P-04-308

Oskarshamn site investigation

Geological single-hole interpretation of KAV04A, KAV04B and KLX01

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July 2006

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Keywords: Geophysics, Rock unit, Borehole, Deformation zone, Fractures, Alteration.

Abstract

This report contains geological single-hole interpretations of the cored boreholes KAV04A and KV04B at Ävrö, and the cored borehole KLX01 at Laxemar. Each interpretation combines the geological core mapping, interpreted geophysical logs and borehole radar measurements to identify rock units and possible deformation zones in the boreholes.

The geological single-hole interpretation shows that six rock units (RU1–RU6) are identified in KAV04A. The borehole is dominated by Ävrö granite. Subordinate rock types are fine-grained dioritoid, fine-grained granite and quartz monzodiorite. One possible deformation zone has been identified in KAV04A (DZ1).

One rock unit (RU1), which is dominated by Ävrö granite, is identified in KAV04B. Subordinate rock types are fine-grained granite, pegmatite and granite. No deformation zone has been identified in KAV04B.

Two rock units are identified in borehole KLX01 (RU1–RU2). One of the units is recurrent in the borehole and the borehole can therefore be subdivided into three separate sections. The borehole is dominated by Ävrö granite. Subordinate rock types are fine-grained diorite to gabbro, fine-grained granite, diorite to gabbro, granite and pegmatite. One possible deformation zone has been identified in KLX01 (DZ1).

Sammanfattning

Denna rapport behandlar geologisk enhålstolkning av kärnborrhålen KAV04A och KAV04B på Ävrö, samt kärnborrhålet KLX01 i Laxemar. Den geologiska enhålstolkningen syftar till att utifrån den geologiska karteringen, tolkade geofysiska loggar och borrhålsradarmätningar identifiera litologiska enheter och möjliga deformationszoner i borrhålen.

Sex litologiska enheter (RU1–RU6) har identifierats i KAV04A. Generellt sett domineras borrhålet av Ävrögranit. Finkornig dioritoid, finkornig granit och kvartsmonzodiorit förekommer i mindre omfattning. En möjlig deformationszon har identifierats i KAV04A (DZ1).

Borrhål KAV04B domineras av Ävrögranit, vilken utgör en litologisk enhet (RU1). Inslag av finkornig diorit till gabbro, finkornig granit, pegmatit och granit förekommer. Inga deformationszoner har identifierats i KAV04B.

I KLX01 finns det två litologiska enheter (RU1–RU2). Borrhålet kan delas in i tre enheter, baserat på repetition av en av de litologiska enheterna. Borrhålet domineras av Ävrö granit. Inslag av finkornig diorit till gabbro, finkornig granit, diorit till gabbro, granit och pegmatit förekommer. En möjlig deformationszon har identifierats i KLX01 (DZ1).

Contents

1 Introduction

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

This document reports the results gained by the geological single-hole interpretations of the cored boreholes KAV04A and KAV04B at Ävrö and the cored borehole KLX01 at Laxemar (Figure 1-1), which is one of the activities performed within the site investigation at Oskarshamn. The work was carried out in accordance with activity plan SKB PS 400-04-091. The controlling documents for performing this activity are listed in Table 1-1. Both the activity plan and method description are SKB's internal controlling documents. Rock type nomenclature that has been used is shown in Table 1-2.

