RU2. Five possible deformation zones of brittle character have been identified in KFM08C (DZ1–DZ5). Vuggy rock occurs along DZ2.

The geological single-hole interpretation shows that there is one rock unit (RU1) in KFM10A. Fine- to medium-grained metagranite-granodiorite (101057) dominates the borehole. Subordinate rock types in the unit are pegmatitic granite (101061), amphibolite (102017), fine- to medium-grained metagranitoid (101051) and fine- to medium-grained granite (111058). A few minor occurrences of felsic to intermediate metavolcanic rock (103076) are also present. Three possible deformation zones of brittle character have been identified in KFM10A (DZ1–DZ3). Vuggy rock occurs along DZ1 and DZ3.

The percussion borehole HFM23 is dominated by medium-grained metagranite-granodiorite (101057). The borehole is divided into two rock units (RU1–RU2) on the basis of an increased presence of biotite and a stronger tectonic foliation in the metagranite-granodiorite (101057) in RU2. Three possible deformation zones of brittle character have been identified in HMF23 (DZ1–DZ3).

One rock unit (RU1) occurs in percussion borehole HFM28, which is dominated by medium-grained metagranite-granodiorite (101057). Pegmatitic granite (101061), fine- to medium-grained granite (111058), amphibolite (102017), metagranodiorite (101056), fine- to medium-grained metagranitoid (101051) and aplitic metagranite (101058) occur as subordinate rock types. One possible deformation zone of brittle character has been identified in HFM28 (DZ1).

The percussion borehole HFM30 contains three rock units (RU1–RU3). The upper unit (RU1) is dominated by metagranite-granodiorite (101057) with subordinate pegmatite and metatonalite-granodiorite (101054). In the central unit (RU2), metatonalite-granodiorite (101054) dominates the borehole. Subordinate rock types are pegmatite (101061), amphibolite (102017) and felsic to intermediate volcanic rock (103076). The lower unit (RU3) is heterogeneous with metatonalite-granodiorite (101054), pegmatite (101061), metagranite-granodiorite (101057) and amphibolite (102017) as dominant rock types. Felsic to intermediate volcanic rock (103076), metadiorite-gabbro (101033) and granite (1058) occur as minor constituents. One possible deformation zone of brittle character has been identified in HFM30 (DZ1). With the help of both geological and geophysical data, it has been possible to identify four distinct geological segments along this zone.

The geological single-hole interpretation shows that there are two rock units (RU1–RU2) in HFM31. However, the borehole can be divided into three separate sections due to the repetition of RU1 (RU1a and RU1b). The upper and lower parts of the borehole are dominated by metamorphosed diorite to gabbro (101033) and the central part of the borehole (RU2) is dominated by pegmatitic granite (101061). Fine- to medium-grained metagranitoid (101051) and amphibolite (102017) occur as subordinate rock types. No possible deformation zone has been recognised in HFM31.

The percussion borehole HFM32 contains four rock units (RU1–RU4). However, the borehole can be divided into six separate sections due to the repetition of RU2 (RU2a, RU2b and RU2c). The borehole is dominated by medium-grained metagranite-granodiorite (101057). A section in the uppermost part of the borehole (RU1) contains amphibolite (102017) and a section in the lower part (RU4) is dominated by pegmatitic granite (101061), which is characterized by increased frequency of open and sealed fractures. The dominating rock type in each rock unit also occurs as a subordinate rock type in the other rock units. No possible deformation zone has been recognised in HFM32.

The percussion borehole HFM38 contains two rock units (RU1–RU2). The borehole is dominated by medium-grained metagranite-granodiorite (101057). RU1 is distinguished by an increased frequency of open fractures, and RU2 by a more intense albitization. Subordinate rock types are pegmatitic granite (101061), amphibolite (102017) and fine- to medium-grained metagranitoid (101051). One possible deformation zone of brittle character has been identified in HFM38 (DZ1).

Sammanfattning

Denna rapport behandlar geologisk enhålstolkning av kärnborrhålen KFM08C och KFM10A samt hammarborrhålen HFM23, HFM28, HFM30, HFM31, HFM32 och HFM38 i Forsmark. Den geologiska enhålstolkningen syftar till att utifrån den geologiska karteringen, tolkade geofysiska loggar och borrhålsradarmätningar indikera olika litologiska enheters fördelning i borrhålen samt möjliga deformationszoners läge och utbredning. En kort beskrivning av varje bergenhet och möjlig deformationszon presenteras.

Denna undersökning visar att det i KFM08C finns tre litologiska enheter (RU1–RU3). Baserat på repetition av enheterna RU1 (RU1a, RU1b, RU1c och RU1d) och RU2 (RU2a och RU2b) kan borrhålet delas in i sju sektioner. Medelkorning metagranit-granodiorit (101057) dominerar borrhålet. I mindre omfattning förekommer pegmatitisk granit (101061), amfibolit (102017), aplitisk metagranit (101058), fin- till medelkornig metagranitoid (101051) och mindre förekomster av felsisk till intermediär metavulkanisk bergart (103076). Albitisering är framträdande speciellt i RU2. Fem möjliga deformationszoner som är spröda har identifierats i KFM08C (DZ1–DZ5). Porösa bergarter förekommer i DZ2.

Kärnborrhål KFM10A domineras av fin- till medelkornig metagranit-granodiorit (101057) vilken utgör en litologisk enhet (RU1). I mindre omfattning förekommer pegmatitisk granit (101061), amfibolit (102017), fin- till medelkornig metagranitoid (101051) och fin- till medelkornig granit (111058). Även några mindre förekomster av felsisk till intermediär metavulkanisk bergart (103076) finns. Tre möjliga deformationszoner som är spröda har identifierats i KFM10A (DZ1–DZ3). Porösa bergarter förekommer i DZ1 och DZ3.

Hammarborrhål HFM23 domineras av medelkornig metagranit-granodiorit (101057). Borrhålet delas in i två litologiska enheter (RU1 och RU2) med avseende på ökad mängd av biotit och starkare tektonisk foliation. Tre möjliga deformationszoner av spröd karaktär har identifierats i HFM23 (DZ1–DZ3).

En litologisk enhet (RU1) har identifierats i hammarborrhål HFM28. Borrhålet domineras av medelkornig metagranit-granodiorit (101057). Pegmatitisk granit (101061), fin- till medelkornig granit (111058), amfibolit (102017), metagranodiorit (101056), fin- till medelkornig metagranitoid (101051) och aplitisk metagranit (101058) förekommer som underordnade bergarter. Fem möjliga deformationszoner av spröd karaktär har identifierats i HFM28 (DZ1–DZ5).

Hammarborrhål HFM30 innehåller tre litologiska enheter (RU1–RU3). Den övre enheten (RU1) domineras av metagranit-granodiorit (101057) med underordnad pegmatit (101061) och metatonalit-granodiorit (101054). I den centrala enheten (RU2) dominerar metatonalit-granodiorit (101054). Mindre förekomster av pegmatit (101061), amfibolit (102017) och felsisk till intermediär vulkanit (103076) förekommer också. Den nedre enheten (RU3) är en heterogen bergartssekvens med metatonalit-granodiorit (101054), pegmatit (101061), metagranit-granodiorit (101057) och amfibolit (102017) som dominerande bergarter. Felsisk till intermediär vulkanit (103076), metadiorit-gabbro (101033) och granit (1058) förekommer i mindre mängd. En möjlig deformationszon av spröd karaktär har identifierats i HFM30 (DZ1). Med hjälp av geologiska och geofysiska data har det varit möjligt att identifiera fyra distinkta geologiska segment i denna zon.

Denna undersökning visar att två litologiska enheter (RU1 och RU2) har identifierats i HFM31. Baserat på repetition av RU1 (RU1a och RU1b) kan borrhålet delas in i tre sektioner. Den övre och den nedre delen av borrhålet domineras av metadiorit till metagabbro (101033) och den centrala delen (RU2) domineras av pegmatitisk granit (101061). I mindre omfattning förekommer fin- till medelkornig metagranitoid (101051) och amfibolit (102017). Möjliga deformationszoner har inte identifierats i HFM31.

Hammarborrhål HFM32 innehåller fyra litologiska enheter (RU1–RU4). Baserat på repetition av RU2 (RU2a, RU2b och RU2c) kan borrhålet delas in i sex sektioner. Borrhålet domineras av medelkornig metagranit-granodiorit (101057). En sektion i den allra översta delen av borrhålet (RU1) domineras av amfibolit (102017). En sektion i borrhålets nedre del (RU4) domineras av pegmatitisk granit (101061), vilken karaktäriseras av en ökad frekvens av öppna och läkta sprickor. Den dominerande bergarten i varje litologisk enhet förekommer även i mindre omfattning i de andra litologiska enheterna. Möjliga deformationszoner har inte identifierats i HFM32.

Hammarborrhål HFM38 består av två litologiska enheter (RU1–RU2) vilka domineras av medelkornig metagranit-granodiorit (101057). RU1 karaktäriseras av ökad frekvens av öppna sprickor medan RU2 karaktäriseras av en mer intensiv albitisering. Underordnade bergarter utgörs av pegmatitisk granit (101061), amfibolit (102017) och fin- till medelkornig metagranitoid (101051). En möjlig deformationszon av spröd karaktär har identifierats i HFM38 (DZ1).

Contents

1 Introduction

Much of the primary geological and geophysical borehole data stored in the SKB database SICADA need to be integrated and synthesized before they can be used for modelling in the 3D-CAD Rock Visualization System (RVS). The end result of this procedure is a geological single-hole interpretation, which consists of an integrated series of different logs and accompanying descriptive documents.

This document reports the geological single-hole interpretations of boreholes KFM08C, KFM10A, HFM23, HFM28, HFM30, HFM31, HFM32 and HFM38 in the Forsmark area. The horizontal projections of the boreholes are shown in Figure 1-1. The work was carried out in accordance with activity plan SKB PF 400-06-057. The controlling documents for performing this activity are listed in Table 1-1. Both the activity plan and method description are SKB's internal controlling documents.

Figure 1-1. *Map showing position and horizontal projection of the cored boreholes KFM08C and KFM10A and the percussion boreholes HFM23, HFM28, HFM30, HFM31, HFM32 and HFM38.*

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

Activity plan	Number	Version
Geologisk enhålstolkning av KFM08C, KFM10A samt HFM23, 28, 30, 31, 32 och 38	AP PF 400-06-057	1.0
Method description	**Number**	**Version**
Metodbeskrivning för geologisk enhålstolkning	SKB MD 810.003	3.0

2 Objective and scope

A geological single-hole interpretation is carried out in order to identify and to describe briefly the characteristics of major rock units and possible deformation zones within a borehole. The work involves an integrated interpretation of data from the geological mapping of the borehole (Boremap), different borehole geophysical logs and borehole radar data.

The geological mapping of the cored boreholes involves a documentation of the character of the bedrock in the drill core. This work component is carried out in combination with an inspection of the oriented image of the borehole walls that is obtained with the help of the *B*orehole *I*mage *P*rocessing *S*ystem (BIPS). The geological mapping of the percussion boreholes focuses more attention on an integrated interpretation of the information from the geophysical logs and the BIPS images. For this reason, the results from the percussion borehole mapping are more uncertain. The interpretations of the borehole geophysical and radar logs are available when the single-hole interpretation is completed. The result from the geological single-hole interpretation is presented in a WellCad plot. A more detailed description of the technique is provided in the method description for geological single-hole interpretation (SKB MD 810.003, internal document). The work reported here concerns stage 1 in the single-hole interpretation, as defined in the method description.

3 Data used for the geological single-hole interpretation

The following data and interpretations have been used for the single-hole interpretation of the boreholes KFM08C, KFM10A, HFM23, HFM28, HFM30, HFM31, HFM32 and HFM38:

- Boremap data (including BIPS and geological mapping data) /3, 4, 5/.
- Generalized geophysical logs and their interpretation /6, 7, 8/.
- Radar data and their interpretation /9, 10, 11, 12/.

The material used as a basis for the geological single-hole interpretation was a WellCad plot consisting of parameters from the geological mapping in the Boremap system, geophysical logs and borehole radar. An example of a WellCad plot used during geological single-hole interpretation is shown in Figure 3-1. The plot consists of ten main columns and several subordinate columns. These include:

1: Length along the borehole

2: Rock type
  2.1: Rock type
  2.2: Rock type structure
  2.3: Rock type texture
  2.4: Rock type grain size
  2.5: Structure orientation
  2.6: Rock occurrence (< 1 m)
  2.7: Rock alteration
  2.8: Rock alteration intensity

3: Unbroken fractures
  3.1: Primary mineral
  3.2: Secondary mineral
  3.3: Third mineral
  3.4: Fourth mineral
  3.5: Alteration, dip direction

4: Broken fractures
  4.1: Primary mineral
  4.2: Secondary mineral
  4.3: Third mineral
  4.4: Fourth mineral
  4.5: Aperture (mm)
  4.6: Roughness
  4.7: Surface
  4.8: Alteration, dip direction

5: Crush zones
  5.1: Primary mineral
  5.2: Secondary mineral
  5.3: Third mineral
  5.4: Fourth mineral
  5.5: Roughness
  5.6: Surface
  5.7: Crush alteration, dip direction
  5.8: Piece (mm)
  5.9: Sealed network
  5.10: Core loss

6: Fracture frequency
    6.1: Open fractures
    6.2: Sealed fractures

7: Geophysics
    7.1: Magnetic susceptibility
    7.2: Natural gamma radiation
    7.3: Possible alteration
    7.4: Silicate density
    7.5: Estimated fracture frequency

8: Radar
    8.1: Length
    8.2: Angle

9: Reference mark (not used for percussion-drilled boreholes)

10: BIPS

The geophysical logs are described below:

Magnetic susceptibility: The rock has been classified into sections of low, medium, high, and very high magnetic susceptibility. The susceptibility measurement is strongly connected to the magnetite content in the different rock types.

Natural gamma radiation: The rock has been classified into sections of low, medium, and high natural gamma radiation. Low radiation may indicate mafic rock types and high radiation may indicate younger, fine-grained granite or pegmatite. The rocks with high natural gamma radiation have been included in the younger, Group D intrusive suite /1/.

Possible alteration: This parameter has not been used in the geological single-hole interpretation in the Forsmark area.

Silicate density: This parameter indicates the density of the rock after subtraction of the magnetic component in the rock. It provides general information on the mineral composition of the rock types, and serves as a support during classification of rock types.

Estimated fracture frequency: This parameter provides an estimate of the fracture frequency along 5 m sections, calculated from short and long normal resistivity, SPR, P-wave velocity as well as focused resistivity 140 and 300. The estimated fracture frequency is based on a statistical connection after a comparison has been made between the geophysical logs and the mapped fracture frequency. The log provides an indication of sections with low and high fracture frequencies.

Close inspection of the borehole radar data was carried out during the interpretation process, especially during the identification of possible deformation zones. The occurrence and orientation of radar anomalies within the possible deformation zones are commented upon in the text that describes these zones.

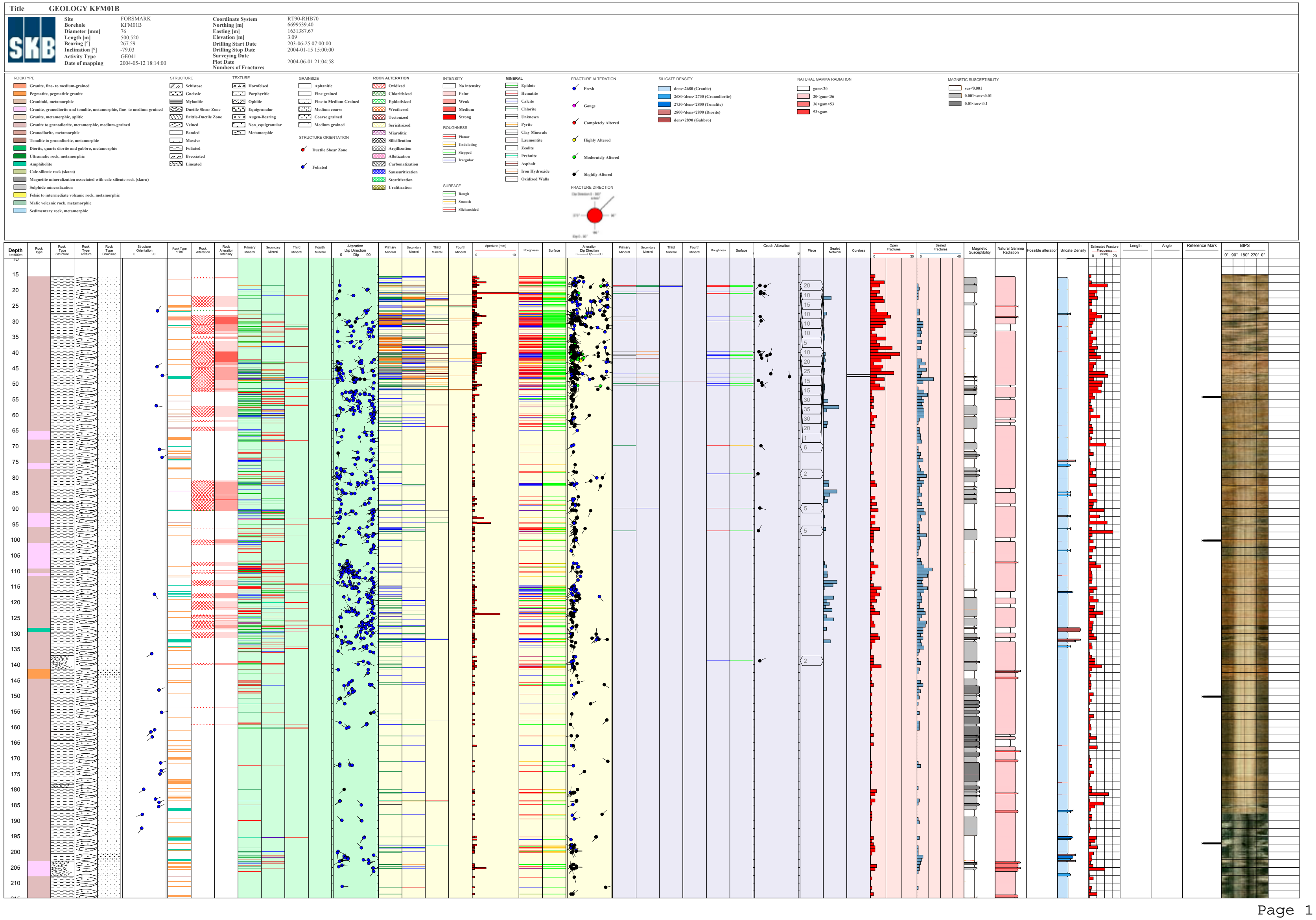

***Figure 3-1.** Example of WellCad plot (from borehole KFM01B) used as a basis for the single-hole interpretation.*

4 Execution of the geological single-hole interpretation

4.1 General

The geological single-hole interpretation has been carried out by a group of geoscientists consisting of both geologists and geophysicists. Several of these geoscientists previously participated in the development of the source material for the single-hole interpretation. All data to be used (see Chapter 3) are visualized side by side in a borehole document extracted from the software WellCad. The working procedure is summarized in Figure 4-1 and in the text below.

