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Forsmark site investigations

Boremap mapping of core drilled borehole KFM01B

Johan Berglund, Jesper Petersson,
Anders Wängnerud, Peter Danielsson
SwedPower AB

June 2004

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co
Box 5864
SE-102 40 Stockholm Sweden
Tel 08-459 84 00
+46 8 459 84 00
Fax 08-661 57 19
+46 8 661 57 19

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Contents

1 Introduction

Since 2002, SKB investigates two potential sites, at Forsmark and Oskarshamn communities, for a deep repository in the Swedish Precambrian basement. In order to characterise the rock mass down to a depth of about 1 km at the Forsmark test site area, SKB has initiated a drilling program with deep telescopic boreholes (Fig. 1). Each borehole starts with 100 m of percussion drilling, and is followed by core drilling down to about 1000 m depth. To obtain a core from the upper 100 m, a second borehole is drilled at each drilling site, close to the first.

A detailed mapping of the material obtained through the drilling program is essential for a more specific sampling and for three-dimensional modelling of the site geology. For this purpose, the so-called Boremap system has been developed. The system integrates information from drill core mapping, alternatively, drill cuttings when a core is not available, with results from BIPS-logging (Borehole Image Processing System) and calculates the absolute position and orientation of fractures and lithological features /1/.

This report presents the results from the Boremap-mapping of cored borehole KFM01B, the second hole at drilling site 1 (DS1 in Fig. 2-1). Another prime target with the drilling of KFM01B, besides achieving a core from the upper 100 m at this drilling site, was to perform rock mechanical tests. For this purpose the borehole was drilled to c. 500 m. The core was mapped after tests (overcoring technique, see SKB MD 181.001) where made on the core.

2 Objective and scope

The aim of the mapping activities is to obtain a detailed documentation of all structures and lithologies intersected by cored borehole KFM01B (DS1). The result of these activities will serve as a platform for forthcoming analyses of the drill core, aimed at investigating geological, petrophysical and mechanical aspects of the rock volume, as well as for site descriptive modelling. The first borehole at DS1, KFM01A, was drilled and mapped in spring, 2003 /2/.

The mapping comprises all fractures, fracture mineralogy and lithologies found in the core, except for parts not covered by a BIPS image. It also includes structures and alterations, but also drill induced features, such as core-disking. All objects or object boundaries are oriented automatically in the Boremap system, by manual fitting of plane to the feature in question if they are visible in the BIPS image. If "not visible" in the BIPS image, the orientation stored in the database (SICADA) is not reliable.

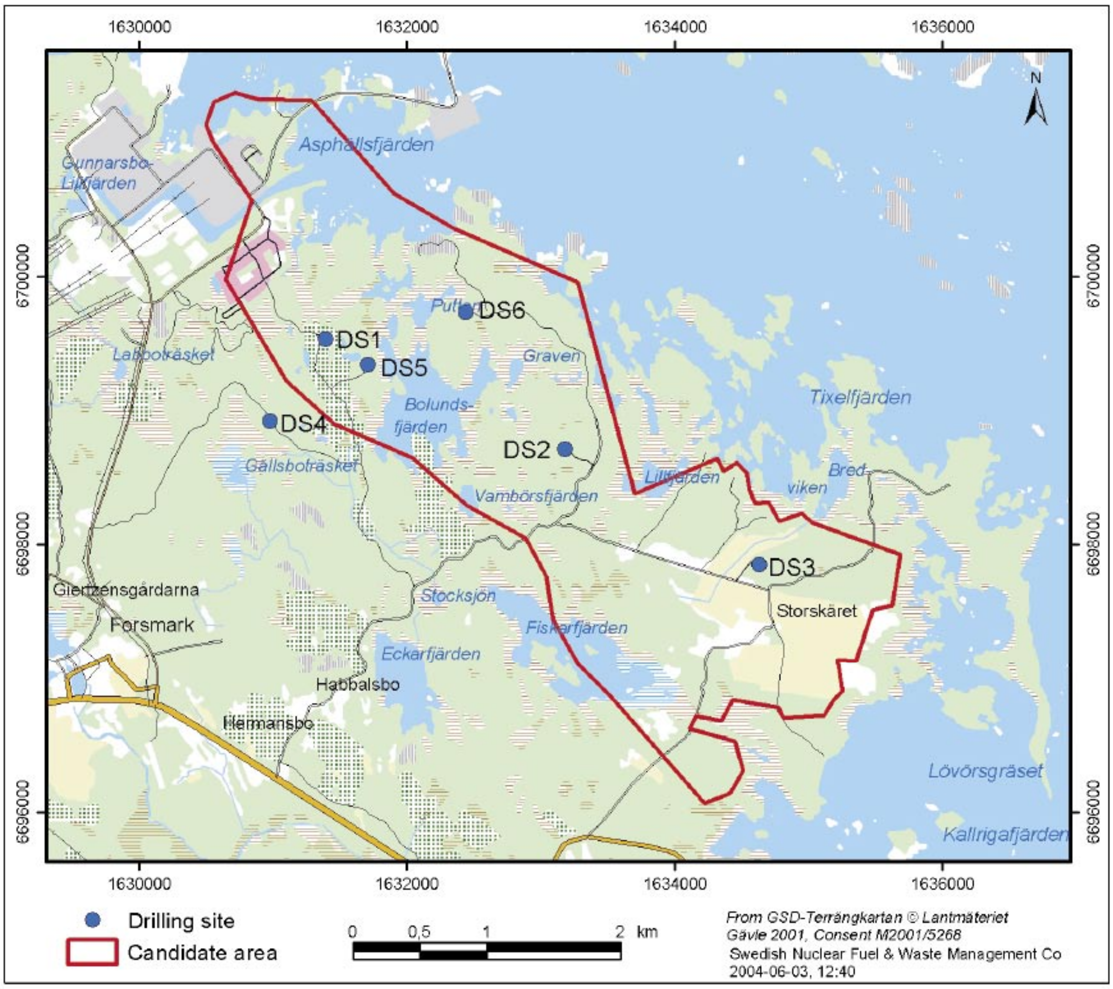


Figure 2-1. *Location of the first six drilling sites in the Forsmark test site area. KFM01B is located at DS1.*

3 Equipment

3.1 Description of equipment

The BIPS-based mapping was performed in Boremap v. 3.4.2. This software contains the bedrock and mineral standard used by the Geological Survey of Sweden for surface mapping at the Forsmark investigation site to enable correlation with the surface geology. Additional software used during the course of the mapping was BIPS Viewer and Microsoft Access. The final data presentation was made using Geoplot and WellCad v. 3.2.

The following equipment was used to facilitate the core mapping: folding rule, hydrochloric acid, knife, hand lens and paintbrush + bucket of water.

4 Execution

The borehole KFM01B is core drilled down to about 500 m depth. The soil cover is about 3.8 m. The upper c. 15,5 m in the rock was in part drilled with percussion drilling, and in part with a coarser diameter (core Ø86 and Ø101 mm). No BIPS image is available from this part. A few samples have been taken here, but no mapping has been performed yet.

The mapped part of the core is 51 mm in diameter. The core starts at length 15.56 and ends at 501.46. Although exceptions occur, the BIPS images from the borehole are generally of poor or very poor quality, the major problem being black coating on the borehole wall, suspended particles and vertical white stripes in the image.

During the mapping of the 483 m drill core, the core was available in its entire length on roller tables in the core-mapping accommodation at Forsmark (the Lentab hall, near the SKB/SFR-office at Forsmark). The Swedish Geological Survey (SGU) provided reference samples from the surface mapping. No thin-sections were available from the drill cores, thus all mineralogical and lithological descriptions are based on ocular inspection.

The KFM01B was used for rock mechanical tests with the over-coring technique prior to the mapping of the core. This fact affected the mapping, not only because of less good BIPS images. Many sections were mechanically crushed or missing and most of the cylindrical cores from the over-coring were affected by core-discing, which made the fitting of pieces in the core complex at many places.

The mapping of KFM01B was performed in accordance to activity plan AP PF 400-03-94 (SKB internal controlling document) following the SKB method description for Boremap mapping, SKB MD 143.006 (v. 1.0), with the exception that no geophysical logs were available.

4.1 Preparations

The length registered in the BIPS-image deviates from the true borehole length with increasing depth, and the difference at the bottom of the borehole is about 1.5 m. The length has therefore been adjusted with reference to groove millings cut into the borehole wall at approximately every 50:th metre. The exact level of each reference mark can be found in SKB's database SICADA (See also Appendix 5). The adjusted length in the BIPS-image is still not completely identical with the one given at the drill core, as the core recovery may yield erroneous lengths. For this particular borehole, the overcoring technique used for stress measurements, made the correlation of length between drill core and BIPS image especially complicated, because of the many and partly long sections with missing and fragmented core. The difference between length in the core and adjusted length in BIPS may even reach over 0.5 m at a few locations, but is generally less than 2-3 dm. After adjustment, the BIPS-image from the cored interval of KFM01B covers a length interval between 15.63 to c. 498.20 m.

Data necessary for calculations of absolute orientation of structures in the borehole includes borehole diameter, azimuth and inclination, and these data were collected from SKB's database SICADA (Appendices 3 and 4). Corrections for the borehole deviation were done at every third metre.

4.2 Data handling

To obtain the best possible data security, the mapping generally is written directly to the Access database located on a central server, with regular back ups on the local drive. During the time when the mapping was performed, however, the network to the Lentab hall was out of order, so the Access database was stored on the local drive.

The mapping was quality checked by a routine in the Boremap software before it was archived. The data were subsequently exported to the SKB database SICADA and stored under field note Forsmark GE041 (Boremap-mapping).

During mapping all fractures in KFM01B were mapped as either "sealed" or "natural", according to procedure used up to now in Boremap. However, recent considerations, made by the analysis group at SKB, have lead to a change in presentation of fractures as open and sealed, with and without aperture, respectively. A new feature in SICADA will from now on automatically separate and store open and sealed fractures, according to this procedure. During mapping, however, the fractures will be separated into broken (natural) and unbroken (sealed), depending on if the part they core or not.

4.3 Analysis and interpretation

There are a few limitations and biases related to mapping in the Boremap system. The ones that are considered most important are mentioned here.

Since all geological features must be represented by intersecting and planar surfaces, non-planar structures (such as small scale folding, linear objects and curved fractures) cannot be correctly documented. A major problem is curved structures (e.g. fractures) that run almost parallel with the borehole axis and structures that only penetrate part of the core. During the mapping sessions of KFM01B such features were generally approximated by fitting the plane after one of their ends in the borehole, normally the one that was most obvious in the BIPS image. If such structures not actually intersect the borehole, or if the structure in any other way not fit the chosen plane (sinus-wave) in the BIPS-image, this is only noted in the comments, attached to the object in the database.

Another problem in the system is geological features (mainly fractures) that can be observed only in the drill core. This problem usually arises from poor BIPS-image, which in the present case particularly is caused by the presence of brownish black coating on the borehole walls and suspension of particles in the borehole water or sedimentation on the borehole wall. However, even with the most perfect BIPS-image, it can sometimes be difficult to distinguish a thin fracture sealed by some low contrast mineral. Most fractures and lithological contacts observed in the drill core, but not in the BIPS-image, have been registered perpendicular to the borehole axis, regardless of their actual orientation. These are registered as 'not visible in BIPS' in the database to prevent fractures from this group to be used in forthcoming fracture orientation analysis, an alternative that has become possible in v. 3.2 of Boremap. Almost all fractures suspected to be induced by the drilling fall within this category. Obvious drill induced fractures are not included in the mapping.

A large amount of the steeply dipping fractures intersected by KFM01B are sealed by laumontite. This sealing tends to expand, and eventually crack and part the core. As a consequence, some fractures mapped as broken may in fact represent originally unbroken fractures. All laumontite filled fractures that are suspected to be sealed in the intact rock, prior to drilling, are mapped as unbroken. Most laumontite fractures in the core actually broke apart during their time on the roller tables.

The minimum width/aperture possible to assign to a fracture in Boremap is 0.5 mm. If a fracture is considerably less wide this is normally stated in the comment attached to the object in the database.

