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Forsmark site investigation

Boremap mapping of percussion boreholes HFM01–03

Christin Nordman, Geosigma

April 2003

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1 Introduction

This document reports the data gained by Boremap mapping of three percussion boreholes drilled within the site investigation at Forsmark. The three percussion boreholes (HFM01, HFM02 and HFM03) are located at drill site 1, close to the telescopic drilled 1000 m deep borehole KFM01A (Figures 2-1 and 3-1). The HFM01–03 percussion boreholes were drilled in order to follow up geophysical reflectors, to enable groundwater level monitoring, to gain hydrogeochemical data etc. Borehole HFM01 was also used for water supply during the drilling of KFM01A.

The percussion drilled boreholes, were after completion of drilling, investigated with several logging methods, for example, conventional geophysical logging, borehole radar and TV-logging. The latter method includes logging with a colour TV-camera to produce images of the borehole wall, so called BIPS-images (Borehole Image Processing System). The method is described in the method description for TV-logging with BIPS, SKB MD 222.006 (SKB internal controlling document).

Mapping of percussion boreholes according to the Boremap method is based on the use of BIPS-images of the borehole wall, supported by the study of drill cuttings. Although the rock is crushed into small fractions, the mineralogical composition of the samples can still be studied. During drilling, the sampling of drill cuttings is discontinuous and this introduces a degree of uncertainty in the judgement of the rock composition between the sampling points. However, the combination of BIPS-images and samples of drill cuttings offers a reasonably efficient method for a continuous mapping of the geology along the borehole.

The BIPS-images also enable the study of the distribution of fractures along the borehole. Fracture characteristics like aperture, colour of fracture minerals etc are possible to study as well. Furthermore, since the BIPS software has the potential of calculating strike and dip of planar structures such as foliations, rock contacts and fractures intersecting the borehole, also the orientation of each planar structure is documented with the Boremap method. Important to keep in mind is that drill holes and drill cores provide information of the shape of a rock body in one dimension only.

The Boremap mapping of the percussion drilled boreholes HFM01–03 was performed and documented with the software Boremap 3.0 in accordance with the activity plan for Boremap-mapping of percussion drilled boreholes HFM01–HFM08, AP PF 400-02-50 (SKB, internal controlling document). The Boremap mapping was subsequently revised in Boremap 3.2.

2 Objective and scope

The aim of this activity was to document lithologies, ductile structures and the occurrence and character of fractures and fracture zones in the bedrock penetrated by the three percussion drilled boreholes HFM01–03. Data was collected in order to obtain a foundation for a preliminary assessment of the bedrock conditions adjacent to the telescopic drilled borehole KFM01A down to about 250 m. Other data obtained from the percussion drilled boreholes, such as thickness of soil cover, soil stratigraphy, groundwater level and groundwater flow, will not be treated in this paper.

Figure 2-1. *Location of drill sites at Forsmark 2003 (BP1=drill site 1; BP2=drill site 2; BP3=drill site 3).*

3 Equipment

The Boremap mapping was performed with the latest updated version of the software Boremap 3.0 and revised in Boremap 3.2. The Boremap software calculates actual directions (strike and dip) of planar structures penetrated by the borehole (foliations, fractures, fracture zones, rock contacts etc). Data on inclination, bearing and diameter of the borehole are used as in-data for the calculations (Table 4-1). The Boremap software is loaded with 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.

Mapping of drill cuttings included a documentation of the mineralogical composition of the samples using a stereo microscope (work by Johan Kjellman, Uppsala University).

The Boremap mapping was performed on-line on SKB's network in order to obtain the best possible data security.

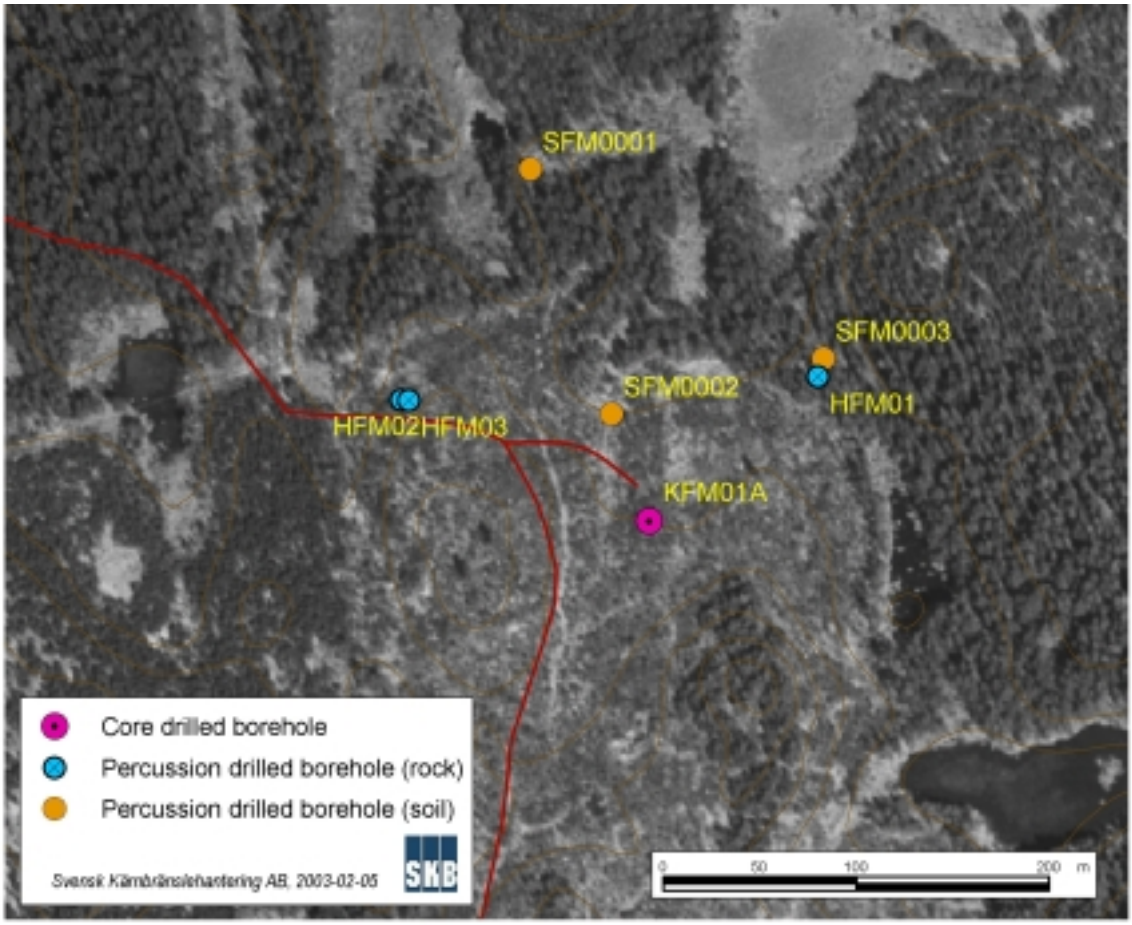


Figure 3-1. *Location of the telescopic drilled (KFM) and the percussion drilled (rock – HFM, soil – SFM) boreholes at drill site 1 at Forsmark.*

4 Execution

The Boremap-mapping of the percussion drilled boreholes HFM01–03 was performed and documented according to activity plan AP PF 400-02-50 (SKB internal controlling document) referring to the Method Description for Boremap mapping (SKB MD 143.006, version 1.0, SKB internal controlling document). The analysis of drill cuttings was carried out prior to the Boremap-mapping (work by Johan Kjellman, Uppsala University) according to Method Description for mapping of drill cuttings (SKB MD 142.001, version 1.0, SKB internal controlling document). This data was available to the interpreter during the Boremap-mapping.

When BIPS-images were not available, i.e. in the beginning of the boreholes, the lithological classification was based on mapping of drill cuttings only.

4.1 Preparations

Background data collected from SICADA included:

- borehole diameter (Appendix 8),
- total borehole length (Appendix 8),
- deviation data (Appendix 9),
- results from mapping of drill cuttings (Appendix 11).

Direction angles of the boreholes were edited using deviation data from the SKB database SICADA.

Table 4-1. Borehole data for HFM01–HFM03 (values from starting point).

ID-code	Northing	Easting	Borehole length (m)	BIPS-image interval (m)	Bearing (degrees)	Inclination (degrees)	Depth to bedrock surface (m)
HFM01	6699605	1631485	200.20	31.0–197.0	34.06	–77.51	11.30
HFM02	6699593	1631269	100.00	25.0–99.3	6.52	–87.79	12.20
HFM03	6699593	1631273	26.00	13.0–25.7	264.53	–87.28	12.00

4.2 Execution of measurements

The available geoscientific information is more limited for Boremap mapping of percussion drilled boreholes compared to the information available for Boremap-mapping of core drilled boreholes when a continuous drill core can be directly compared with the BIPS-image of the borehole wall. During mapping of percussion boreholes, fractures can only be seen on the BIPS-images and rock samples are only available as crushed fragments. As solid rock samples are not available, certain assumptions and simplifications have to be made during the mapping; these are described below.

4.2.1 Fractures

As fractures could only be seen in the BIPS-image they could not be confidently classified as rough, smooth or slickensided, nor could their mineralogy be confidently determined. Hence, the classifications of fracture minerals in the percussion boreholes should be treated with caution. The following assumptions were made:

- The width of very thin fractures (<1 mm) were hard to measure accurately and was therefore, as a rule, interpreted as 1 mm thick or, if only vaguely observed, as 0.5 mm thick.
- Fractures were assumed to be open fractures if they were not clearly observed to be sealed.
- Dark coloured fractures were interpreted to contain some chlorite (such colouration may also be caused by shadows in the fracture walls or by a different dark coloured mineral).
- Bright white (usually sealed) fracture fillings were interpreted to contain calcite.
- White to greyish fracture material was interpreted as feldspar and quartz.
- Sulphide minerals, as well as laumontite and epidote, was identified in the mapping of drill cuttings. It was, however, not possible to correlate these mineral occurrences to certain fractures in the BIPS-image.

4.2.2 Rock colour

The rock colour documented in the Boremap mapping was only classified from the BIPS-image. However, from comparison with the drill cutting samples, the rock colours in the BIPS-image appear somewhat modified and bleached. For example, a rock that was pinkish grey in the BIPS-image was greyish red in the drill cuttings. This discrepancy will be accounted for in further Boremap mapping that will involve synchronous mapping of drill cuttings and BIPS-images. The problem with determination of colour may, however, remain for smaller rock occurrences.

4.2.3 Rock contacts

Orientation of irregular or diffuse rock contacts may be difficult to observe and measure with the BIPS-method, since only planar and discrete features can be measured accurately.

4.2.4 Lithologies

Lithological classifications were sometimes difficult. Recognition of amphibolite and pegmatite was generally easy. However, from the BIPS-image only, it was in places difficult to distinguish very thin bands of amphibolite from fractures, and some misinterpretation must therefore be accounted for.

Data from the mapping of drill-cuttings was used to support classification of the mineralogy, rock type and extent of secondary alteration. The accuracy of this classification may be affected by contamination of the samples due to mixing of rock fragments from different levels of the borehole during the drilling.

4.2.5 Grain size

Classification of grain size can be difficult for minor rock occurrences. If the rock type in question does not differ in mineralogy from the dominating rock in which it is included, it may be difficult to separate the two lithologies in the fine-grained drill cutting samples. When the rock is composed of minerals of similar colours, the grain size can be overestimated when relying too much on the BIPS-images, since single grains are hard to distinguish. This problem is especially evident for minor rock occurrences and the grain size classification for limited rock units is therefore more uncertain.

4.2.6 Ductile deformational structures

By experience, mapping of ductile structures using only BIPS-images can be treacherous. For example, it can be difficult to distinguish and measure the orientation of a weakly or moderately developed ductile foliation in a rock with a strongly developed mineral lineation. Ductile deformation structures were observed in the dominating rock type (metagranodiorite-granite) almost throughout the bore holes HFM01–03 and deformation fabrics were also observed in the drill cuttings. Rocks in outcrops at drill site 1 and in drill core KFM01A commonly show a composite ductile deformational fabric with a mineral lineation and foliation defined by the preferred orientation of biotite and strung out aggregates of quartz and feldspar. It was, however, frequently difficult to distinguish and measure an obvious mineral foliation in the BIPS images from the bore holes HFM01–03, and therefore no measurements of foliations were made.

The Boremap 3.0 and 3.2 software do not allow classification of ductile structures as composite. The rock type structure in HFM01 and HFM02 have been classified as massive despite the fact that both the BIPS-images and the drill cutting samples clearly show that most rocks along the borehole have been exposed to ductile deformation.

The structural character of minor rock occurrences were generally not possible to classify.

4.2.7 Supporting data to the BIPS-images

Data from the mapping of drill-cuttings was used to support classification of mineralogy and extent of secondary alteration in lithological units observed in the BIPS-image. Drill cuttings from HFM02 (41–47 m) were re-examined in order to get a better understanding of the character of an observed crush zone.

Drilling penetration rate was used as complementary data for the geological interpretation (Appendix 10). For example, major anomalies in drilling penetration rate correlated well with crush zones (increase) or thicker occurrences of amphibolite (decrease).

Observations in the BIPS-images were compared with the drill core from borehole KFM01A, located in the vicinity of the investigated percussion boreholes (Figure 3-1). The complete core of KFM01A (100–1000 m) was available in full length on a roller table during the Boremap-mapping.

4.3 Data handling

The mapping was performed on-line on SKB's network in order to obtain the best possible data security. Before every break (exceeding 15 minutes) a back up file was saved on the local disk.

Length correlations of the BIPS-images were performed after the mapping. The BIPS-logging stopped approximately 30 cm before the end of the borehole. However, the actual borehole length (determined from the drilling) cannot be used without reservations as a reference point for the correlations of BIPS-images, since some amount of drill cuttings always covers the bottom of the borehole.

The BIPS-images for HFM01 originally indicated a length of 197.2 m, whereas the borehole length is 200.2 m. The end-point of the BIPS-images was corrected to 199.3 m, based on estimates of the thickness of infillings (drill cuttings) at the bottom of the borehole, stretching of the logging cable etc (length deviation for logging cable generally estimated to about 50 cm per 100 m). For HFM02 the corresponding values for the logging end-point and borehole lengths were 99.4 and 100 m, and for HFM03 25.7 and 26 m, respectively. Length corrections were not considered to be necessary for HFM02 and HFM03.

The mapping was quality checked by a routine in Boremap before it was archived and exported to SICADA.

All data are stored in the SKB SICADA database:

- Data from the Boremap mapping are stored under field note Forsmark 104.
- Data from the mapping of drill cuttings are stored under the field note Forsmark 26.

5 Results

The geology of the three percussion drilled boreholes HFM01–03 corresponds well with the geology in drill core KFM01A and nearby outcrops documented during the regional bedrock mapping in the area (Data in SICADA, field note Forsmark 22, 26, and 104). See also P-report on field data from bedrock mapping in the Forsmark area during 2002 (SKB P-03-09, P-rapport, Bedrock mapping – Forsmark, Stage 1 (2002) Outcrop data including fracture data. SKB 2003).

The results from the borehole mapping are briefly described in Sections 5.1–5.3 below, and graphical presentations of the data are given in Appendices 1–6 (WellCad and BIPS-images with observations). Equal area stereogram projections of poles to natural and sealed fracture planes are shown in Appendix 7.

5.1 HFM01

Lithologies

The dominating rock type (ca 90 %) is a greyish red to reddish grey medium-grained metagranodiorite-granite, tending to be more greyish in colour towards the end of the borehole. From approximately 86 m depth it appears poorer in biotite, alternatively, the biotite aggregates become too small to be seen in the BIPS-image. Pegmatite and thin bands with leucogranitic material occur throughout the borehole (ca 5 %). Wider sections with pegmatite occurs between 53.5–55.0, 66.2–67.0, 115.4–115.8, 121.9–125.1, and 132.0–133.0 m. Thin bands of leucocratic granite are abundant between 110.5–112.0, 115.5–120.5, and 147–160.0 m. Amphibolite (ca 5 %) is observed at 34.0, 133.0–137.4, and 182 m, and is abundant between 60–72 m.

Fractures

The overall fracture frequency calculated from observations in BIPS-images (available between 31–197m depth, Appendix 1) of the HFM01 borehole wall is 2.2 fractures/m. However, the Boremap-mapping of fractures demonstrates a variation in both orientation and frequency of fractures with depth (Appendix 4). Sub horizontal to shallowly dipping fracture sets dominate but are virtually absent below ca 175 m depth. Below 175 m, NW-striking, sub-vertical to steeply dipping fractures dominates. The variations in fracture frequency is shown in the WellCad plot in Appendix 4. In the upper part of the borehole, between 31–75 m the fracture frequency is around 3 fractures/m. Between 75–158 m depth the fracture frequency is considerably lower with slightly less than 1 fracture/m (the section between 75–88 m is almost devoid of fractures). Between 161–174 m, the fracture frequency increase considerably with slightly more than 4 fractures/m (predominance of shallowly dipping fractures, dip direction varies). Below 174 m the fracture frequency is slightly more than 2.5 fractures/m.

A 20 cm wide shallowly dipping crush zone was documented at 42.9 m (measured strike and dip 324/22).