The first step in the working procedure is to study all types of data (rock type, rock alteration, silicate density, natural gamma radiation, etc.) related to the character of the rock type and to merge sections of similar rock types, or sections where one rock type is very dominant, into rock units (minimum length of c. 5 m). Each rock unit is defined in terms of the borehole length interval and provided with a brief description for inclusion in the WellCad plot. The confidence in the interpretation of a rock unit is made on the following basis: 3 = high, 2 = medium and 1 = low.

The second step in the working procedure is to identify possible deformation zones by visual inspection of the results of the geological mapping (fracture frequency, fracture mineral, aperture, alteration, etc.) in combination with the geophysical logging and radar data. The section of each identified possible deformation zone is defined in terms of the borehole length interval and provided with a brief description for inclusion in the WellCad plot. This includes a brief description of the rock types affected by the possible deformation zone. The confidence in the interpretation of a possible deformation zone is made on the following basis: 3 = high, 2 = medium and 1 = low.

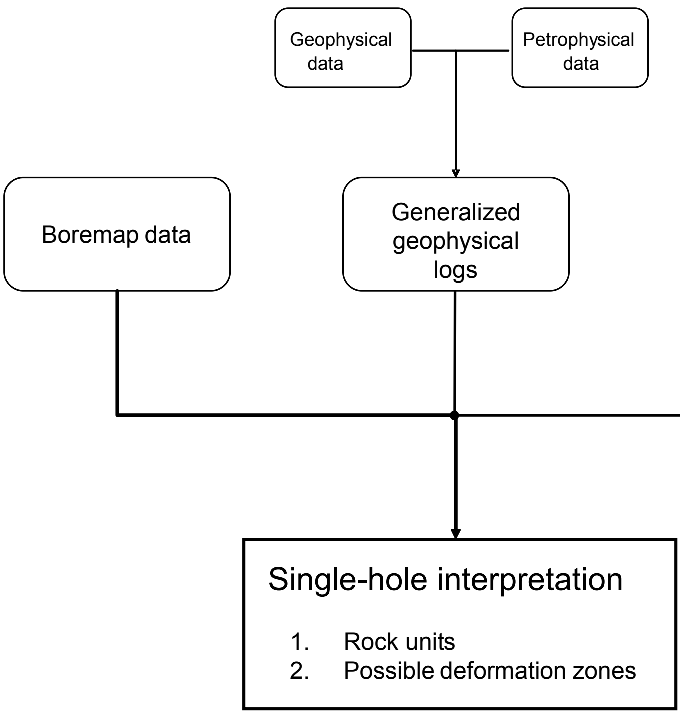

Figure 4-1. *Schematic chart that shows the procedure for the development of a geological single-hole interpretation.*

Inspection of BIPS images is carried out wherever it is judged necessary during the working procedure. Furthermore, following definition of rock units and possible deformation zones, with their respective confidence estimates, the drill cores are inspected in order to check the selection of the boundaries between these geological entities. If judged necessary, the location of these boundaries is adjusted.

Possible deformation zones that are brittle in character have been identified primarily on the basis of the frequency of fractures, according to the concept presented in /2/. Brittle deformation zones defined by an increased fracture frequency of extensional fractures (joints) or shear fractures (faults) are not distinguished. Both the transitional part, with a fracture frequency in the range 4–9 fractures/m, and the core part, with a fracture frequency >9 fractures/m, have been included in each zone (Figure 4-2). The frequencies of open and sealed fractures have been assessed in the identification procedure, and the character of the zone has been described accordingly. Partly open fractures are included together with open fractures in the brief description of each zone. The presence of bedrock alteration, the occurrence and, locally, inferred orientation of radar reflectors, the resistivity, SPR, P-wave velocity, caliper and magnetic susceptibility logs have all assisted in the identification of the zones. The anomalies in these parameters that assist with the identification are presented in the short description.

Since the frequency of fractures is of key importance for the definition of the possible deformation zones, moving average plots for this parameter are shown for the cored borehole KFM08C, KFM10A and the percussion boreholes HFM23, HFM28, HFM30, HFM31, HFM32 and HFM38 (Figures 4-3 to 4-10). A 5 m window and 1 m steps have been used in the calculation procedure. The moving averages for open fractures alone, the total number of open fractures (open, partly open and crush), the sealed fractures alone, and the total number of sealed fractures (sealed and sealed fracture network) are shown in each diagram.

The occurrence and orientation of radar anomalies within the possible deformation zones are used during the identification of these zones. An overview of the borehole radar measurements in KFM08C, KFM10A and the percussion boreholes HFM28, HFM30, HFM31, HFM32 and HFM38 is shown in Figures 4-11 to 4-17. Conductive environment causes attenuation of the radar wave, which in turn decreases the penetration. The effect of attenuation can be observed in some of the boreholes. The effect of attenuation varies between the different antenna frequencies (20 MHz, 100 MHz, 250 MHz and 60 MHz directional antenna). In some cases, alternative orientations for oriented radar reflectors are presented. One of the alternatives is considered to be correct, but due to uncertainty in the interpretation of radar data, a decision concerning which of the alternatives that represent the true orientation cannot be made. Orientations from directional radar are presented as strike/dip using the right-hand-rule.

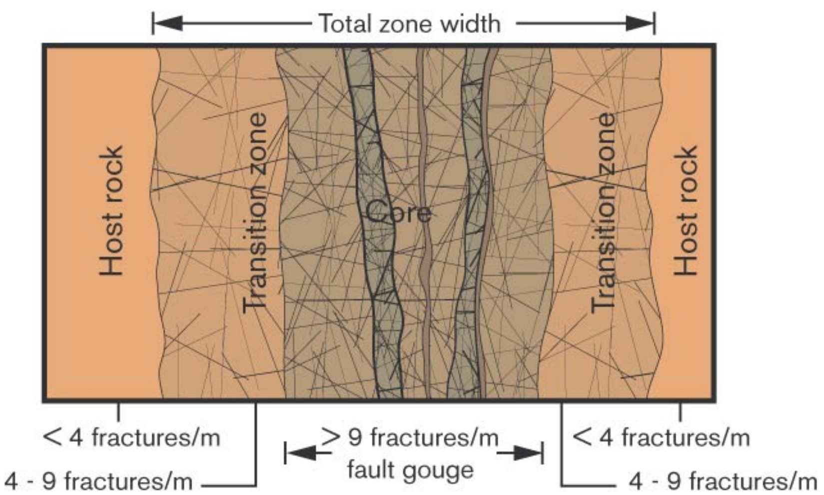

Figure 4-2. *Terminology for brittle deformation zones (after /2/).*

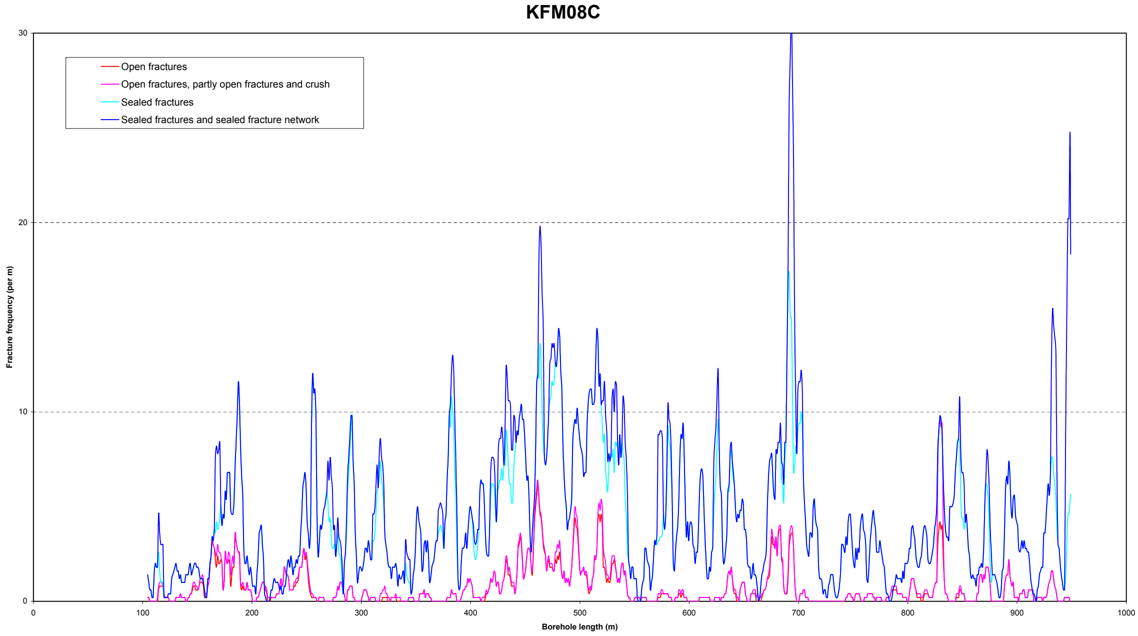

Figure 4-3. *Fracture frequency plot for KFM08C. Moving average with a 5 m window and 1 m steps.*

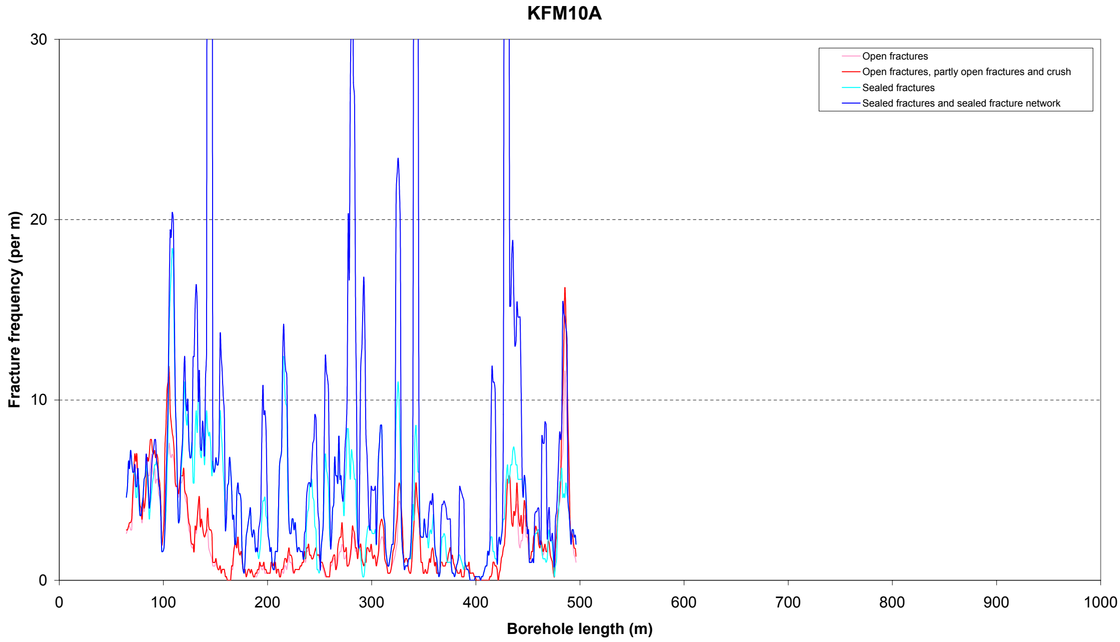

Figure 4-4. *Fracture frequency plot for KFM10A. Moving average with a 5 m window and 1 m steps.*

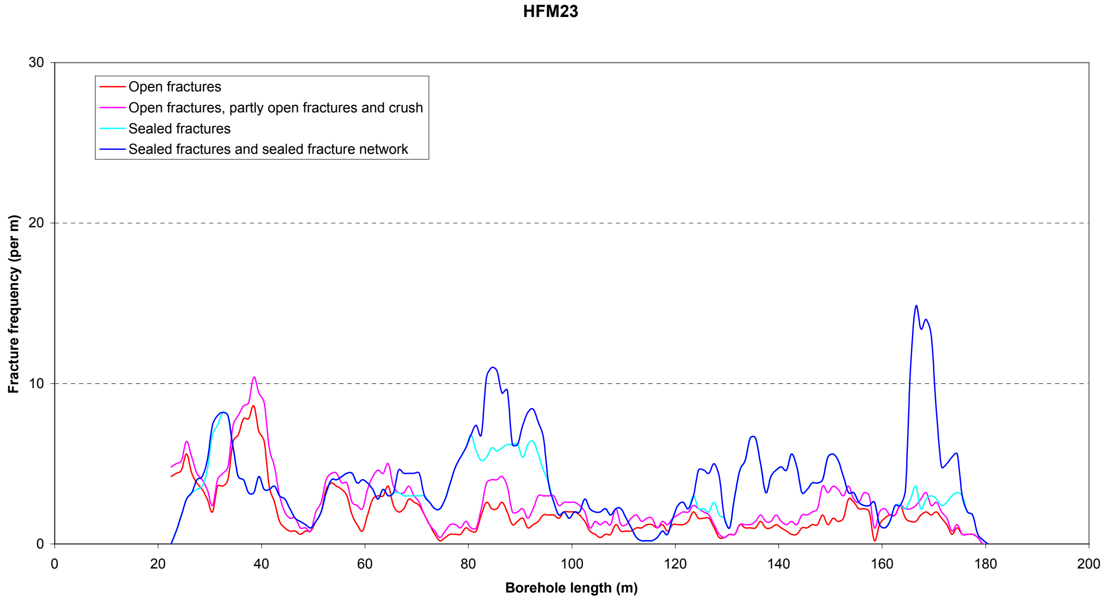

Figure 4-5. *Fracture frequency plot for HFM23. Moving average with a 5 m window and 1 m steps.*

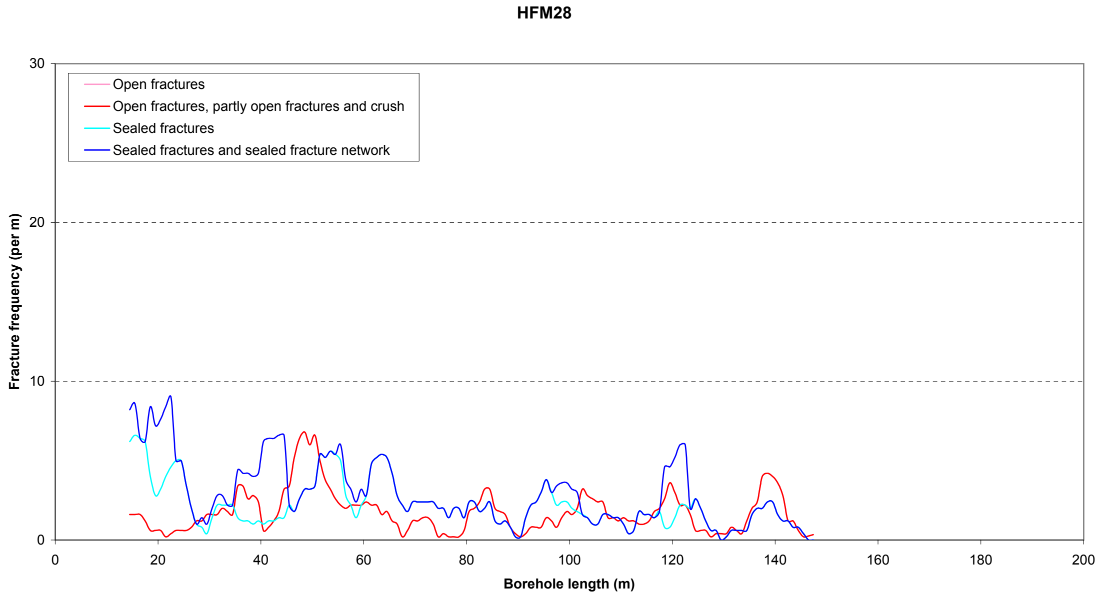

Figure 4-6. *Fracture frequency plot for HFM28. Moving average with a 5 m window and 1 m steps.*

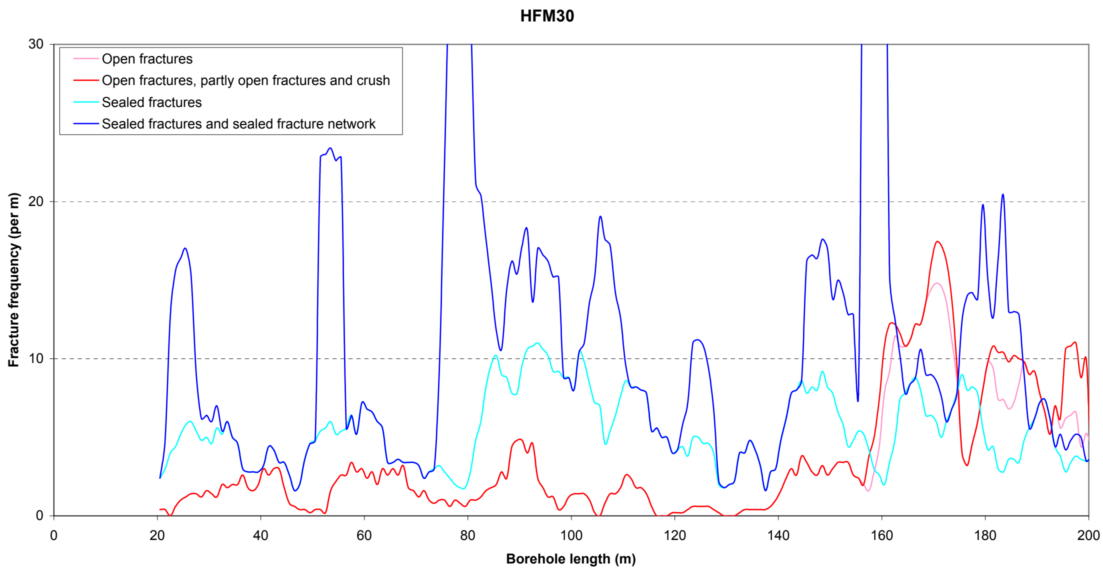

Figure 4-7. *Fracture frequency plot for HFM30. Moving average with a 5 m window and 1 m steps.*