All fractures must be mapped with a zero-aperture, or an aperture equal to, or larger than 0.5 mm, in the Boremap system. If an aperture is visible in the BIPS-image or in the core, it is simply measured at the widest spot in the core or averaged (visually) in the BIPS-image. If the core is broken, however, and no aperture can be identified in the image (or in the core), the procedure is as follows. If the fracture plane is judged as “fresh” and the pieces have a good fit to each other, the fracture is mapped as having no aperture. In other cases it is mapped as having aperture 0.5 mm. It has to be noted that the judgement of whether a fracture is “fresh” or “slightly altered” is often not straightforward.

Fractures in intervals with core loss, are registered only if they are visible in the BIPS-image. However, it has not been possible to give any feature details, such as roughness and mineral filling, for these fractures. Thus, the only reliable information regarding individual fractures in crush zones is fracture orientation, width and aperture. There are 26 intervals in the core where core loss has been detected. All but one of these is related to “planning”, during rock mechanical testing. All core losses are less than 0.2 m long.

As in earlier boreholes, the mapping was hampered by the occurrence of brownish black coatings on the borehole walls, as mentioned above. However, the coating is often more conspicuous here than in previous deep (1000 m) boreholes. In the worst cases it obscures most of the borehole wall. The coating occurs throughout the borehole, generally as coating lines or areas parallel with the borehole axis. The intense transport of drill-pipes up and down in this borehole is the probable cause of this coating.

The contouring of plotted poles in this report uses a “modified” Kamb method based on Vollmer /4/ after Kamb /5/.

5 Results

5.1 Core Lithology

The far most abundant rock in borehole KFM01B is a medium-grained, reddish-grey to grey metagranodiorite-granite. It occupies c. 85 % of the mapped core. Other rock units, including finer grained metagranitoids, pegmatitic granites, amphibolites and minor bands, dykes or veins of leucogranitic material, are common throughout the core, though volumetrically subordinate.

The medium-grained metagranite (-granodiorite) (code 101057) is rather equigranular, considering the actual grain-size, but it normally has aggregates of quartz and feldspar that are deformed, which give the appearance of a porphyroblastic texture in macroscopic view. The rock is typically reddish grey in colour, although both more greyish and reddish varieties do occur. The composition has a tendency to be slightly granodioritic.

The fine-grained, equigranular granitoids (code 101051) are subordinate components in borehole KFM01B, comprising c. 6 % of the total mapped core length. They are grey to light reddish-grey in colour. Most rocks in this group are of inferred granitic composition and rarely exceed a few metres in length. Generally they are in contact with the coarser metagranodiorite-granite and most of these are diffuse and gradational, but a few sharper contacts occur (eg. at c. 206.95 m, Figure 5-1). Petrographical variations and different degree of fabric development indicate that it is a composite group, which may include more than one generation.

Dykes, veins and patches of pegmatite, pegmatitic granite, aplite and leucogranitic material are frequent throughout the boreholes, but the rock group occupies less than 7 % of the mapped drill core length. Most occurrences occupy a few decimetres or less in the core and only one exceed one metre. The pegmatitic granites are generally texturally heterogeneous, often with a highly variable grain-size. Some of the more extensive occurrences include intervals of medium-grained, equigranular granite. Minor occurrences of leucocratic granite and pegmatitic granite are also mapped with this rock code (code 101061). These are typically irregular with blurred or indistinct contacts toward the surrounding metagranite-granodiorite. Pegmatitic occurrences suspected to be more or less locally derived metamorphic segregation, because of its blurry appearance and indistinct contact to the host rock, are also included in this rock code. These latter are generally noted as metamorphic segregations in the comment field in the database. Rather coarse hematite has been identified in a few pegmatites, whereas several other contain distinct magnetite crystals. Despite the obvious temporal span within this group, including at least three different pegmatite/aplite generations, these rocks were grouped as “pegmatite, pegmatitic granite” (code 101061). A few also contain narrow bands of aplitic material, but rocks mapped as such or “fine- to medium-grained granite” (code 111058) are rare in this borehole.

Amphibolites (code 102017) occupy about 2.5 % of the cored interval in KFM01B. Their extension and contacts are more or less parallel with the tectonic foliation. The mineralogy is normally dominated by ferromagnesian minerals, but a few have approximately equal amounts of plagioclase. The majority is fine-grained, equigranular with a variable, but locally large proportion of biotite. During retrograde metamorphism, normally where higher strain prevails, the amphibolites are instead rich in chlorite.

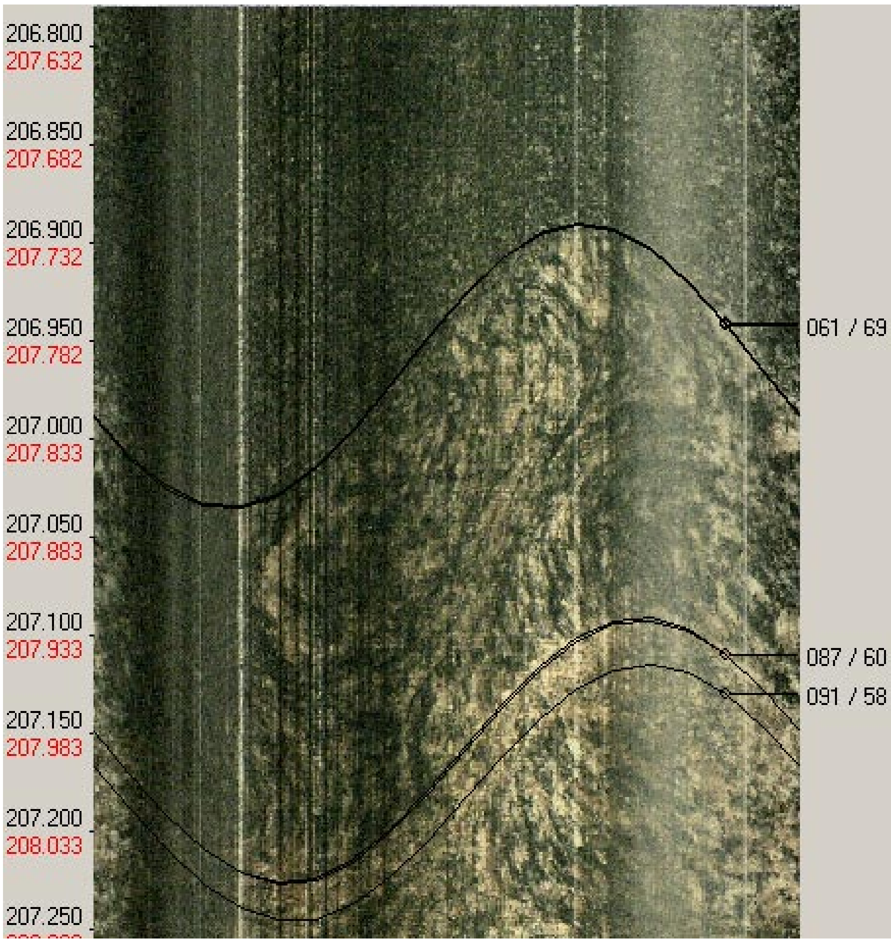


Figure 5-1. *BIPS image of sharp contact (061/69) between a medium-grained metagranite (-granodiorite) (bottom, code 101057) and a finer grained, equigranular granitoid (top, code 101051).*

A probable high grade alteration found in granitoids close to their contacts towards most amphibolites is a few cm wide zone of light, quartz-feldspar-dominated rock, commonly totally deficient of ferromagnesian minerals. The zone is related to as "bleached" in the text, in the comment attached to the mapped object (amphibolite) in the database.

5.2 Alteration

About 20 % of the core is mapped as altered; almost exclusively as oxidation. The oxidation is especially pronounced in fractured sections. "Oxidized walls" close to fractures, are a common feature throughout the borehole. It is generally only a few millimetres wide, but at a few places it reaches c. 1 dm. This type of oxidation is almost exclusively found around fractures without aperture. Though rare, other types of alteration found in the borehole includes epidotization, sericitization, chloritization and clay alteration.

The amphibolites at 418.6 and 419.2 m are strongly clay altered. Also the amphibolite at c. 47.5 m has a medium clay alteration. High proportions of these rocks are now composed of chlorite and clay minerals and the rock is easily decomposed by hand. The amphibolite occurrences at around 420 m are associated with a c. 2 dm wide breccia sealed with calcite (above the occurrences), and are surrounded by higher strain of ductile to brittle-ductile character.

5.3 Ductile Structures

The medium-grained metagranodiorite-granite (code 101057) that dominates the borehole KFM01B is characterised by composite L-S fabrics. Between c. 280 and 455 m, the L-component (lineation) dominates, whereas elsewhere a planar fabric, of weak to medium intensity prevails.

The finer grained granitoid (code 101051) generally show a weaker mineral foliation or lineation than the surrounding metagranodiorite-granite (code 101057). Although their external contacts are generally parallel with the tectonic foliation, their weaker fabric and the existence of discordant contacts suggests that at least some of the finer grained metagranitoids are younger than the main phase of the ductile deformation.

The internal fabric in the amphibolites varies. In most amphibolites, however, the internal tectonic fabric is less pronounced than in the surrounding granitoids, and many of them in fact only show a weak preferred mineral orientation.

A majority of the pegmatites and pegmatitic granites exhibit a faint to weak tectonic fabric, although there are several examples of clearly discordant contacts and apparently massive pegmatites. However, it must be emphasized that even though the structure in most pegmatites has been mapped as faintly foliated it is normally difficult to distinguish the tectonic fabric in these rocks.

Less than 5 m of the core is classified as ductile shear zones, of which the longest section is c. 1.5 m. All are regarded as faint or weak and generally grade into what can be regarded as medium to strong foliation. The foliation in the shear zones is parallel or sub-parallel to the foliation in the surrounding rock. The rocks in these shear zones seem to consist of deformed and grain-size reduced varieties of the medium-grained metagranodiorite-granite.

It is a common feature that the strain in the granitoid is higher towards the contact to the amphibolites, exemplified by the sections around 130 m, at c. 424 m and at c. 444 m.

The foliation generally strikes NW-SE with a moderate to steep dip (Figure 5-2). Lineation, when found, plunges gently to moderately towards SE. Although small scale folds are rarely observed in the core (but examples at c. 112 m and in amphibolites at c. 130 m), the distribution of foliation indicate that the foliation is folded around axes dipping moderately to the SE. A few short intervals in pegmatites and amphibolites are massive.

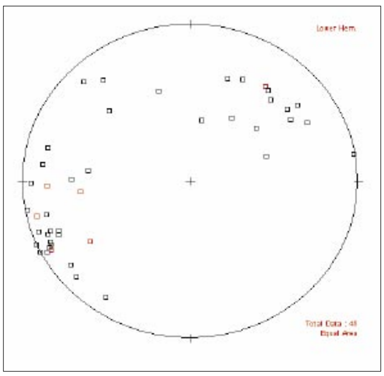


Figure 5-2. *Poles to foliation (black) and ductile shear zones in KFM01B.*

5.4 Fractures

5.4.1 Fracture frequencies and orientation

The fracture with and without aperture in KFM01B is plotted in Figure 5-3. There is a considerable difference between the two patterns shown by open and closed fractures, respectively. However, there is also a depth dependent difference. In Figure 5-5 a brake at 270 m is chosen so that the most intense fracturing, and also the vast majority of fractures with aperture are above this limit. In Figure 5-4 the fracture frequency towards depth is plotted. Both all fractures and fractures with an aperture are plotted separately. Also fractures with the mineral laumontite are plotted. Please note that the frequency is per m, but that the sample section is moved in increments of one dm down the hole. Somewhat simplified, from only a visual inspection of the figures, the population of fractures in KFM01B can be regarded as belonging to four separate fracture sets. As seen in Figure 5-3, 5-5 and 5-6, there is a set of sub-horizontal fractures, which are particularly common in the upper part of the borehole. Below c. 270 m (Figure 5-5) two sub-vertical sets of fractures are particularly common. These have orientations around NNW-SSE and NE-SW respectively. They normally have no aperture and the most common fracture minerals in these steep fractures are calcite, chlorite, laumontite, quartz and oxidized walls.