5.2 HFM02

Lithologies

The dominating rock type (ca 85 %) is a medium-grained, reddish grey metagranodiorite-granite. A structurally younger, equigranular, medium-grained, grey granitoid (< 5 %) occurs between 73–75 m. Pegmatite (ca 5 %) occurs between 48.0–48.5, 85–85.5 and 94.5–95 m. Thin bands of pegmatite are observed between 67–73 m. Amphibolite constitute approximately 5 % of the borehole. Less than 1 m wide sections with amphibolite occur between 26.0–46.5 and 82.5–99.4 m.

Fractures

The overall fracture frequency calculated from observations in BIPS-images (available between 25.4 to 99.4 m depth, Appendix 2) of the HFM02 borehole wall is 1.9 fractures/m. Orientation and frequency of fractures are shown in Appendices 5 and 7. The fracture frequency show little variation with depth, except for a concentration of fractures between ca 42–48m depth. NE-striking, shallowly dipping fractures, dominates in this section in which the fracture frequency is more than 6 fractures/m. In the BIPS-image, the zone appears to be spatially associated with the occurrence of amphibolite. Between 43.4–43.6 m depth, there is a shallow crush/fracture zone (measured strike and dip 198/22) probably filled with clay material. During drilling, an additional sample was taken from this crush/fracture zone in addition to the regular sampling program (one sample per metre). The sample contained a high proportion of very fine-grained clayey material.

5.3 HFM03

Lithologies

The BIPS-images (available from 13.1 to 25.9 m depth, Appendix 3) are poor in quality as suspandates were still present in the borehole water during BIPS-logging. The same metagranodiorite-granite as in HFM01 and HFM02 is dominating. It is light grey, with sparse occurrences of leucogranitic material. According to the mapping of drill cuttings, it is finer in grain size than the similar rock observed in HFM01–HFM02. Amphibolite occurs at 24.8 m and continues till the end of the borehole (25.9 m).

Fractures

The borehole wall in HFM03 has a calculated fracture frequency of ca 1.0 fractures/m. The fracture frequency is probably underestimated since some fractures were probably not observed due to the poor quality of the BIPS-images. Two crush/fracture zones were detected at between 15.5–15.8 and 21.1–21.2 m, respectively. The upper one strikes approximately 124/25 and the lower one 122/37.

5.4 Discussion

From the above described working procedures it is understood that Boremap mapping of percussion drilled boreholes suffers from certain shortcomings compared to the corresponding method for core drilled boreholes. For example, classification of thin fractures as open or sealed, classification of fracture minerals, and the colour and grain size of minor rock occurrences, are clearly problematic. The relatively low sampling frequency of drill cuttings (one sample per metre, where three samples are stored together in the same sampling box) limits the possibility of making confident judgements of the mineralogical composition of rocks continuously along the borehole. It is, for example, almost impossible to follow up a thin amphibolite occurrence or to estimate the proportions of different rock types in the drill cuttings. The exact sampling-depth is also uncertain since transportation of drill cuttings from the bottom of the drill hole to the surface is not instantaneous. The mapping clearly benefit from synchronous analysis of supporting data from the drilling, such as drilling penetration rate and flush-water colour, and not least, observations of drill cores from the same drill site.

The BIPS-images were usually of poor quality at the end of the boreholes, since suspandates were still present in the borehole water when BIPS-logging was performed. This problem was especially evident in borehole HFM03.

Appendix 1

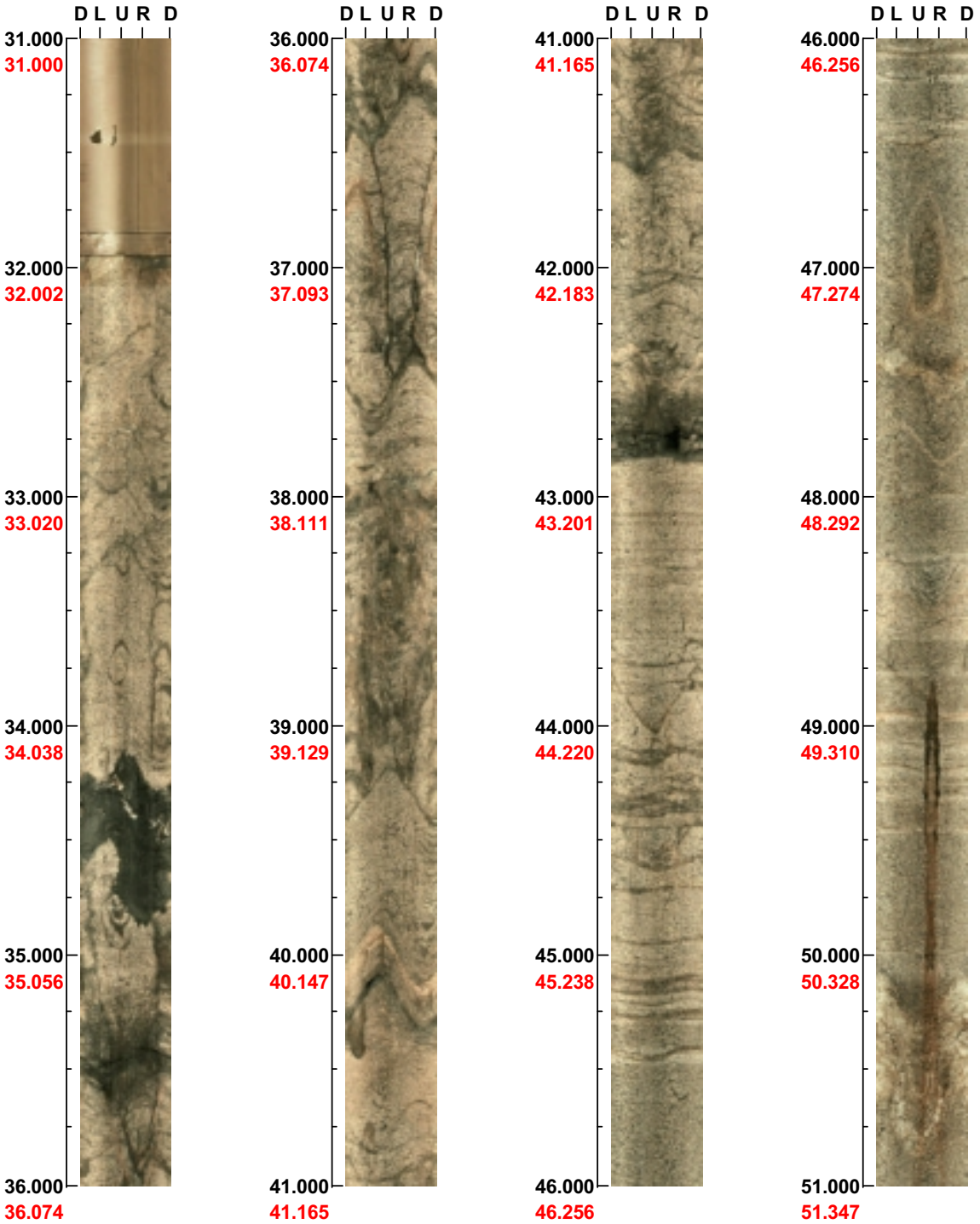
BIPS-images of HFM01

Project name: Forsmark

Image file	**: c:\borema~1\hfm01.bip**
BDT file	**: c:\borema~1\hfm01.bdt**
Locality	**: FORSMARK**
Bore hole number	**: HFM01**
Date	**: 02/05/30**
Time	**: 07:00:00**
Depth range	**: 31.000 - 197.172 m**
Azimuth	**: 34**
Inclination	**: -79**
Diameter	**: 140.0 mm**
Magnetic declination	**: 0.0**
Span	**: 4**
Scan interval	**: 0.25**
Scan direction	**: To bottom**
Scale	**: 1/25**
Aspect ratio	**: 90 %**
Pages	**: 9**
Color	**:**  **+0 +0 +0**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 34** **Inclination: -79**

Depth range: 31.000 - 51.000 m



(1 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 35** **Inclination: -79**

Depth range: 51.000 - 71.000 m

(2 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 37** **Inclination: -80**

Depth range: 71.000 - 91.000 m

(3 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 45** **Inclination: -82**

Depth range: 91.000 - 111.000 m

(4 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

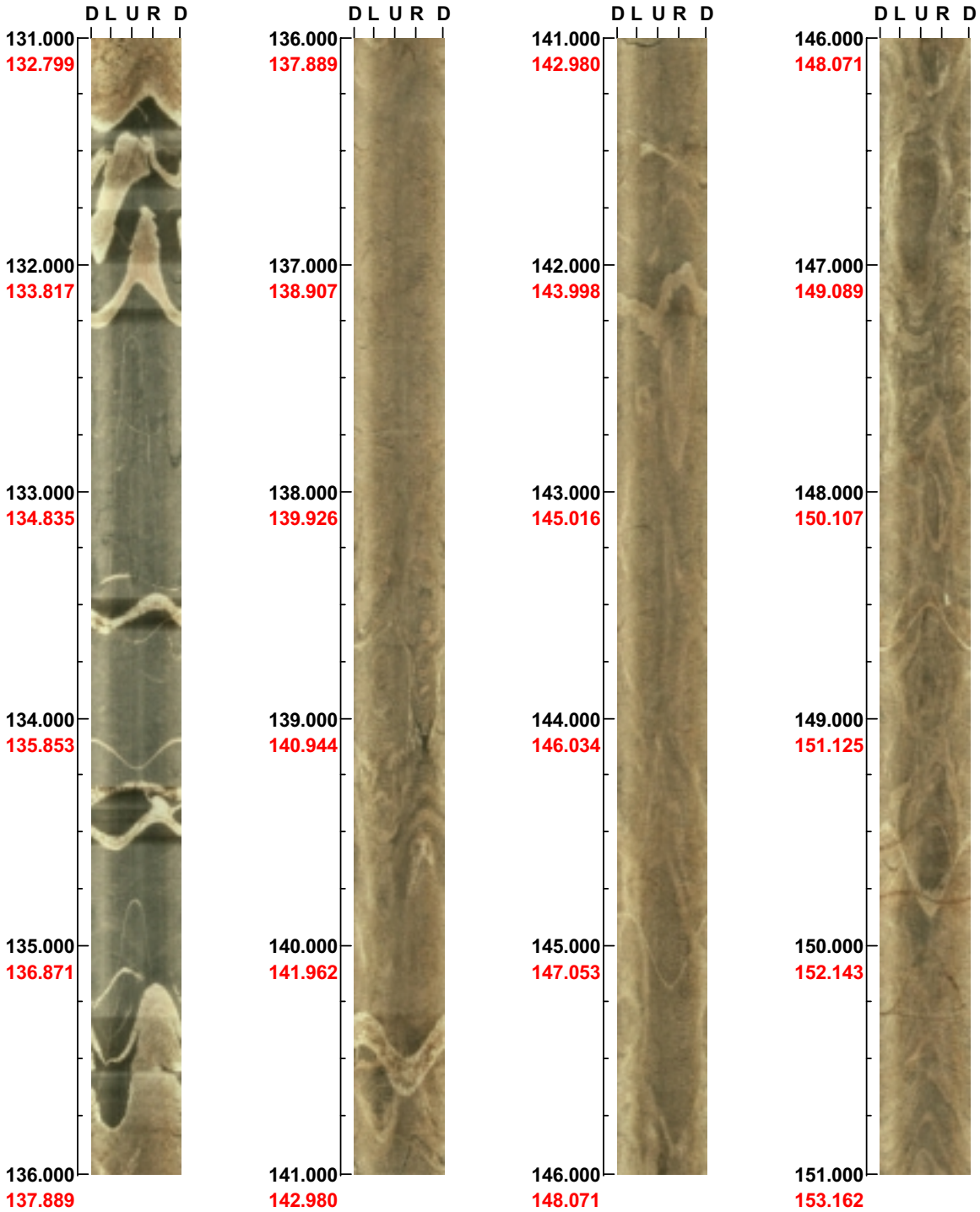
Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 57** **Inclination: -82**

Depth range: 111.000 - 131.000 m

(5 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 57** **Inclination: -81**

Depth range: 131.000 - 151.000 m



(6 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

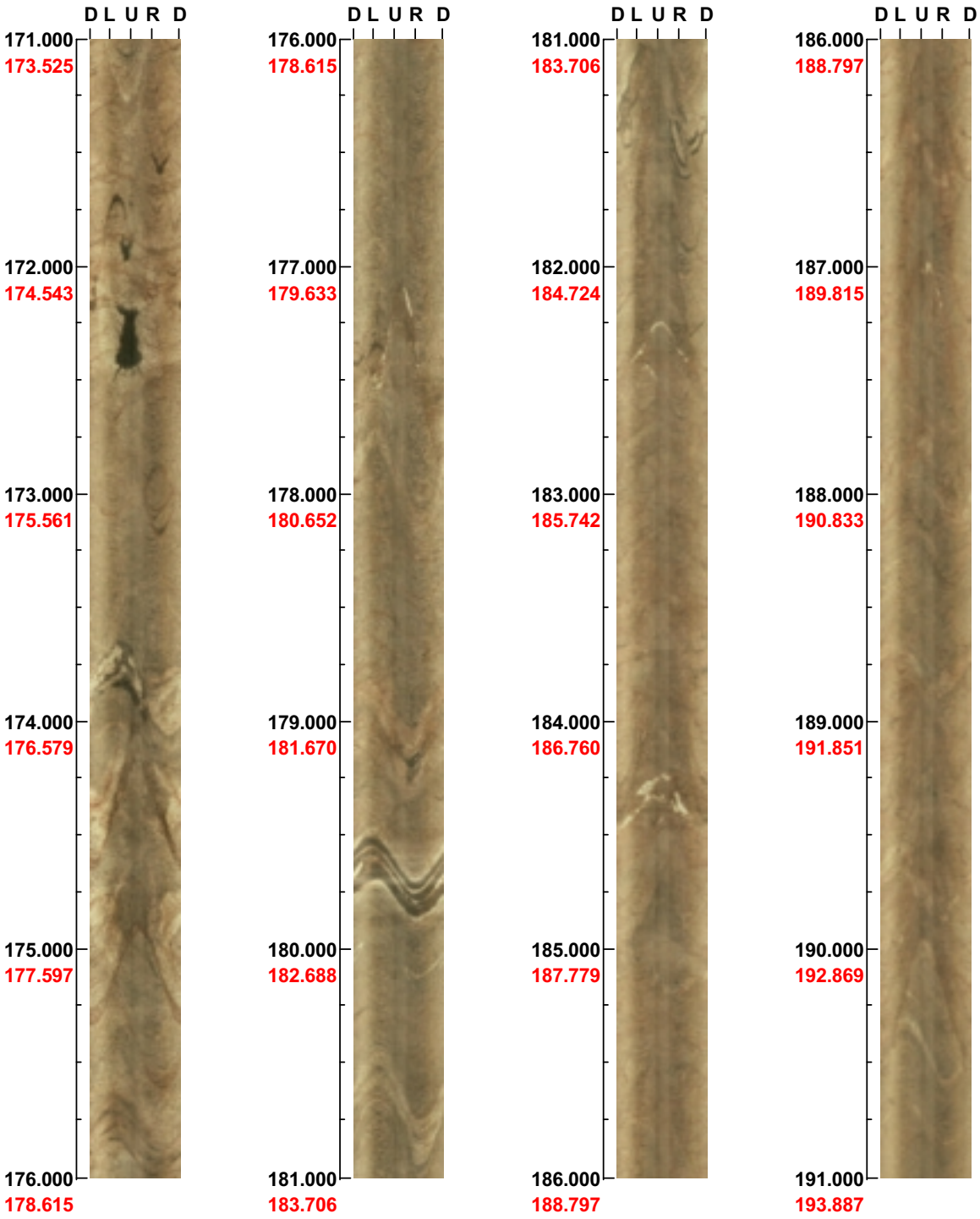
Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 55** **Inclination: -80**

Depth range: 151.000 - 171.000 m

(7 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 54** **Inclination: -78**

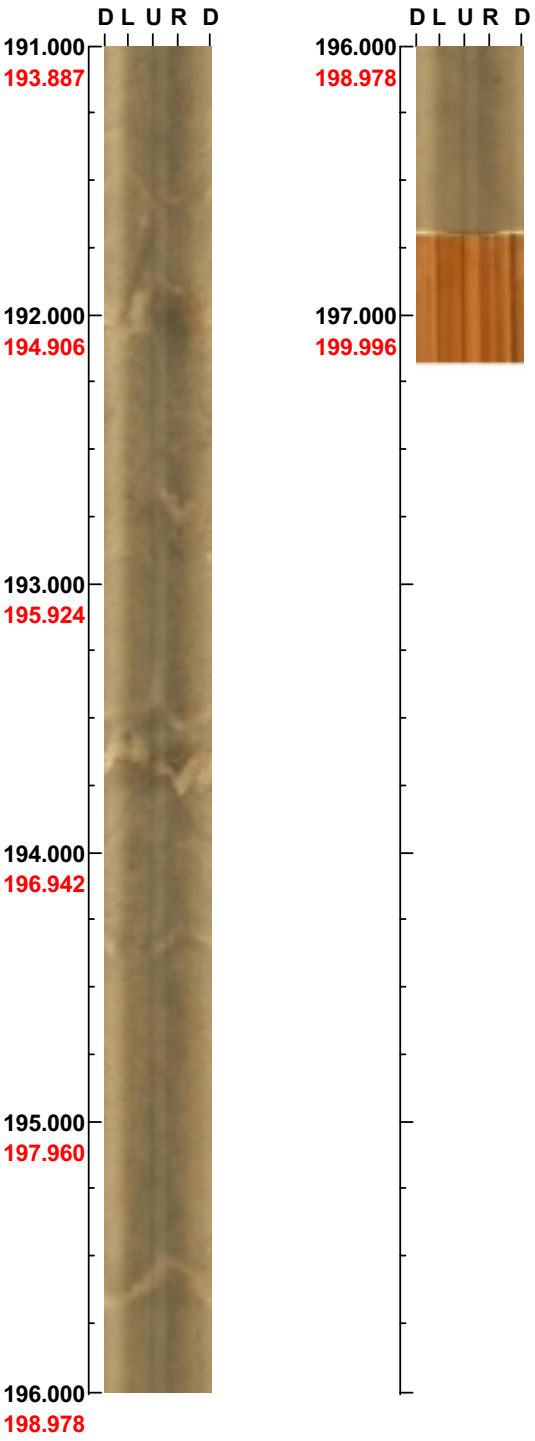
Depth range: 171.000 - 191.000 m



(8 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 54** **Inclination: -78**