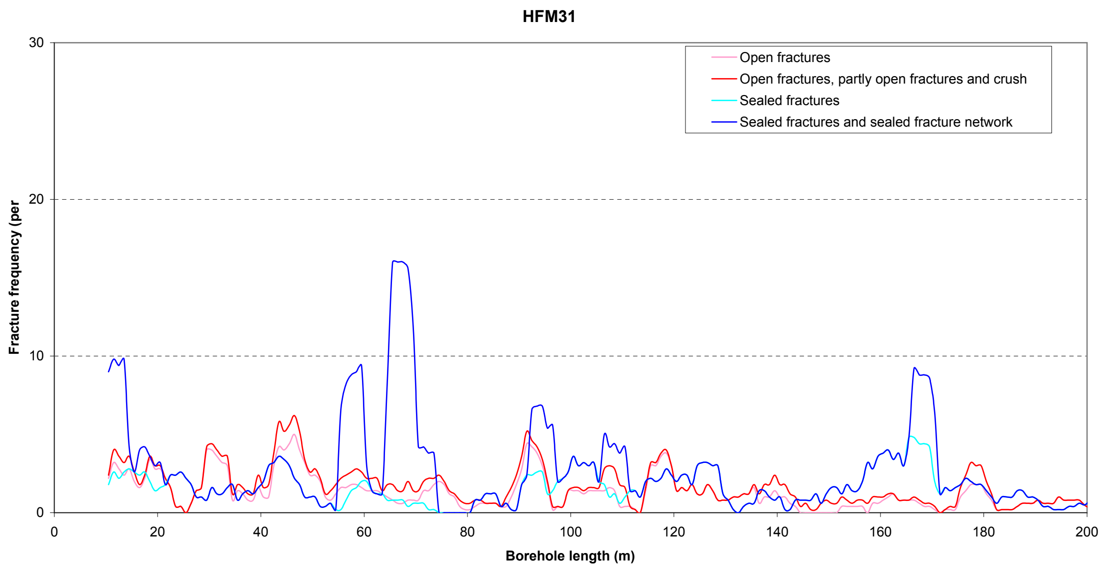

Figure 4-8. *Fracture frequency plot for HFM31. Moving average with a 5 m window and 1 m steps.*

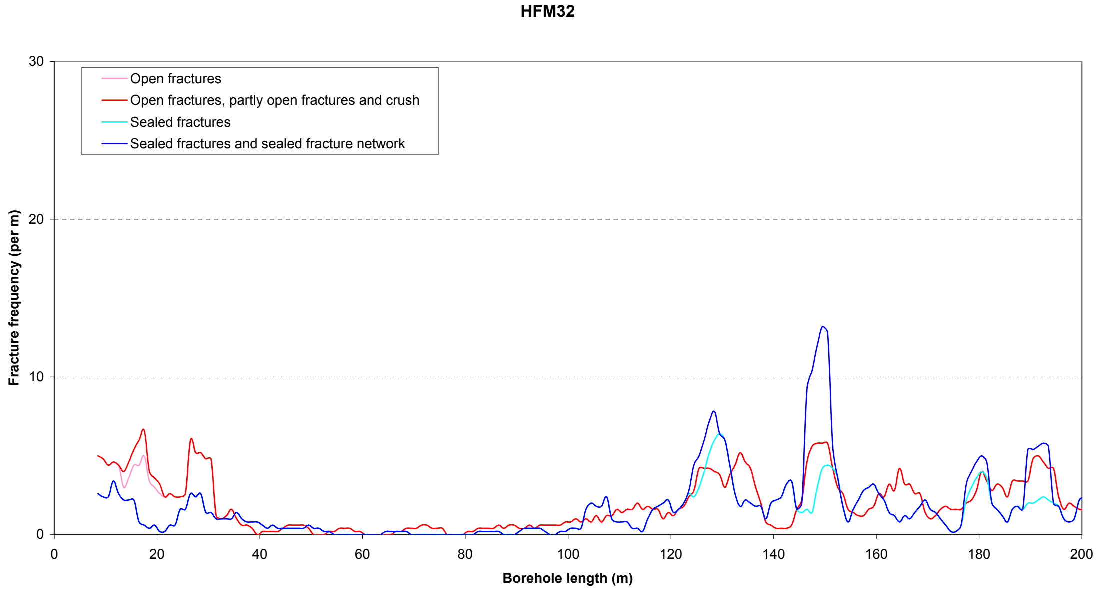

Figure 4-9. *Fracture frequency plot for HFM32. Moving average with a 5 m window and 1 m steps.*

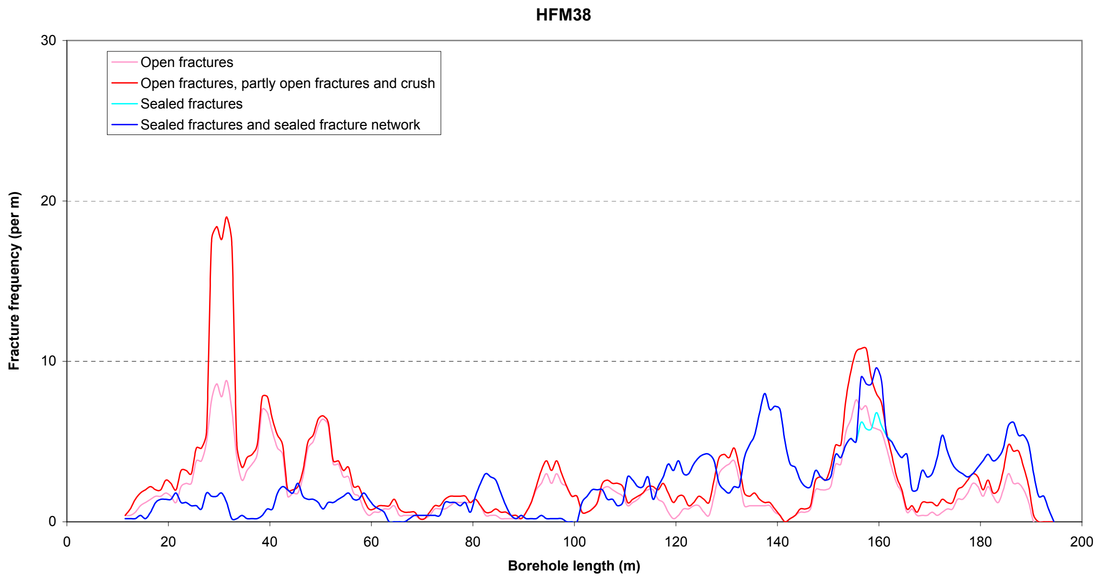

Figure 4-10. *Fracture frequency plot for HFM38. Moving average with a 5 m window and 1 m steps.*

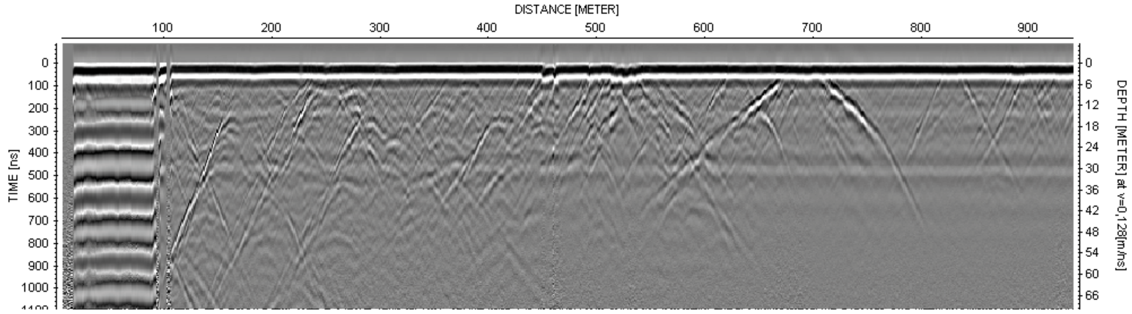

Figure 4-11. *Overview (20 MHz data) of the borehole radar measurements in KFM08C.*

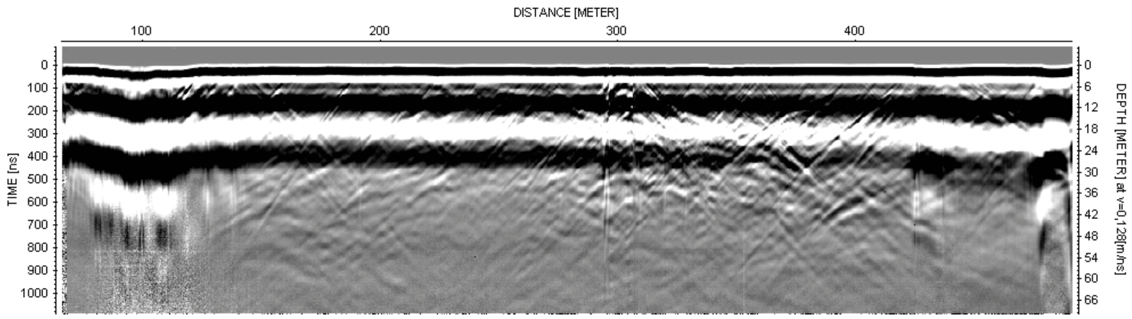

Figure 4-12. *Overview (20 MHz data) of the borehole radar measurements in KFM10A.*

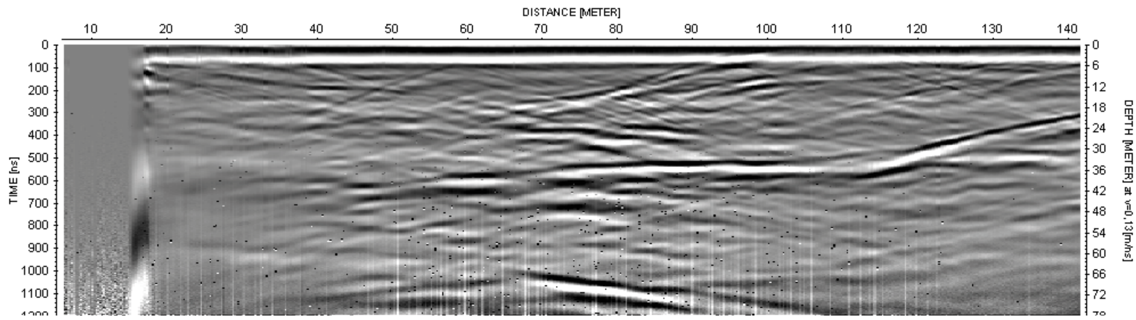

Figure 4-13. *Overview (20 MHz data) of the borehole radar measurements in HFM28.*

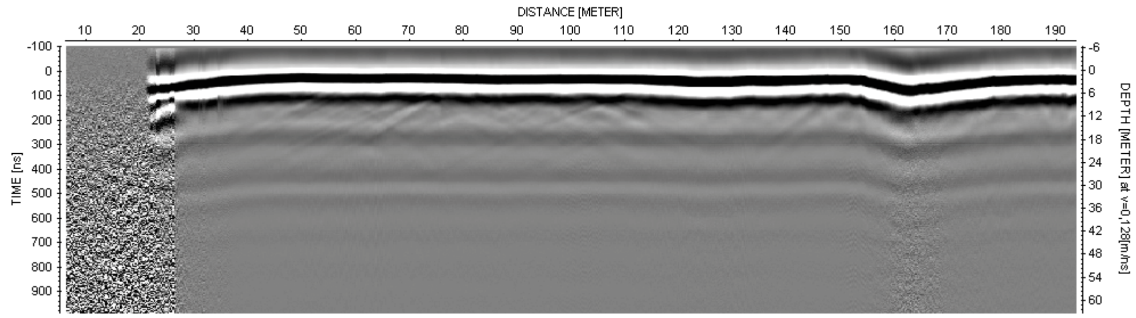

Figure 4-14. *Overview (20 MHz data) of the borehole radar measurements in HFM30.*

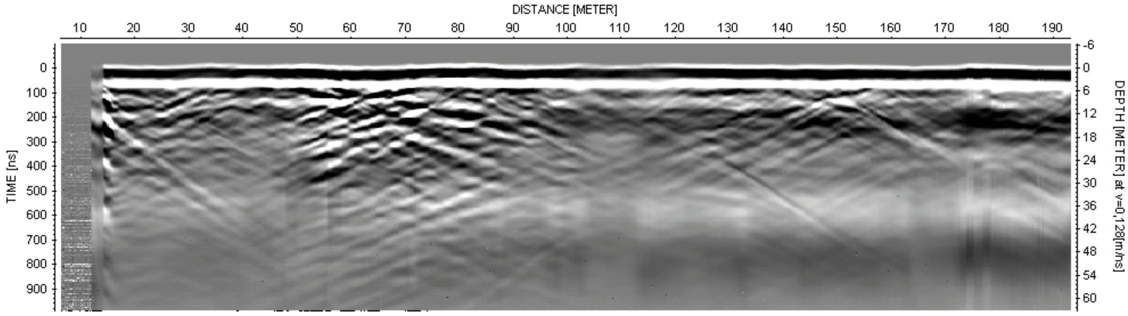

Figure 4-15. *Overview (20 MHz data) of the borehole radar measurements in HFM31.*

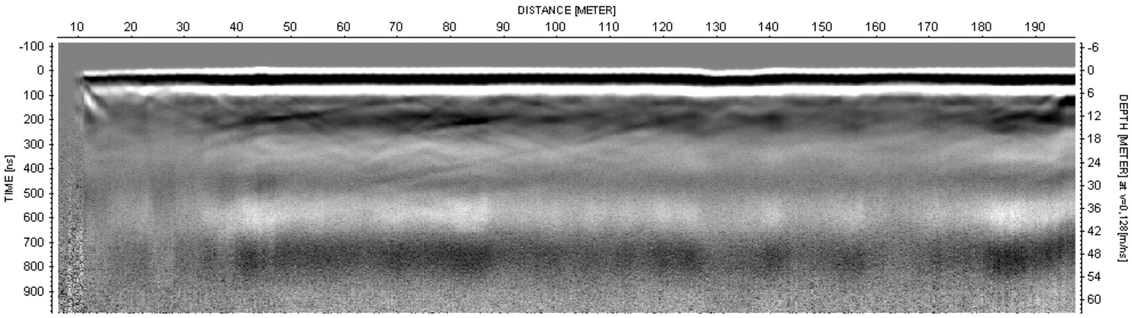

Figure 4-16. *Overview (20 MHz data) of the borehole radar measurements in HFM32.*

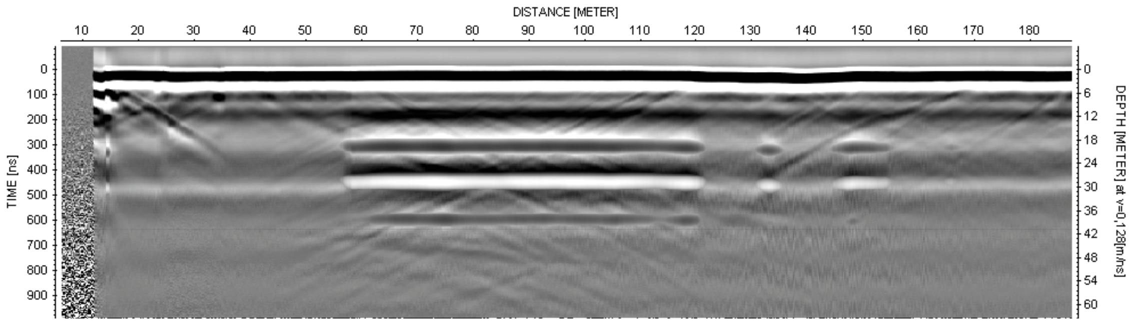

Figure 4-17. *Overview (20 MHz data) of the borehole radar measurements in HFM38.*

4.2 Nonconformities

Radar logging was not performed in percussion borehole HFM23.

Geophysical logging was not performed in HFM23.

The section 949.09–951.85 m in KFM8C was mapped without access to BIPS image.

The section 496.32–500.16 m in KFM10A was mapped without access to BIPS image.

5 Results

The result of the geological single-hole interpretation is presented as print-outs from the software WellCad (Appendix 1 for KFM08C, Appendix 2 for KFM10A, Appendix 3 for HFM23, Appendix 4 for HFM28, Appendix 5 for HFM30, Appendix 6 for HFM31, Appendix 7 for HFM32 and Appendix 8 for HFM38).

5.1 KFM08C

The borehole direction at the start is 036°/–60°.

Rock units

The borehole can be divided into three different rock units, RU1–RU3. Rock unit 1 occurs in four separate length intervals and rock unit 2 occurs in two separate length intervals. All rock units have been recognized with a high degree of confidence.

102.23–342.18 m

RU1a: Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), amphibolite (102017) in the interval 245–312 m, aplitic metagranite (101058) and one occurrence of fine- to medium-grained metagranitoid (101051). Local occurrences of faint to weak albitization especially beneath 260 m. Increased frequency of sealed fractures along restricted intervals beneath 245 m, possible deformation zone (DZ1) excluded. One prominent radar reflector occurs at 319 m (160/77). Confidence level = 3.

342.18–545.94 m

RU2a: Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of aplitic metagranite (101058), fine- to medium-grained metagranitoid (101051) and pegmatitic granite (101061). All rock types show medium to strong albitization. Minor occurrences of amphibolite (102017) in the interval 530–535 m. Several intervals of altered vuggy rocks below 455 m inside DZ2 (see below). Increased frequency of sealed fractures in the interval c 376–385 m, possible deformation zone (DZ2) excluded. Slightly reduced natural gamma radiation. Confidence level = 3.

545.94–603.53 m

RU1b: Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), aplitic metagranite (101058). Minor occurrences of amphibolite (102017) in the interval 446–550 m and one occurrence of fine- to medium-grained metagranitoid (101051) in the interval 592–593 m. Local occurrences of faint to weak albitization in the upper half of the rock unit. Increased frequency of sealed fractures along restricted intervals in the lower half of the rock unit. Confidence level = 3.

603.53–616.76 m

RU2b: Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of aplitic metagranite (101058). All rock types show faint to medium albitization. Increased frequency of sealed fractures in the interval 610–614 m. Confidence level = 3.

616.76–722.71 m

RU1c: Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), amphibolite (102017), aplitic metagranite (101058) and one occurrence of fine- to medium-grained metagranitoid (101051). Faint to strong albitization in the lowermost part of the rock unit. Increased frequency of sealed fractures along restricted intervals in the upper part of the rock unit, possible deformation zone (DZ3) excluded. Confidence level = 3.

722.71–736.54 m

RU3: Pegmatitic granite (101061) and fine- to medium-grained metagranitoid (101051). Increased natural gamma radiation associated with the pegmatitic granite. Low magnetic susceptibility associated with the fine- to medium-grained metagranitoid. Confidence level = 3.