With the exception for a highly fractured zone in the depth interval c. 415–460 m, there is a conspicuous concentration of fractures in the upper 150 m of KFM01A, and even more so in the upper 53 m (see figure 5-4 and 5-5). The orientations of the fractures in the upper 53 m have a strong preference for horizontal to sub-horizontal orientation, and most have an aperture. The aperture is normally less than a few millimetres. Many of these fractures do not have any infilling mineral (or other material) at all, but otherwise typical mineralogies are calcite and/or chlorite, which form thin coatings on the fracture walls.

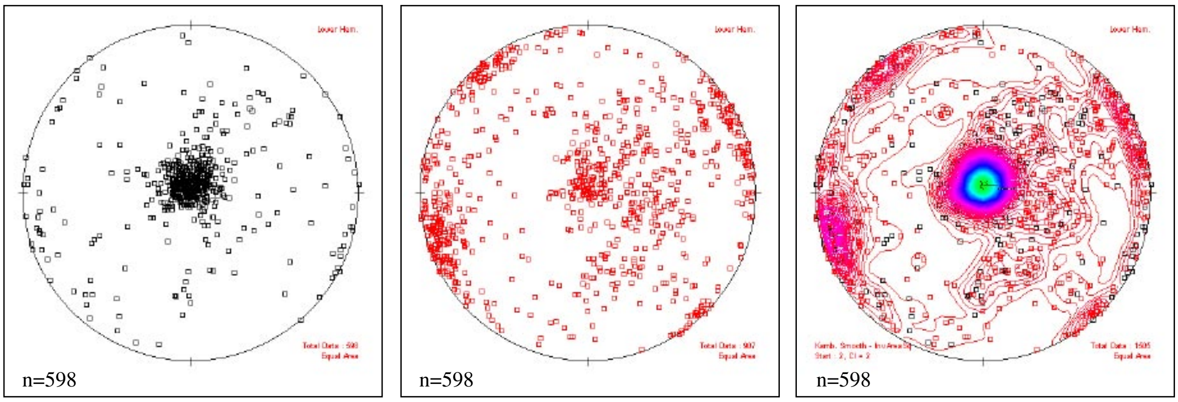


Figure 5-3. *Lower hemisphere equal-area stereographic projections showing the poles to fracture planes with (black squares) and without (red squares) aperture, in borehole KFM01B. Right figure show the same data, but contoured.*

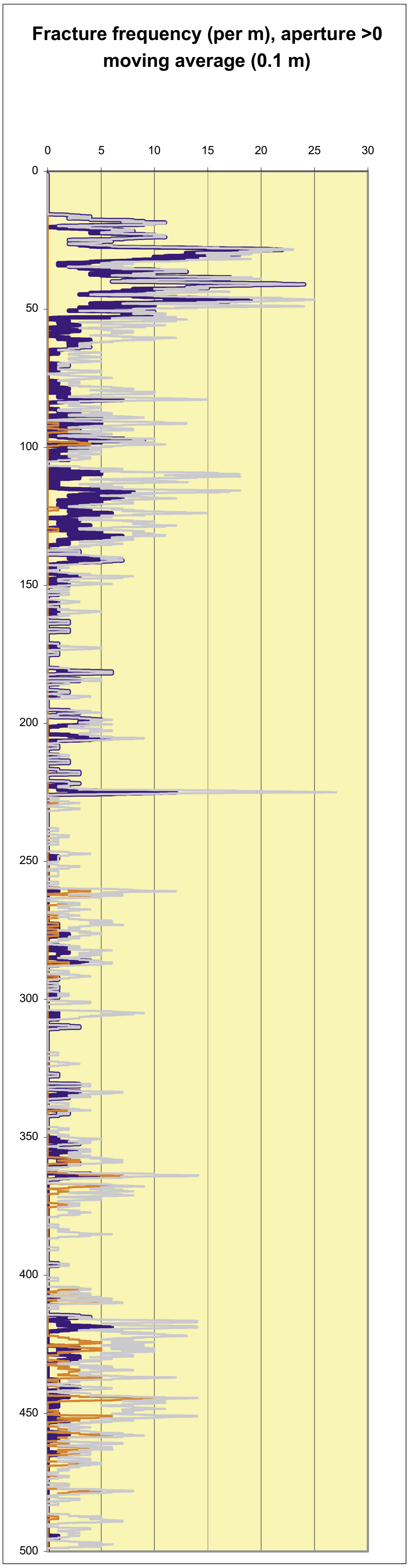


Figure 5-4. *Fracture frequency in borehole KFM01B. Grey line denotes all fractures, blue is fractures with aperture and orange are fractures with laumontite.*

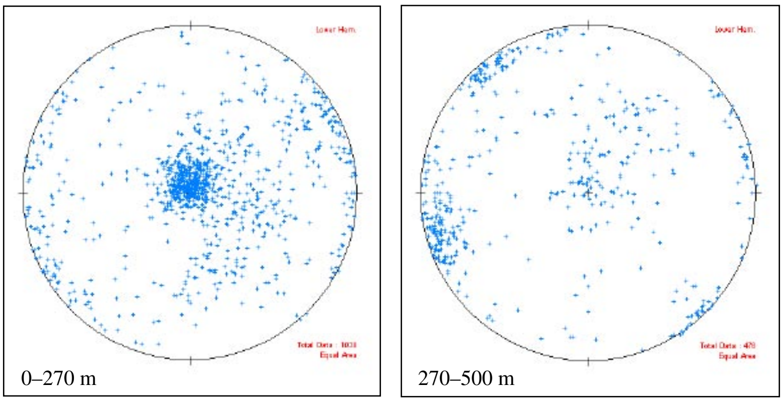


***Figure 5-5.** Poles to all fracture planes visible in the BIPS image at different depth in KFM01B (Lower hemisphere, equal-area).*

The total amount of fractures in KFM01B, open and closed, is 1752, with a fracture frequency of 3.6 fractures per metre (open: 1.4/m and closed: 2.2/m), and thus much higher than in boreholes KFM01A-KFM03A /2 and 3/. 1505 of the fractures are visible in the BIPS image, and thus oriented. The upper 53 m has a fracture frequency (open fractures) of 8.4 fractures per metre (primarily sub-horizontal fractures, see Figure 5-6). If these are excluded the rest of the borehole has a fracture frequency of only 0.8 fractures with aperture per metre.

It should be noted that many fractures mapped in the core could not be found in the BIPS-image, primarily because of poor image quality. These are all classified as not visible in the BIPS image and are not plotted in the stereograms in this chapter. Another bias in the stereograms is that many fractured intervals that are classified as sealed network do not show up in the stereograms plotted here, because the orientation of individual fractures in these networks has not been oriented. Only the orientation of the boundaries and two arbitrary chosen fractures are stored in the database. These latter have not been plotted here.

The interval between c. 415 and c. 460 m is anomalous in several ways. This is part of the target area for rock mechanical tests in the borehole. The interval has an increased fracture frequency and is also altered to varying degree. The fractures in the interval do generally not have any aperture and many of the fractures are pre-dominantly sealed by laumontite. The most common orientation of fractures here is a NNW strike and a steep dip to the SW. In the interval between 433 and 443 m there are also more than 6 m of core mapped as sealed network, primarily sealed with laumontite. Fractures in these networks generally have steep dips and either strike NNW or NE. This interval also comprises two ductile shear zones at around 420 m, and higher ductile strain than normal has been noted in and around a few amphibolites. This seems to indicate that older ductile structures have been reactivated during brittle deformation.

In less than ten fractures in KFM01B a measurable displacement has been noted. All these faults show a displacement less than a few cm.

In total 24 crush zones have been mapped in the borehole, all but three in the upper 100 m. In total they make up c. 2.4 m of the borehole. The most severe of the crush zone is found at c. 49-50 m (Figure 5-8).

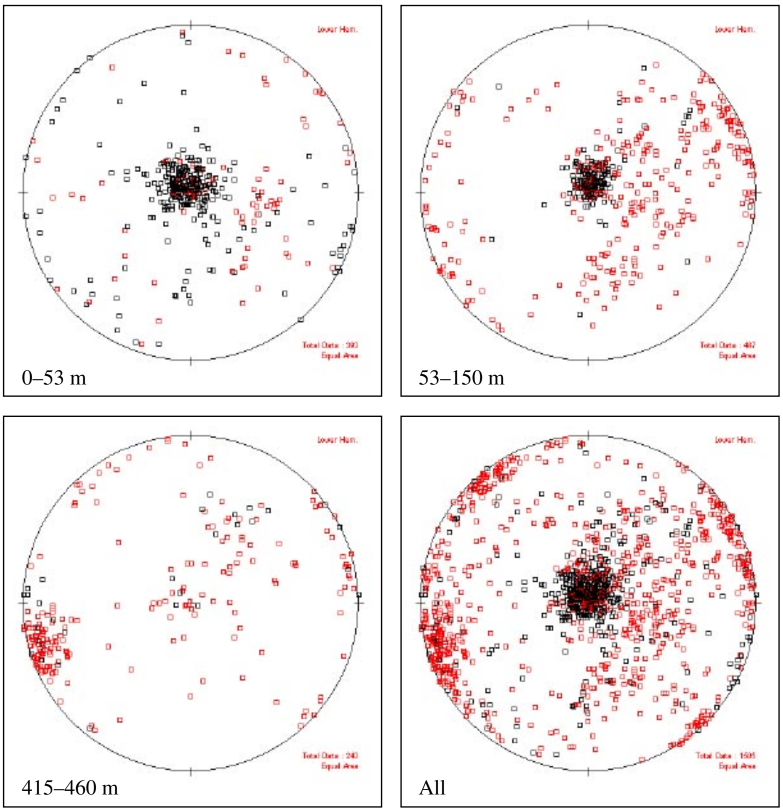
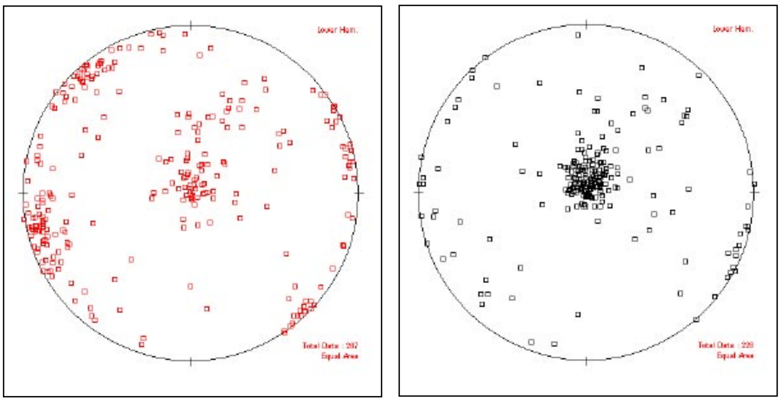
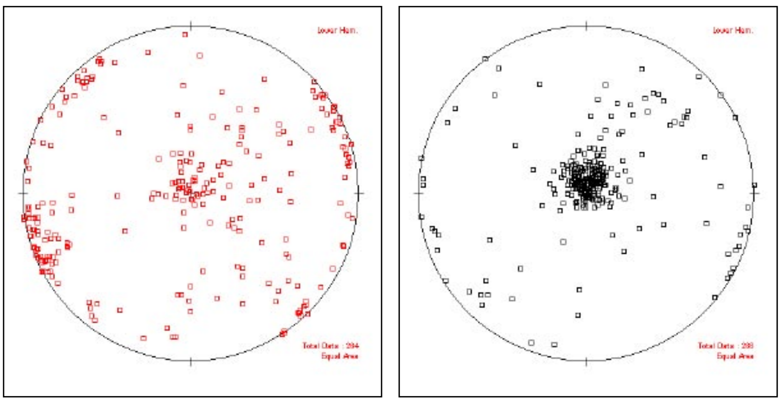