Depth range: 191.000 - 197.172 m



(9 / 9) **Scale: 1/25** **Aspect ratio: 90 %**

Appendix 2

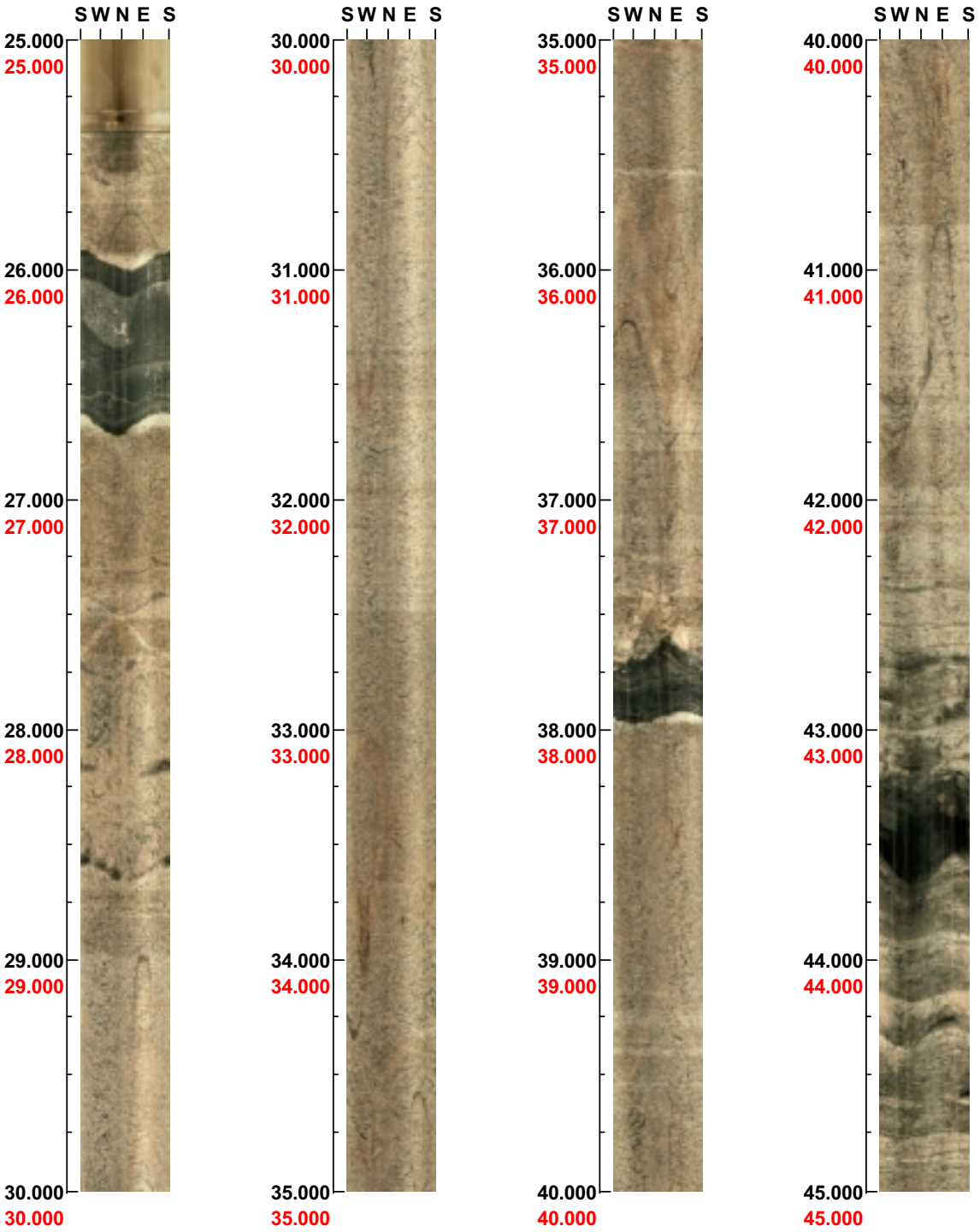
BIPS-images of HFM02

Project name: Forsmark

Image file	**: c:\borema~1\hfm02.bip**
BDT file	**: c:\borema~1\hfm02.bdt**
Locality	**: FORSMARK**
Bore hole number	**: HFM01**
Date	**: 02/05/30**
Time	**: 07:00:00**
Depth range	**: 25.000 - 99.353 m**
Azimuth	**: 0**
Inclination	**: -87**
Diameter	**: 137.0 mm**
Magnetic declination	**: 0.0**
Span	**: 4**
Scan interval	**: 0.25**
Scan direction	**: To bottom**
Scale	**: 1/25**
Aspect ratio	**: 90 %**
Pages	**: 4**
Color	**: +0 +0 +0**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 0** **Inclination: -87**

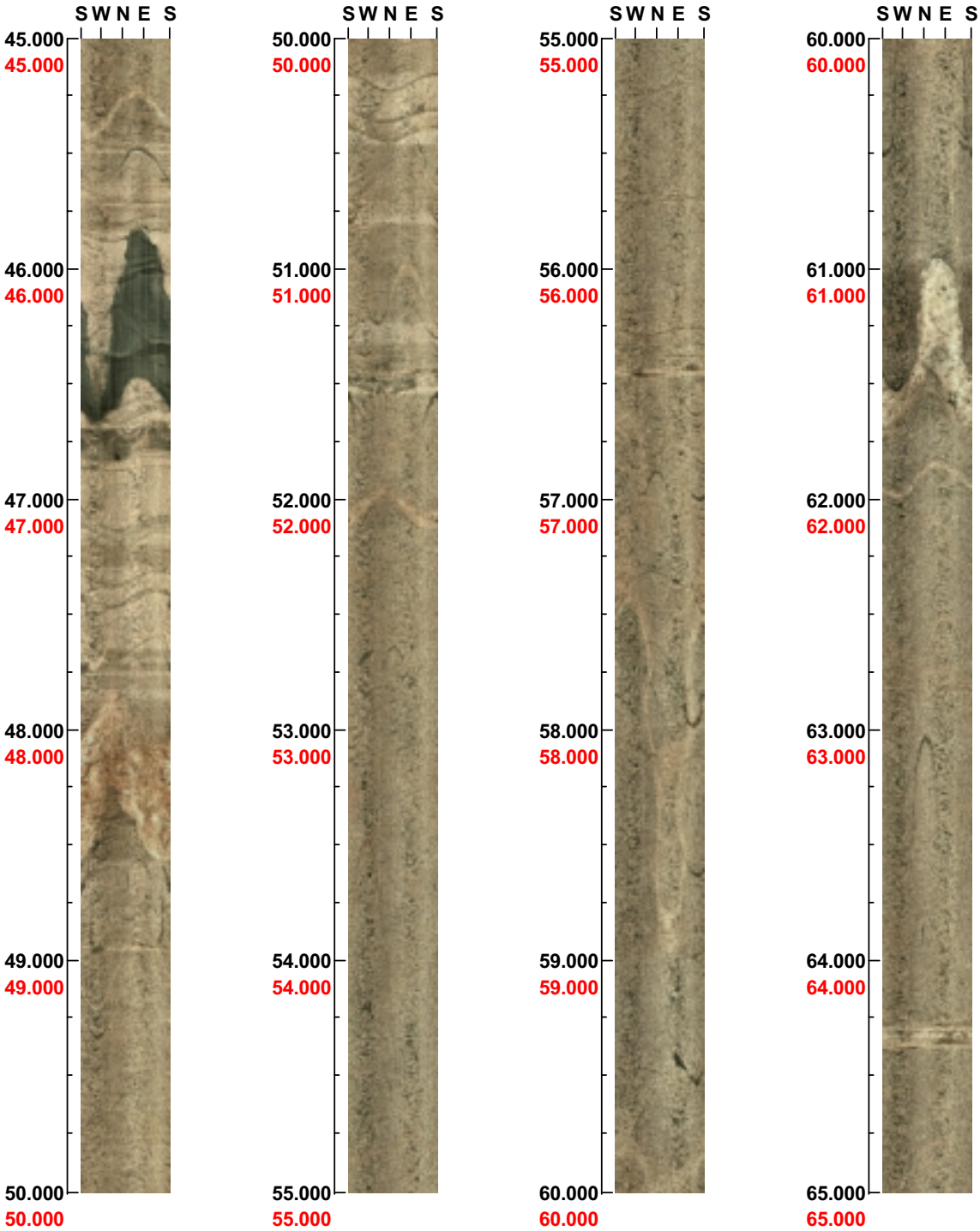
Depth range: 25.000 - 45.000 m



(1 / 4) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 0** **Inclination: -87**

Depth range: 45.000 - 65.000 m



(2 / 4) **Scale: 1/25** **Aspect ratio: 90 %**

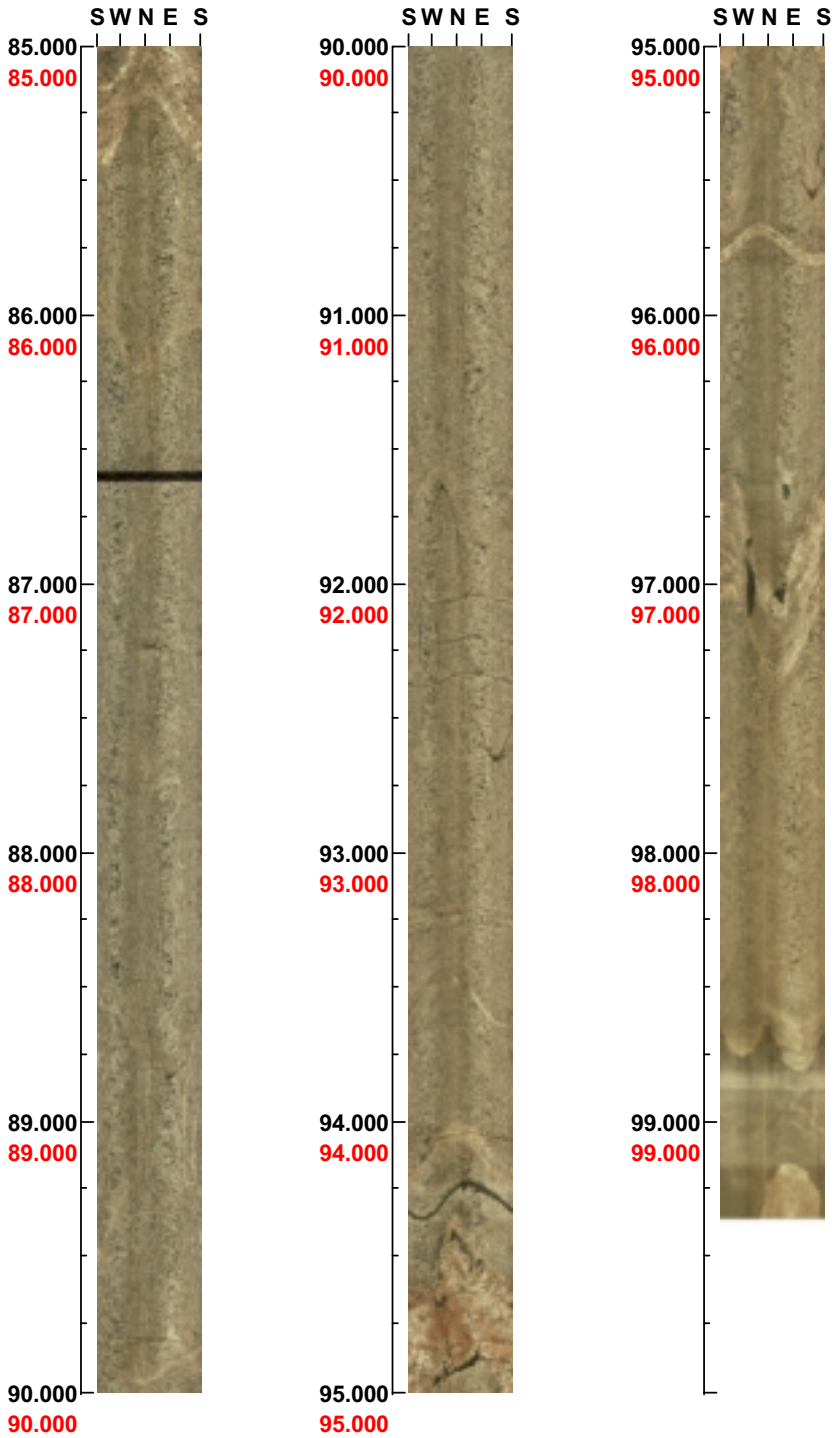
Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 0** **Inclination: -87**

Depth range: 65.000 - 85.000 m

(3 / 4) **Scale: 1/25** **Aspect ratio: 90 %**

Project name: Forsmark
Bore hole No.: HFM01 **Azimuth: 0** **Inclination: -88**

Depth range: 85.000 - 99.353 m



(4 / 4) **Scale: 1/25** **Aspect ratio: 90 %**

Appendix 3

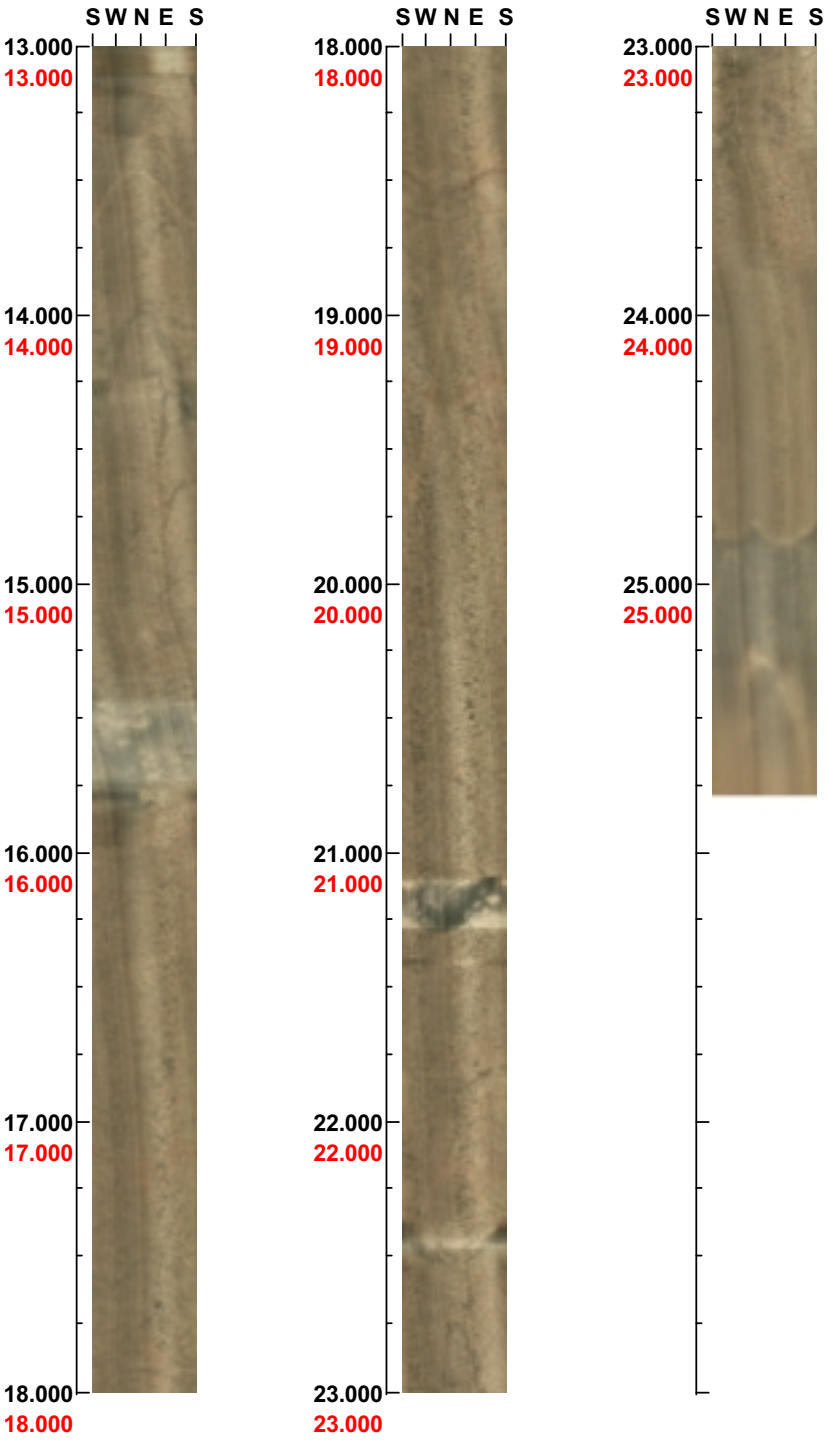
BIPS-images of HFM03

Project name: Forsmark

Image file	: c:\borema~1\hfm03_~1.bip
BDT file	: c:\borema~1\hfm03.bdt
Locality	: FORSMARK
Bore hole number	: HFM03
Date	: 30/05/02
Time	: 17:55:00
Depth range	: 13.000 - 25.780 m
Azimuth	: 0
Inclination	: -86
Diameter	: 136.0 mm
Magnetic declination	: 0.0
Span	: 4
Scan interval	: 0.25
Scan direction	: To bottom
Scale	: 1/25
Aspect ratio	: 90 %
Pages	: 1
Color	:  +0 +0 +0