736.54–951.85 m

RU1d: Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), amphibolite (102017), aplitic metagranite (101058). Minor occurrences of both felsic to intermediate metavolcanic rock (103076) and fine- to medium-grained metagranitoid (101051). Local occurrences of faint to strong albitization, commonly in contact with amphibolite. Increased frequency of sealed fractures along restricted intervals in the lower part of the rock unit, possible deformation zones (DZ4 and DZ5) excluded. Confidence level = 3.

Possible deformation zones

Five possible deformation zones of brittle character, of which four have been recognised with a high degree of confidence and one with a medium degree of confidence, are present in KFM08C.

161–191 m

DZ1: Increased frequency of sealed and open fractures. Fractures are variable in orientation. Apertures generally less than 1 mm with four fracture apertures ranging up to 5 mm. Faint to weak oxidation in the lower half of the possible deformation zone. Low resistivity and locally low magnetic susceptibility. The most intense anomaly at 186 m. Thirteen radar reflectors of which three are confidently oriented (279/08, 178/86, 027/73). One prominent radar reflector occurs at 178 m intersecting the borehole axis with 57°. The most frequent fracture filling minerals in order of decreasing abundance are chlorite, calcite, adularia, quartz and pyrite. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite. Confidence level = 3.

419–542 m

DZ2 419–542 m: Increased frequency of sealed and open fractures. Fractures are variable in orientation. Two concentrations are apparent, one of which strikes SSW and dips steeply WNW, and the other is gently dipping to sub-horizontal. Apertures 1.5 mm or less. Faint to medium oxidation in the upper and lowermost parts of the possible zone. Altered vuggy rock occurs in association with oxidation along the following intervals: 454.96–462.50 m, 497.84–499.00 m and 511.62–531.79 m. Low resistivity, low magnetic susceptibility below 452 m and locally low P-wave velocity. Very low resistivity and slightly increased gamma radiation related to vuggy rock. 34 radar reflectors of which six are oriented (072/71 or 212/55, 074/69, 107/66 or 211/22, 084/77, 042/44, 213/45). One interval with decreased penetration occurs between 520 and 535 m associated with the reflector oriented 084/77. The most frequent fracture filling minerals in order of decreasing abundance include calcite, chlorite, hematite, adularia and quartz. The zone is situated in albitized medium-grained metagranite-granodiorite (101057) with subordinate occurrences of aplitic metagranite (101058), and pegmatitic granite (101061).

Minor occurrences of amphibolite (102017) and fine- to medium-grained metagranitoid (101051). Confidence level = 3.

673–705 m

DZ3: Increased frequency of sealed and open fractures. Fractures are variable in orientation. Fractures that strike in the NW/SE quadrants with variable dip are prominent. Apertures generally less than 1 mm, with two exceptions at 3 and 10 mm. Faint to medium oxidation throughout the possible deformation zone. Low resistivity above 700 m and locally low magnetic susceptibility. Twelve radar reflectors of which three are oriented (196/71, 320/71, 025/34 or 164/82). One reflector at 698 m is prominent (320/71). Two intervals with decreased radar penetration around 685 and 695 m. The most frequent fracture filling minerals in order of decreasing abundance include chlorite, calcite, adularia, epidote and quartz. The zone is situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite, amphibolite and aplitic metagranite. Confidence level = 3.

829–832 m

DZ4: Increased frequency of open and sealed fractures. Fractures are variable in orientation. Apertures 1 mm or less. Faint to medium oxidation throughout most of the possible zone. One 8 cm wide crush zone associated with chloritization along the lower contact of an amphibolite at 830.02 m. Low resistivity and slightly decreased P-wave velocity. One prominent radar reflector (179/61) at 830 m associated with decreased amplitude. The most frequent fracture filling minerals in order of decreasing abundance include calcite, chlorite, hematite and clay minerals. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of amphibolite. Confidence level = 3.

946–949 m

DZ5: Increased frequency of sealed fractures predominantly as a sealed fracture network. Fractures are variable in orientation. Fractures that strike in the NW/SE quadrants with variable dip are prominent. Faint to weak oxidation throughout the interval. Low resistivity. Two radar reflectors intersecting the borehole axis with 28° and 29°. The most frequent fracture filling minerals in order of decreasing abundance include adularia, chlorite and calcite. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite. Confidence level = 2.

5.2 KFM10A

The borehole direction at the start is 010°/–50°.

Rock units

The borehole consists of one rock unit, RU1, which has been recognized with a high degree of confidence.

62.85–500.16 m

RU1: Metagranite-granodiorite (101057) with a grain-size varying from fine to medium related to variation in ductile strain. Subordinate occurrences of pegmatitic granite (101061), amphibolite (102017), fine- to medium-grained metagranitoid (101051) and fine- to medium-grained granite (111058). Few minor occurrences of felsic to intermediate metavolcanic rock (103076) are also present. Minor intervals with faint to weak albitization or oxidation. Intervals with an increased frequency of sealed fractures and low resistivity anomalies occur at regular intervals throughout the rock unit, possible deformation zones excluded. These intervals increase in abundance between 267 and 347 m, and are enhanced by an increased frequency of open fractures between 305 and 347 m. Confidence level = 3.

Possible deformation zones

Three possible deformation zones of brittle character that have been recognised with a high degree of confidence are present in KFM10A.

62.85–145 m

DZ1: Increased frequency of sealed and open fractures. Fractures are variable in orientation. Three concentrations are apparent: (1) strike SE and dip steeply to the SW, (2) gently dipping to sub-horizontal and, (3) strike NE and dip variably to the SE. Three crush zones. Apertures generally less than 1 mm with few fracture apertures ranging up to 5 mm. Faint to medium oxidation throughout the possible deformation zone. Several short intervals of altered vuggy rock between 90 and 120 m. Minor intervals show epidotization or argillitization. Low resistivity, low P-wave velocity and low magnetic susceptibility. Very low resistivity, increased gamma radiation and low density in association with altered vuggy rock. Nineteen radar reflectors of which five are oriented (030/48 or 133/63, 034/50, 085/41 or 092/44, 033/51, 028/51). In the interval 85 to 120 m decreased radar penetration associated with altered vuggy rock. The most frequent fracture filling minerals in the order of decreasing abundance are calcite, adularia, hematite, chlorite and clay minerals. Zone situated in generally fine- to medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite and amphibolite. Confidence level = 3.

430–449 m

DZ2: Increased frequency of open and sealed fractures of which some of the latter occur in sealed fracture networks. Fractures are variable in orientation with one concentration of fractures that dips gently to the SSE. Apertures 1 mm or less, except in one fracture which shows an aperture of 5 mm. Low resistivity, low P-wave velocity and locally low magnetic susceptibility. Seven radar reflectors of which one is oriented (337/09 or 287/74). One prominent radar reflector intersects the borehole axis at an angle of 37°. Slightly reduced radar penetration. The most frequent fracture filling minerals in the order of decreasing abundance include calcite, chlorite, adularia and laumontite. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite and amphibolite. Confidence level = 3.

478–490 m

DZ3: Increased frequency of open and sealed fractures. Fractures are variable in orientation with a concentration that dips moderately to gently to the SSW. Apertures generally less than 1 mm. Generally weak to medium oxidation and faint development of altered vuggy rock. Low resistivity, low P-wave velocity, low magnetic susceptibility, low density, as well as increased gamma radiation. Six radar reflectors of which one is oriented (345/11 or 290/74). Strongly reduced radar penetration around 485 m. The most frequent fracture filling minerals in the order of decreasing abundance are calcite, prehnite and chlorite. The zone is situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite. Confidence level = 3.

5.3 HFM23

The borehole direction at the start is 324°/–58°.

Rock units

The borehole consists of two rock units, RU1–RU2, which have been recognized with a low degree of confidence.

20.80–146.43 m

RU1: Medium-grained metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061) and amphibolite (102017). Confidence level = 1.

146.43–180.89 m

RU2: Medium-grained, foliated and relatively biotite rich metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061) and amphibolite (102017). Confidence level = 1.

Possible deformation zones

Three possible deformation zones of brittle character that have been recognised with a low degree of confidence are present in HFM23.

26–42 m

DZ1: Increased frequency of open fractures in the lower part and sealed fractures in the upper part of the possible zone. Fractures strike ENE with sub-vertical dip or are gently dipping to sub-horizontal. Fracture apertures generally less than 1 mm with the exception of one which is 3 mm. Locally faint to medium oxidation. Upper part of zone situated in amphibolite and lower part in medium-grained metagranite-granodiorite, with subordinate occurrences of pegmatitic granite. Confidence level = 1.

82–95 m

DZ2: Increased frequency of sealed fractures and sealed fracture networks. Fractures are variable in orientation. Moderately to steeply dipping fractures that strike in the NE/SW quadrants are prominent. Some open fractures are gently dipping. Fracture apertures less than 1 mm. Locally weak to medium oxidation. Zone situated in pegmatitic granite. Confidence level = 1.

166–169 m

DZ3: Increased frequency of sealed fracture networks. Apertures less than 1 mm. Weak oxidation in the lower half of the possible zone. Zone situated in medium-grained metagranite-granodiorite, with subordinate occurrences of amphibolite. Confidence level = 1.

5.4 HFM28

The borehole direction at the start is 147°/–85°.

Rock units

The borehole consists of one rock unit, RU1, which has been recognized with a medium degree of confidence.

12.02–148.41 m

RU1: Medium-grained metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061), fine- to medium-grained granite (111058), amphibolite (102017), metagranodiorite (101056), fine- to medium-grained metagranitoid (101051) and aplitic metagranite (101058). Scattered narrow low resistivity anomalies throughout the borehole. Four sub-parallel radar reflectors observed at a distance of 20–70 m from the borehole are all inferred to represent sub-vertical structures. Confidence level = 2.

Possible deformation zones

One possible deformation zone of brittle character that has been recognised with a medium degree of confidence is present in HFM28.

12.02–65 m

DZ1: Slightly increased frequency of open fractures in the lower half of the possible zone. Fractures that either strike SW and dip moderate to steep towards the NW or are gently dipping to sub-horizontal are prominent. Locally increased frequency of sealed fractures. Several occurrences of sealed fracture networks. Apertures generally less than 1 mm. Low resistivity apart from the interval 45–52 m and slightly decreased magnetic susceptibility. Eleven radar reflectors identified (angle to borehole axis 17–84°), most of which intersect borehole with a high angle. Zone situated in medium-grained metagranite-granodiorite, with subordinate occurrences of pegmatitic granite, amphibolite and metagranodiorite. Confidence level = 2.

5.5 HFM30

The borehole direction at the start is 029°/–56°.

Rock units

The borehole consists of three rock units, RU1–RU3. All rock units have been recognized with a medium or low degree of confidence.

18.03–57.45 m

RU1: The rock unit is dominated by metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061) and metatonalite-granodiorite (101054). Locally weak to medium oxidation, particularly at the base of the rock unit. Lower density and higher gamma radiation in the upper part of the rock unit. Confidence level = 1.

57.45–126.34 m

RU2: Metatonalite-granodiorite (101054) dominates the borehole in this interval. Minor constituents of pegmatitic granite (101061), amphibolite (102017) and felsic to intermediate volcanic rock (103076) are present. Confidence level = 2.

126.34–200.44 m

RU3: Heterogeneous rock unit with medium-grained metatonalite-granodiorite (101054), pegmatitic granite (101061), medium-grained metagranite-granodiorite (101057) and amphibolite (102017) as dominant rock types. Felsic to intermediate volcanic rock (103076), aplitic metagranite (101058) and metadiorite-gabbro (101033) occur as minor constituents. Confidence level = 2.

Possible deformation zones

One possible deformation zone of brittle character that has been recognised with a medium or low degree of confidence is present in HFM30.

79–200 m

DZ1: Generally increased frequency of sealed fractures, most of which occur in sealed fracture networks, and an increased frequency of open fractures in the lower half of the possible zone. Fractures are variable in orientation. Fractures that strike in the SE quadrant and variable dip to the SW are conspicuous. Several crush zones beneath 157 m. The zone can be divided into four segments based on combined geophysical and geological characteristics.

79–85 m: Increased frequency of sealed fractures in sealed fracture networks. Apertures generally less than 1 mm, occasionally up to 2 mm. Weak oxidation in the upper part. Normal geophysical character. Three radar reflectors intersect the borehole axis at moderate angles.

85–119 m: Increased frequency of sealed fractures, mostly in sealed fracture networks. Apertures generally less than 1 mm, occasionally up to 2 mm. Generally weak oxidation. Some low resistivity anomalies in the upper part as well as low magnetic susceptibility beneath 107 m. Five radar reflectors intersect the borehole axis at moderate angles.

119–174 m: Generally increased frequency of sealed fractures, mostly in sealed fracture networks and increased frequency of open fractures in the lower half. Five crush zones beneath 157 m. Apertures are generally less than 1 mm, but in the lower part extend up to 5 mm. The whole interval shows low resistivity, low magnetic susceptibility and low P-wave velocity. Seven radar reflectors intersect the borehole axis at a high angle and one at a low angle. Possible cataclasite and crush rocks coincide with low radar penetration, very low resistivity and very low P-wave velocity in the interval 158–167 m.

174–200 m: Increased frequency of open and sealed fractures, the latter mostly as sealed fracture networks. Three crush zones are present. Fracture apertures are generally less than 1 mm, occasionally up to 2 mm. Locally weak to medium oxidation. Scattered low resistivity anomalies, normal P-wave velocity and local low magnetic susceptibility. Three radar reflectors intersecting the borehole axis at moderate to high angles. Confidence level = 3.

5.6 HFM31

The borehole direction at the start is 312°/–69°.

Rock units

The borehole consists of two rock units, RU1–RU2. Rock unit 1 occurs at two separate borehole intervals. All rock units have been recognized with a medium degree of confidence.

9.00–28.46 m

RU1a: Metadiorite to gabbro (101033) with subordinate pegmatitic granite (101061) and one occurrence of fine- to medium-grained metagranitoid (101051). Pegmatitic rock is associated with high gamma radiation and low magnetic susceptibility and low density. The opposite applies to metadiorite to gabbro. Two occurrences of sealed fracture networks associated with either oxidation or albitization. Confidence level = 2.

28.46–120.50 m

RU2: Pegmatitic granite (101061) with subordinate metadiorite to -gabbro (101033) and amphibolite (102017). One occurrence of fine- to medium-grained metagranitoid (101051). Two crush zones at 45.200–45.215 m and 108.36–108.45 m are associated with low resistivity. The latter is associated with possible cataclasite at 108.15–108.76 m and a sealed fracture network at 108.46–108.79 m. Four other sealed networks occur in the rock unit. One occurrence of weak albitization associated with amphibolite. Locally weak to medium oxidation, of which one is associated with crush. Pegmatitic rock is associated with high gamma radiation and low magnetic susceptibility and low density. The amphibolite in the borehole interval 95.04–98.61 m coincides with low magnetic susceptibility. Confidence level = 2.

120.50–200.45 m

RU1b: Metadiorite to gabbro (101033) with subordinate pegmatitic granite (101061) and amphibolite (102017). Pegmatitic rock is associated with high gamma radiation and low magnetic susceptibility and low density. The opposite applies to metadiorite to gabbro. One sealed fracture network at 168.15–168.80 m. Confidence level = 2.

Possible deformation zones

No possible deformation zone has been recognised in HFM31.

5.7 HFM32

The borehole direction at the start is 116°/–86°.

Rock units

The borehole consists of four rock unit, RU1–RU4. Rock unit 2 occurs at three separate borehole intervals (RU2a, RU2b and RU2c). All rock units have been recognized with a medium or high degree of confidence.

6.03–19.60 m

RU1: Amphibolite (102017) with subordinate occurrences of medium-grained metagranite-granodiorite (101057) and pegmatitic granite (101061). The rock unit is also characterized by an increased frequency of open and sealed fractures, relative to RU3 (see below) and two crush zones. High density, low gamma radiation and low magnetic susceptibility. Low bulk resistivity and three distinct caliper anomalies. Confidence level = 3.

19.60–29.0 m

RU2a: Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of pegmatitic granite (101061) and one minor occurrence of amphibolite (102017). The rock unit is also characterized by an increased frequency of open and sealed fractures, relative to RU3 (see below). Slightly decreased bulk resistivity and one prominent resistivity and caliper anomaly at 28 m. Confidence level = 2.

29.0–122.37 m

RU3: Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of pegmatitic granite (101061) and a few minor occurrences of amphibolite (102017). High gamma radiation, low density and low magnetic susceptibility associated with pegmatitic rock. Confidence level = 2.

122.37–135.13 m

RU2b: Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of pegmatitic granite (101061) and amphibolite (102017). The rock unit is also characterized by an increased frequency of open and sealed fractures, relative to RU3. High density and low gamma radiation associated with amphibolite whereas the opposite applies to pegmatitic granite. Low magnetic susceptibility throughout the section. No anomalous character in the resistivity logs. Confidence level = 2.

135.13–161.63 m

RU4: Pegmatitic granite (101061) characterized by an increased frequency of open and sealed fractures relative to RU3. Low density, low magnetic susceptibility and increased gamma radiation. Slightly decreased bulk resistivity. Confidence level = 2.

161.63–202.61 m

RU2c: Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of pegmatitic granite (101061) and a few minor occurrences of amphibolite (102017). The rock unit is also characterized by an increased frequency of open and sealed fractures, relative to RU3. Low magnetic susceptibility and some minor resistivity anomalies in the upper part of the unit. Confidence level = 2.

Possible deformation zones

No possible deformation zone has been recognised in HFM32.

5.8 HFM38

The borehole direction at the start is 094°/–54°.

Rock units

The borehole consists of two rock units, RU1–RU2, which have been recognized with a medium and low degree of confidence.

9.15–54.0 m

RU1: Medium-grained metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061). Possibly local occurrences of albitization inferred from frequent intervals of low gamma radiation. Locally weak to medium oxidation. The rock unit is also characterized by an increased frequency of open fractures, relative to RU2 (see below). One crush zone and one fracture with an aperture at 10 mm at 30 m. Low bulk resistivity, scattered caliper anomalies and, between 20 and 38 m, low magnetic susceptibility. Prominent geophysical anomaly at 29 to 30.5 m characterized by low resistivity and low density. Confidence level = 1.

54.0-194.79 m

RU2: Medium-grained metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061), amphibolite (102017) and fine- to medium-grained metagranitoid (101051). Most of the rock unit is affected by albitization of varying intensity which is reflected in generally low gamma radiation throughout the rock unit. Amphibolite is associated with high density and low gamma radiation. Confidence level = 2.

Possible deformation zones

One possible deformation zone of brittle character with a medium degree of confidence is present in HFM38.