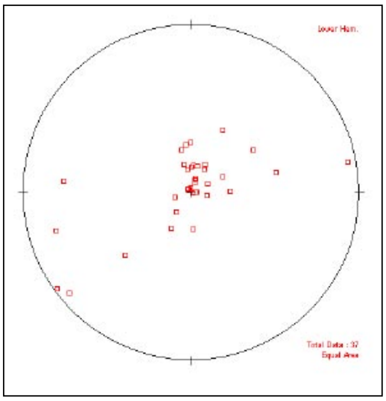
Figure 5-6. *Lower hemisphere equal-area stereographic projections showing the poles to fracture planes with (black squares) and without (red squares) aperture, at different depth intervals in borehole KFM01B.*

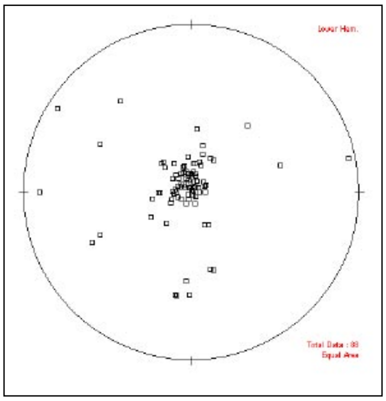


Calcite



Chlorite





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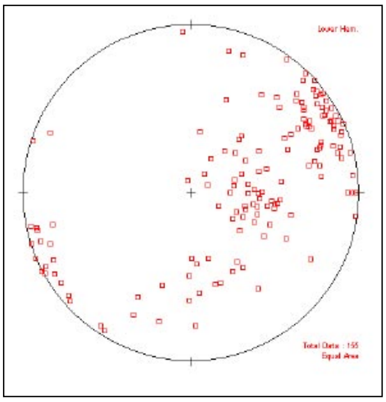
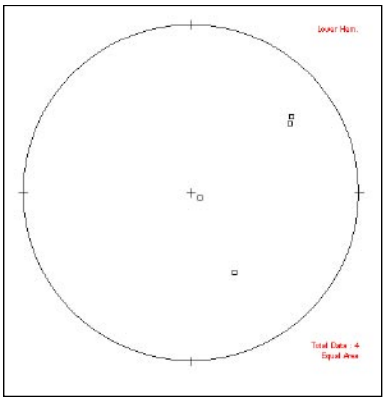
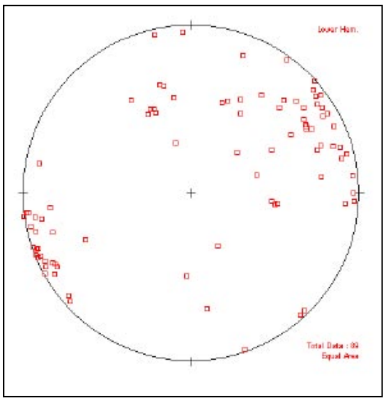
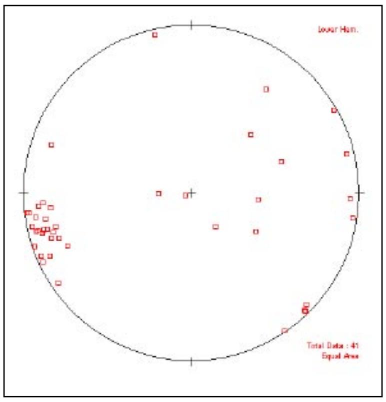




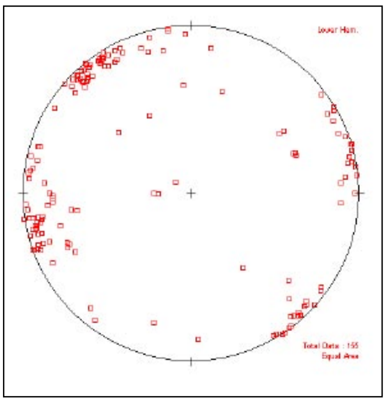
Epidote

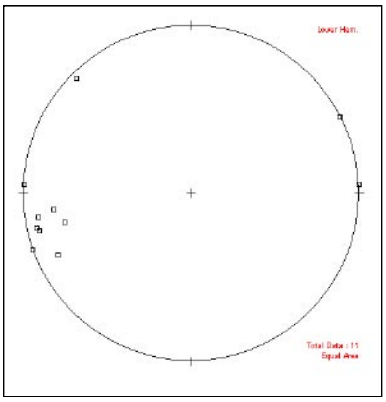


Quartz

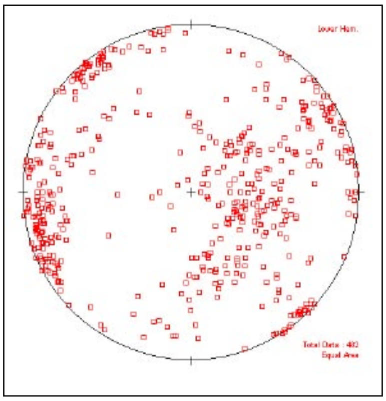


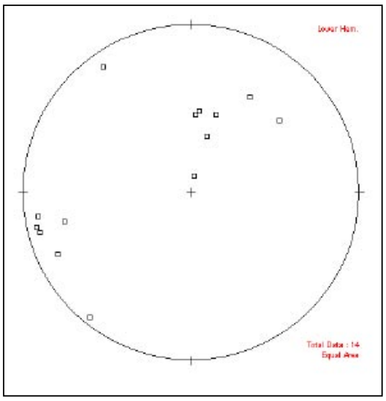
Prehnite



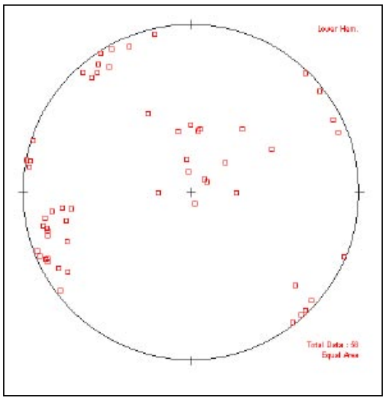


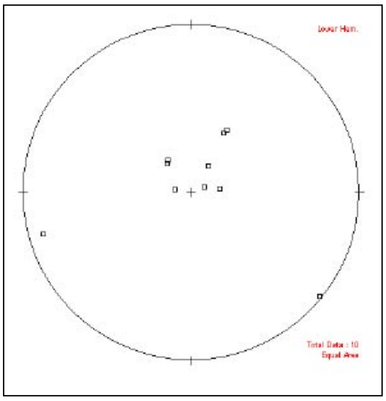
Laumontite



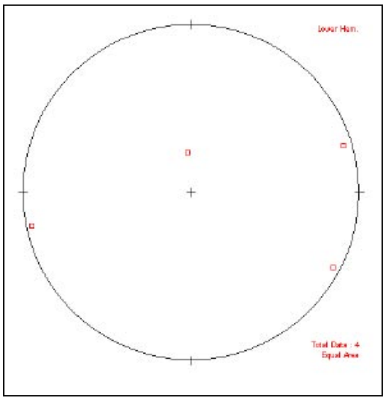


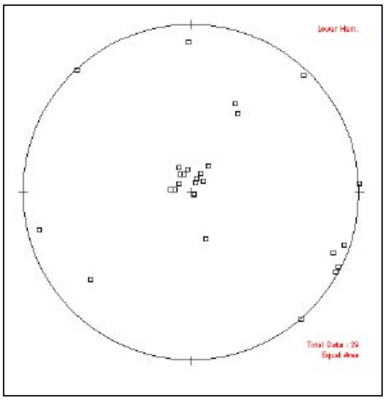
Oxidized walls



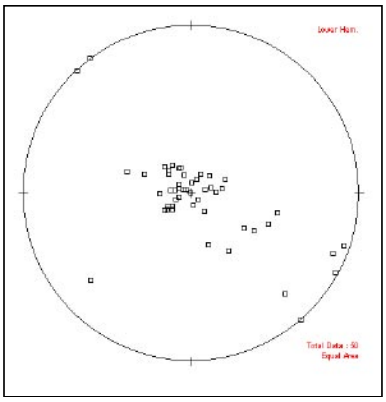


Hematite





Pyrite



Asphalt

Figure 5-7. *Lower hemisphere, equal-area, stereographic projections. The figures show the poles to fracture planes with (black squares) and without (red squares) aperture, for fractures with different infilling material in borehole KFM01B.*

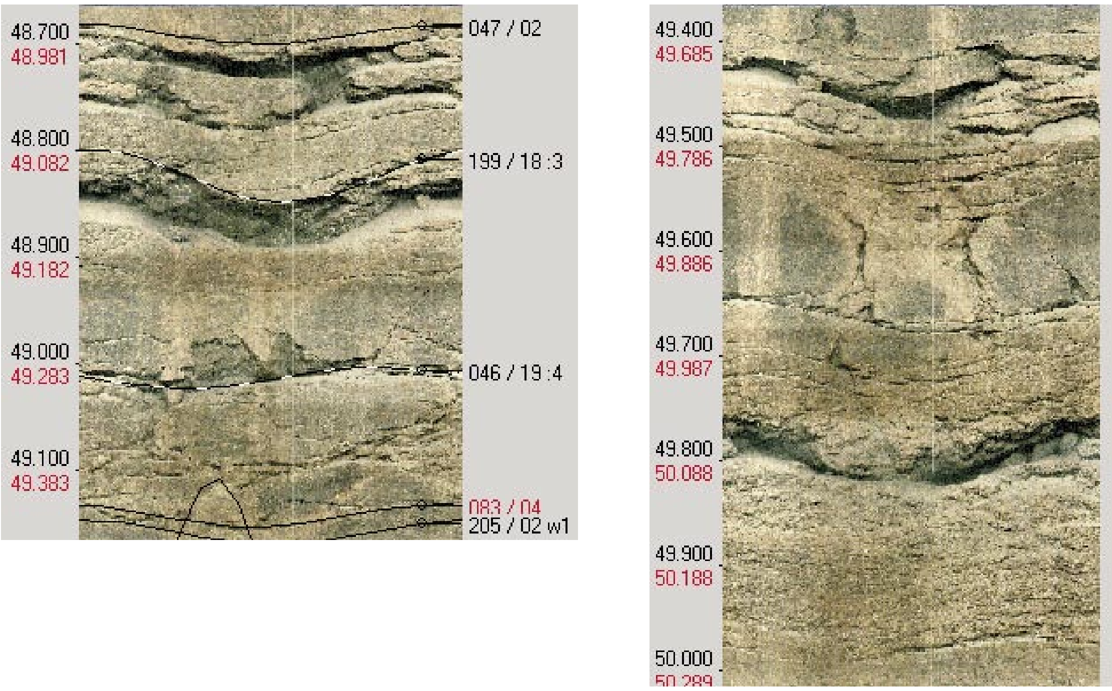


Figure 5-8. *BIPS images from a section of crush zones in KFM01B. Numbers in red correspond to adjusted depth.*

Lithological contacts may act as mechanical discontinuities in the rock. It is hence reasonable to expect that high contrast in competence, such as between granitic material and amphibolite, may facilitate fracture formation. In fact c. 30 % of the contacts between the amphibolites and the surrounding metagranodiorite-granite are fractured. Most of these fractures are open. There is a tendency that open fractures along such boundaries are more common in the top of the borehole.

5.4.2 Fracture mineralogy

Figure 5-7 gives a good view of how the different fracture mineralogies are distributed in fractures of different orientation, with and without aperture.

As can be seen most fracture minerals occur in fractures of different orientation. However, there are several minerals that preferentially occur only in restricted fracture sets. Most obvious is that fractures with no minerals normally are open and sub-horizontal.

More than 50 % of the fractures in KFM01B are filled with chlorite and/or calcite.

Certain minerals occur frequently associated with certain other minerals. Especially common association are epidote-quartz, calcite-chlorite, and calcite-laumontite. Oxidized walls occur in many different fractures, both with respect to orientation and fracture filling.

Asphalt is an infilling found in 54 fractures, all but two broken. As seen in Figure 5-7 there is a clear concentration of these in fractures striking NE-SW (besides sub-horizontal ones).

5.5 Discussion

Direct correlation between the top surface geology and the lithology in KFM01A is somewhat hampered by the poor bedrock exposure in the area immediately surrounding the drilling site. A thick cover of soil and irregular bedrock topography did not allow stripping. However, the general picture is that the core lithology corresponds well with what is to be expected from the regional surface mapping made by SGU during 2002, though the rock proportions differ slightly /6/. Also the ductile features, including the near-horizontal lineation and steep, NW–NNE striking foliation, are in close agreement with the structural pattern which emerged from SGU's surface mapping in the area /6/.