Project name: Forsmark
Bore hole No.: HFM03 **Azimuth: 0** **Inclination: -86**

Depth range: 13.000 - 25.780 m



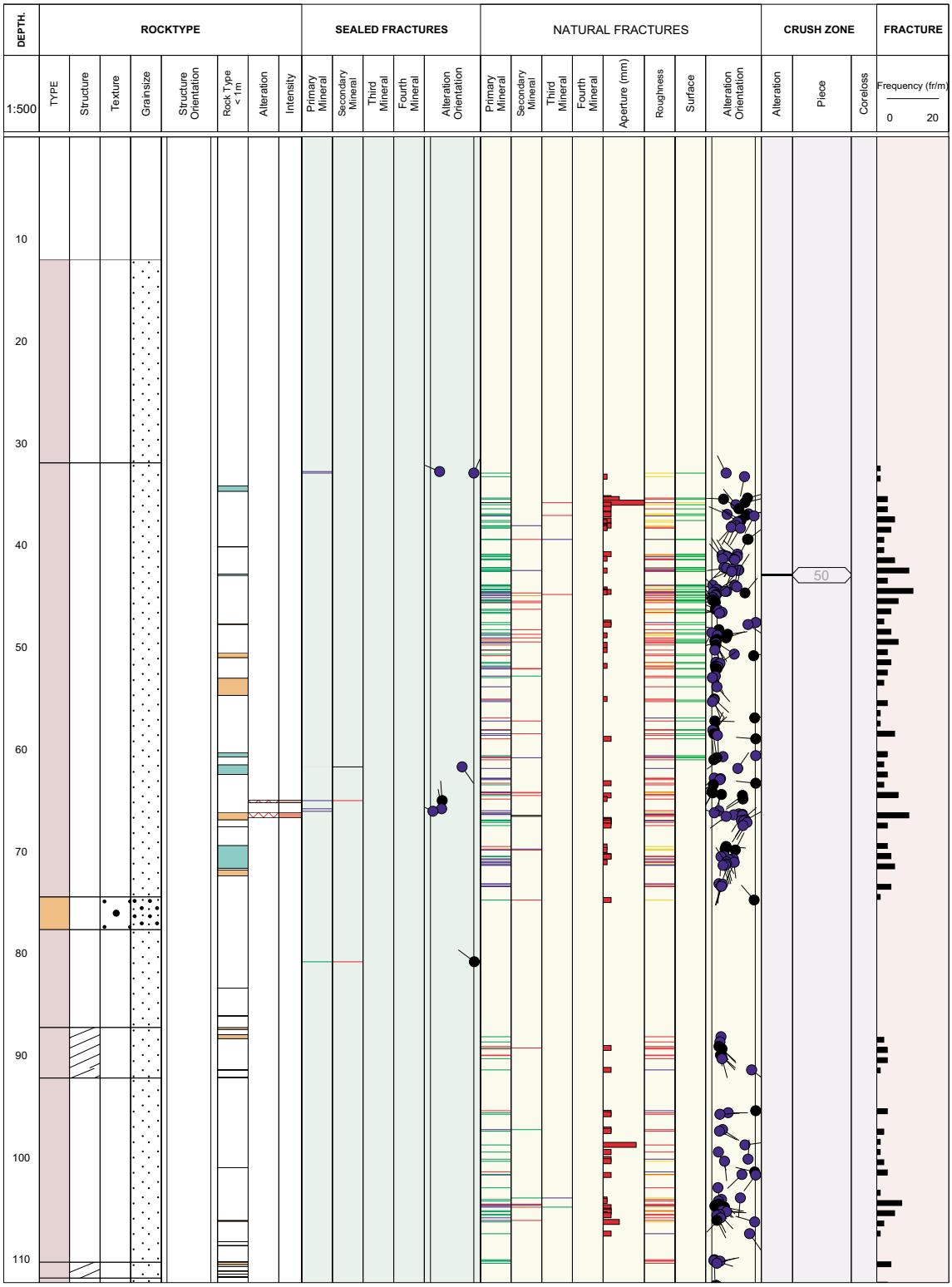
(1 / 1) **Scale: 1/25** **Aspect ratio: 90 %**

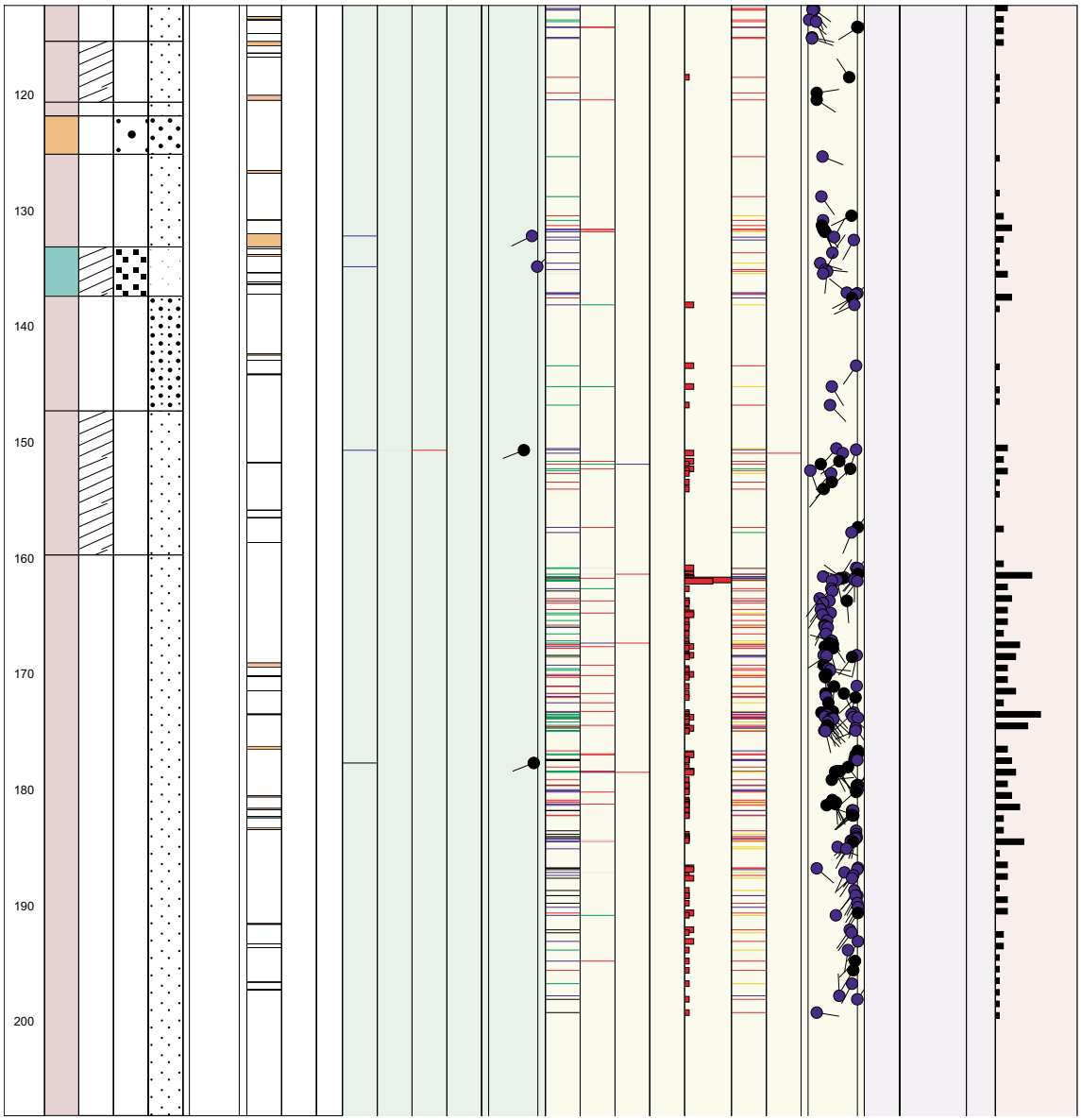
Appendix 4

WellCad diagram of HFM01

Title GEOLOGY HFM01

Site	FORSMARK	**Coordinate System**	RT90-RHB70
Borehole	HFM01	**Northing [m]**	6699605.181
Diameter [m]	0.14	**Easting [m]**	1631484.552
Length [m]	200.2	**Elevation [m.a.s.l.]**	1.731
Bearing [°]	34.0606	**Drilling Start Date**	2002-04-18 14:30:00
Inclination [°]	-77.5135	**Drilling Stop Date**	2002-05-03 17:22:00
Remark		**Plot Date**	2003-04-10 11:09:19



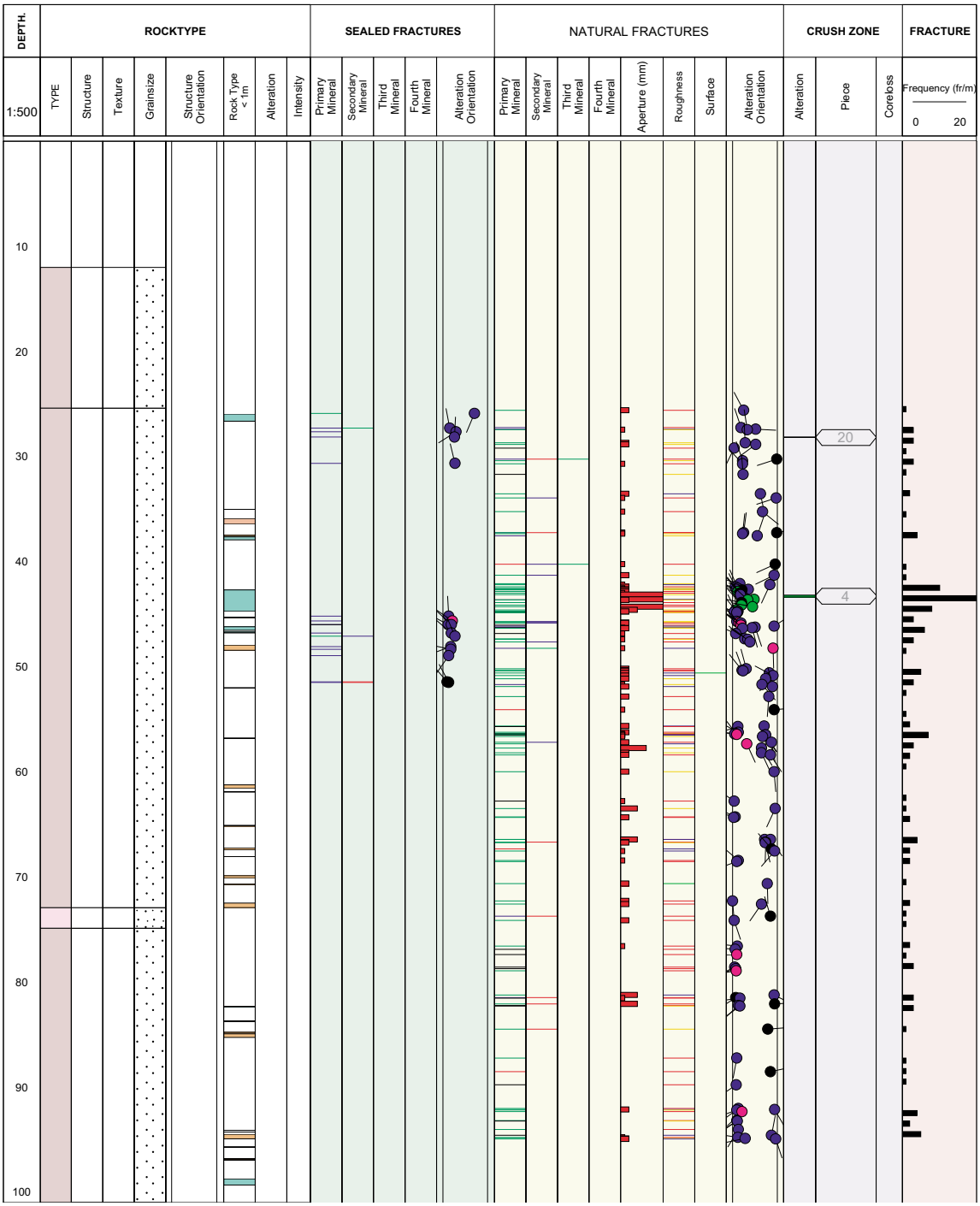

120
130
140
150
160
170
180
190
200

Appendix 5

WellCad diagram of HFM02

Title GEOLOGY HFM02

Site	FORSMARK	**Coordinate System**	RT90-RHB70
Borehole	HFM02	**Northing [m]**	6699593.212
Diameter [m]	0.1369	**Easting [m]**	1631268.674
Length [m]	100	**Elevation [m.a.s.l.]**	3.053
Bearing [°]	6.5165	**Drilling Start Date**	2002-05-07 10:00:00
Inclination [°]	-87.7868	**Drilling Stop Date**	2002-05-21 12:00:00
Remark		**Plot Date**	2003-04-10 11:16:39

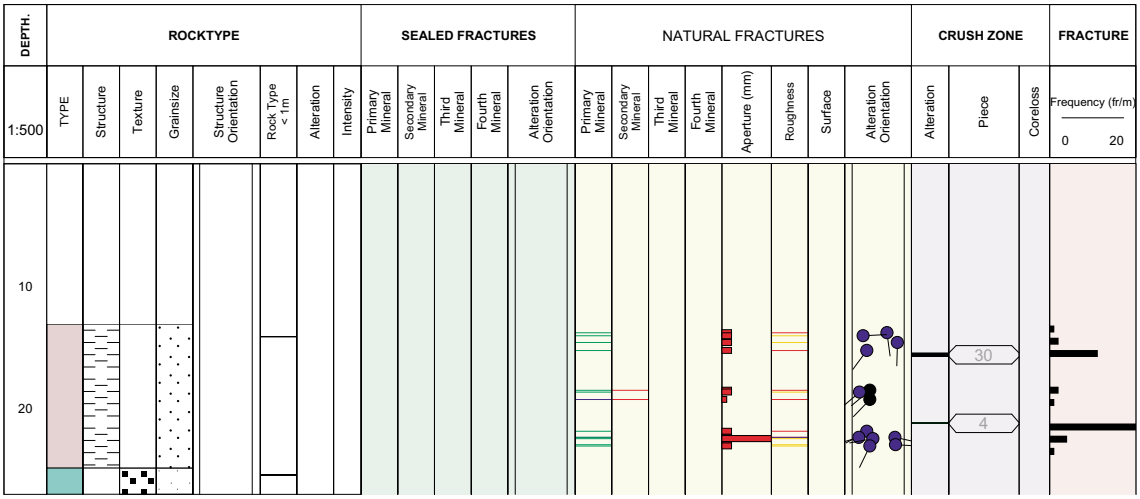


Appendix 6

WellCad diagram of HFM03

Title GEOLOGY HFM03

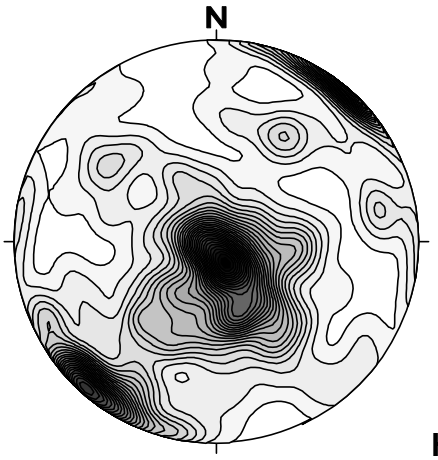
Site	FORSMARK	**Coordinate System**	RT90-RHB70
Borehole	HFM03	**Northing [m]**	6699592.812
Diameter [m]	0.136	**Easting [m]**	1631272.626
Length [m]	26	**Elevation [m.a.s.l.]**	3.148
Bearing [°]	264.5276	**Drilling Start Date**	2002-05-27 12:30:00
Inclination [°]	-87.2835	**Drilling Stop Date**	2002-05-28 12:30:00
Remark		**Plot Date**	2003-04-10 11:21:13



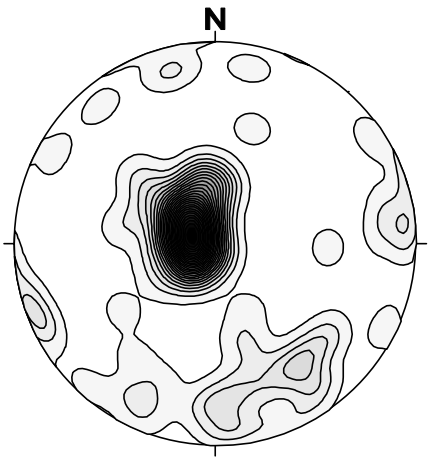
Appendix 7

Lower hemisphere equal area projection of fracture data from HFM01–03

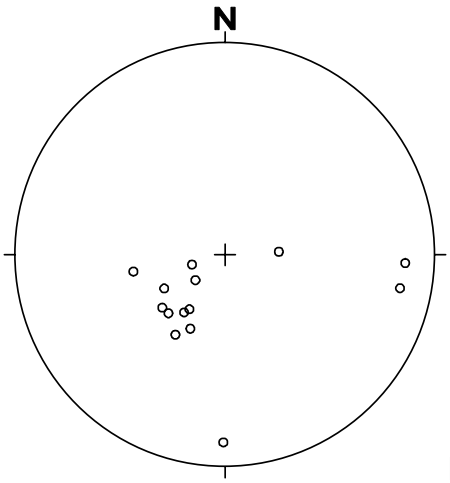
Lower hemisphere equal-area stereographic projections (Schmidt net) showing poles to sealed and natural fracture planes in boreholes HFM01–HFM03. Data from borehole HFM01 and HFM02 are countered (1 line = 28%).