149–164 m

DZ1: Increased frequency of sealed and possibly open fractures. Fractures that strike SSW and dip steeply to the WNW dominate. Gently dipping fractures as well as fractures that strike SSE and dip moderately to steeply to the WSW are also present. No fracture shows an aperture wider than 1 mm. Faint to medium oxidation throughout the possible zone. Geophysical anomaly at 161 m with low resistivity, low magnetic susceptibility and caliper anomaly. Six radar reflectors intersecting the borehole axis at moderate to high angles. Confidence level = 2.

6 Comments

The results of the geological single-hole interpretations of KFM08C, KFM10A, HFM23, HFM28, HFM30, HFM31, HFM32 and HFM38 are presented in WellCad plots (Appendix 1–8). The WellCad plot consists of the following columns:

1: Depth (length along the borehole)

2: Rock type

3: Rock alteration

4: Sealed fractures

5: Open and partly open fractures

6: Crush zones

7: Silicate density

8: Magnetic susceptibility

9: Natural gamma radiation

10: Estimated fracture frequency

11: Description: Rock unit

12: Stereogram for sealed fractures in rock unit (blue symbols)

13: Stereogram for open and partly open fractures in rock unit (red symbols)

14: Description: Possible deformation zone

15: Stereogram for sealed fractures in possible deformation zone (blue symbols)

16: Stereogram for open and partly open fractures in possible deformation zone (red symbols)

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/9/ **Gustafsson J, Gustafsson C, 2006.** Forsmark site investigation. RAMAC and BIPS logging in boreholes KFM09B, HFM24, HFM26, HFM27, HFM29 and HFM32. SKB P-06-64. Svensk Kärnbränslehantering AB.

/10/ **Gustafsson J, Gustafsson C, 2006.** Forsmark site investigation. RAMAC and BIPS logging in boreholes KFM08C, HFM30, HFM31, HFM33 and HFM34. SKB P-06-178. Svensk Kärnbränslehantering AB.

/11/ **Gustafsson J, Gustafsson C, 2006.** Forsmark site investigation. RAMAC and BIPS logging in boreholes KFM10A, HFM35 and HFM38. SKB P-06-177. Svensk Kärnbränslehantering AB.

/12/ **Gustafsson J, Gustafsson C, 2006.** Forsmark site investigation. RAMAC and BIPS logging in boreholes KFM07B, KFM09A, HFM24 and HFM28. SKB P-06-44. Svensk Kärnbränslehantering AB.

Appendix 1

Geological single-hole interpretation of KFM08C

Title	SINGLE HOLE INTERPRETATION KFM08C					
Site	FORSMARK	Inclination [°]	-60.45	Elevation [m.a.s.l.]	2.47	Signed data
Borehole	KFM08C	Date of mapping	2006-06-20 15:25:00	Drilling Start Date	2005-04-13 09:00:00	
Diameter [mm]	77	Coordinate System	RT90-RHB70	Drilling Stop Date	2005-04-26 15:00:00	
Length [m]	951.080	Northing [m]	6700495.88	Surveying Date		
Bearing [°]	35.88	Easting [m]	1631187.57	Plot Date	2006-10-19 21:09:52	

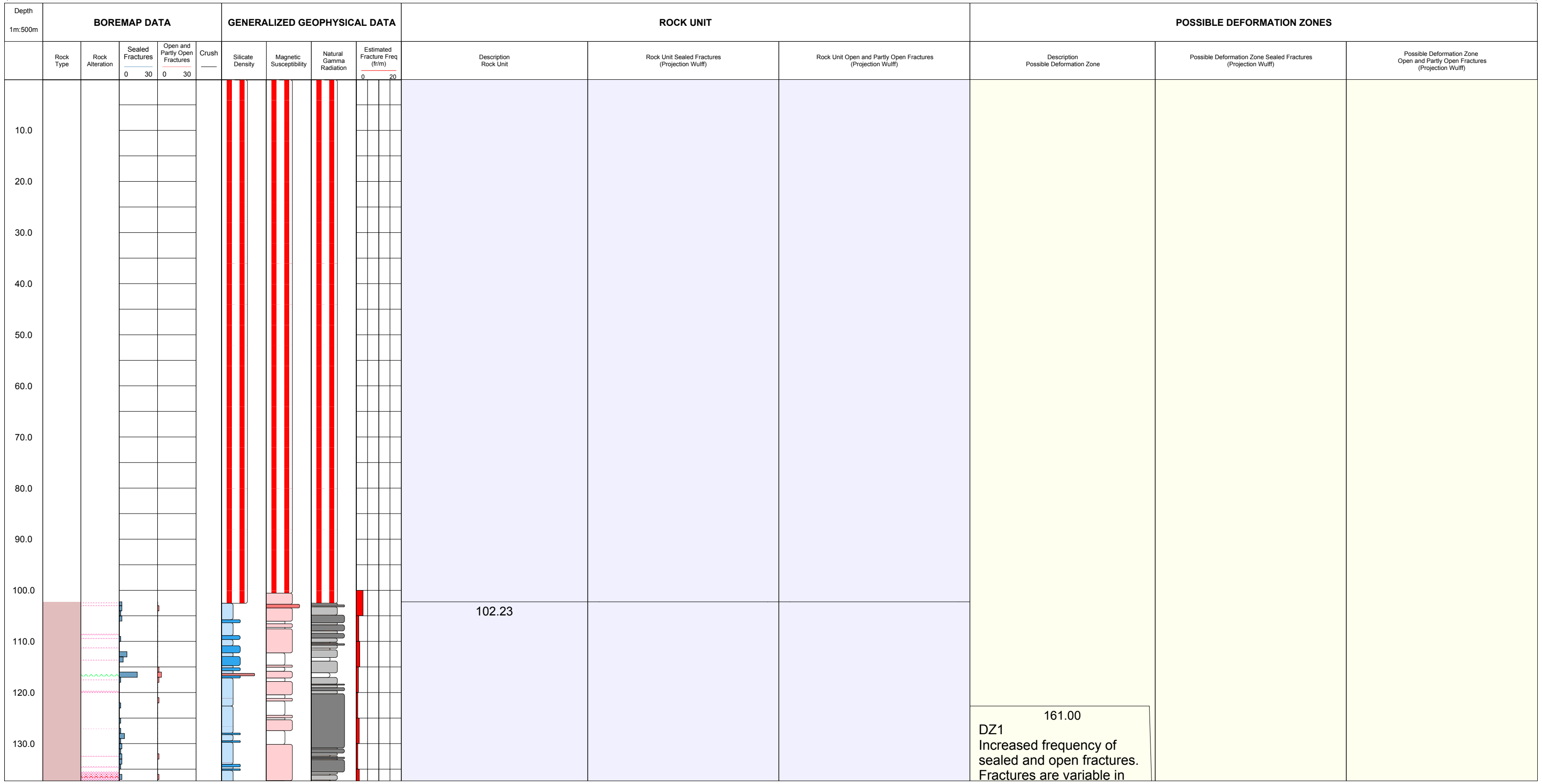
ROCKTYPE FORSMARK
- Pegmatite, pegmatitic granite
- Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained
- Granite, metamorphic, aplitic
- Granite to granodiorite, metamorphic, medium-grained
- Amphibolite
- Calc-silicate rock (skarn)

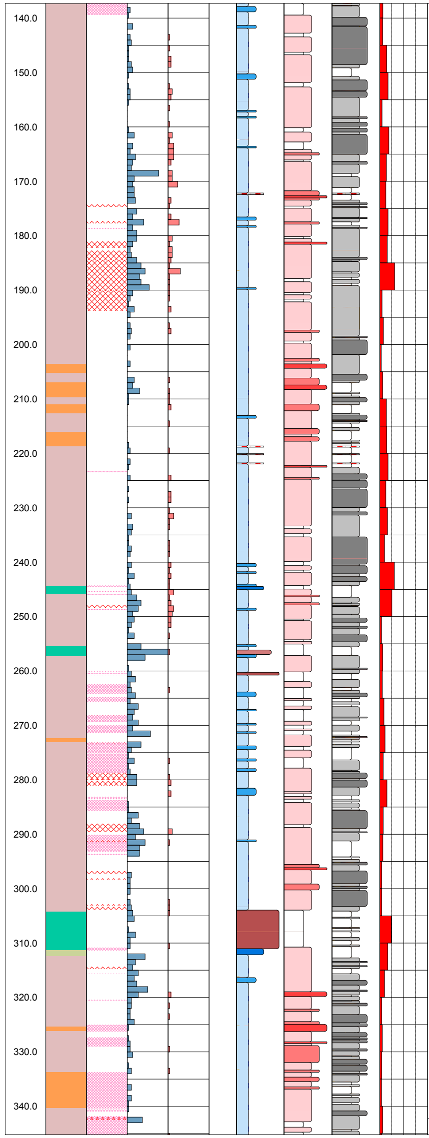
ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized
- Quartz dissolution
- Albitization
- Carbonatization
- Saussuritization

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53
- 53<gam

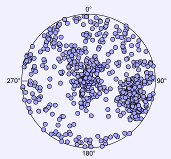


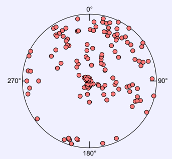


RU1a
Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), amphibolite (102017) in the interval 245-312 m, aplitic metagranite (101058) and one occurrence of fine- to medium-grained metagranitoid (101051). Local occurrences of faint to weak albitization especially beneath 260 m. Increased frequency of sealed fractures along restricted intervals beneath 245 m, possible deformation zone (DZ1) excluded. One prominent radar reflector occurs at 319 m (160/77). Confidence level = 3.

342.18

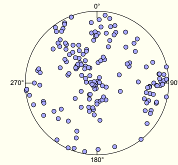
342.18

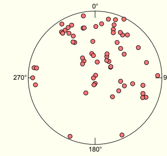


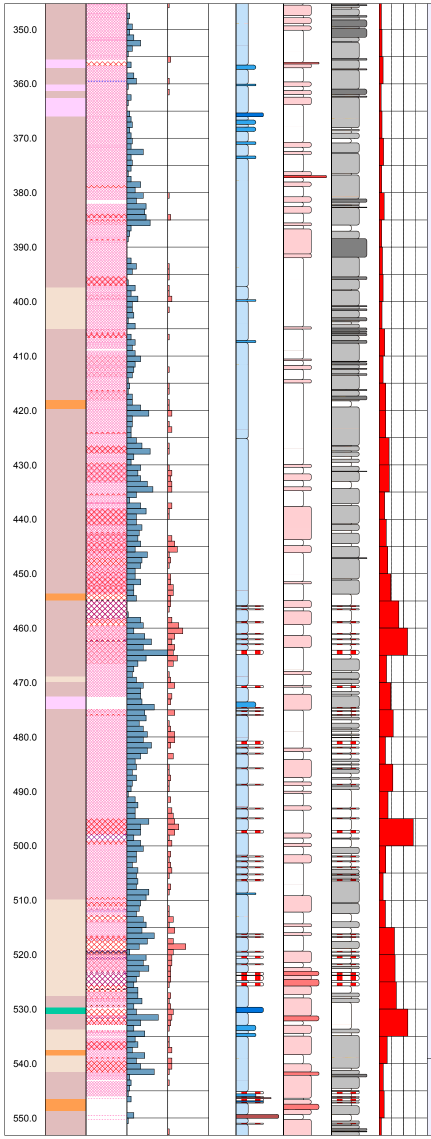


orientation. Apertures generally less than 1 mm with four fracture apertures ranging up to 5 mm. Faint to weak oxidation in the lower half of the possible deformation zone. Low resistivity and locally low magnetic susceptibility. The most intense anomaly at 186 m. Thirteen radar reflectors of which three are confidently oriented (279/08, 178/86, 027/73). One prominent radar reflector occurs at 178 m intersecting the borehole axis with 57°. The most frequent fracture filling minerals in order of decreasing abundance are chlorite, calcite, adularia, quartz and pyrite. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite. Confidence level = 3.

191.00



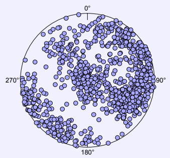


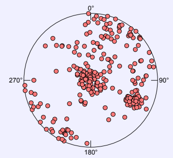


RU2a
Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of aplitic metagranite (101058), fine- to medium-grained metagranitoid (101051) and pegmatitic granite (101061). All rock types show medium to strong albitization. Minor occurrences of amphibolite (102017) in the interval 530-535 m. Several intervals of altered vuggy rocks below 455 m inside DZ2 (see below). Increased frequency of sealed fractures in the interval c. 376-385 m, possible deformation zone (DZ2) excluded. Slightly reduced natural gamma radiation. Confidence level = 3.

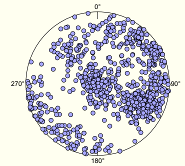
545.94

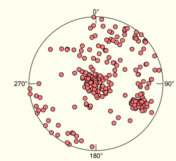
545.94
RU1b
Medium-grained metagranite-granodiorite (101057) with subordinate

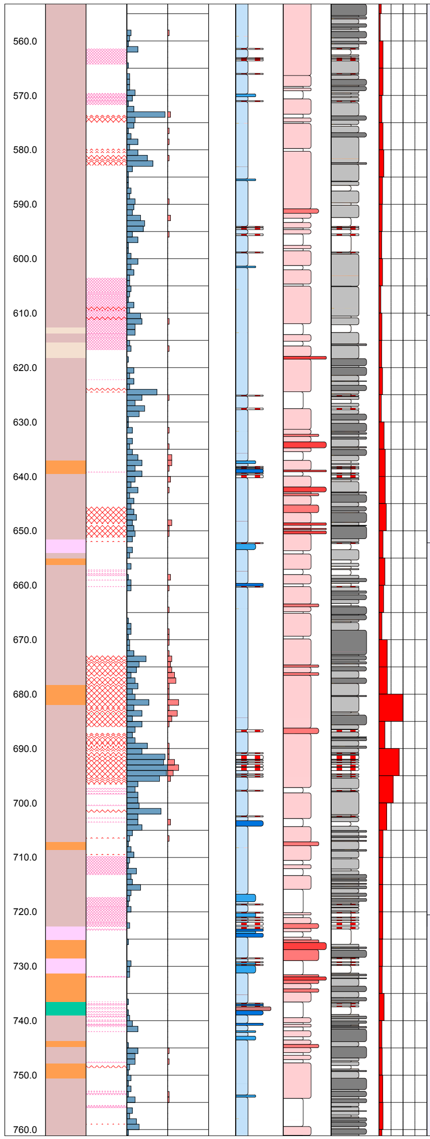




419.00
DZ2
Increased frequency of sealed and open fractures. Fractures are variable in orientation. Two concentrations are apparent, one of which strikes SSW and dips steeply WNW, and the other is gently dipping to sub-horizontal. Apertures 1.5 mm or less. Faint to medium oxidation in the upper and lowermost parts of the possible zone. Altered vuggy rock occurs in association with oxidation along the following intervals: 454.96-462.50 m, 497.84-499.00 m and 511.62-531.79 m. Low resistivity, low magnetic susceptibility below 452 m and locally low P-wave velocity. Very low resistivity and slightly increased gamma radiation related to vuggy rock. 34 radar reflectors of which six are oriented (072/71 or 212/55, 074/69, 107/66 or 211/22, 084/77, 042/44, 213/45). One interval with decreased penetration occurs between 520 and 535 m associated with the reflector oriented 084/77. The most frequent fracture filling minerals in order of decreasing abundance include calcite, chlorite, hematite, adularia and quartz. The zone is situated in albitized medium-grained metagranite-granodiorite (101057) with subordinate occurrences of aplitic metagranite (101058), and pegmatitic granite (101061). Minor occurrences of amphibolite





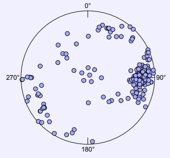
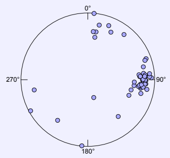
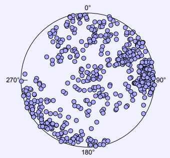
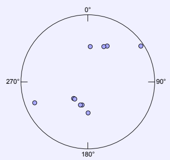
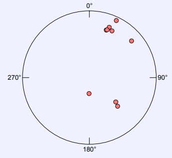
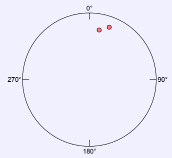
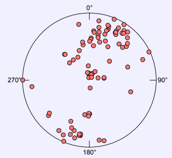
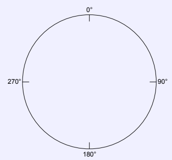


(101057) with subordinate pegmatitic granite (101061), aplitic metagranite (101058). Minor occurrences of amphibolite (102017) in the interval 446-550 m and one occurrence of fine- to medium-grained metagranitoid (101051) in the interval 592-593 m. Local occurrences of faint to weak albitization in the upper half of the rock unit. Increased frequency of sealed fractures along restricted intervals in the lower half of the rock unit. Confidence level = 3.
603.53

603.53
RU2b
Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of aplitic metagranite (101058). All rock types show faint to medium albitization. Increased frequency of sealed fractures in the interval 610-614 m. Confidence level = 3.
616.76

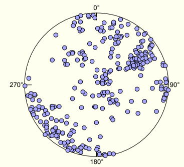
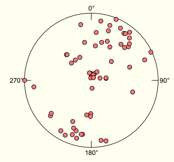
616.76
RU1c
Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), amphibolite (102017), aplitic metagranite (101058) and one occurrence of fine- to medium-grained metagranitoid (101051). Faint to strong albitization in the lowermost part of the rock unit. Increased frequency of sealed fractures along restricted intervals in the upper part of the rock unit, possible deformation zone (DZ3) excluded. Confidence level = 3.
722.71

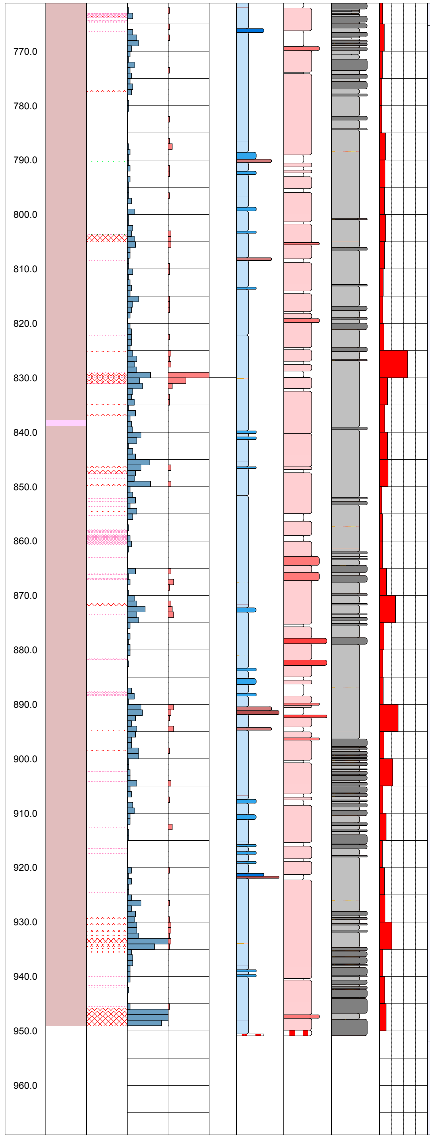
722.71
RU3
Pegmatitic granite (101061) and fine- to medium-grained metagranitoid (101051). Increased natural gamma radiation associated with the pegmatitic granite. Low magnetic susceptibility associated with the fine- to medium-grained metagranitoid. Confidence level = 3.

occurrences of amphibolite (102017) and fine- to medium-grained metagranitoid (101051). Confidence level = 3.
542.00

673.00
DZ3
Increased frequency of sealed and open fractures. Fractures are variable in orientation. Fractures that strike in the NW/SE quadrants with variable dip are prominent. Apertures generally less than 1 mm, with two exceptions at 3 and 10 mm. Faint to medium oxidation throughout the possible deformation zone. Low resistivity above 700 m and locally low magnetic susceptibility. Twelve radar reflectors of which three are oriented (196/71, 320/71, 025/34 or 164/82). One reflector at 698 m is prominent (320/71). Two intervals with decreased radar penetration around 685 and 695 m. The most frequent fracture filling minerals in order of decreasing abundance include chlorite, calcite, adularia, epidote and quartz. The zone is situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite, amphibolite and aplitic metagranite. Confidence level = 3.
705.00

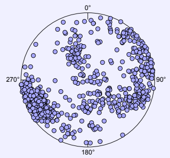


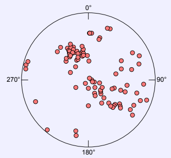
736.54

736.54

RU1d
Medium-grained metagranite-granodiorite (101057) with subordinate pegmatitic granite (101061), amphibolite (102017), aplitic metagranite (101058). Minor occurrences of both felsic to intermediate metavolcanic rock (103076) and fine- to medium-grained metagranitoid (101051). Local occurrences of faint to strong albitization, commonly in contact with amphibolite. Increased frequency of sealed fractures along restricted intervals in the lower part of the rock unit, possible deformation zones (DZ4 and DZ5) excluded. Confidence level = 3.