One of the major differences between the upper 500 m in KFM01A and KFM01B is the occurrence of a NW-SE set of fractures in the latter. These fractures are preferentially sealed with laumontite. It appears as if this set has a distinct steep orientation locally, but that the strike varies considerably within a few tens of metres laterally.

6 References

/1/ Stråhle A, 2003. Introduktion för boremapkartering. Svensk Kärnbränslehantering AB, 58 pp.

/2/ Petersson J, Wängnerud A, 2003. Boremap mapping of telescopic drilled borehole KFM01A. SKB P-03-23, Svensk Kärnbränslehantering AB, 97 pp.

/3/ Petersson J, Wängnerud A, Stråhle A, 2003. Boremap mapping of telescopic drilled borehole KFM02A. SKB P-03-98, Svensk Kärnbränslehantering AB, 111 pp.

/4/ Vollmer, F. W. 1995. C program for automatic contouring of spherical orientation data using a modified Kamb method. Computers and Geosciences 21, 31-49.

/5/ Kamb, W. B. 1959. Ice petrofabric observations from Blue Glacier, Washington, in relation to theory and experiment. Journal of Geophysical Research 64, 1891-1909.

/6/ Stephens M B, Bergman T, Andersson J, Hermansson T, Wahlgren C-H, Albrecht L, Mikko H, 2003. Bedrock mapping – Forsmark: Stage 1 (2002) – Outcrop data including fracture data. SKB P-03-09, Svensk Kärnbränslehantering AB, 23 pp.

Appendix 1

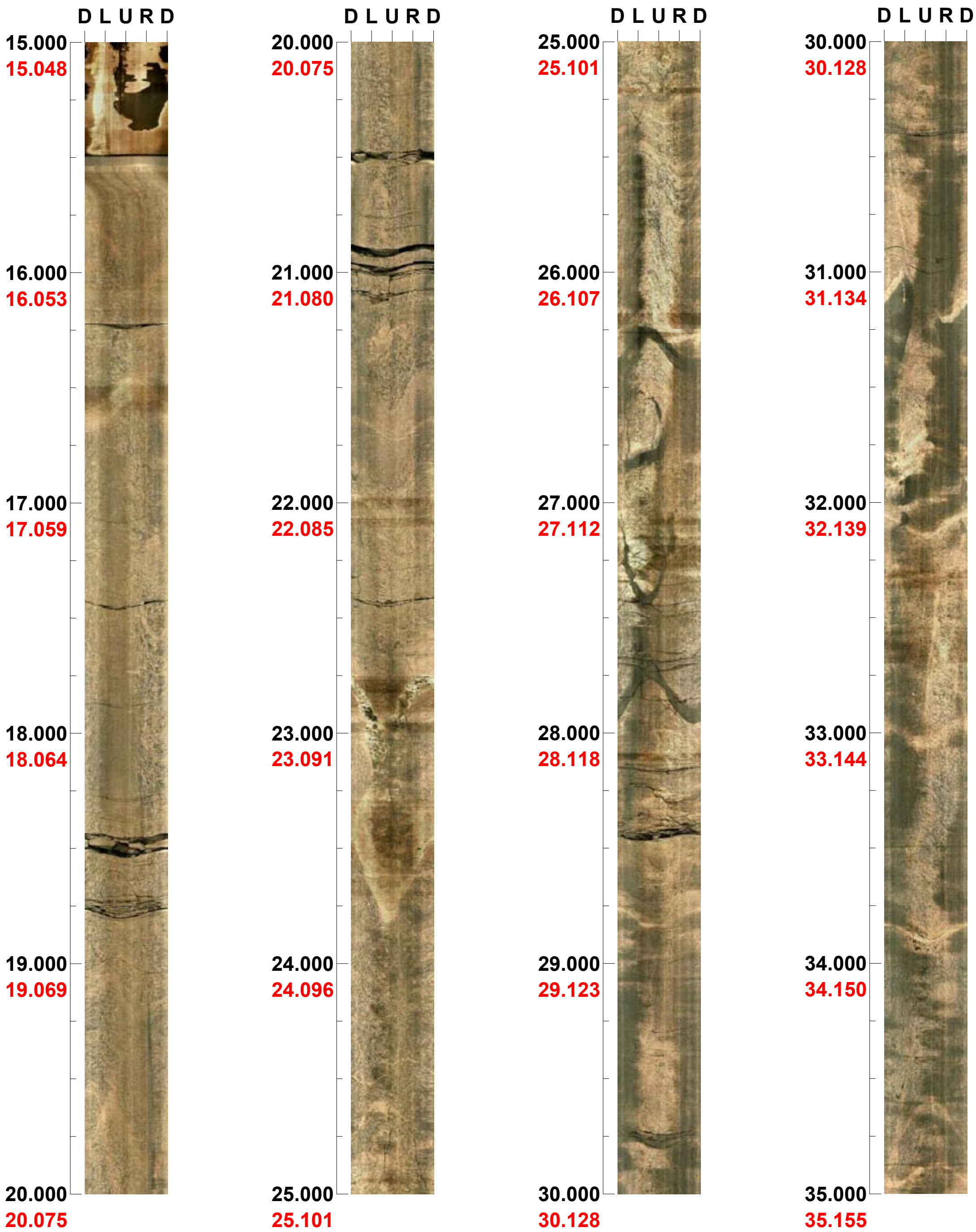
BIPS-image: 15-497 m

Project name: Forsmark

Image file	: g:\skb\bips\forsmark\kfm01b\kfm01b\omlog~er\used\kfm
BDT file	: g:\skb\bips\forsmark\kfm01b\kfm01b\omlog~er\used\ksh
Locality	: FORSMARK
Bore hole number	: KFM01B
Date	: 03/08/31
Time	: 09:30:00
Depth range	: 15.000 - 496.738 m
Azimuth	: 174
Inclination	: -80
Diameter	: 76.0 mm
Magnetic declination	: 0.0
Span	: 4
Scan interval	: 0.25
Scan direction	: To bottom
Scale	: 1/25
Aspect ratio	: 150 %
Pages	: 25
Color	: +0 +0 +0

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 174** **Inclination: -80**

Depth range: 15.000 - 35.000 m

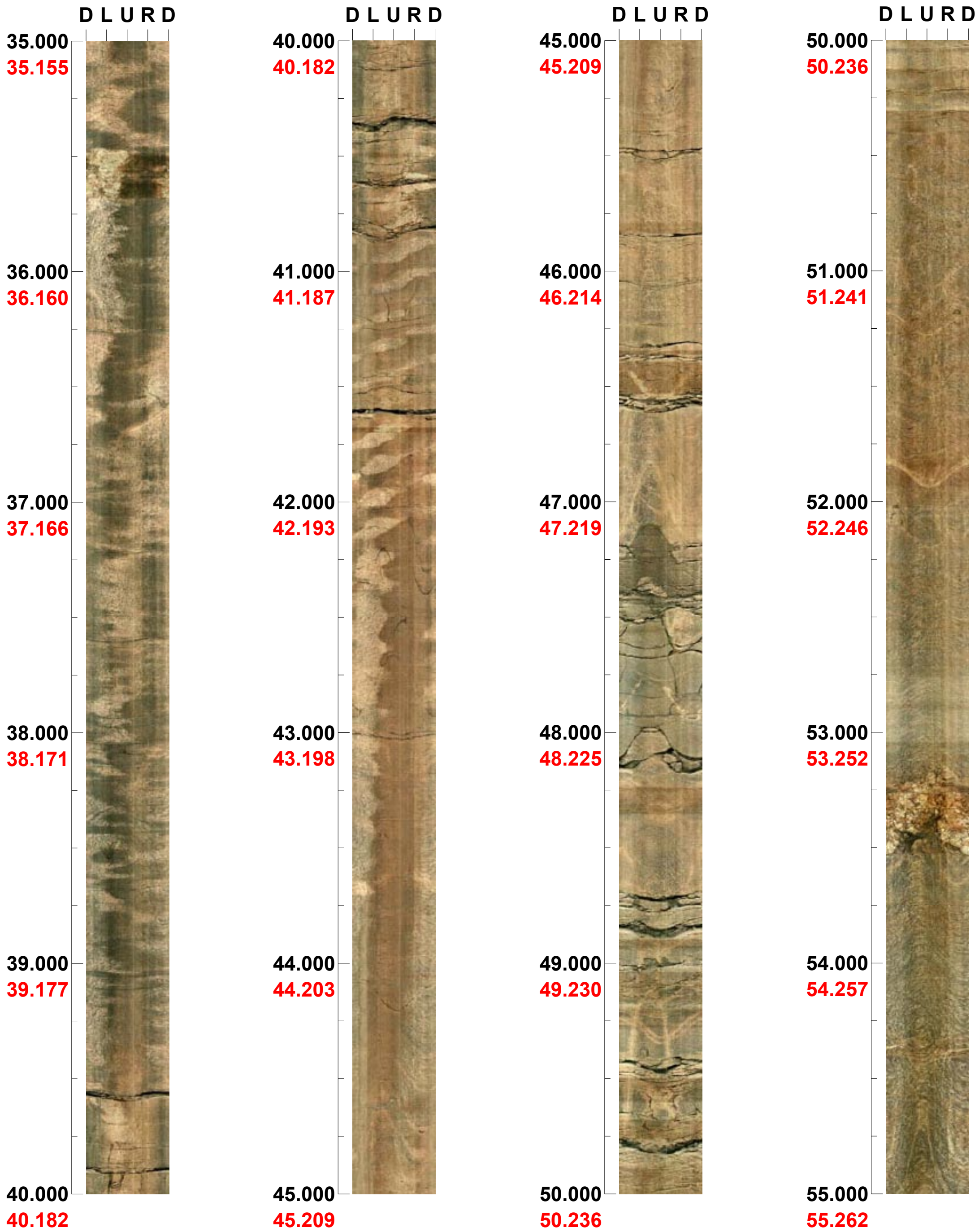


(1 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B

Azimuth: 175 Inclination: -79

Depth range: 35.000 - 55.000 m



(2 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 172** **Inclination: -78**

Depth range: 55.000 - 75.000 m

(3 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 171** **Inclination: -78**

Depth range: 75.000 - 95.000 m

(4 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 95.000 - 115.000 m

(5 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark

Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 115.000 - 135.000 m

(6 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 135.000 - 155.000 m

(7 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark

Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 155.000 - 175.000 m

(8 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 175.000 - 195.000 m

(9 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark

Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 195.000 - 215.000 m

(10 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 215.000 - 235.000 m

(11 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B Azimuth: 167 Inclination: -76

Depth range: 235.000 - 255.000 m

(12 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 255.000 - 275.000 m

(13 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 275.000 - 295.000 m

(14 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B Azimuth: 167 Inclination: -76

Depth range: 295.000 - 315.000 m

(15 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 315.000 - 335.000 m

(16 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B Azimuth: 167 Inclination: -76

Depth range: 335.000 - 355.000 m

(17 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark
Bore hole No.: KFM01B Azimuth: 167 Inclination: -76

Depth range: 355.000 - 375.000 m

(18 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 375.000 - 395.000 m

(19 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B Azimuth: 167 Inclination: -76

Depth range: 395.000 - 415.000 m

(20 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 415.000 - 435.000 m

(21 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B Azimuth: 167 Inclination: -76

Depth range: 435.000 - 455.000 m

(22 / 25) Scale: 1/25 Aspect ratio: 150 %

Project name: Forsmark

Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 455.000 - 475.000 m

(23 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

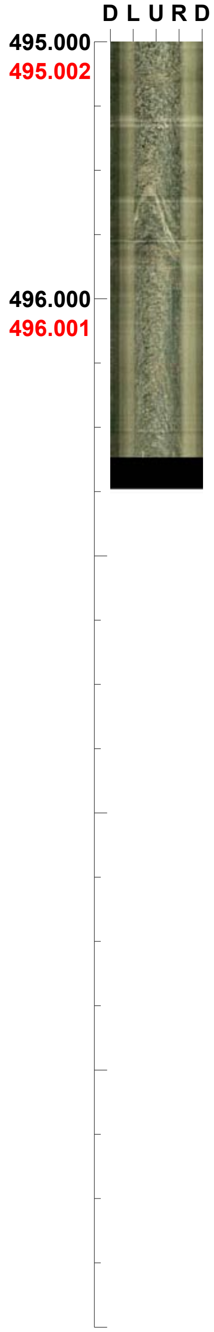
Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 475.000 - 495.000 m