HFM 01 (n=363)



HFM02 (n=141)



HFM03 (n=16)

Appendix 8

In data: Borehole length and diameter, HFM01–03

Hole Diam T - Drilling: Borehole diameter

HFM01, 2002-04-18 14:30:00 - 2002-05-03 17:22:00 (0.000 - 200.200 m)

Sub Secup (m)	Sub Seclow (m)	Hole Diam (m)	Comment
0.000	31.930	0.204	@
31.900	200.200	0.140	@

Printout from SICADA 2003-01-30 17:06:03.

Hole Diam T - Drilling: Borehole diameter

HFM02, 2002-05-07 10:00:00 - 2002-05-21 12:00:00 (0.000 - 100.000 m)

Sub Secup (m)	Sub Seclow (m)	Hole Diam (m)	Comment
0.000	25.400	0.204	@
25.400	100.000	0.137	@

Printout from SICADA 2003-01-30 17:10:21.

Hole Diam T - Drilling: Borehole diameter

HFM03, 2002-05-27 12:30:00 - 2002-05-28 12:30:00 (0.000 - 26.000 m)

Sub Secup (m)	Sub Seclow (m)	Hole Diam (m)	Comment
0.000	13.100	0.204	Stainles steel casing
13.100	26.000	0.136	

Printout from SICADA 2003-01-30 17:11:04.

Maxibor T - Borehole deviation: Maxibor

HFM01, 2002-08-13 14:00:00 - 2002-08-13 18:00:00

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
0.00	6699605.181	1631484.552	1.731	RT90-RHB70	-77.5100	34.0600	0.0000	0.0000	0.0000	
3.00	6699605.718	1631484.915	-1.198	RT90-RHB70	-77.5300	34.1800	0.6490	0.0000	0.0000	
6.00	6699606.254	1631485.279	-4.127	RT90-RHB70	-77.6200	33.8500	1.2960	0.0010	-0.0010	
9.00	6699606.788	1631485.637	-7.058	RT90-RHB70	-77.7200	33.6200	1.9390	-0.0010	-0.0070	
12.00	6699607.319	1631485.990	-9.989	RT90-RHB70	-77.8600	33.5500	2.5770	-0.0060	-0.0180	
15.00	6699607.845	1631486.339	-12.922	RT90-RHB70	-78.1900	33.4500	3.2080	-0.0120	-0.0360	
18.00	6699608.357	1631486.677	-15.858	RT90-RHB70	-78.6200	33.5600	3.8220	-0.0180	-0.0720	
21.00	6699608.850	1631487.004	-18.800	RT90-RHB70	-79.0700	33.8000	4.4130	-0.0230	-0.1300	
24.00	6699609.323	1631487.321	-21.745	RT90-RHB70	-79.3300	33.9600	4.9820	-0.0260	-0.2120	
27.00	6699609.783	1631487.631	-24.693	RT90-RHB70	-79.5600	33.7100	5.5370	-0.0270	-0.3070	
30.00	6699610.236	1631487.933	-27.644	RT90-RHB70	-79.9300	33.8400	6.0810	-0.0300	-0.4140	
33.00	6699610.672	1631488.225	-30.597	RT90-RHB70	-80.1600	34.2100	6.6060	-0.0320	-0.5400	
36.00	6699611.095	1631488.513	-33.553	RT90-RHB70	-80.2500	34.6700	7.1180	-0.0310	-0.6790	
39.00	6699611.513	1631488.802	-36.510	RT90-RHB70	-80.3100	35.1200	7.6260	-0.0250	-0.8220	
42.00	6699611.926	1631489.093	-39.467	RT90-RHB70	-80.2200	35.4100	8.1310	-0.0160	-0.9680	
45.00	6699612.342	1631489.388	-42.423	RT90-RHB70	-80.0300	35.4400	8.6410	-0.0040	-1.1100	
48.00	6699612.765	1631489.689	-45.378	RT90-RHB70	-79.9000	35.5900	9.1600	0.0080	-1.2420	
51.00	6699613.192	1631489.995	-48.332	RT90-RHB70	-79.8900	35.5900	9.6860	0.0230	-1.3670	

54.00	6699613.621	1631490.302	-51.285	RT90-RHB70	-80.0300	36.1200	10.2120	0.0370	-1.4920
57.00	6699614.041	1631490.608	-54.240	RT90-RHB70	-80.2500	36.7400	10.7310	0.0550	-1.6240
60.00	6699614.448	1631490.912	-57.196	RT90-RHB70	-80.4700	37.1500	11.2390	0.0790	-1.7670
63.00	6699614.844	1631491.212	-60.155	RT90-RHB70	-80.7300	37.7900	11.7350	0.1060	-1.9230
66.00	6699615.226	1631491.508	-63.116	RT90-RHB70	-81.0100	38.4800	12.2170	0.1370	-2.0920
69.00	6699615.593	1631491.800	-66.079	RT90-RHB70	-81.2200	39.2400	12.6850	0.1730	-2.2760
72.00	6699615.948	1631492.090	-69.044	RT90-RHB70	-81.4200	40.3100	13.1410	0.2150	-2.4720
75.00	6699616.289	1631492.379	-72.010	RT90-RHB70	-81.5900	41.3900	13.5860	0.2630	-2.6790
78.00	6699616.618	1631492.669	-74.978	RT90-RHB70	-81.7800	42.7300	14.0210	0.3190	-2.8960
81.00	6699616.933	1631492.960	-77.947	RT90-RHB70	-81.9100	44.1500	14.4450	0.3840	-3.1240
84.00	6699617.236	1631493.255	-80.917	RT90-RHB70	-81.9900	45.6400	14.8610	0.4580	-3.3600
87.00	6699617.528	1631493.554	-83.888	RT90-RHB70	-82.1000	47.3900	15.2710	0.5420	-3.6020
90.00	6699617.808	1631493.857	-86.860	RT90-RHB70	-82.2300	49.2400	15.6720	0.6370	-3.8530
93.00	6699618.072	1631494.164	-89.832	RT90-RHB70	-82.3000	51.0000	16.0630	0.7430	-4.1140
96.00	6699618.325	1631494.477	-92.805	RT90-RHB70	-82.3100	52.5900	16.4480	0.8600	-4.3810
99.00	6699618.569	1631494.796	-95.778	RT90-RHB70	-82.2800	54.0200	16.8290	0.9880	-4.6520
102.00	6699618.806	1631495.122	-98.751	RT90-RHB70	-82.2300	55.2700	17.2070	1.1250	-4.9250
105.00	6699619.037	1631495.455	-101.723	RT90-RHB70	-82.1400	56.4400	17.5860	1.2720	-5.1980
108.00	6699619.264	1631495.797	-104.695	RT90-RHB70	-82.0000	57.1200	17.9650	1.4280	-5.4700
111.00	6699619.491	1631496.148	-107.666	RT90-RHB70	-81.8300	57.3100	18.3490	1.5920	-5.7380
114.00	6699619.721	1631496.506	-110.635	RT90-RHB70	-81.6500	57.4600	18.7410	1.7600	-5.9970
117.00	6699619.95	1631496.8	-113.604	RT90-RHB70	-81.4700	57.4700	19.1400	1.9330	-6.2490

	5	74							
120.00	6699620.194	1631497.249	-116.570	RT90-RHB70	-81.2300	57.1300	19.5490	2.1100	-6.4920
123.00	6699620.442	1631497.633	-119.535	RT90-RHB70	-81.0200	56.8700	19.9690	2.2890	-6.7220
126.00	6699620.698	1631498.025	-122.499	RT90-RHB70	-80.9000	56.7800	20.4010	2.4710	-6.9410
129.00	6699620.958	1631498.421	-125.461	RT90-RHB70	-80.8100	56.5600	20.8380	2.6540	-7.1550
132.00	6699621.222	1631498.821	-128.422	RT90-RHB70	-80.7400	56.3900	21.2810	2.8370	-7.3630
135.00	6699621.490	1631499.224	-131.383	RT90-RHB70	-80.6200	56.2700	21.7280	3.0210	-7.5670
138.00	6699621.761	1631499.630	-134.343	RT90-RHB70	-80.4600	56.1400	22.1800	3.2060	-7.7650
141.00	6699622.038	1631500.043	-137.302	RT90-RHB70	-80.3200	55.9900	22.6410	3.3920	-7.9540
144.00	6699622.320	1631500.461	-140.259	RT90-RHB70	-80.1300	55.8200	23.1090	3.5810	-8.1370
147.00	6699622.609	1631500.887	-143.214	RT90-RHB70	-79.9500	55.6400	23.5870	3.7720	-8.3090
150.00	6699622.905	1631501.319	-146.168	RT90-RHB70	-79.8400	55.5200	24.0740	3.9640	-8.4730
153.00	6699623.204	1631501.755	-149.121	RT90-RHB70	-79.7000	55.3400	24.5660	4.1580	-8.6310
156.00	6699623.509	1631502.196	-152.073	RT90-RHB70	-79.5100	55.2000	25.0660	4.3520	-8.7810
159.00	6699623.821	1631502.645	-155.023	RT90-RHB70	-79.3500	54.9900	25.5760	4.5490	-8.9210
162.00	6699624.139	1631503.099	-157.971	RT90-RHB70	-79.1900	54.8100	26.0930	4.7470	-9.0530
165.00	6699624.463	1631503.559	-160.918	RT90-RHB70	-78.9900	54.7000	26.6190	4.9470	-9.1760
168.00	6699624.794	1631504.027	-163.863	RT90-RHB70	-78.7800	54.5600	27.1560	5.1490	-9.2900
171.00	6699625.133	1631504.502	-166.805	RT90-RHB70	-78.5900	54.3800	27.7020	5.3530	-9.3920
174.00	6699625.478	1631504.984	-169.746	RT90-RHB70	-78.4500	54.2200	28.2590	5.5590	-9.4850
177.00	6699625.830	1631505.472	-172.685	RT90-RHB70	-78.3000	53.9900	28.8230	5.7660	-9.5690
180.00	6699626.188	1631505.964	-175.623	RT90-RHB70	-78.1300	53.8300	29.3950	5.9740	-9.6460

183.00	6699626.552	1631506.462	-178.559	RT90-RHB70	-77.9400	53.7600	29.9760	6.1820	-9.7140
186.00	6699626.922	1631506.968	-181.493	RT90-RHB70	-77.7900	53.7000	30.5660	6.3940	-9.7720
189.00	6699627.298	1631507.479	-184.425	RT90-RHB70	-77.6200	53.6000	31.1630	6.6070	-9.8230
192.00	6699627.679	1631507.997	-187.355	RT90-RHB70	-77.3900	53.5500	31.7690	6.8220	-9.8640
198.00	6699628.472	1631509.068	-193.205	RT90-RHB70	-77.0600	53.4500	33.0260	7.2650	-9.9020

Printout from SICADA 2003-01-30 11:42:45.

Maxibor T - Borehole deviation: Maxibor

HFM02, 2002-08-14 08:30:00 - 2002-08-14 12:00:00

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
0.00	6699593.212	1631268.674	3.053	RT90-RHB70	-87.7900	6.5200	0.0000	0.0000	0.0000	
3.00	6699593.327	1631268.687	0.055	RT90-RHB70	-87.8300	8.3900	0.1160	0.0000	0.0000	
6.00	6699593.439	1631268.704	-2.943	RT90-RHB70	-87.8800	10.1900	0.2290	0.0040	-0.0030	
9.00	6699593.549	1631268.723	-5.941	RT90-RHB70	-87.8500	11.8300	0.3400	0.0110	-0.0070	
12.00	6699593.659	1631268.746	-8.938	RT90-RHB70	-87.8400	12.6900	0.4520	0.0210	-0.0110	
15.00	6699593.769	1631268.771	-11.936	RT90-RHB70	-87.7800	12.5200	0.5650	0.0330	-0.0150	
18.00	6699593.883	1631268.796	-14.934	RT90-RHB70	-87.6700	12.7000	0.6800	0.0460	-0.0150	
21.00	6699594.002	1631268.823	-17.932	RT90-RHB70	-87.5400	13.0200	0.8010	0.0590	-0.0100	
24.00	6699594.127	1631268.852	-20.929	RT90-RHB70	-87.4400	12.8500	0.9300	0.0730	0.0030	
27.00	6699594.258	1631268.882	-23.926	RT90-RHB70	-87.3200	11.6400	1.0630	0.0880	0.0200	
30.00	6699594.395	1631268.910	-26.923	RT90-RHB70	-87.2000	11.7300	1.2030	0.1010	0.0440	
33.00	6699594.539	1631268.940	-29.919	RT90-RHB70	-87.1800	13.0100	1.3480	0.1140	0.0740	
36.00	6699594.683	1631268.973	-32.915	RT90-RHB70	-87.1900	14.1500	1.4950	0.1310	0.1050	
39.00	6699594.825	1631269.009	-35.912	RT90-RHB70	-87.1900	15.5400	1.6410	0.1500	0.1350	
42.00	6699594.967	1631269.049	-38.908	RT90-RHB70	-87.2400	16.9400	1.7860	0.1730	0.1640	
45.00	6699595.105	1631269.091	-41.905	RT90-RHB70	-87.2800	18.1400	1.9280	0.1990	0.1910	
48.00	6699595.241	1631269.135	-44.901	RT90-RHB70	-87.2400	19.6200	2.0680	0.2280	0.2140	
51.00	6699595.377	1631269.184	-47.898	RT90-RHB70	-87.2300	21.2700	2.2090	0.2610	0.2390	

54.00	6699595.512	1631269.236	-50.894	RT90-RHB70	-87.2900	22.0900	2.3490	0.2980	0.2640
57.00	6699595.643	1631269.290	-53.891	RT90-RHB70	-87.4000	21.7100	2.4850	0.3360	0.2840
60.00	6699595.769	1631269.340	-56.888	RT90-RHB70	-87.5200	21.3700	2.6160	0.3710	0.3000
63.00	6699595.890	1631269.387	-59.885	RT90-RHB70	-87.6300	21.3600	2.7420	0.4050	0.3090
66.00	6699596.006	1631269.432	-62.882	RT90-RHB70	-87.7300	21.3000	2.8620	0.4370	0.3130
69.00	6699596.117	1631269.476	-65.880	RT90-RHB70	-87.8300	20.9300	2.9770	0.4670	0.3130
72.00	6699596.223	1631269.516	-68.878	RT90-RHB70	-87.9300	19.6600	3.0870	0.4950	0.3070
75.00	66699596.330	1631269.553	-71.876	RT90-RHB70	-88.0000	18.8900	3.1930	0.5200	0.2970
78.00	6699596.424	1631269.587	-74.874	RT90-RHB70	-88.0200	19.7700	3.2950	0.5420	0.2830
81.00	6699596.522	1631269.622	-77.872	RT90-RHB70	-88.0600	20.2700	3.3960	0.5660	0.2680
84.00	6699596.617	1631269.657	-80.871	RT90-RHB70	-88.1000	20.5700	3.4940	0.5900	0.2510
87.00	6699596.710	1631269.692	-83.869	RT90-RHB70	-88.1000	22.1500	3.5910	0.6140	0.2310
90.00	6699596.802	1631269.729	-86.867	RT90-RHB70	-88.0500	24.3600	3.6870	0.6410	0.2110
96.00	6699596.994	1631269.825	-92.864	RT90-RHB70	-87.9100	27.5200	3.8880	0.7140	0.1810

Printout from SICADA 2003-01-30 13:04:30.