951.85

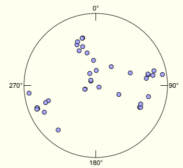


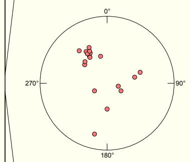


829.00

DZ4
Increased frequency of open and sealed fractures. Fractures are variable in orientation. Apertures 1 mm or less. Faint to medium oxidation throughout most of the possible zone. One 8 cm wide crush zone associated with chloritization along the lower contact of an amphibolite at 830.02 m. Low resistivity and slightly decreased P-wave velocity. One prominent radar reflector (179/61) at 830 m associated with decreased amplitude. The most frequent fracture filling minerals in order of decreasing abundance include calcite, chlorite, hematite and clay minerals. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of amphibolite. Confidence level = 3.

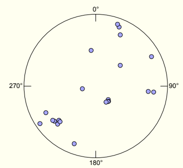
832.00

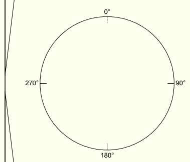




946.00

DZ5
Increased frequency of sealed fractures predominantly as a sealed fracture network. Fractures are variable in orientation. Fractures that strike in the NW/SE quadrants with variable dip are prominent. Faint to weak oxidation throughout the interval. Low resistivity. Two radar reflectors intersecting the borehole axis with 28° and 29°. The most frequent fracture filling minerals in order of decreasing abundance include adularia, chlorite and calcite. Zone situated in





970.0 980.0	medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite. Confidence level = 2. 949.00	

Geological single-hole interpretation of KFM10A

Title	SINGLE HOLE INTERPRETATION KFM10A						
Site	FORSMARK	Inclination [°]	-50.04	Elevation [m.a.s.l.]	4.51	Signed data	
Borehole	KFM10A	Date of mapping	2006-06-20 10:59:00	Drilling Start Date	2005-12-06 09:00:00		
Diameter [mm]	16	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-02-19 15:00:00		
Length [m]	500.160	Northing [m]	6698629.17	Surveying Date			
Bearing [°]	10.42	Easting [m]	1631715.90	Plot Date	2006-10-19 21:09:52		

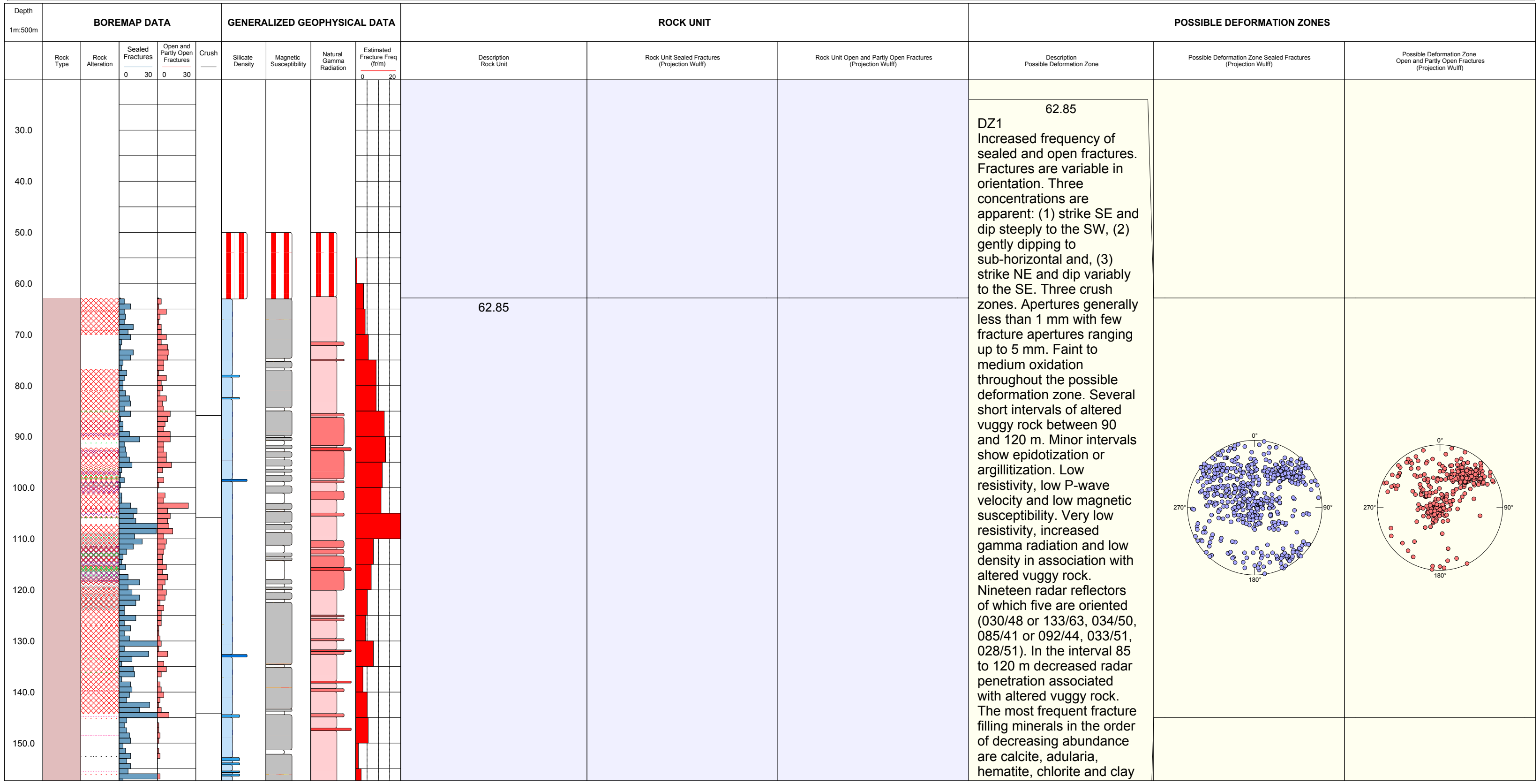
ROCKTYPE FORSMARK
- Granite, fine- to medium-grained
- Pegmatite, pegmatitic granite
- Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained
- Granite to granodiorite, metamorphic, medium-grained
- Amphibolite

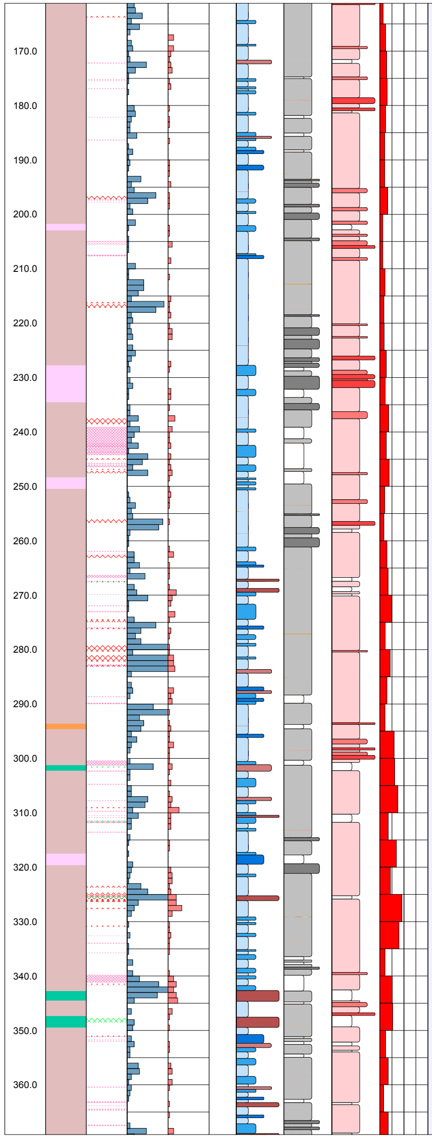
ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized
- Sericitisized
- Quartz dissolution
- Silicification
- Argillization
- Albitization

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

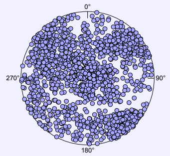
SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

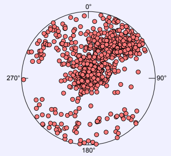
NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53
- 53<gam



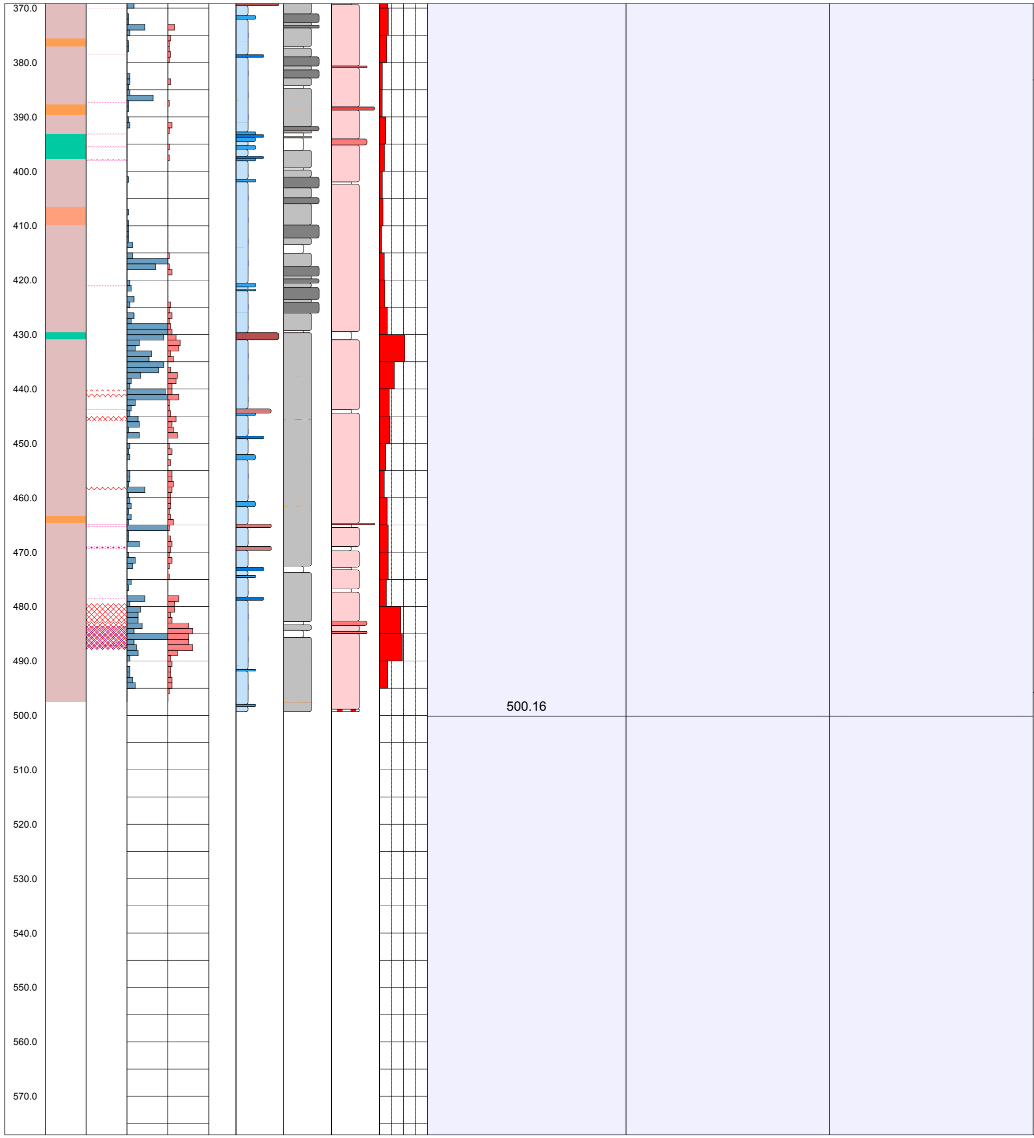


RU1
Metagranite-granodiorite (101057) with a grain-size varying from fine to medium related to variation in ductile strain. Subordinate occurrences of pegmatitic granite (101061), amphibolite (102017), fine- to medium-grained metagranitoid (101051) and fine- to medium-grained granite (111058). Few minor occurrences of felsic to intermediate metavolcanic rock (103076) are also present. Minor intervals with faint to weak albitization or oxidation. Intervals with an increased frequency of sealed fractures and low resistivity anomalies occur at regular intervals throughout the rock unit, possible deformation zones excluded. These intervals increase in abundance between 267 and 347 m, and are enhanced by an increased frequency of open fractures between 305 and 347 m. Confidence level = 3.





generally fine- to medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite and amphibolite. Confidence level = 3.
145.00



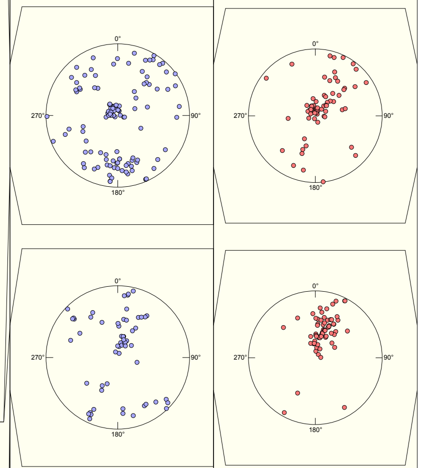
430.00

DZ2
Increased frequency of open and sealed fractures of which some of the latter occur in sealed fracture networks. Fractures are variable in orientation with one concentration of fractures that dips gently to the SSE. Apertures 1 mm or less, except in one fracture which shows an aperture of 5 mm. Low resistivity, low P-wave velocity and locally low magnetic susceptibility. Seven radar reflectors of which one is oriented (337/09 or 287/74). One prominent radar reflector intersects the borehole axis at an angle of 37°. Slightly reduced radar penetration. The most frequent fracture filling minerals in the order of decreasing abundance include calcite, chlorite, adularia and laumontite. Zone situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite and amphibolite. Confidence level = 3.