(24 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Project name: Forsmark
Bore hole No.: KFM01B **Azimuth: 167** **Inclination: -76**

Depth range: 495.000 - 496.738 m



(25 / 25) **Scale: 1/25** **Aspect ratio: 150 %**

Appendix 2

WellCAD diagram: 15-497 m

Title Geological legend for core borehole KFM01B at Forsmark

Site	FORSMARK
Borehole	KFM01B
Plot Date	2004-06-20 21:01:56

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

ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized
- Weathered
- Tectonized
- Sericitisized
- Quartz dissolution
- Silicification
- Argillization
- Albitization
- Carbonatization
- Saussuritization
- Steatitization
- Uralitization

MINERAL
- Biotite
- Epidote
- Hematite
- Calcite
- Chlorite
- Malachite
- Unknown
- Pyrite
- Clay Minerals
- Laumontite
- Zeolite
- Prehnite
- Asphalt
- Iron Hydroxide

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

TEXTURE
- Hornfelsed
- Porphyritic
- Ophitic
- Equigranular
- Augen-Bearing
- Non_equigranular
- Metamorphic

GRAINSIZE
- Aphanitic
- Fine grained
- Fine to Medium Grained
- Medium coarse
- Coarse grained
- Medium grained

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

INTENSITY
- No intensity
- Faint
- Weak
- Medium
- Strong

ROUGHNESS
- Planar
- Undulating
- Stepped
- Irregular

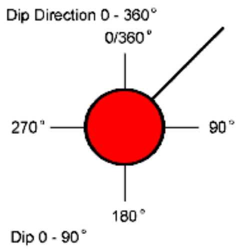
SURFACE
- Rough
- Smooth
- Slickensided

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

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

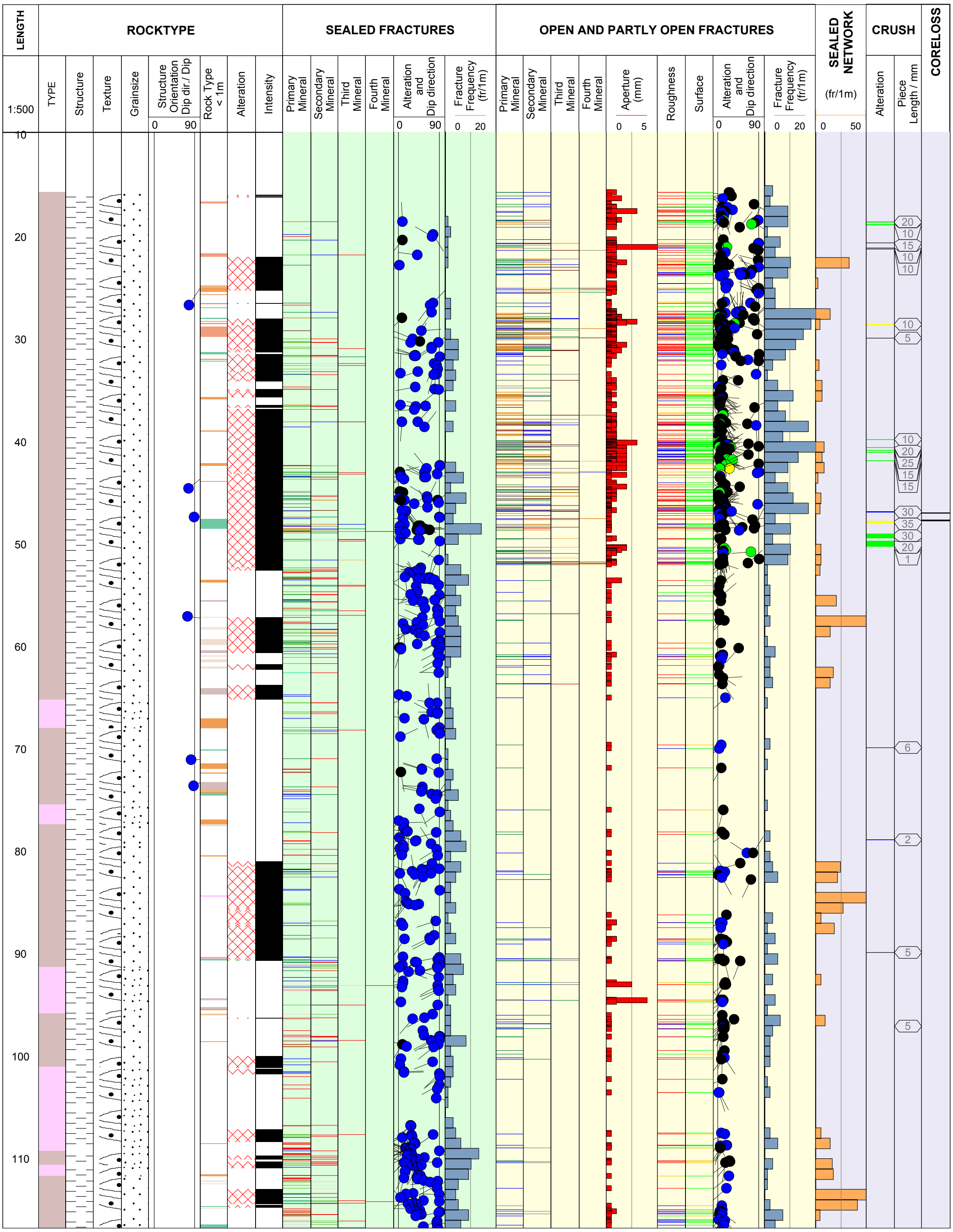
FRACTURE DIRECTION

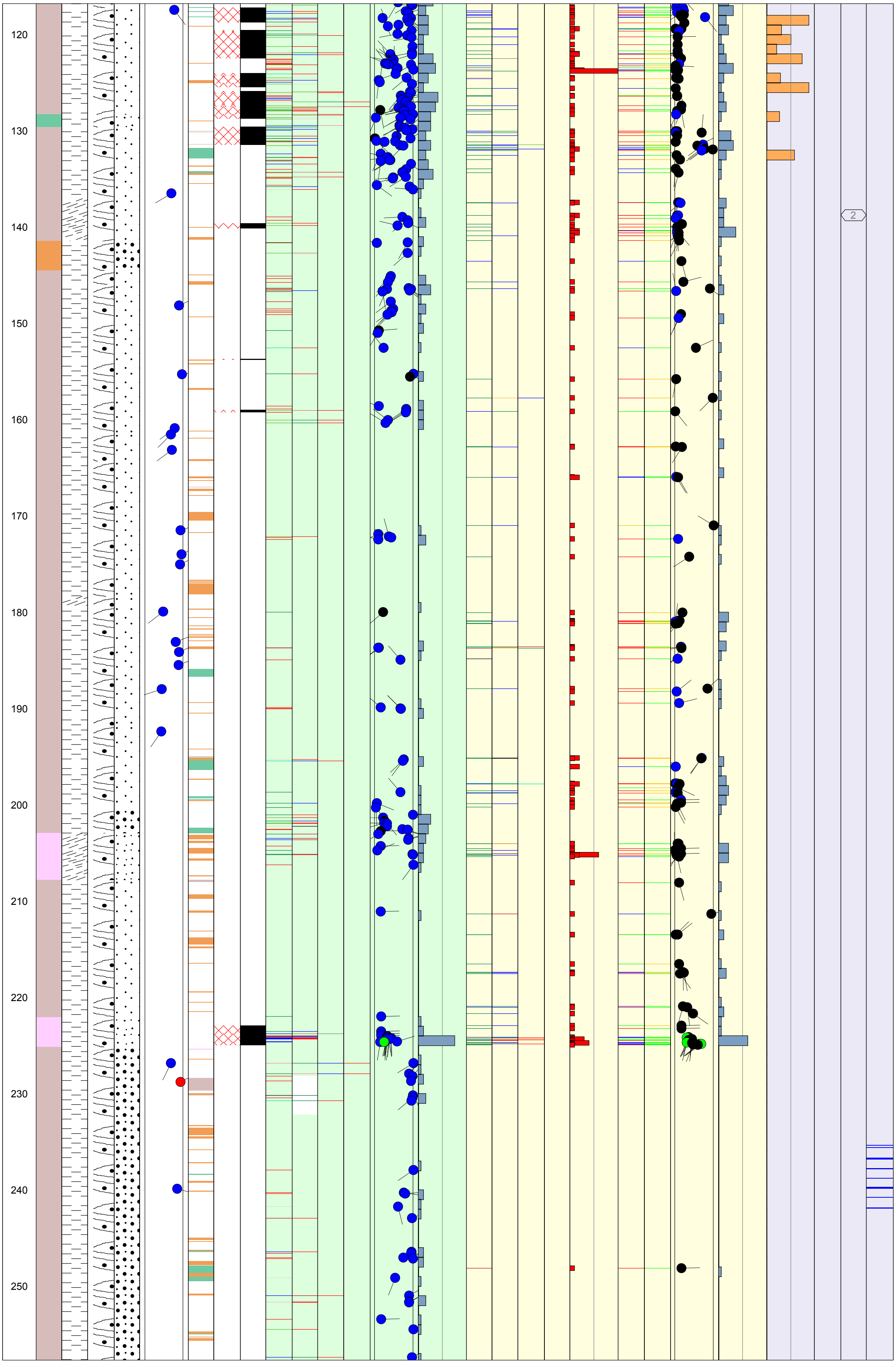
STRUKTURE ORIENTATION



Title **Geological mapping of the core borehole KFM01B at Forsmark**

Site	FORSMARK	**Coordinate System**	RT90-RHB70
Borehole	KFM01B	**Northing [m]**	6699539.40
Diameter [mm]	76	**Easting [m]**	1631387.67
Length [m]	500.520	**Elevation [m.a.s.l.]**	3.09
Bearing [°]	267.59	**Drilling Start Date**	2003-06-25 07:00:00
Inclination [°]	-79.03	**Drilling Stop Date**	2004-01-15 15:00:00
Date of mapping	2004-05-12 18:14:00	**Plot Date**	2004-06-20 21:01:56
Rocktype data from	p_rock_XXXXX	**Fracture data from**	p_fract_core