Maxibor T - Borehole deviation: Maxibor

HFM03, 2002-08-14 08:30:00 - 2002-08-14 12:00:00

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol Flag
0.00	6699592.812	1631272.626	3.148	RT90-RHB70	-87.2800	264.5300	0.0000	0.0000	0.0000	
3.00	6699592.798	1631272.484	0.151	RT90-RHB70	-87.1600	266.1000	0.1420	0.0000	0.0000	
6.00	6699592.788	1631272.336	-2.845	RT90-RHB70	-87.1000	267.0000	0.2910	0.0040	0.0060	
9.00	6699592.780	1631272.185	-5.841	RT90-RHB70	-87.0700	267.7900	0.4420	0.0110	0.0160	
12.00	6699592.774	1631272.031	-8.837	RT90-RHB70	-86.9300	268.1200	0.5950	0.0190	0.0270	
15.00	6699592.769	1631271.871	-11.833	RT90-RHB70	-86.7900	267.7800	0.7560	0.0290	0.0450	
21.00	6699592.756	1631271.519	-17.823	RT90-RHB70	-86.5600	267.8700	1.1070	0.0500	0.1120	

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Appendix 10

In data: Drilling penetration rate, HFM01–03

Drillpen D T - Drill Penetration Log

HFM01, 2002-04-24 07:00:00 - 2002-05-03 17:22:00 (12.000 - 200.200 m)

Bhlen (m)	Pen Time (s)	Water	Fracture	Comment
12.00	22	0	0	0-12 m: NO-x 254
12.20	14	0	0	
12.40	16	0	0	
12.60	17	0	0	
12.80	12	0	0	
13.00	13	0	0	
13.20	12	0	0	
13.40	8	0	0	
13.60	14	0	0	
13.80	18	0	0	
14.00	13	0	0	
14.20	12	0	0	
14.40	13	0	0	
14.60	15	0	0	
14.80	12	0	0	
15.00	15	0	0	
15.20	18	0	0	
15.40	19	0	0	
15.60	17	0	0	
15.80	18	0	0	
16.00	23	0	0	
16.20	19	0	0	
16.40	14	0	0	
16.60	14	0	0	
16.80	17	0	0	
17.00	16	0	0	
17.20	16	0	0	
17.40	17	0	0	
17.60	15	0	0	
17.80	18	0	0	
18.00	21	0	0	
18.20	11	0	0	
18.40	13	0	0	
18.60	22	0	0	
18.80	22	0	0	
19.00	23	0	0	
19.20	24	0	0	
19.40	23	0	0	
19.60	23	0	0	
19.80	24	0	0	
20.00	20	0	0	
20.20	19	0	0	
20.40	21	0	0	
20.60	24	0	0	
20.80	24	0	0	
21.00	25	0	0	
21.20	24	0	0	
21.40	24	0	0	
21.60	22	0	0	
21.80	22	0	0	
22.00	22	0	0	
22.20	22	0	0	

22.40	16	0	1	Very soft zone!22.40 m. no water
22.60	10	0	1	
22.80	12	0	1	
23.00	11	0	1	
23.20	9	0	1	
23.40	10	0	1	
23.60	7	0	1	
23.80	8	0	1	
24.00	8	0	1	
24.20	8	0	1	
24.40	7	0	1	
24.60	9	0	1	
24.80	9	0	1	
25.00	7	0	1	2002-04-24: c. 08:19
25.20	11	0	1	Zone ends at 25.40 m
25.40	18	0	0	
25.60	19	0	0	
25.80	19	0	0	
26.00	20	0	0	
26.20	21	0	0	
26.40	15	0	0	
26.60	18	0	0	
26.80	20	0	0	
27.00	19	0	0	
27.20	17	0	0	
27.40	12	0	0	
27.60	14	0	0	
27.80	13	0	0	
28.00	15	0	0	
28.20	16	0	0	
28.40	18	0	0	
28.60	18	0	0	
28.80	19	0	0	
29.00	20	0	0	
29.20	19	0	0	
29.40	18	0	0	
29.60	19	0	0	
29.80	22	0	0	
30.00	25	0	0	
30.20	22	0	0	
30.40	23	0	0	
30.60	23	0	0	
30.80	20	0	0	
31.00	21	0	0	
31.20	21	0	0	
31.40	20	0	0	
31.60	21	0	0	
31.80	21	0	0	2002-04-24: c. 09:00
32.00	19	0	0	2002-05-02 14:30
32.20	17	0	0	
32.40	17	0	0	
32.60	16	0	0	
32.80	14	0	0	
33.00	15	0	0	
33.20	16	0	0	
33.40	14	0	0	
33.60	15	0	0	
33.80	13	0	0	
34.00	13	0	0	
34.20	12	0	0	
34.40	11	0	0	
34.60	11	0	0	
34.80	13	0	0	
35.00	10	0	0	14:43
35.20	10	0	0	
35.40	9	0	0	
35.60	13	0	0	

35.80	13	0	0	
36.00	14	0	0	
36.20	11	0	0	
36.40	15	0	0	
36.60	15	0	0	
36.80	11	0	0	
37.00	12	0	0	
37.20	11	0	0	
37.40	11	0	0	
37.60	14	0	0	
37.80	11	0	0	
38.00	10	0	0	
38.20	11	0	0	
38.40	11	0	0	
38.60	10	0	0	
38.80	10	0	0	
39.00	10	0	0	
39.20	11	0	0	
39.40	17	0	0	
39.60	18	0	0	
39.80	13	0	0	
40.00	10	0	0	
40.20	13	0	0	
40.40	17	0	0	
40.60	18	0	0	
40.80	15	0	0	
41.00	11	0	0	
41.20	13	0	0	
41.40	11	0	0	
41.60	14	0	0	
41.80	13	0	0	
42.00	15	0	0	
42.20	16	0	0	
42.40	11	0	0	
42.60	7	1	0	4-8 L/min
42.80	16	0	0	
43.00	21	0	0	
43.20	22	0	0	
43.40	23	0	0	
43.60	21	0	0	
43.80	21	0	0	
44.00	18	0	0	Green cuttings !
44.20	13	0	0	
44.40	14	0	0	
44.60	18	0	0	
44.80	24	0	0	
45.00	17	0	0	
45.20	17	0	0	
45.40	22	0	0	
45.60	23	0	0	
45.80	23	0	0	
46.00	21	0	0	
46.20	24	0	0	
46.40	22	0	0	
46.60	23	0	0	
46.80	24	0	0	
47.00	23	0	0	15:14
47.20	23	0	0	
47.40	22	0	0	
47.60	24	0	0	
47.80	24	0	0	
48.00	24	0	0	
48.20	23	0	0	
48.40	23	0	0	
48.60	21	0	0	
48.80	23	0	0	
49.00	22	0	0	

49.20	21	0	0	
49.40	22	0	0	
49.60	22	0	0	
49.80	23	0	0	
50.00	24	0	0	
50.20	23	0	0	
50.40	21	0	0	
50.60	22	0	0	
50.80	23	0	0	
51.00	24	0	0	
51.20	19	0	0	
51.40	22	0	0	
51.60	22	0	0	
51.80	21	0	0	
52.00	23	0	0	
52.20	25	0	0	
52.40	23	0	0	
52.60	19	0	0	
52.80	21	0	0	
53.00	24	0	0	15:24
53.20	21	0	0	
53.40	21	0	0	
53.60	20	0	0	
53.80	14	0	1	
54.00	16	0	0	
54.20	21	0	0	
54.40	22	0	0	
54.60	22	0	0	
54.80	20	0	0	
55.00	22	0	0	
55.20	23	0	0	
55.40	23	0	0	
55.60	25	0	0	
55.80	23	0	0	
56.00	31	0	0	15:31
56.20	24	0	0	
56.40	23	0	0	
56.60	23	0	0	
56.80	23	0	0	
57.00	25	0	0	
57.20	24	0	0	
57.40	23	0	0	
57.60	22	0	0	
57.80	23	0	0	
58.00	21	0	0	
58.20	24	0	0	
58.40	24	0	0	
58.60	23	0	0	
58.80	24	0	0	
59.00	25	0	0	15:39
59.20	23	0	0	
59.40	23	0	0	
59.60	26	0	0	
59.80	24	0	0	
60.00	32	0	0	
60.20	25	0	0	
60.40	24	0	0	
60.60	22	0	0	
60.80	22	0	0	
61.00	25	0	0	Amfibolite 61-62 m ¨c. 8L/min
61.20	28	0	0	
61.40	38	0	0	
61.60	36	0	0	
61.80	35	0	0	
62.00	28	0	0	15:56
62.20	26	0	0	
62.40	15	0	0	

62.60	19	0	0	
62.80	22	0	0	
63.00	18	0	0	
63.20	22	0	0	
63.40	18	0	0	
63.60	18	0	0	
63.80	20	0	0	
64.00	20	0	0	
64.20	24	0	0	
64.40	23	0	0	
64.60	19	0	0	
64.80	10	0	1	
65.00	9	0	1	
65.20	14	0	1	
65.40	17	0	1	
65.60	16	0	0	
65.80	16	0	0	
66.00	14	0	0	
66.20	20	0	0	
66.40	18	0	0	
66.60	21	0	0	
66.80	17	0	0	
67.00	13	0	0	
67.20	22	0	0	
67.40	22	0	0	
67.60	22	0	0	
67.80	24	0	0	
68.00	25	0	0	
68.20	28	0	0	
68.40	25	0	0	
68.60	23	0	0	
68.80	28	0	0	
69.00	23	0	0	
69.20	22	0	0	
69.40	24	0	0	
69.60	26	0	0	
69.80	25	0	0	
70.00	24	0	0	70-71 m granodiorite
70.20	23	0	0	
70.40	26	0	0	
70.60	26	0	0	
70.80	31	0	0	
71.00	35	0	0	
71.20	28	0	0	
71.40	22	0	0	
71.60	24	0	0	
71.80	23	0	0	
72.00	22	0	0	
72.20	24	0	0	
72.40	24	0	0	
72.60	23	0	0	
72.80	19	0	0	
73.00	24	0	0	
73.20	24	0	0	
73.40	25	0	0	
73.60	23	0	0	
73.80	23	0	0	
74.00	23	0	0	
74.20	27	0	0	
74.40	21	0	0	
74.60	19	0	0	
74.80	18	0	0	
75.00	18	0	0	
75.20	19	0	0	
75.40	20	0	0	
75.60	21	0	0	
75.80	21	0	0	

76.00	20	0	0	
76.20	21	0	0	
76.40	21	0	0	
76.60	21	0	0	
76.80	20	0	0	
77.00	20	0	0	
77.20	24	0	0	
77.40	27	0	0	
77.60	22	0	0	
77.80	25	0	0	
78.00	24	0	0	
78.20	24	0	0	
78.40	22	0	0	
78.60	24	0	0	
78.80	25	0	0	
79.00	25	0	0	
79.20	25	0	0	
79.40	26	0	0	
79.60	26	0	0	
79.80	24	0	0	
80.00	27	0	0	
80.20	31	0	0	
80.40	27	0	0	
80.60	25	0	0	
80.80	24	0	0	
81.00	24	0	0	16:42
81.20	28	0	0	
81.40	24	0	0	
81.60	24	0	0	
81.80	25	0	0	
82.00	24	0	0	
82.20	23	0	0	
82.40	24	0	0	
82.60	23	0	0	
82.80	23	0	0	
83.00	26	0	0	16:50
83.20	29	0	0	
83.40	24	0	0	
83.60	24	0	0	
83.80	27	0	0	
84.00	23	0	0	
84.20	25	0	0	
84.40	23	0	0	
84.60	26	0	0	
84.80	25	0	0	
85.00	25	0	0	
85.20	23	0	0	
85.40	24	0	0	
85.60	26	0	0	
85.80	25	0	0	
86.00	26	0	0	16:58
86.20	30	0	0	
86.40	26	0	0	
86.60	25	0	0	
86.80	25	0	0	
87.00	23	0	0	
87.20	25	0	0	
87.40	20	0	0	
87.60	22	0	0	
87.80	22	0	0	
88.00	25	0	0	
88.20	25	0	0	
88.40	20	0	0	
88.60	24	0	0	
88.80	26	0	0	
89.00	28	0	0	17:06
89.20	27	0	0	

89.40	27	0	0	
89.60	24	0	0	
89.80	27	0	0	
90.00	26	0	0	
90.20	26	0	0	
90.40	26	0	0	
90.60	25	0	0	
90.80	27	0	0	
91.00	26	0	0	c. 8 L/min
91.20	25	0	0	
91.40	26	0	0	
91.60	26	0	0	@
91.80	26	0	0	
92.00	28	0	0	
92.20	27	0	0	
92.40	25	0	0	
92.60	24	0	0	
92.80	27	0	0	
93.00	27	0	0	
93.20	29	0	0	
93.40	27	0	0	
93.60	25	0	0	
93.80	26	0	0	
94.00	26	0	0	
94.20	26	0	0	
94.40	27	0	0	
94.60	24	0	0	
94.80	25	0	0	
95.00	25	0	0	17:30
95.20	27	0	0	
95.40	29	0	0	
95.60	28	0	0	
95.80	27	0	0	
96.00	26	0	0	
96.20	27	0	0	
96.40	26	0	0	
96.60	25	0	0	
96.80	26	0	0	
97.00	25	0	0	
97.20	26	0	0	
97.40	28	0	0	
97.60	27	0	0	
97.80	27	0	0	
98.00	28	0	0	
98.20	28	0	0	
98.40	27	0	0	
98.60	26	0	0	
98.80	26	0	0	
99.00	27	0	0	
99.20	24	0	0	
99.40	24	0	0	
99.60	25	0	0	
99.80	23	0	0	
100.00	19	0	0	
100.20	25	0	0	
100.40	27	0	0	
100.60	25	0	0	
100.80	27	0	0	
101.00	25	0	0	
101.20	30	0	0	
101.40	26	0	0	
101.60	29	0	0	
101.80	29	0	0	
102.00	28	0	0	
102.20	31	0	0	
102.40	30	0	0	
102.60	29	0	0	

102.80	29	0	0	
103.00	28	0	0	
103.20	26	0	0	
103.40	29	0	0	
103.60	24	0	0	
103.80	21	0	0	
104.00	28	0	0	
104.20	27	0	0	
104.40	29	0	0	
104.60	27	0	0	
104.80	28	0	0	
105.00	28	0	0	
105.20	28	0	0	
105.40	26	0	0	
105.60	28	0	0	
105.80	27	0	0	
106.00	29	0	0	
106.20	28	0	0	
106.40	29	0	0	
106.60	28	0	0	
106.80	28	0	0	
107.00	30	0	0	
107.20	28	0	0	
107.40	24	0	0	
107.60	26	0	0	
107.80	27	0	0	
108.00	27	0	0	
108.20	27	0	0	
108.40	26	0	0	
108.60	26	0	0	
108.80	26	0	0	
109.00	22	0	0	
109.20	24	0	0	
109.40	23	0	0	
109.60	27	0	0	
109.80	25	0	0	
110.00	25	0	0	18:13
110.20	30	0	0	
110.40	28	0	0	
110.60	30	0	0	
110.80	28	0	0	
111.00	25	0	0	
111.20	28	0	0	
111.40	27	0	0	
111.60	26	0	0	
111.80	27	0	0	
112.00	27	0	0	
112.20	28	0	0	
112.40	24	0	0	
112.60	20	0	1	
112.80	25	0	0	
113.00	24	0	0	18:21
113.20	29	0	0	
113.40	27	0	0	
113.60	25	0	0	
113.80	23	0	0	
114.00	23	0	0	
114.20	28	0	0	
114.40	21	0	0	
114.60	22	0	0	
114.80	27	0	0	
115.00	27	0	0	
115.20	27	0	0	
115.40	28	0	0	
115.60	26	0	0	
115.80	26	0	0	
116.00	26	0	0	18:28

116.20	33	0	0	
116.40	28	0	0	
116.60	28	0	0	
116.80	28	0	0	
117.00	25	0	0	
117.20	25	0	0	
117.40	25	0	0	
117.60	26	0	0	
117.80	25	0	0	
118.00	24	0	0	
118.20	25	0	0	
118.40	25	0	0	
118.60	24	0	0	
118.80	23	0	0	
119.00	26	0	0	
119.20	28	0	0	
119.40	27	0	0	
119.60	27	0	0	
119.80	26	0	0	
120.00	25	0	0	
120.20	26	0	0	
120.40	27	0	0	
120.60	27	0	0	
120.80	22	0	0	
121.00	22	0	0	
121.20	23	0	0	
121.40	25	0	0	
121.60	24	0	0	
121.80	25	0	0	
122.00	26	0	0	2002-05-03:13:20, Drillbit sharpened
122.20	29	0	0	
122.40	28	0	0	
122.60	24	0	0	
122.80	22	0	0	
123.00	23	0	0	
123.20	25	0	0	
123.40	27	0	0	
123.60	26	0	0	
123.80	23	0	0	
124.00	26	0	0	
124.20	24	0	0	
124.40	27	0	0	
124.60	27	0	0	
124.80	24	0	0	
125.00	29	0	0	
125.20	34	0	0	
125.40	24	0	0	
125.60	25	0	0	
125.80	30	0	0	
126.00	27	0	0	
126.20	27	0	0	
126.40	28	0	0	
126.60	28	0	0	
126.80	26	0	0	
127.00	26	0	0	
127.20	26	0	0	
127.40	26	0	0	
127.60	27	0	0	
127.80	26	0	0	
128.00	29	0	0	13:37
128.20	34	0	0	
128.40	29	0	0	
128.60	29	0	0	
128.80	25	0	0	
129.00	26	0	0	
129.20	26	0	0	
129.40	26	0	0	