449.00

478.00

DZ3
Increased frequency of open and sealed fractures. Fractures are variable in orientation with a concentration that dips moderately to gently to the SSW. Apertures generally less than 1 mm. Generally weak to medium oxidation and faint development of altered vuggy rock. Low resistivity, low P-wave velocity, low magnetic susceptibility, low density, as well as increased gamma radiation. Six radar reflectors of which one is oriented (345/11 or 290/74). Strongly reduced radar penetration around 485 m. The most frequent fracture filling minerals in the order of decreasing abundance are calcite, prehnite and chlorite. The zone is situated in



580.0													zone is situated in medium-grained metagranite-granodiorite with subordinate occurrences of pegmatitic granite. Confidence level = 3.		
590.0													490.00		

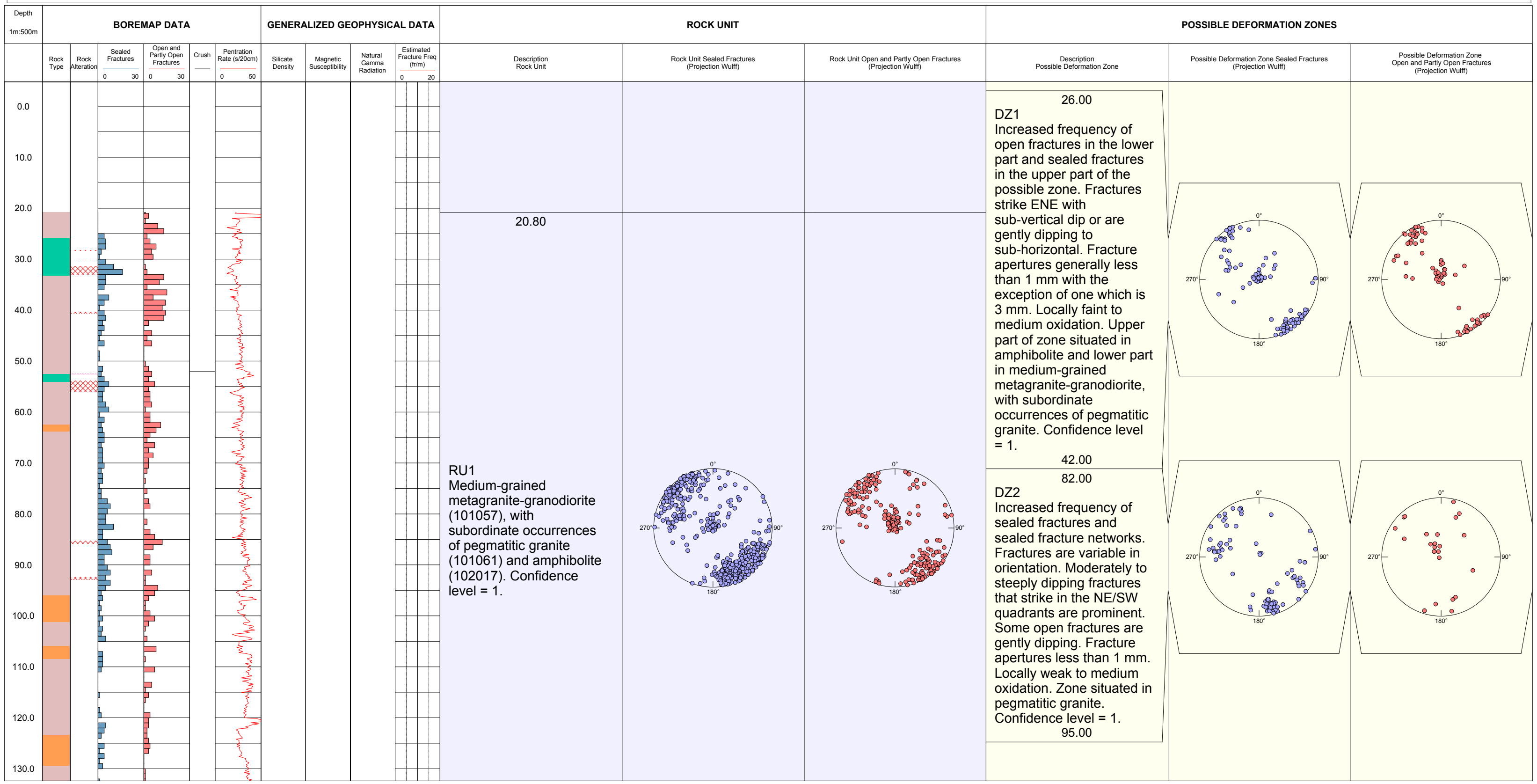
Geological single-hole interpretation of HFM23

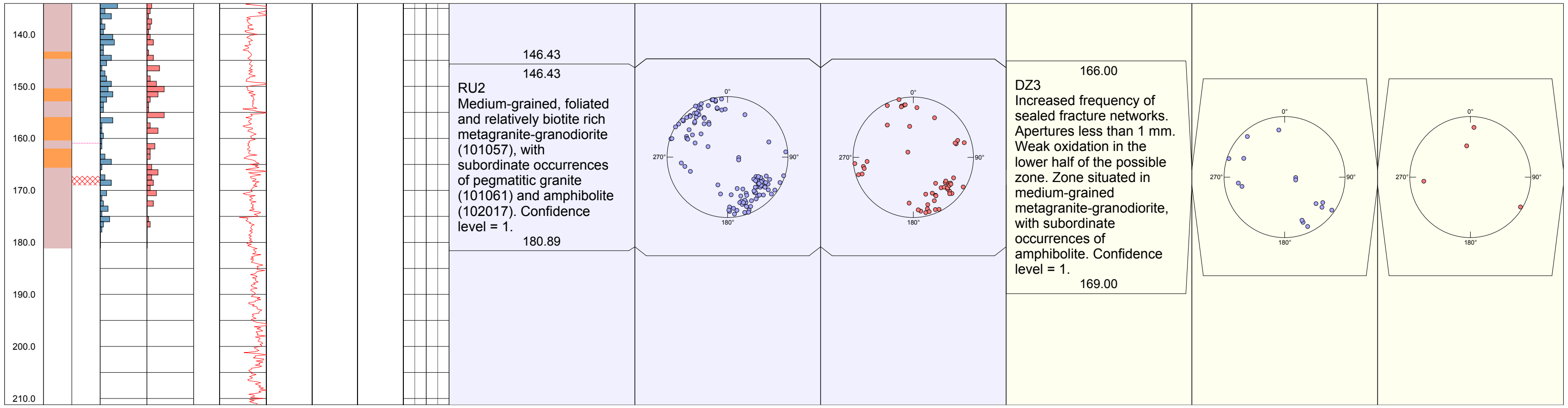
Title	**SINGLE HOLE INTERPRETATION HFM23**						
Site	FORSMARK	**Inclination [°]**	-58.47	**Elevation [m.a.s.l.]**	4.25	**Signed data**	
Borehole	HFM23	**Date of mapping**	2006-08-23 15:29:00	**Drilling Start Date**	2005-08-24 13:00:00		
Diameter [mm]	134	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2005-09-01 14:00:00		
Length [m]	211.500	**Northing [m]**	6700067.69	**Surveying Date**			
Bearing [°]	324.35	**Easting [m]**	1630595.43	**Plot Date**	2006-10-19 21:09:52		

ROCKTYPE FORSMARK
- Pegmatite, pegmatitic granite
- Granite to granodiorite, metamorphic, medium-grained
- Amphibolite

ROCK ALTERATION
- Oxidized
- Albitization

SILICATE DENSITY **SUSCEPTIBILITET** **NATURAL GAMMA**




140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
146.43
146.43
RU2
Medium-grained, foliated and relatively biotite rich metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061) and amphibolite (102017). Confidence level = 1.
180.89
0°
90°
180°
270°
166.00
DZ3
Increased frequency of sealed fracture networks. Apertures less than 1 mm. Weak oxidation in the lower half of the possible zone. Zone situated in medium-grained metagranite-granodiorite, with subordinate occurrences of amphibolite. Confidence level = 1.
169.00

Geological single-hole interpretation of HFM28

Title SINGLE HOLE INTERPRETATION HFM28

Site	FORSMARK	**Inclination [°]**	-84.75	**Elevation [m.a.s.l.]**	4.27	**Signed data**
Borehole	HFM28	**Date of mapping**	2006-03-08 13:37:00	**Drilling Start Date**	2005-09-12 13:30:00	
Diameter [mm]	135	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2005-09-14 19:00:00	
Length [m]	151.200	**Northing [m]**	6700068.84	**Surveying Date**		
Bearing [°]	146.78	**Easting [m]**	1630597.24	**Plot Date**	2006-10-19 21:09:52	

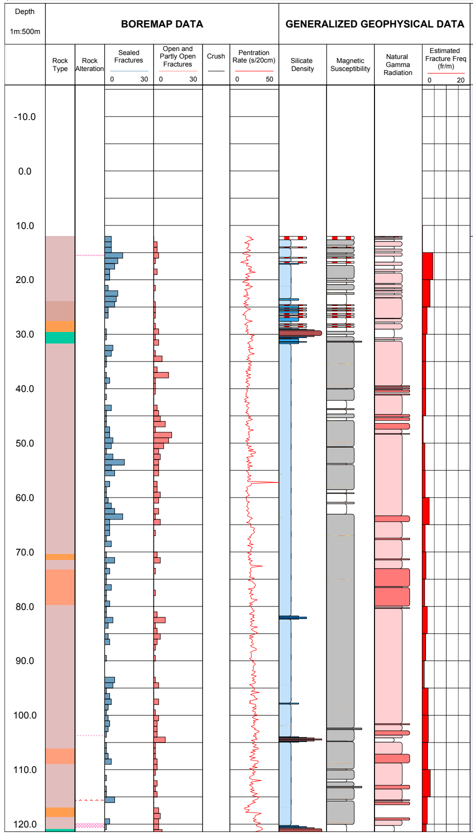
ROCKTYPE FORSMARK
- Granite, fine- to medium-grained
- Pegmatite, pegmatitic granite
- Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained
- Granite to granodiorite, metamorphic, medium-grained
- Granodiorite, metamorphic
- Amphibolite

ROCK ALTERATION
- Oxidized
- Albitization

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53



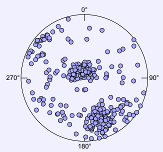
ROCK UNIT

Description Rock Unit

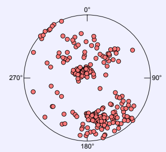
12.02

RU1
Medium-grained metagranite-granodiorite (101057), with subordinate occurrences of pegmatitic granite (101061), fine- to medium-grained granite (111058), amphibolite (102017), metagranodiorite (101056), fine- to medium-grained metagranitoid (101051) and aplitic metagranite (101058). Scattered narrow low resistivity anomalies throughout the borehole. Four sub-parallel radar reflectors observed at a distance of 20-70 m from the borehole are all inferred to represent sub-vertical structures. Confidence level = 2.

Rock Unit Sealed Fractures (Projection Wulff)



Rock Unit Open and Partly Open Fractures (Projection Wulff)



POSSIBLE DEFORMATION ZONES

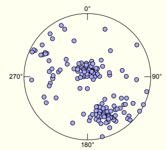
Description Possible Deformation Zone

12.02

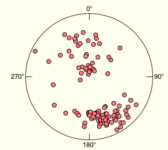
DZ1
Slightly increased frequency of open fractures in the lower half of the possible zone. Fractures that either strike SW and dip moderate to steep towards the NW or are gently dipping to sub-horizontal are prominent. Locally increased frequency of sealed fractures. Several occurrences of sealed fracture networks. Apertures generally less than 1 mm. Low resistivity apart from the interval 45-52 m and slightly decreased magnetic susceptibility. Eleven radar reflectors identified (angle to borehole axis 17-84°), most of which intersect borehole with a high angle. Zone situated in medium-grained metagranite-granodiorite, with subordinate occurrences of pegmatitic granite, amphibolite and metagranodiorite. Confidence level = 2.

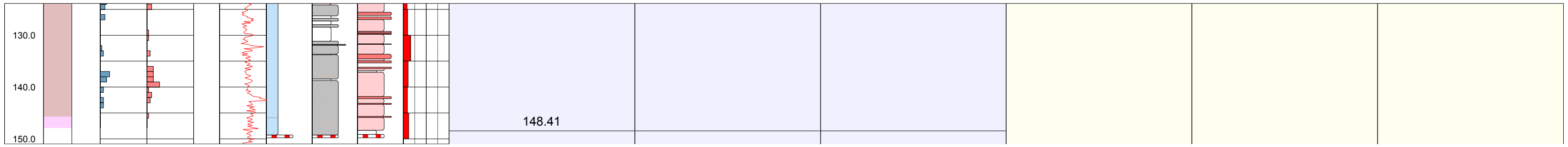
65.00

Possible Deformation Zone Sealed Fractures (Projection Wulff)



Possible Deformation Zone Open and Partly Open Fractures (Projection Wulff)




130.0
140.0
150.0
148.41

Geological single-hole interpretation of HFM30

Title SINGLE HOLE INTERPRETATION HFM30

Site	FORSMARK	**Inclination [°]**	-55.49	**Elevation [m.a.s.l.]**	3.13	**Signed data**
Borehole	HFM30	**Date of mapping**	2006-09-05 20:16:00	**Drilling Start Date**	2006-05-03 16:00:00	
Diameter [mm]	139	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2006-05-11 12:00:00	
Length [m]	200.750	**Northing [m]**	6697930.95	**Surveying Date**		
Bearing [°]	28.81	**Easting [m]**	1631819.57	**Plot Date**	2006-10-19 21:09:52	

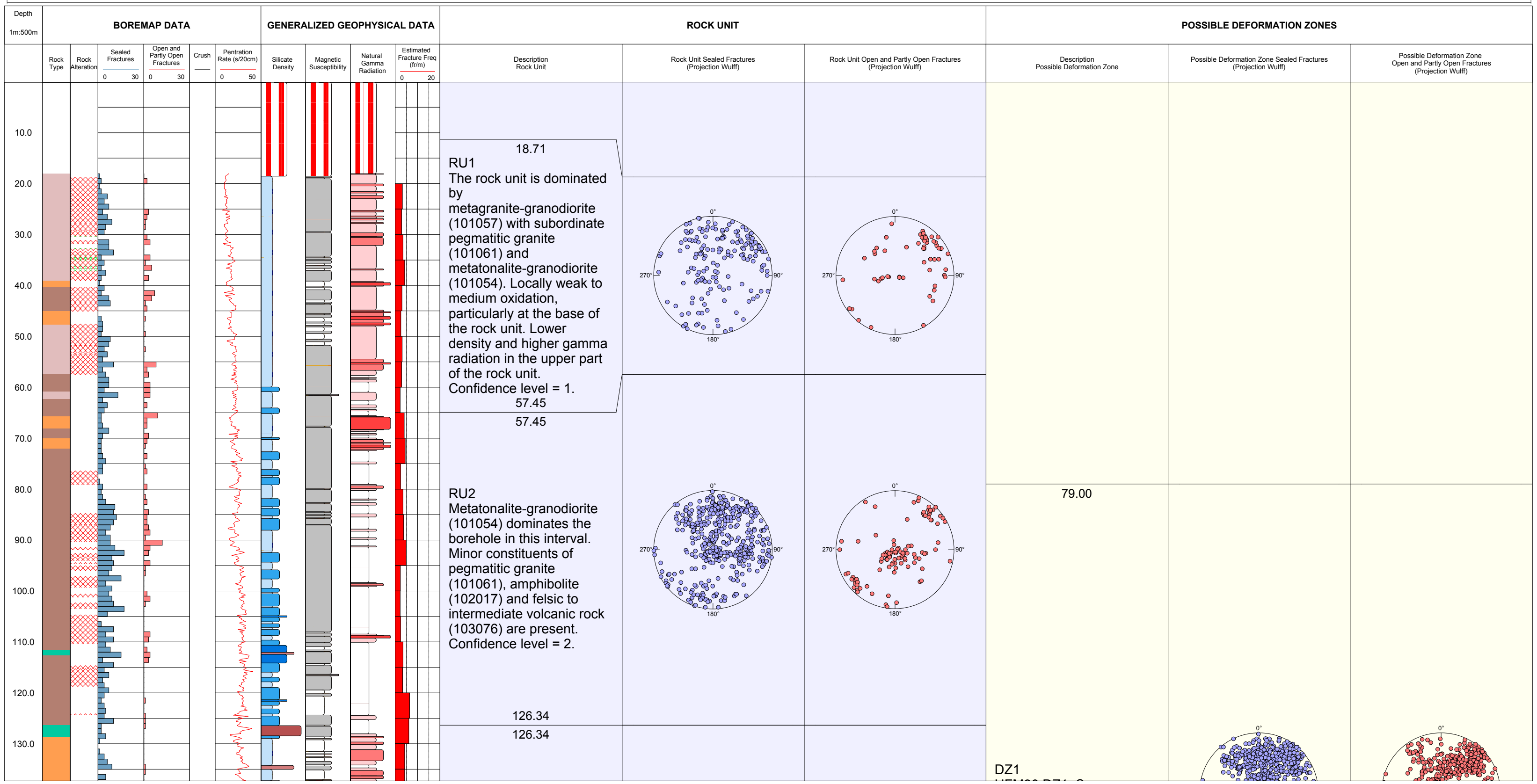
ROCKTYPE FORSMARK
- Pegmatite, pegmatitic granite
- Granite to granodiorite, metamorphic, medium-grained
- Tonalite to granodiorite, metamorphic
- Amphibolite
- Felsic to intermediate volcanic rock, metamorphic

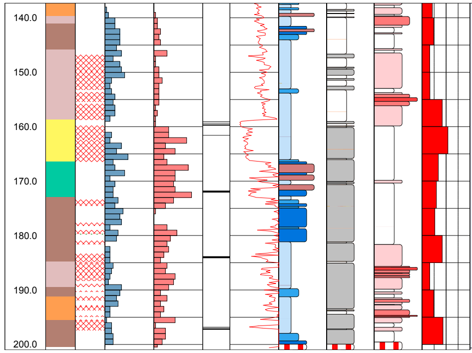
ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

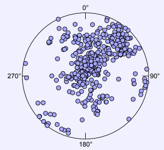
NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53
- 53<gam

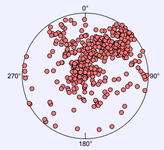




RU3
Heterogeneous rock unit with medium-grained metatonalite-granodiorite (101054), pegmatitic granite (101061), medium-grained metagranite-granodiorite (101057) and amphibolite (102017) as dominant rock types. Felsic to intermediate volcanic rock (103076), aplitic metagranite (101058) and metadiorite-gabbro (101033) occur as minor constituents. Confidence level = 2.

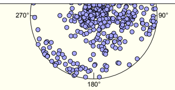
200.63

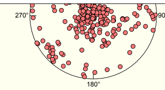




HFM30 DZ1: See description in Activity comment or in report

200.00





Appendix 6

Geological single-hole interpretation of HFM31

Title	SINGLE HOLE INTERPRETATION HFM31					
Site	FORSMARK	Inclination [°]	-69.22	Elevation [m.a.s.l.]	6.07	Signed data
Borehole	HFM31	Date of mapping	2006-06-09 10:46:00	Drilling Start Date	2006-05-15 08:30:00	
Diameter [mm]	139	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-05-19 10:00:00	
Length [m]	200.750	Northing [m]	6700860.44	Surveying Date		
Bearing [°]	311.80	Easting [m]	1629207.28	Plot Date	2006-10-19 21:09:52	

ROCKTYPE FORSMARK
- Pegmatite, pegmatitic granite
- Granite to granodiorite, metamorphic, medium-grained
- Diorite, quarts diorite and gabbro, metamorphic
- Amphibolite

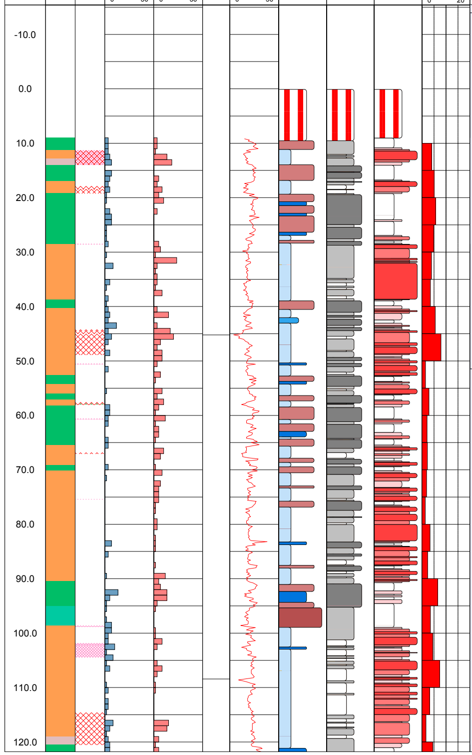
ROCK ALTERATION
- Oxidized
- Chloritisized
- Albitization

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53
- 53<gam

Depth 1m:500m	BOREMAP DATA	GENERALIZED GEOPHYSICAL DATA	ROCK UNIT			POSSIBLE DEFORMATION ZONES		
	Rock Type / Rock Alteration / Sealed Fractures (0–30) / Open and Partly Open Fractures (0–30) / Crush / Pentration Rate (s/20cm) (0–50)	Silicate Density / Magnetic Susceptibility / Natural Gamma Radiation / Estimated Fracture Freq (fr/m) (0–20)	Description Rock Unit	Rock Unit Sealed Fractures (Projection Wulff)	Rock Unit Open and Partly Open Fractures (Projection Wulff)	Description Possible Deformation Zone	Possible Deformation Zone Sealed Fractures (Projection Wulff)	Possible Deformation Zone Open and Partly Open Fractures (Projection Wulff)

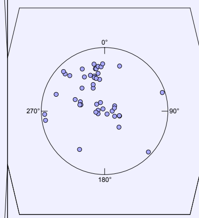


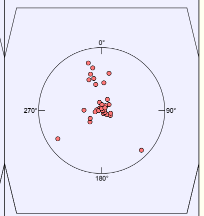
9.00

RU1a

Metadiorite to gabbro (101033) with subordinate pegmatitic granite (101061) and one occurrence of fine- to medium-grained metagranitoid (101051). Pegmatitic rock is associated with high gamma radiation and low magnetic susceptibility and low density. The opposite applies to metadiorite to gabbro. Two occurrences of sealed fracture networks associated with either oxidation or albitization. Confidence level = 2.