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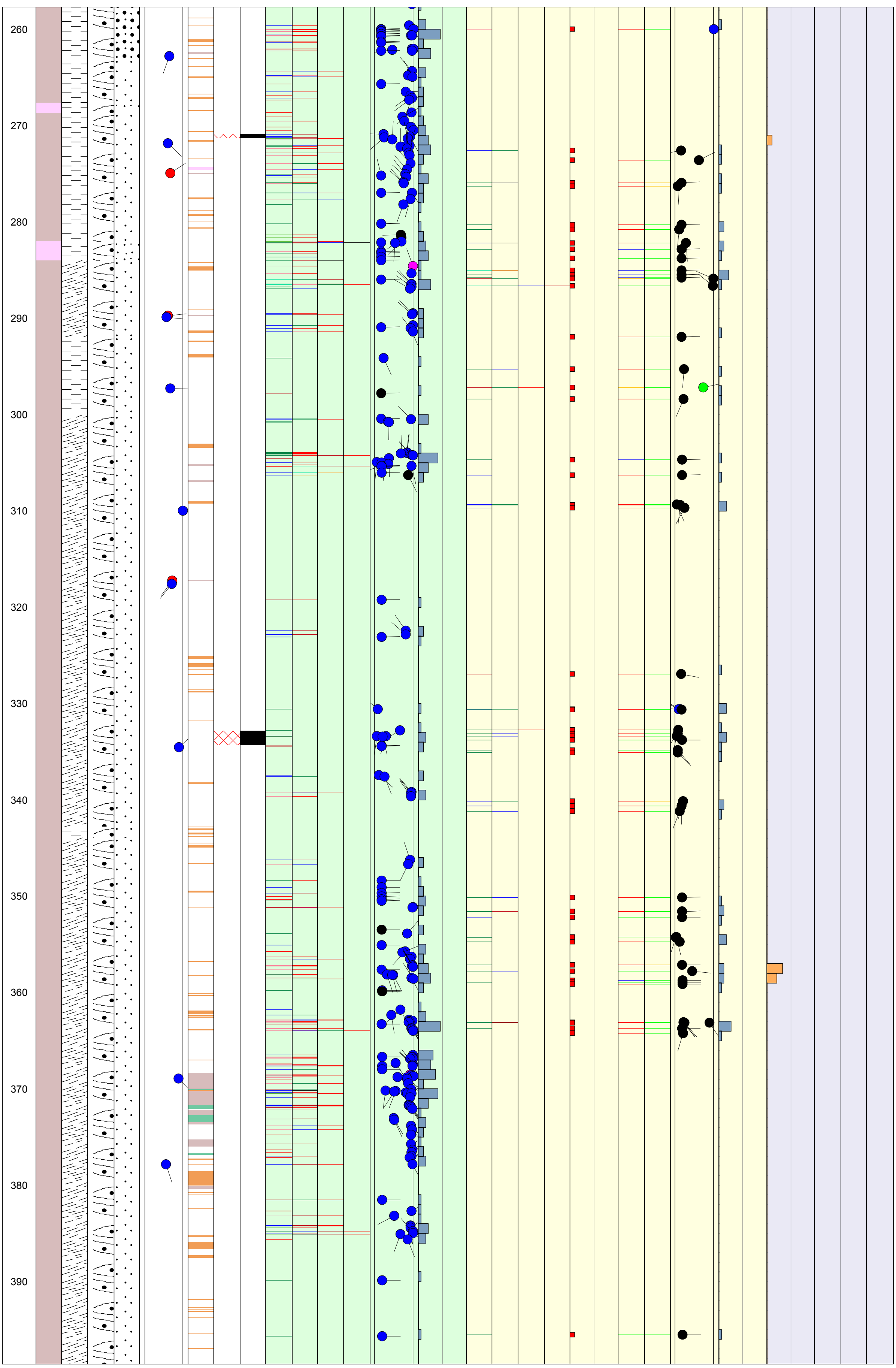
2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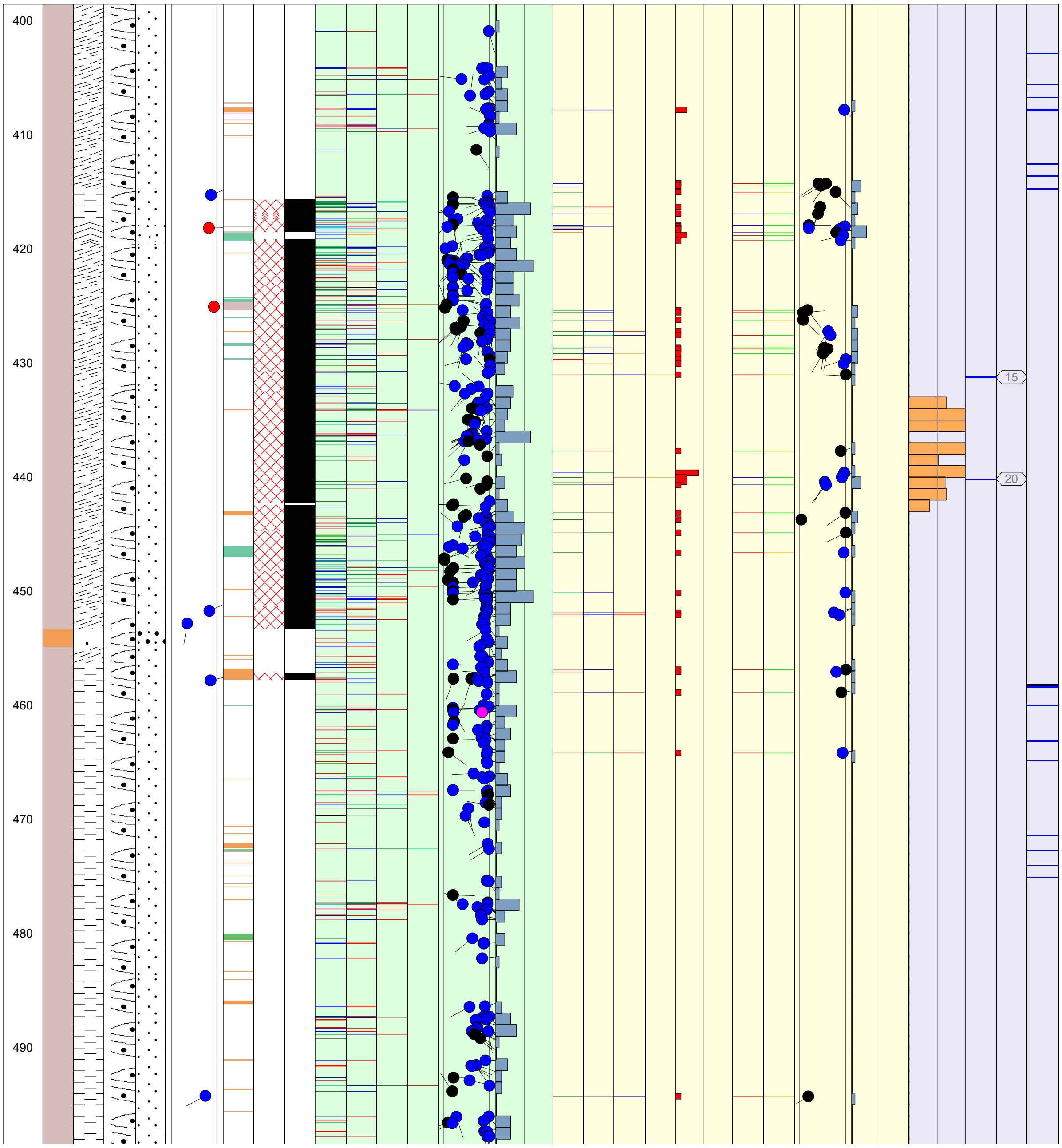
380
390


400
410
420
430
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470
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490
15
20

Appendix 3

In data: Borehole length and diameter

Hole Diam T - Drilling: Borehole diameter

KFM01B, 2003-07-29 11:00:00 - 2004-01-15 15:00:00 (9.170 - 500.520 m)

Sub Secup (m)	Sub Seclow (m)	Hole Diam (m)	Comment
0.150	9.170	0.150	
9.170	15.560	0.101	
15.560	500.520	0.076	

Printout from SICADA 2004-06-16 10:46:25.

Appendix 4

In data: Deviation data

Maxibor T - Borehole deviation: Maxibor

KFM01B, 2004-01-16 00:00:00 (0.000 - 495.000 m)

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
0.00	6699539.40	1631387.67	-3.09	RT90-RHB70	-79.04	267.59				
3.00	6699539.37	1631387.10	-0.15	RT90-RHB70	-78.97	268.26				
6.00	6699539.35	1631386.53	2.80	RT90-RHB70	-78.87	268.33				
9.00	6699539.34	1631385.95	5.74	RT90-RHB70	-78.77	268.24				
12.00	6699539.32	1631385.37	8.68	RT90-RHB70	-78.71	268.09				
15.00	6699539.30	1631384.78	11.62	RT90-RHB70	-78.62	267.98				
18.00	6699539.28	1631384.19	14.57	RT90-RHB70	-78.58	267.83				
21.00	6699539.26	1631383.59	17.51	RT90-RHB70	-78.57	267.71				
24.00	6699539.23	1631383.00	20.45	RT90-RHB70	-78.56	267.67				
27.00	6699539.21	1631382.40	23.39	RT90-RHB70	-78.53	267.75				
30.00	6699539.19	1631381.81	26.33	RT90-RHB70	-78.48	267.71				
33.00	6699539.16	1631381.21	29.27	RT90-RHB70	-78.45	267.67				
36.00	6699539.14	1631380.61	32.21	RT90-RHB70	-78.45	267.69				
39.00	6699539.11	1631380.01	35.15	RT90-RHB70	-78.43	267.64				
42.00	6699539.09	1631379.41	38.08	RT90-RHB70	-78.43	267.64				
45.00	6699539.06	1631378.81	41.02	RT90-RHB70	-78.42	267.62				
48.00	6699539.04	1631378.21	43.96	RT90-RHB70	-78.41	267.61				
51.00	6699539.01	1631377.60	46.90	RT90-RHB70	-78.38	267.56				
54.00	6699538.99	1631377.00	49.84	RT90-RHB70	-78.34	267.63				
57.00	6699538.96	1631376.39	52.78	RT90-RHB70	-78.30	267.74				

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
60.00	6699538.94	1631375.79	55.72	RT90-RHB70	-78.25	267.78				
63.00	6699538.91	1631375.18	58.65	RT90-RHB70	-78.19	267.82				
66.00	6699538.89	1631374.56	61.59	RT90-RHB70	-78.10	267.90				
69.00	6699538.87	1631373.94	64.52	RT90-RHB70	-78.03	267.88				
72.00	6699538.85	1631373.32	67.46	RT90-RHB70	-77.97	267.88				
75.00	6699538.82	1631372.70	70.39	RT90-RHB70	-77.93	267.96				
78.00	6699538.80	1631372.07	73.33	RT90-RHB70	-77.89	268.10				
81.00	6699538.78	1631371.44	76.26	RT90-RHB70	-77.83	268.37				
84.00	6699538.76	1631370.81	79.19	RT90-RHB70	-77.80	268.48				
87.00	6699538.74	1631370.18	82.13	RT90-RHB70	-77.82	268.56				
90.00	6699538.73	1631369.54	85.06	RT90-RHB70	-77.83	268.72				
93.00	6699538.71	1631368.91	87.99	RT90-RHB70	-77.78	268.75				
96.00	6699538.70	1631368.28	90.92	RT90-RHB70	-77.68	268.72				
99.00	6699538.69	1631367.64	93.85	RT90-RHB70	-77.59	268.89				
102.00	6699538.67	1631366.99	96.78	RT90-RHB70	-77.52	268.94				
105.00	6699538.66	1631366.34	99.71	RT90-RHB70	-77.45	268.95				
108.00	6699538.65	1631365.69	102.64	RT90-RHB70	-77.41	268.96				
111.00	6699538.64	1631365.04	105.57	RT90-RHB70	-77.36	268.99				
114.00	6699538.63	1631364.38	108.50	RT90-RHB70	-77.29	269.08				
117.00	6699538.62	1631363.72	111.42	RT90-RHB70	-77.25	269.09				
120.00	6699538.61	1631363.06	114.35	RT90-RHB70	-77.21	269.02				
123.00	6699538.59	1631362.39	117.27	RT90-RHB70	-77.15	269.01				
126.00	6699538.58	1631361.73	120.20	RT90-RHB70	-77.07	268.87				
129.00	6699538.57	1631361.06	123.12	RT90-RHB70	-77.02	268.91				
132.00	6699538.56	1631360.38	126.05	RT90-RHB70	-76.96	268.88				
135.00	6699538.54	1631359.71	128.97	RT90-RHB70	-76.85	268.85				
138.00	6699538.53	1631359.02	131.89	RT90-RHB70	-76.75	268.89				