129.60	24	0	0	
129.80	27	0	0	
130.00	26	0	0	
130.20	26	0	0	
130.40	26	0	0	
130.60	27	0	0	
130.80	20	0	0	
131.00	21	0	0	13:46
131.20	26	0	0	
131.40	24	0	0	
131.60	25	0	0	
131.80	37	0	0	
132.00	30	0	0	132-134:Py, Greenstone,Granodiorite
132.20	34	0	0	
132.40	30	0	0	
132.60	28	0	0	
132.80	30	0	0	
133.00	34	0	0	
133.20	34	0	0	
133.40	37	0	0	
133.60	35	0	0	
133.80	33	0	0	
134.00	30	0	0	13:55
134.20	46	0	0	
134.40	41	0	0	
134.60	38	0	0	
134.80	32	0	0	
135.00	28	0	0	
135.20	36	0	0	
135.40	35	0	0	
135.60	31	0	0	
135.80	28	0	0	
136.00	30	0	0	
136.20	27	0	0	
136.40	28	0	0	
136.60	28	0	0	
136.80	27	0	0	
137.00	27	0	0	14:06, Granite
137.20	32	0	0	
137.40	39	0	0	
137.60	26	0	0	
137.80	25	0	0	
138.00	27	0	0	
138.20	27	0	0	
138.40	24	0	0	
138.60	26	0	0	
138.80	24	0	0	
139.00	25	0	0	
139.20	26	0	0	
139.40	26	0	0	
139.60	24	0	0	
139.80	24	0	0	
140.00	28	0	0	
140.20	33	0	0	
140.40	29	0	0	
140.60	28	0	0	
140.80	25	0	0	
141.00	23	0	0	
141.20	26	0	0	
141.40	26	0	0	
141.60	28	0	0	
141.80	28	0	0	
142.00	25	0	0	
142.20	27	0	0	
142.40	29	0	0	
142.60	27	0	0	
142.80	25	0	0	

143.00	28	0	0	
143.20	29	0	0	
143.40	29	0	0	
143.60	27	0	0	
143.80	26	0	0	
144.00	27	0	0	
144.20	27	0	0	
144.40	27	0	0	
144.60	27	0	0	
144.80	27	0	0	
145.00	26	0	0	
145.20	23	0	0	
145.40	25	0	0	
145.60	26	0	0	
145.80	25	0	0	
146.00	28	0	0	14:31
146.20	34	0	0	
146.40	29	0	0	
146.60	27	0	0	
146.80	26	0	0	
147.00	27	0	0	
147.20	27	0	0	
147.40	26	0	0	
147.60	27	0	0	
147.80	27	0	0	
148.00	27	0	0	
148.20	25	0	0	
148.40	26	0	0	
148.60	27	0	0	
148.80	26	0	0	
149.00	26	0	0	
149.20	31	0	0	
149.40	29	0	0	
149.60	26	0	0	
149.80	25	0	0	
150.00	24	0	0	
150.20	23	0	0	
150.40	23	0	0	
150.60	26	0	0	
150.80	23	0	0	
151.00	27	0	0	
151.20	26	0	0	
151.40	27	0	0	
151.60	25	0	0	
151.80	24	0	0	flow rate = 45 L/min
152.00	25	0	0	14:44
152.20	29	0	0	
152.40	29	0	0	
152.60	28	0	0	
152.80	25	0	0	
153.00	26	0	0	
153.20	26	0	0	
153.40	26	0	0	
153.60	25	0	0	
153.80	25	0	0	
154.00	23	0	0	
154.20	22	0	0	
154.40	26	0	0	
154.60	25	0	0	
154.80	25	0	0	
155.00	27	0	0	
155.20	31	0	0	
155.40	28	0	0	
155.60	24	0	0	
155.80	25	0	0	
156.00	26	0	0	
156.20	25	0	0	

156.40	23	0	0	
156.60	25	0	0	
156.80	24	0	0	
157.00	26	0	0	
157.20	26	0	0	
157.40	26	0	0	
157.60	26	0	0	
157.80	26	0	0	
158.00	28	0	0	15:12
158.20	38	0	0	
158.40	26	0	0	
158.60	25	0	0	
158.80	26	0	0	
159.00	25	0	0	Red granite
159.20	26	0	0	
159.40	22	0	0	
159.60	23	0	0	
159.80	22	0	0	
160.00	23	0	0	
160.20	23	0	0	
160.40	24	0	0	
160.60	23	0	0	
160.80	25	0	0	
161.00	26	0	0	15:21
161.20	33	0	0	
161.40	28	0	0	
161.60	28	0	0	
161.80	24	0	0	
162.00	26	0	0	
162.20	27	0	0	
162.40	26	0	0	
162.60	27	0	0	
162.80	27	0	0	
163.00	27	0	0	
163.20	25	0	0	
163.40	24	0	0	
163.60	24	0	0	
163.80	25	0	0	
164.00	24	0	0	15:29
164.20	32	0	0	
164.40	30	0	0	
164.60	27	0	0	
164.80	23	0	0	
165.00	27	0	0	
165.20	26	0	0	
165.40	25	0	0	
165.60	24	0	0	
165.80	25	0	0	
166.00	25	0	0	
166.20	26	0	0	
166.40	26	0	0	
166.60	25	0	0	
166.80	26	0	0	
167.00	27	0	0	1115:38
167.20	29	0	0	
167.40	27	0	0	
167.60	26	0	0	
167.80	22	0	0	
168.00	24	0	0	
168.20	24	0	0	
168.40	24	0	0	
168.60	26	0	0	
168.80	26	0	0	
169.00	26	0	0	
169.20	25	0	0	
169.40	27	0	0	
169.60	27	0	0	

169.80	26	0	0	
170.00	27	0	0	
170.20	28	0	0	
170.40	24	0	0	
170.60	24	0	0	
170.80	26	0	0	
171.00	26	0	0	
171.20	24	0	0	
171.40	24	0	0	
171.60	23	0	0	
171.80	23	0	0	
172.00	23	0	0	
172.20	24	0	0	
172.40	24	0	0	
172.60	23	0	0	
172.80	24	0	0	
173.00	26	0	0	15:55
173.20	32	0	0	
173.40	29	0	0	
173.60	24	0	0	
173.80	26	0	0	
174.00	26	0	0	
174.20	28	0	0	
174.40	27	0	0	
174.60	23	0	0	
174.80	26	0	0	
175.00	24	0	0	
175.20	24	0	0	
175.40	27	0	0	
175.60	25	0	0	
175.80	24	0	0	
176.00	27	0	0	16:04
176.20	35	0	0	
176.40	29	0	0	
176.60	24	0	0	
176.80	23	0	0	
177.00	23	0	0	
177.20	25	0	0	
177.40	26	0	0	
177.60	26	0	0	
177.80	24	0	0	
178.00	24	0	0	
178.20	23	0	0	
178.40	26	0	0	
178.60	24	0	0	
178.80	24	0	0	
179.00	27	0	0	
179.20	31	0	0	
179.40	29	0	0	
179.60	27	0	0	
179.80	27	0	0	
180.00	27	0	0	
180.20	26	0	0	
180.40	27	0	0	
180.60	27	0	0	
180.80	27	0	0	
181.00	28	0	0	
181.20	27	0	0	
181.40	28	0	0	
181.60	27	0	0	
181.80	26	0	0	
182.00	26	0	0	16:29. 45 L/min
182.20	31	0	0	
182.40	30	0	0	
182.60	29	0	0	
182.80	26	0	0	
183.00	26	0	0	

183.20	25	0	0	
183.40	26	0	0	
183.60	27	0	0	
183.80	26	0	0	
184.00	24	0	0	
184.20	23	0	0	
184.40	24	0	0	
184.60	23	0	0	
184.80	22	0	0	
185.00	24	0	0	16:37
185.20	31	0	0	
185.40	29	0	0	
185.60	26	0	0	
185.80	26	0	0	
186.00	24	0	0	
186.20	25	0	0	
186.40	27	0	0	
186.60	27	0	0	
186.80	26	0	0	
187.00	26	0	0	
187.20	24	0	0	
187.40	25	0	0	
187.60	24	0	0	
187.80	25	0	0	
188.00	26	0	0	16:45
188.20	29	0	0	
188.40	24	0	0	
188.60	26	0	0	
188.80	26	0	0	
189.00	27	0	0	
189.20	27	0	0	
189.40	27	0	0	
189.60	27	0	0	
189.80	27	0	0	
190.00	25	0	0	
190.20	22	0	0	
190.40	25	0	0	
190.60	25	0	0	
190.80	26	0	0	
191.00	28	0	0	
191.20	30	0	0	
191.40	24	0	0	
191.60	27	0	0	
191.80	30	0	0	
192.00	29	0	0	
192.20	30	0	0	
192.40	29	0	0	
192.60	29	0	0	
192.80	26	0	0	
193.00	26	0	0	
193.20	28	0	0	
193.40	28	0	0	
193.60	26	0	0	
193.80	29	0	0	
194.00	29	0	0	17:05
194.20	34	0	0	
194.40	27	0	0	
194.60	27	0	0	
194.80	27	0	0	
195.00	28	0	0	
195.20	28	0	0	
195.40	29	0	0	
195.60	27	0	0	
195.80	26	0	0	
196.00	27	0	0	
196.20	27	0	0	
196.40	28	0	0	

196.60	28	0	0	
196.80	27	0	0	
197.00	30	0	0	17:15
197.20	33	0	0	
197.40	32	0	0	
197.60	28	0	0	
197.80	26	0	0	
198.00	27	0	0	
198.20	27	0	0	
198.40	24	0	0	
198.60	26	0	0	
198.80	27	0	0	
199.00	26	0	0	
199.20	27	0	0	
199.40	26	0	0	
199.60	27	0	0	
199.80	26	0	0	
200.00	27	0	0	17:22.Flow rate= 48L/min at 17:44

Printout from SICADA 2003-04-11 09:14:38.

Drillpen D T - Drill Penetration Log

HFM02, 2002-05-13 12:50:00 - 2002-05-17 16:00:00 (12.600 - 100.000 m)

Bhlen (m)	Pen Time (s)	Water	Fracture	Comment
12.60	18	0	0	
12.80	17	0	0	
13.00	17	0	0	2002-05-13 12:50
13.20	16	0	0	
13.40	14	0	0	
13.60	19	0	0	
13.80	19	0	0	
14.00	18	0	0	
14.20	11	0	1	
14.40	14	0	1	
14.60	16	0	0	
14.80	15	0	0	
15.00	17	0	0	
15.20	17	0	0	
15.40	16	0	0	
15.60	15	0	0	
15.80	14	0	0	
16.00	14	0	0	
16.20	7	1	1	c. 30-40 L/min
16.40	9	1	1	
16.60	11	1	1	
16.80	9	0	1	
17.00	13	0	0	
17.20	14	0	0	
17.40	15	0	0	
17.60	14	0	0	
17.80	15	0	0	
18.00	14	0	0	
18.20	13	0	0	
18.40	13	0	0	
18.60	13	0	0	
18.80	15	0	0	
19.00	12	0	0	
19.20	12	0	0	
19.40	11	0	0	
19.60	13	0	0	
19.80	14	0	0	
20.00	15	0	0	
20.20	14	0	0	
20.40	13	0	0	
20.60	14	0	0	
20.80	17	0	0	
21.00	17	0	0	
21.20	18	0	0	
21.40	16	0	0	
21.60	8	0	0	
21.80	19	0	0	
22.00	19	0	0	
22.20	16	0	0	
22.40	10	0	0	
22.60	19	0	0	
22.80	15	0	0	
23.00	17	0	0	
23.20	18	0	0	
23.40	16	0	0	
23.60	19	0	0	
23.80	18	0	0	
24.00	17	0	0	
24.20	17	0	0	
24.40	17	0	0	

24.60	19	0	0	
24.80	19	0	0	
25.00	19	0	0	
25.20	20	0	0	
25.40	0	0	0	2002-05-13 13:20
25.60	19	0	0	2002-05-17 08:40
25.80	18	0	0	
26.00	33	0	0	
26.20	17	0	0	
26.40	23	0	0	
26.60	27	0	0	
26.80	25	0	0	
27.00	24	0	0	
27.20	23	0	0	
27.40	15	0	0	
27.60	19	0	0	
27.80	19	0	0	
28.00	18	0	0	
28.20	19	0	0	
28.40	17	0	0	
28.60	19	0	0	
28.80	22	0	0	
29.00	21	0	0	09:10
29.20	22	0	0	
29.40	21	0	0	
29.60	21	0	0	
29.80	21	0	0	
30.00	21	0	0	
30.20	21	0	0	
30.40	20	0	0	
30.60	19	0	0	
30.80	20	0	0	
31.00	21	0	0	
31.20	21	0	0	
31.40	20	0	0	
31.60	22	0	0	
31.80	20	0	0	
32.00	21	0	0	
32.20	22	0	0	09:17
32.40	22	0	0	
32.60	21	0	0	
32.80	22	0	0	
33.00	21	0	0	
33.20	22	0	0	
33.40	21	0	0	
33.60	20	0	0	
33.80	21	0	0	
34.00	22	0	0	
34.20	21	0	0	
34.40	21	0	0	
34.60	22	0	0	
34.80	22	0	0	
35.00	23	0	0	
35.20	23	0	0	
35.40	22	0	0	
35.60	21	0	0	
35.80	22	0	0	
36.00	20	0	0	
36.20	20	0	0	
36.40	19	0	0	
36.60	20	0	0	
36.80	21	0	0	
37.00	20	0	0	
37.20	15	0	1	
37.40	14	0	1	
37.60	9	0	2	
37.80	19	0	0	

38.00	22	0	0	
38.20	23	0	0	
38.40	22	0	0	
38.60	23	0	0	
38.80	24	0	0	
39.00	22	0	0	
39.20	24	0	0	
39.40	24	0	0	
39.60	21	0	0	
39.80	23	0	0	
40.00	23	0	0	09:36
40.20	22	0	0	
40.40	22	0	0	
40.60	22	0	0	
40.80	20	0	0	
41.00	21	0	0	
41.20	20	0	0	
41.40	18	0	0	
41.60	20	0	0	
41.80	22	0	0	
42.00	23	0	0	
42.20	22	0	0	
42.40	21	0	0	
42.60	13	0	1	
42.80	13	0	1	
43.00	16	0	1	
43.20	8	3	2	1000 L/min !
43.40	7	3	2	
43.60	10	0	0	
43.80	12	0	0	
44.00	17	0	0	09:51
44.20	19	0	0	
44.40	19	0	0	
44.60	18	0	0	
44.80	28	0	0	
45.00	32	0	0	
45.20	38	0	0	
45.40	36	0	0	
45.60	35	0	0	
45.80	29	0	0	
46.00	20	0	0	11:03
46.20	20	0	0	
46.40	18	0	0	
46.60	19	0	0	
46.80	33	0	0	
47.00	25	0	0	
47.20	30	0	0	
47.40	28	0	0	
47.60	33	0	0	
47.80	30	0	0	
48.00	26	0	0	
48.20	22	0	0	
48.40	30	0	0	
48.60	32	0	0	
48.80	28	0	0	
49.00	32	0	0	
49.20	36	0	0	
49.40	32	0	0	
49.60	30	0	0	El. cond. sampling at 11:13
49.80	34	0	0	
50.00	36	0	0	11:16
50.20	21	0	0	
50.40	33	0	0	
50.60	35	0	0	
50.80	36	0	0	
51.00	37	0	0	
51.20	39	0	0	

51.40	27	0	0	
51.60	34	0	0	
51.80	34	0	0	
52.00	32	0	0	
52.20	36	0	0	
52.40	33	0	0	
52.60	34	0	0	
52.80	33	0	0	
53.00	37	0	0	11:23
53.20	36	0	0	
53.40	37	0	0	
53.60	36	0	0	
53.80	36	0	0	
54.00	39	0	0	
54.20	38	0	0	
54.40	39	0	0	
54.60	40	0	0	
54.80	37	0	0	
55.00	36	0	0	
55.20	37	0	0	
55.40	36	0	0	
55.60	34	0	0	
55.80	38	0	0	
56.00	38	0	0	
56.20	37	0	0	
56.40	34	0	0	
56.60	35	0	0	
56.80	34	0	0	
57.00	32	0	0	
57.20	30	0	0	
57.40	31	0	0	
57.60	33	0	0	
57.80	34	0	0	
58.00	33	0	0	
58.20	36	0	0	
58.40	36	0	0	
58.60	37	0	0	
58.80	38	0	0	
59.00	38	0	0	
59.20	40	0	0	
59.40	40	0	0	
59.60	38	0	0	
59.80	37	0	0	
60.00	35	0	0	
60.20	38	0	0	
60.40	38	0	0	
60.60	37	0	0	
60.80	37	0	0	
61.00	36	0	0	
61.20	35	0	0	
61.40	37	0	0	
61.60	39	0	0	
61.80	40	0	0	Lunch 11:57
62.00	42	0	0	13:08
62.20	38	0	0	
62.40	48	0	0	
62.60	45	0	0	
62.80	39	0	0	
63.00	46	0	0	
63.20	45	0	0	
63.40	44	0	0	
63.60	41	0	0	
63.80	42	0	0	
64.00	42	0	0	
64.20	35	0	0	
64.40	42	0	0	
64.60	40	0	0	