28.46

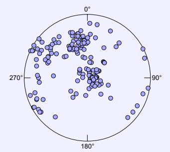


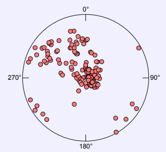


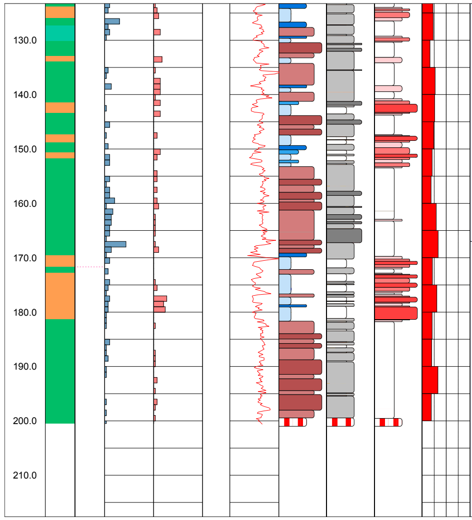
28.46

RU2

Pegmatitic granite (101061) with subordinate metadiorite to -gabbro (101033) and amphibolite (102017). One occurrence of fine- to medium-grained metagranitoid (101051). Two crush zones at 45.200-45.215 m and 108.36-108.45 m are associated with low resistivity. The latter is associated with possible cataclasite at 108.15-108.76 m and a sealed fracture network at 108.46-108.79 m. Four other sealed networks occur in the rock unit. One occurrence of weak albitization associated with amphibolite. Locally







weak to medium oxidation, of which one is associated with crush. Pegmatitic rock is associated with high gamma radiation and low magnetic susceptibility and low density. The amphibolite in the borehole interval 95.04-98.61 m coincides with low magnetic susceptibility. Confidence level = 2.

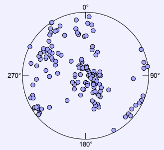
120.50

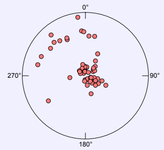
120.50

RU1b

Metadiorite to gabbro (101033) with subordinate pegmatitic granite (101061) and amphibolite (102017). Pegmatitic rock is associated with high gamma radiation and low magnetic susceptibility and low density. The opposite applies to metadiorite to gabbro. One sealed fracture network at 168.15-168.80 m. Confidence level = 2.

200.45





Geological single-hole interpretation of HFM32

Title	SINGLE HOLE INTERPRETATION HFM32					
Site	FORSMARK	Inclination [°]	-86.05	Elevation [m.a.s.l.]	0.97	Signed data
Borehole	HFM32	Date of mapping	2006-03-21 14:46:00	Drilling Start Date	2006-01-11 08:30:00	
Diameter [mm]	132	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-01-14 16:00:00	
Length [m]	202.650	Northing [m]	6699015.04	Surveying Date		
Bearing [°]	116.15	Easting [m]	1632137.07	Plot Date	2006-10-19 21:09:52	

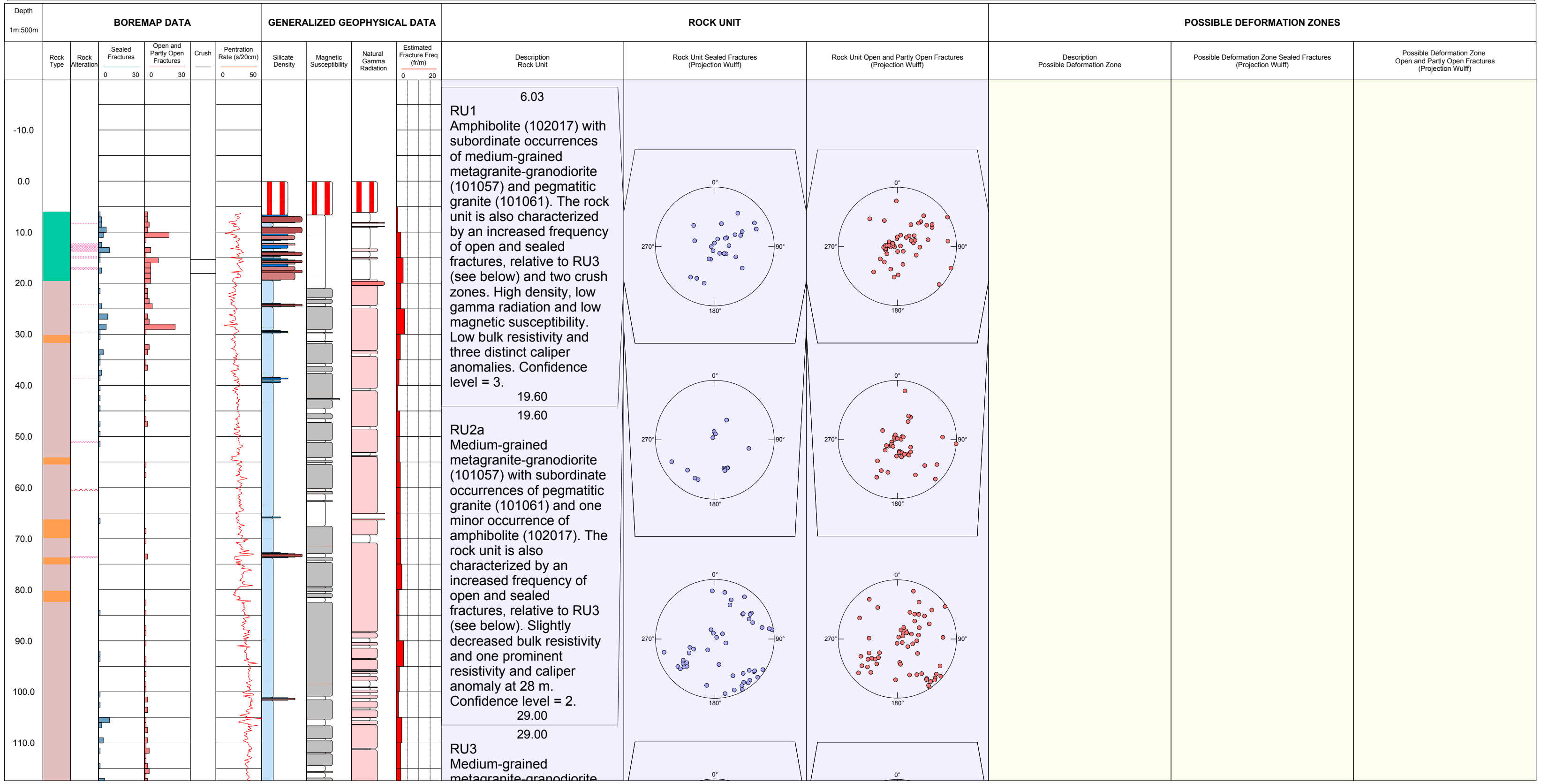
ROCKTYPE FORSMARK
- Pegmatite, pegmatitic granite
- Granite to granodiorite, metamorphic, medium-grained
- Amphibolite

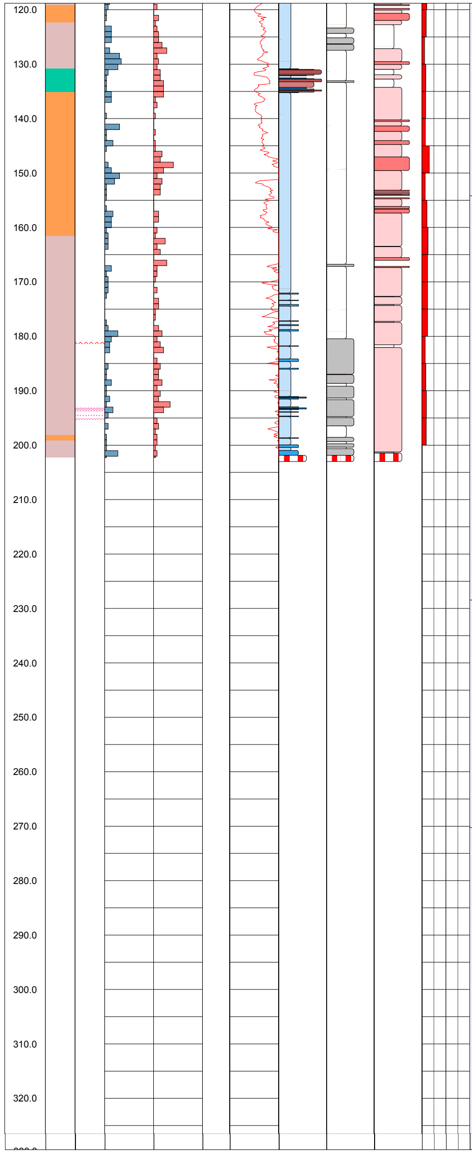
ROCK ALTERATION
- Oxidized
- Argillization
- Albitization

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53





(101057) with subordinate occurrences of pegmatitic granite (101061) and a few minor occurrences of amphibolite (102017). High gamma radiation, low density and low magnetic susceptibility associated with pegmatitic rock. Confidence level = 2.

122.37

122.37

RU2b

Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of pegmatitic granite (101061) and amphibolite (102017). The rock unit is also characterized by an increased frequency of open and sealed fractures, relative to RU3. High density and low gamma radiation associated with amphibolite whereas the opposite applies to pegmatitic granite. Low magnetic susceptibility throughout the section. No anomalous character in the resistivity logs. Confidence level = 2.

135.13

135.13

RU4

Pegmatitic granite (101061) characterized by an increased frequency of open and sealed fractures relative to RU3. Low density, low magnetic susceptibility and increased gamma radiation. Slightly decreased bulk resistivity. Confidence level = 2.

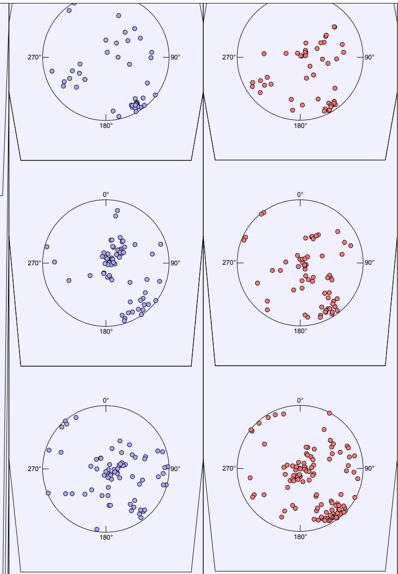
161.63

161.63

RU2c

Medium-grained metagranite-granodiorite (101057) with subordinate occurrences of pegmatitic granite (101061) and a few minor occurrences of amphibolite (102017). The rock unit is also characterized by an increased frequency of open and sealed fractures, relative to RU3. Low magnetic susceptibility and some minor resistivity anomalies in the upper part of the unit. Confidence level = 2.

202.61



Geological single-hole interpretation of HFM38

Title	SINGLE HOLE INTERPRETATION HFM38					
Site	FORSMARK	Inclination [°]	-54.44	Elevation [m.a.s.l.]	2.21	Signed data
Borehole	HFM38	Date of mapping	2006-09-05 15:29:00	Drilling Start Date	2006-06-14 16:00:00	
Diameter [mm]	136	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-06-22 12:00:00	
Length [m]	200.750	Northing [m]	6700701.28	Surveying Date		
Bearing [°]	93.62	Easting [m]	1631301.71	Plot Date	2006-10-19 21:09:52	

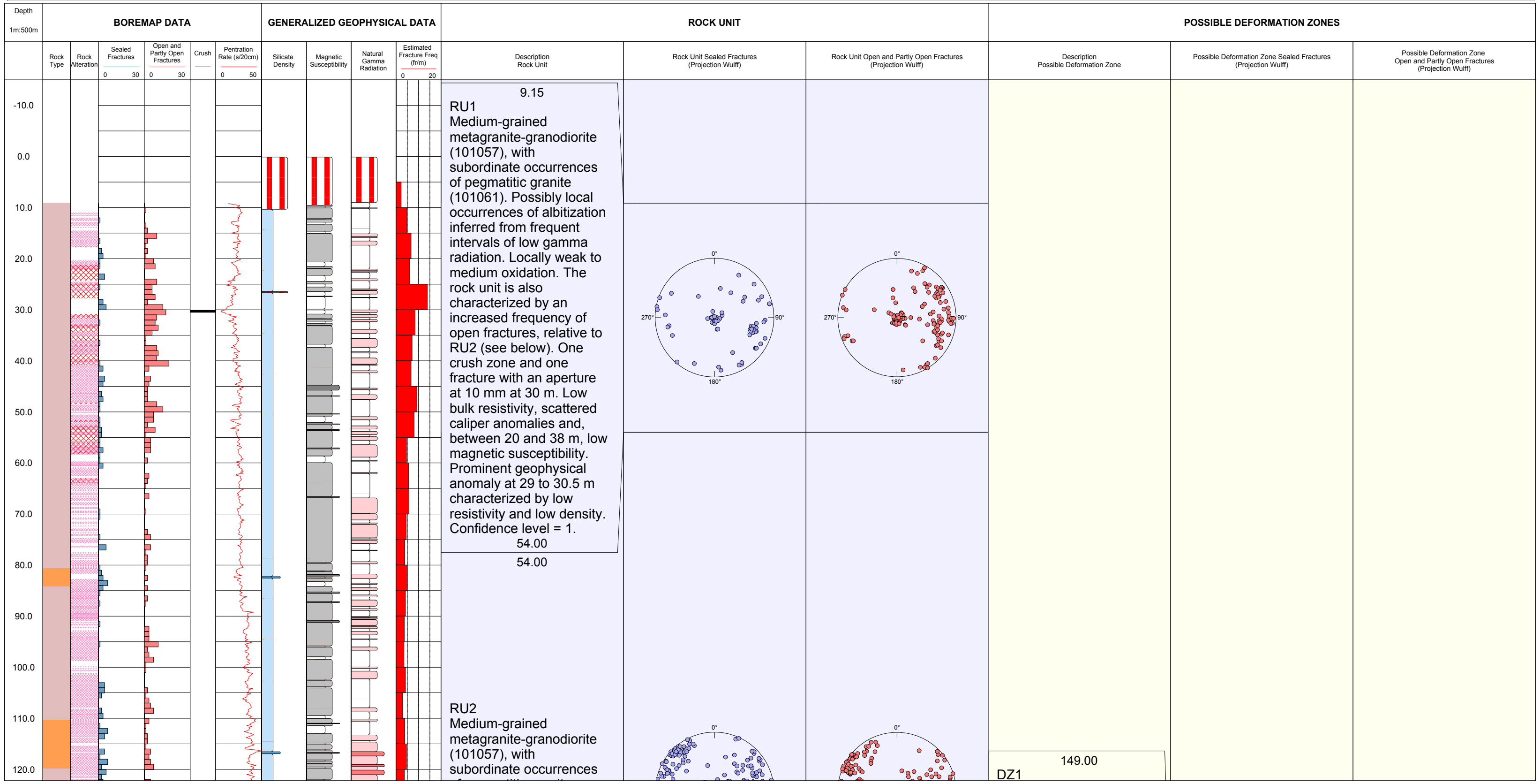
ROCKTYPE FORSMARK
- Pegmatite, pegmatitic granite
- Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained
- Granite to granodiorite, metamorphic, medium-grained
- Amphibolite

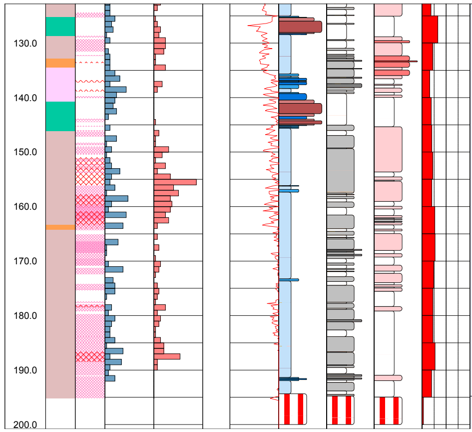
ROCK ALTERATION
- Oxidized
- Albitization

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)
- 2730<dens<2800 (Tonalite)
- 2800<dens<2890 (Diorite)
- dens>2890 (Gabbro)

SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

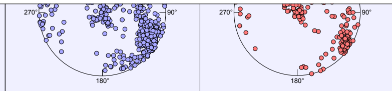
NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<36
- 36<gam<53
- 53<gam





of pegmatitic granite (101061), amphibolite (102017) and fine- to medium-grained metagranitoid (101051). Most of the rock unit is affected by albitization of varying intensity which is reflected in generally low gamma radiation throughout the rock unit. Amphibolite is associated with high density and low gamma radiation. Confidence level = 2.

194.79



Increased frequency of sealed and possibly open fractures. Fractures that strike SSW and dip steeply to the WNW dominate. Gently dipping fractures as well as fractures that strike SSE and dip moderately to steeply to the WSW are also present. No fracture shows an aperture wider than 1 mm. Faint to medium oxidation throughout the possible zone. Geophysical anomaly at 161 m with low resistivity, low magnetic susceptibility and caliper anomaly. Six radar reflectors intersecting the borehole axis at moderate to high angles. Confidence level = 2.

164.00