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
141.00	6699538.52	1631358.34	134.81	RT90-RHB70	-76.65	268.96				
144.00	6699538.50	1631357.64	137.73	RT90-RHB70	-76.62	268.89				
147.00	6699538.49	1631356.95	140.65	RT90-RHB70	-76.56	269.03				
150.00	6699538.48	1631356.25	143.57	RT90-RHB70	-76.53	269.05				
153.00	6699538.47	1631355.55	146.48	RT90-RHB70	-76.49	269.08				
156.00	6699538.46	1631354.85	149.40	RT90-RHB70	-76.43	269.09				
159.00	6699538.44	1631354.15	152.32	RT90-RHB70	-76.38	269.19				
162.00	6699538.43	1631353.44	155.23	RT90-RHB70	-76.34	269.15				
165.00	6699538.42	1631352.73	158.15	RT90-RHB70	-76.28	269.15				
168.00	6699538.41	1631352.02	161.06	RT90-RHB70	-76.24	269.18				
171.00	6699538.40	1631351.31	163.98	RT90-RHB70	-76.19	269.25				
174.00	6699538.39	1631350.59	166.89	RT90-RHB70	-76.13	269.28				
177.00	6699538.38	1631349.87	169.80	RT90-RHB70	-76.07	269.23				
180.00	6699538.38	1631349.15	172.71	RT90-RHB70	-76.00	269.19				
183.00	6699538.36	1631348.43	175.62	RT90-RHB70	-75.94	269.08				
186.00	6699538.35	1631347.70	178.53	RT90-RHB70	-75.87	269.09				
189.00	6699538.34	1631346.97	181.44	RT90-RHB70	-75.76	268.94				
192.00	6699538.33	1631346.23	184.35	RT90-RHB70	-75.65	268.80				
195.00	6699538.31	1631345.49	187.26	RT90-RHB70	-75.54	268.76				
198.00	6699538.30	1631344.74	190.16	RT90-RHB70	-75.41	268.63				
201.00	6699538.28	1631343.98	193.07	RT90-RHB70	-75.27	268.35				
204.00	6699538.26	1631343.22	195.97	RT90-RHB70	-75.15	268.03				
207.00	6699538.23	1631342.45	198.87	RT90-RHB70	-75.09	267.97				
210.00	6699538.20	1631341.68	201.77	RT90-RHB70	-75.00	268.05				
213.00	6699538.18	1631340.90	204.66	RT90-RHB70	-74.92	268.25				
216.00	6699538.15	1631340.12	207.56	RT90-RHB70	-74.81	268.36				
219.00	6699538.13	1631339.34	210.46	RT90-RHB70	-74.71	268.36				

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
222.00	6699538.11	1631338.55	213.35	RT90-RHB70	-74.64	268.34				
225.00	6699538.08	1631337.75	216.24	RT90-RHB70	-74.59	268.36				
228.00	6699538.06	1631336.95	219.13	RT90-RHB70	-74.54	268.36				
231.00	6699538.04	1631336.16	222.03	RT90-RHB70	-74.48	268.33				
234.00	6699538.01	1631335.35	224.92	RT90-RHB70	-74.42	268.24				
237.00	6699537.99	1631334.55	227.81	RT90-RHB70	-74.37	268.22				
240.00	6699537.97	1631333.74	230.70	RT90-RHB70	-74.34	268.22				
243.00	**6699537.94**	**1631332.93**	**233.58**	**RT90-RHB70**	**-74.32**	**268.15**				
246.00	**6699537.91**	**1631332.12**	**236.47**	**RT90-RHB70**	**-74.28**	**268.24**				
249.00	**6699537.89**	**1631331.31**	**239.36**	**RT90-RHB70**	**-74.26**	**268.29**				
252.00	**6699537.86**	**1631330.49**	**242.25**	**RT90-RHB70**	**-74.25**	**268.39**				
255.00	**6699537.84**	**1631329.68**	**245.14**	**RT90-RHB70**	**-74.23**	**268.45**				
258.00	**6699537.82**	**1631328.87**	**248.02**	**RT90-RHB70**	**-74.19**	**268.48**				
261.00	**6699537.80**	**1631328.05**	**250.91**	**RT90-RHB70**	**-74.15**	**268.50**				
264.00	**6699537.78**	**1631327.23**	**253.79**	**RT90-RHB70**	**-74.10**	**268.45**				
267.00	**6699537.75**	**1631326.41**	**256.68**	**RT90-RHB70**	**-74.04**	**268.41**				
270.00	6699537.73	1631325.58	259.56	RT90-RHB70	-74.00	268.32				
273.00	6699537.71	1631324.76	262.45	RT90-RHB70	-73.97	268.31				
276.00	6699537.68	1631323.93	265.33	RT90-RHB70	-73.95	268.32				
279.00	6699537.66	1631323.10	268.21	RT90-RHB70	-73.91	268.40				
282.00	6699537.64	1631322.27	271.10	RT90-RHB70	-73.87	268.46				
285.00	6699537.61	1631321.43	273.98	RT90-RHB70	-73.83	268.51				
288.00	6699537.59	1631320.60	276.86	RT90-RHB70	-73.79	268.52				
291.00	6699537.57	1631319.76	279.74	RT90-RHB70	-73.75	268.56				
294.00	6699537.55	1631318.92	282.62	RT90-RHB70	-73.69	268.54				
297.00	6699537.53	1631318.08	285.50	RT90-RHB70	-73.63	268.54				
300.00	6699537.51	1631317.24	288.38	RT90-RHB70	-73.57	268.51				

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
303.00	6699537.48	1631316.39	291.26	RT90-RHB70	-73.50	268.49				
306.00	6699537.46	1631315.54	294.13	RT90-RHB70	-73.44	268.48				
309.00	6699537.44	1631314.68	297.01	RT90-RHB70	-73.39	268.46				
312.00	6699537.42	1631313.82	299.88	RT90-RHB70	-73.33	268.48				
315.00	6699537.39	1631312.96	302.76	RT90-RHB70	-73.30	268.53				
318.00	6699537.37	1631312.10	305.63	RT90-RHB70	-73.27	268.61				
321.00	6699537.35	1631311.24	308.50	RT90-RHB70	-73.23	268.73				
324.00	6699537.33	1631310.37	311.38	RT90-RHB70	-73.20	268.78				
327.00	6699537.31	1631309.51	314.25	RT90-RHB70	-73.16	268.85				
330.00	6699537.29	1631308.64	317.12	RT90-RHB70	-73.10	268.88				
333.00	6699537.28	1631307.77	319.99	RT90-RHB70	-73.02	268.92				
336.00	6699537.26	1631306.89	322.86	RT90-RHB70	-72.95	268.98				
339.00	6699537.24	1631306.01	325.73	RT90-RHB70	-72.89	268.97				
342.00	6699537.23	1631305.13	328.59	RT90-RHB70	-72.82	269.00				
345.00	6699537.21	1631304.24	331.46	RT90-RHB70	-72.76	269.05				
348.00	6699537.20	1631303.35	334.33	RT90-RHB70	-72.72	269.08				
351.00	6699537.18	1631302.46	337.19	RT90-RHB70	-72.69	269.11				
354.00	6699537.17	1631301.57	340.05	RT90-RHB70	-72.67	269.24				
357.00	6699537.16	1631300.68	342.92	RT90-RHB70	-72.65	269.29				
360.00	6699537.15	1631299.78	345.78	RT90-RHB70	-72.63	269.32				
363.00	6699537.14	1631298.89	348.65	RT90-RHB70	-72.61	269.40				
366.00	6699537.13	1631297.99	351.51	RT90-RHB70	-72.57	269.44				
369.00	6699537.12	1631297.09	354.37	RT90-RHB70	-72.53	269.47				
372.00	6699537.11	1631296.19	357.23	RT90-RHB70	-72.49	269.51				
375.00	6699537.10	1631295.29	360.09	RT90-RHB70	-72.46	269.50				
378.00	6699537.10	1631294.38	362.95	RT90-RHB70	-72.43	269.55				
381.00	6699537.09	1631293.48	365.81	RT90-RHB70	-72.42	269.65				

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
384.00	6699537.08	1631292.57	368.67	RT90-RHB70	-72.40	269.63				
387.00	6699537.08	1631291.66	371.53	RT90-RHB70	-72.36	269.66				
390.00	6699537.07	1631290.76	374.39	RT90-RHB70	-72.32	269.80				
393.00	6699537.07	1631289.84	377.25	RT90-RHB70	-72.28	269.75				
396.00	6699537.06	1631288.93	380.11	RT90-RHB70	-72.22	269.75				
399.00	6699537.06	1631288.02	382.96	RT90-RHB70	-72.18	269.75				
402.00	6699537.06	1631287.10	385.82	RT90-RHB70	-72.14	269.74				
405.00	6699537.05	1631286.18	388.68	RT90-RHB70	-72.09	269.77				
408.00	6699537.05	1631285.25	391.53	RT90-RHB70	-72.05	269.71				
411.00	6699537.04	1631284.33	394.38	RT90-RHB70	-72.01	269.73				
414.00	6699537.04	1631283.40	397.24	RT90-RHB70	-71.97	269.80				
417.00	6699537.04	1631282.47	400.09	RT90-RHB70	-71.93	269.93				
420.00	6699537.03	1631281.54	402.94	RT90-RHB70	-71.90	270.05				
423.00	6699537.04	1631280.61	405.79	RT90-RHB70	-71.87	270.18				
426.00	6699537.04	1631279.68	408.65	RT90-RHB70	-71.85	270.17				
429.00	6699537.04	1631278.74	411.50	RT90-RHB70	-71.80	270.10				
432.00	6699537.04	1631277.81	414.35	RT90-RHB70	-71.81	269.99				
435.00	6699537.04	1631276.87	417.20	RT90-RHB70	-71.85	270.05				
438.00	6699537.04	1631275.94	420.05	RT90-RHB70	-71.91	270.24				
441.00	6699537.05	1631275.01	422.90	RT90-RHB70	-71.94	270.47				
444.00	6699537.06	1631274.08	425.75	RT90-RHB70	-71.91	270.59				
447.00	6699537.06	1631273.14	428.60	RT90-RHB70	-71.86	270.71				
450.00	6699537.08	1631272.21	431.45	RT90-RHB70	-71.82	270.75				
453.00	6699537.09	1631271.27	434.30	RT90-RHB70	-71.79	270.70				
456.00	6699537.10	1631270.34	437.15	RT90-RHB70	-71.76	270.60				
459.00	6699537.11	1631269.40	440.00	RT90-RHB70	-71.73	270.49				
462.00	6699537.12	1631268.46	442.85	RT90-RHB70	-71.70	270.50				

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
465.00	6699537.13	1631267.52	445.70	RT90-RHB70	-71.68	270.51				
468.00	6699537.13	1631266.57	448.55	RT90-RHB70	-71.65	270.57				
471.00	6699537.14	1631265.63	451.40	RT90-RHB70	-71.62	270.60				
474.00	6699537.15	1631264.68	454.24	RT90-RHB70	-71.59	270.72				
477.00	6699537.17	1631263.74	457.09	RT90-RHB70	-71.55	270.87				
480.00	6699537.18	1631262.79	459.93	RT90-RHB70	-71.53	271.04				
483.00	6699537.20	1631261.84	462.78	RT90-RHB70	-71.54	271.16				
486.00	6699537.22	1631260.89	465.63	RT90-RHB70	-71.54	271.27				
489.00	6699537.24	1631259.94	468.47	RT90-RHB70	-71.51	271.29				
495.00	6699537.28	1631258.03	474.16	RT90-RHB70	-71.46	271.34				

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Appendix 5

In data: Reference marks

Reference Mark T - Reference mark in drillhole

KFM01B, 2004-01-14 07:00:00 - 2004-01-14 16:00:00 (54.000 - 450.000 m)

Bhlen (m)	Rotation Speed (rpm)	Start Flow (l/min)	Stop Flow (l/min)	Stop Pressure (bar)	Cutter Time (s)	Trace Detectable	Cutter Diameter (mm)	Comment
54.00	400.00	400	800	42.0	90	JA		53,97-54,07 OK Klar signal NK
100.00	400.00	300	850	45.0	115	JA		100,00-100,10 OK Klar signal NK
150.00	400.00	500	1100	50.0	175	JA		150,08-150,18 OK Klar signal NK
197.00	400.00	500	1100	49.0	200	JA		197,17-197,27 OK Klar signal NK
250.00	400.00	520	1100	50.0	290	JA		250,29-250,39 OK Klar signal NK
300.00	400.00	500	1100	52.0	330	JA		300,57-350,67 OK Klar signal NK
350.00	400.00	500	1050	52.0	390	JA		350,57-350,67 OK Klar signal NK
400.00	400.00	480	1100	52.0	450			Vattenläckage i utr Ingen signal pumpstopp NK
450.00	400.00	480	1100	52.0	510			Ingen signal NK

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