64.80	45	0	0	
65.00	42	0	0	13:19
65.20	43	0	0	
65.40	42	0	0	
65.60	42	0	0	
65.80	42	0	0	
66.00	43	0	0	
66.20	42	0	0	
66.40	39	0	0	
66.60	41	0	0	
66.80	39	0	0	
67.00	41	0	0	
67.20	39	0	0	
67.40	40	0	0	
67.60	38	0	0	
67.80	39	0	0	
68.00	36	0	0	13:33
68.20	39	0	0	
68.40	39	0	0	
68.60	38	0	0	
68.80	38	0	0	
69.00	39	0	0	
69.20	41	0	0	
69.40	39	0	0	
69.60	39	0	0	
69.80	40	0	0	
70.00	33	0	0	
70.20	37	0	0	
70.40	39	0	0	
70.60	38	0	0	
70.80	40	0	0	
71.00	44	0	0	13:43
71.20	38	0	0	
71.40	41	0	0	
71.60	40	0	0	
71.80	39	0	0	
72.00	42	0	0	
72.20	38	0	0	
72.40	38	0	0	
72.60	39	0	0	
72.80	37	0	0	
73.00	38	0	0	
73.20	42	0	0	
73.40	45	0	0	
73.60	44	0	0	
73.80	44	0	0	
74.00	49	0	0	13:56
74.20	45	0	0	
74.40	45	0	0	
74.60	48	0	0	
74.80	46	0	0	
75.00	44	0	0	
75.20	44	0	0	
75.40	39	0	0	
75.60	45	0	0	
75.80	42	0	0	
76.00	41	0	0	
76.20	44	0	0	
76.40	41	0	0	
76.60	40	0	0	
76.80	46	0	0	El. cond. sample
77.00	47	0	0	14:09
77.20	48	0	0	
77.40	47	0	0	
77.60	46	0	0	
77.80	46	0	0	
78.00	47	0	0	

78.20	45	0	0	
78.40	45	0	0	
78.60	41	0	1	
78.80	38	0	1	
79.00	34	0	1	
79.20	46	0	0	
79.40	42	0	0	
79.60	44	0	0	
79.80	44	0	0	
80.00	37	0	0	14:23
80.20	41	0	0	
80.40	42	0	0	
80.60	41	0	0	
80.80	44	0	0	
81.00	46	0	0	
81.20	46	0	0	
81.40	42	0	0	
81.60	42	0	0	
81.80	43	0	0	
82.00	37	0	0	
82.20	38	0	0	
82.40	42	0	0	
82.60	43	0	0	
82.80	48	0	0	
83.00	49	0	0	14:37
83.20	48	0	0	
83.40	47	0	0	
83.60	43	0	0	
83.80	41	0	0	
84.00	48	0	0	
84.20	46	0	0	
84.40	44	0	0	
84.60	44	0	0	
84.80	45	0	0	
85.00	45	0	0	14:48
85.20	49	0	0	
85.40	47	0	0	
85.60	48	0	0	
85.80	50	0	0	
86.00	46	0	0	
86.20	49	0	0	
86.40	46	0	0	
86.60	52	0	0	
86.80	54	0	0	
87.00	51	0	0	
87.20	49	0	0	
87.40	48	0	0	
87.60	47	0	0	
87.80	52	0	0	
88.00	54	0	0	15:04
88.20	50	0	0	
88.40	49	0	0	
88.60	48	0	0	
88.80	48	0	0	
89.00	49	0	0	
89.20	48	0	0	
89.40	48	0	0	
89.60	50	0	0	
89.80	49	0	0	
90.00	49	0	0	
90.20	50	0	0	
90.40	52	0	0	
90.60	49	0	0	
90.80	50	0	0	
91.00	51	0	0	
91.20	48	0	0	
91.40	49	0	0	

91.60	52	0	0	
91.80	51	0	0	
92.00	53	0	0	15:18
92.20	52	0	0	
92.40	54	0	0	
92.60	55	0	0	
92.80	54	0	0	
93.00	53	0	0	
93.20	56	0	0	
93.40	53	0	0	
93.60	59	0	0	
93.80	59	0	0	
94.00	62	0	0	
94.20	58	0	0	
94.40	56	0	0	
94.60	56	0	0	
94.80	59	0	0	
95.00	51	0	0	
95.20	59	0	0	
95.40	61	0	0	
95.60	62	0	0	
95.80	58	0	0	
96.00	57	0	0	
96.20	61	0	0	
96.40	58	0	0	
96.60	55	0	0	
96.80	54	0	0	
97.00	56	0	0	
97.20	59	0	0	
97.40	56	0	0	
97.60	58	0	0	
97.80	61	0	0	
98.00	60	0	0	15:48
98.20	59	0	0	
98.40	60	0	0	
98.60	63	0	0	
98.80	68	0	0	
99.00	65	0	0	
99.20	62	0	0	
99.40	63	0	0	
99.60	62	0	0	
99.80	63	0	0	15:58. El. cond. sample

Printout from SICADA 2003-04-11 09:16:16.

Drillpen D T - Drill Penetration Log

HFM03, 2002-05-28 08:57:00 - 2002-05-28 09:20:00 (13.200 - 26.000 m)

Bhlen (m)	Pen Time (s)	Water	Fracture	Comment
13.20	20	0	0	start 08:37
13.40	20	0	0	
13.60	18	0	0	
13.80	18	0	0	
14.00	14	0	0	08:59
14.20	18	0	0	
14.40	17	0	0	
14.60	15	0	0	
14.80	16	0	0	
15.00	17	0	0	
15.20	15	0	0	
15.40	8	0	2	
15.60	7	0	2	
15.80	18	0	0	
16.00	19	0	0	
16.20	19	0	0	
16.40	17	0	0	
16.60	19	0	0	
16.80	19	0	0	
17.00	17	0	0	09:08
17.20	18	0	0	
17.40	20	0	0	
17.60	19	0	0	
17.80	20	0	0	
18.00	19	0	0	
18.20	21	0	0	
18.40	17	0	0	
18.60	17	0	0	
18.80	16	0	0	
19.00	20	0	0	
19.20	19	0	0	
19.40	18	0	0	
19.60	19	0	0	
19.80	21	0	0	
20.00	19	0	0	09:14
20.20	18	0	0	
20.40	21	0	0	
20.60	19	0	0	
20.80	19	0	0	
21.00	20	0	0	
21.20	12	3	0	388 L/min
21.40	18	0	0	
21.60	19	0	0	
21.80	16	0	0	
22.00	20	0	0	
22.20	19	0	0	
22.40	11	0	0	
22.60	16	0	0	
22.80	20	0	0	
23.00	13	0	0	09:24
23.20	17	0	0	
23.40	19	0	0	
23.60	18	0	0	
23.80	16	0	0	
24.00	19	0	0	
24.20	19	0	0	
24.40	20	0	0	
24.60	18	0	0	
24.80	18	0	0	
25.00	15	0	0	

25.20	16	0	0	
25.40	14	0	0	
25.60	15	0	0	
25.80	18	0	0	end at 09:29

Printout from SICADA 2003-04-11 09:17:14.

Drill Cuttings Samp T - Drill cuttings sampling an analysis

HFM01, 2002-07-01 07:00:00 - 2002-07-31 07:00:00 (12.000 - 200.200 m)

From Length (m)	To Length (m)	Colour Code Unwashed (code)	Grainsize Code Unwashed (code)	Colour Code Washed (code)	Grainsize Code Washed (code)	Rocktype A (code)	Rocktype B (code)	Mineral 1 (code)	Mineral 2 (code)	Mineral 3 (code)	Mineral 4 (code)	Mineral 5 (code)	Rock type Distr. (%)	Comment
12.00	14.00	282	6	82	6	101057		36	42	49	10			red ironoxide mud
14.00	17.00	208	6	82	6	101057		36	42	49	10			biotite rich and biotite poor parts
17.00	20.00	8	6	102	6	101057		36	42	49	10			clay coating
20.00	23.00	84	2	28	6	101057		36	42	49	10			biotite rich and biotite poor parts, clay coating
23.00	26.00	4	2	2	6	101057		36	42	49	10	33		Asphalt, calcite on frac. Large fsp, frac. at 23m
26.00	29.00	284	6	2	6	101057		36	42	49	10			dry clay fracture coating
29.00	32.00	42	6	2	6	101057		36	42	49	10			dry clay fracture coating
32.00	35.00	242	6	2	6	101057		36	49	42	10			dry clay fracture coating
35.00	38.00	4	6	2	6	101057		36	49	42	10	33		dry clay fracture coating
38.00	41.00	184	6	2	6	101057		36	49	42	10	33		dry clay fracture coating
41.00	44.00	184	6	82	6	101057		36	49	42	10	33		dry clay fracture coating, epidote, talc, prehnit
44.00	47.00	184	6	82	6	101057		36	49	42	10	33		dry clay fracture coating, epidote, talc, prehnit
47.00	50.00	8	6	82	6	101057		36	49	42	10			
50.00	53.00	8	6	182	6	101057		36	49	42	10	10		5 % pegmatite
53.00	56.00	82	6	254	6	101057	102017	36	49	42	10		70	mafic veins, miscoloured and talcization
56.00	59.00	82	6	252	6	101057	102017	36	49	42	10	28	90	talc, photo?
59.00	62.00	89	6	252	6	102017	101057	28	49	36	10	50	60	alteration, distribution on photo!
62.00	65.00	82	8	82	6	101057		36	49	42	10	50		isolated amphibolite, chalcopyrite?
65.00	68.00	82	8	82	6	101057		36	49	42	10			comapre photo??
68.00	71.00	287	8	282	6	102017	101057	28	49	36	10		80	alteration, distribution on photo!
71.00	74.00	82	9	182	6	101057		36	49	42	10	28		Amphibolite
74.00	77.00	82	9	82	9	101051		36	42	49	10	33		pyrrhotite
77.00	80.00	8	9	82	6	101057		36	42	49	10	33		
80.00	83.00	8	9	82	9	101057		36	42	49	10			
83.00	86.00	8	6	82	6	101057		36	42	49	10	50		
86.00	89.00	82	6	82	6	101057		36	42	49	10			
89.00	92.00	82	6	82	6	101057		36	42	49	10	50		larger cuttings (10-30 mm)
92.00	95.00	82	6	82	6	101057		36	49	42	10			
95.00	98.00	82	6	28	6	101057	111058	36	49	10	42			
98.00	101.00	8	6	8	6	101057	102017	36	49	10	16			
101.00	104.00	28	9	82	6	101057		36	49	42	10			

104.00	107.00	28	9	82	6	101057		36	49	42	10			
107.00	110.00	8	9	282	6	101057	111058	49	36	10	42	28	50	10 % Amphibolite cuttings (<4mm)
110.00	113.00	28	9	82	6	101057	111058	49	36	42	10	28	90	<5% Aplite, frac.with asphalt and pyrite
113.00	116.00	8	8	82	6	101057	111058	49	36	10	42	28	80	
116.00	119.00	8	9	8	6	101057		36	49	42	10			
119.00	122.00	8	6	182	6	101057	111058	36	49	42	10		50	
122.00	125.00	2	8	182	6	101057	111058	36	49	42	10		70	
125.00	128.00	28	9	82	6	101057	111058	36	42	49	10			"pure granite"
128.00	131.00	82	6	182	6	101057	101061	36	49	42	10		70	
131.00	134.00	9	6	282	6	102017	101061	36	49	42	10		70	
134.00	137.00	89	9	282	6	102017	101057	28	49	10	36	42	50	2 rock type contacts
137.00	140.00	82	9	82	6	101057		36	42	49	10		50	some mafic grains
140.00	143.00	82	9	128	6	101057	101061	36	42	49	10		90	Kaolinized grain in Pegmatite?
143.00	146.00	82	9	128	6	101057		36	42	49	10			
146.00	149.00	8	6	128	2	101057		36	42	49	10			
149.00	152.00	82	9	82	2	101057		36	42	49	10	33		fracture mineral
152.00	155.00	82	8	28	2	101057		36	42	49	10			
155.00	158.00	8	9	28	2	101057		36	42	49	10			"pure granite"
158.00	161.00	28	8	82	2	101057		36	42	49	10	16	90	Frac.min. laumontite
161.00	164.00	2	9	2	2	101057		36	42	49	10	33		
164.00	167.00	2	8	2	2	101057		36	42	49	10	33	90	Epidote, pyrite, chalcopyrite
167.00	170.00	28	8	102	6	101057		36	42	49	10	33		Epidote, titanite
170.00	173.00	102	8	102	6	101057		36	42	49	10	16		
173.00	176.00	28	9	28	6	101057		36	42	49	10	33		
176.00	179.00	28	9	182	2	101057		36	42	49	10	33		Epidote, titanite
179.00	182.00	28	9	82	6	101057	102017	36	42	49	10	16	90	Titanite
182.00	185.00	202	9	28	2	101057		36	42	49	10	33		Epidote, pyrrhotite
185.00	188.00	2	9	28	6	101057		36	42	49	10	33		Epidote
188.00	191.00	2	8	28	6	101057		36	42	49	10	33		Pyrrhotite
191.00	194.00	102	9	128	6	101057		36	42	49	10	33		Pyrrhotite, zircone?, röd ton=laumontite?
194.00	197.00	28	9	128	6	101057		36	42	49	10			Pyrrhotite, röd ton=laumontite?
197.00	200.00	2	9	28	6	101057		36	42	49	10	33		Epidote, röd ton=laumontite?

Drill Cuttings Samp T - Drill cuttings sampling an analysis

HFM02, 2002-07-01 00:00:00 - 2002-07-31 00:00:00 (12.600 - 100.000 m)

From Length (m)	To Length (m)	Colour Code Unwashed (code)	Grainsize Code Unwashed (code)	Colour Code Washed (code)	Grainsize Code Washed (code)	Rocktype A (code)	Rocktype B (code)	Mineral 1 (code)	Mineral 2 (code)	Mineral 3 (code)	Mineral 4 (code)	Mineral 5 (code)	Rock type Distr (%)	Comment
13.00	14.00	4	9	28	6	101057		36	42	49	10			"Rusty fractures"
17.00	20.00	228	6	228	6	101057		36	42	49	10	33		RE-oxide?
20.00	23.00	28	9	24	6	101057		36	42	49	10			Larger fragments in cuttings (>10mm)
23.00	25.00	2	6	2	9	101057		36	42	49	10			Cuttings have a sandy charater
25.00	26.00	28	6	2	6	101057		36	42	49	10			Clayey
26.00	29.00	42	2	28	6	101057	102017	36	42	49	10		70	Sandy fraction with small dark grains, Clayey
29.00	32.00	24	6	102	6	101057		36	42	49	10			Clayey
32.00	35.00	104	2	128	6	101057		36	42	49	10			Clayey
35.00	38.00	254	2	212	6	101057	102017	36	42	49	10	33	50	"Biotite sand", photo!
38.00	41.00	104	2	102	6	101057		36	42	49	10			sandy
41.00	44.00	28	6	128	6	101057		36	42	49	10	83		Clayey, larger fragments
43.00	44.00	208	1	8	2			83						Fracture zone/crush zone
44.00	47.00	242	8	258	6	101057	102017	36	42	49	10	16	70	Large fragments, Pyrrhotite, chlorite
50.00	53.00	202	8	125	6	101057		36	42	49	10	108		Large fragments, Talc, chlorite. Breccia
53.00	56.00	82	4	102	6	101057		36	42	49	10	108		Almost empty can, large fragments, talc, chlorite. Breccia
56.00	59.00	102	8	102	6	101057		36	42	49	10	108		Large fragments, talc, chlorite, pyrite. Breccia
59.00	62.00	82	4	128	6	101057		36	42	49	10	108		Large fragments, almost empty can
62.00	65.00	25	4	125	6	101057		36	42	49	10	108		Large green altered fragments, talc, chlorite
65.00	68.00	28	8	125	6	101057		36	42	49	10	108		Large fragments, talc, chlorite
68.00	71.00	182	8	182	6	101057		36	42	49	10		90	
71.00	74.00	182	8	182	6	101057		36	42	49	10			
74.00	77.00	182	9	182	6	101057		36	49	42	10	16		Titanite, magnetite
77.00	80.00	82	9	82	6	101057		36	49	42	10	50		Titanite
80.00	83.00	229	4	229	9	101057	102017	36	49	42	10	10	90	Epidote, hornblende, chlorite
83.00	86.00	82	9	182	6	101057		36	49	42	10	16		Large fragments, fractures
86.00	89.00	87	4	87	2	101057	101051	36	49	10				Green alteration on fracture planes
89.00	92.00	102	8	102	6	101057		36	49	42	10	16		gravel-like
92.00	95.00	129	8	129	6	101057	102017	36	49	42	10	16	80	Aplite-Pegmatite, pyrite
95.00	98.00	82	8	82	6	101057		36	49	42	10	50	80	Aplite-Pegmatite, RE-sil?
98.00	100.00	282	8	129	6	101057	102017	36	49	42	10	16	50	Pyrite

Drill Cuttings Samp T - Drill cuttings sampling an analysis

HFM03, 2002-07-01 08:57:00 - 2002-07-31 08:57:00 (13.100 - 26.100 m)

From Length (m)	To Length (m)	Colour Code Unwashed (code)	Grainsize Code Unwashed (code)	Colour Code Washed (code)	Grainsize Code Washed (code)	Rocktype A (code)	Rocktype B (code)	Mineral 1 (code)	Mineral 2 (code)	Mineral 3 (code)	Mineral 4 (code)	Mineral 5 (code)	Rock type Distr (%)	Comment
13.00	17.00	104	6	102	6	101057		36	42	49	10	28	100	
17.00	20.00	128	6	102	6	101057		36	42	49	10	28	100	
20.00	23.00	128	6	102	6	101057		36	42	49	10	28	100	
23.00	26.00	282	6	29	9	101057		36	42	49	10	28	100	Gneissic, 2 contacts?, Aplite-granite/Amphibolite