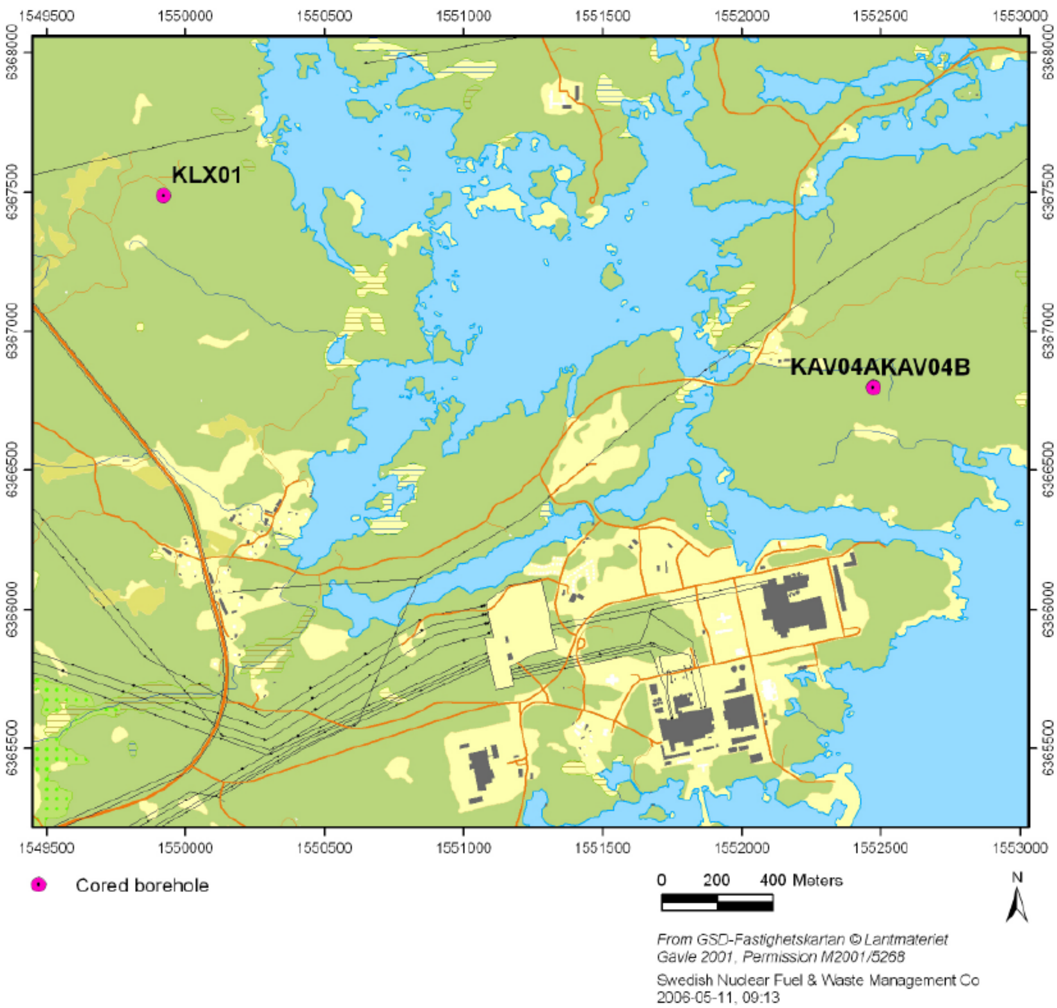

***Figure 1-1.** Map showing the position of the boreholes KAV04A, KAV04B and KLX01.*

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

Activity plan	Number	Version
Geologisk enhålstolkning av KLX01, KAV04A och KAV04B	AP PS 400-04-091	1.0
Method description	**Number**	**Version**
Metodbeskrivning för geologisk enhålstolkning	SKB MD 810.003	1.0

Table 1-2. Rock type nomenclature for the site investigation at Oskarshamn.

Rock type	Rock code	Rock description
Dolerite	501027	Dolerite
Fine-grained Götemar granite	531058	Granite, fine- to medium-grained, ("Götemar granite")
Coarse-grained Götemar granite	521058	Granite, coarse-grained, ("Götemar granite")
Fine-grained granite	511058	Granite, fine- to medium-grained
Pegmatite	501061	Pegmatite
Granite	501058	Granite, medium- to coarse-grained
Ävrö granite	501044	Granite to quartz monzodiorite, generally porphyritic
Quartz monzodiorite	501036	Quartz monzonite to monzodiorite, equigranular to weakly porphyritic
Diorite/gabbro	501033	Diorite to gabbro
Fine-grained dioritoid	501030	Intermediate magmatic rock
Fine-grained diorite-gabbro	505102	Mafic rock, fine-grained
Sulphide mineralization	509010	Sulphide mineralization
Sandstone	506007	Sandstone

2 Objective and scope

A geological single-hole interpretation is carried out in order to identify and to describe briefly the characteristics of major rock units and possible deformation zones within a borehole. The work involves an integrated interpretation of data from the geological mapping of the borehole (Boremap), different borehole geophysical logs and borehole radar data. The geological mapping of the cored boreholes involves a documentation of the character of the bedrock in the drill core. This work component is carried out in combination with an inspection of the oriented image of the borehole walls that is obtained with the help of the *B*orehole *I*mage *P*rocessing *S*ystem (BIPS). The geological mapping of the percussion boreholes focuses more attention on an integrated interpretation of the information from the geophysical logs and the BIPS images. For this reason, the results from the percussion borehole mapping are more uncertain. The interpretations of the borehole geophysical and radar logs are available when the single-hole interpretation is performed. The result from the geological single-hole interpretation is presented in a WellCad plot.

3 Equipment

The following data have been used in the single-hole interpretations of the boreholes KAV04A, KAV04B and KLX01:

- Boremap data (including BIPS and geological mapping data) /1/.
- Generalized geophysical logs and their interpretation /2, 3/.
- Radar data and their interpretation /4, 5/.

As a basis for the geological single-hole interpretation a combined WellCad plot consisting of the above mentioned data sets were used. An example of a WellCad plot used during the geological single-hole interpretation is shown in Figure 3-1. The plot consists of ten main columns and several subordinate columns. These include:

1: Length along the borehole

2: Boremap data
- 2.1: Rock type
- 2.2: Rock type < 1 m
- 2.3: Rock type structure
- 2.4: Rock structure intensity
- 2.5: Rock type texture
- 2.6: Rock type grain size
- 2.7: Structure orientation
- 2.8: Rock alteration
- 2.9: Rock alteration intensity
- 2.10: Crush

3: Generalized geophysical data
- 3.1: Silicate density
- 3.2: Magnetic susceptibility
- 3.3: Natural gamma radiation
- 3.4: Estimated fracture frequency

4: Unbroken fractures
- 4.1: Primary mineral
- 4.2: Secondary mineral
- 4.3: Third mineral
- 4.4: Fourth mineral
- 4.5: Alteration, dip direction

5: Broken fractures
- 5.1: Primary mineral
- 5.2: Secondary mineral
- 5.3: Third mineral
- 5.4: Fourth mineral
- 5.5: Aperture (mm)
- 5.6: Roughness
- 5.7: Surface
- 5.8: Slickenside
- 5.9: Alteration, dip direction

6: Crush zones
- 6.1: Piece (mm)
- 5.9: Sealed network
- 5.10: Core loss

7: Fracture frequency
- 6.1: Sealed fractures
- 6.2: Open fractures

9: BIPS

The geophysical logs are described below:

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

Natural gamma radiation: The rock has been classified into sections of low, medium, and high natural gamma radiation. Low radiation may indicate mafic rock types and high radiation may indicate younger, fine-grained granite or pegmatite.

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

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

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

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

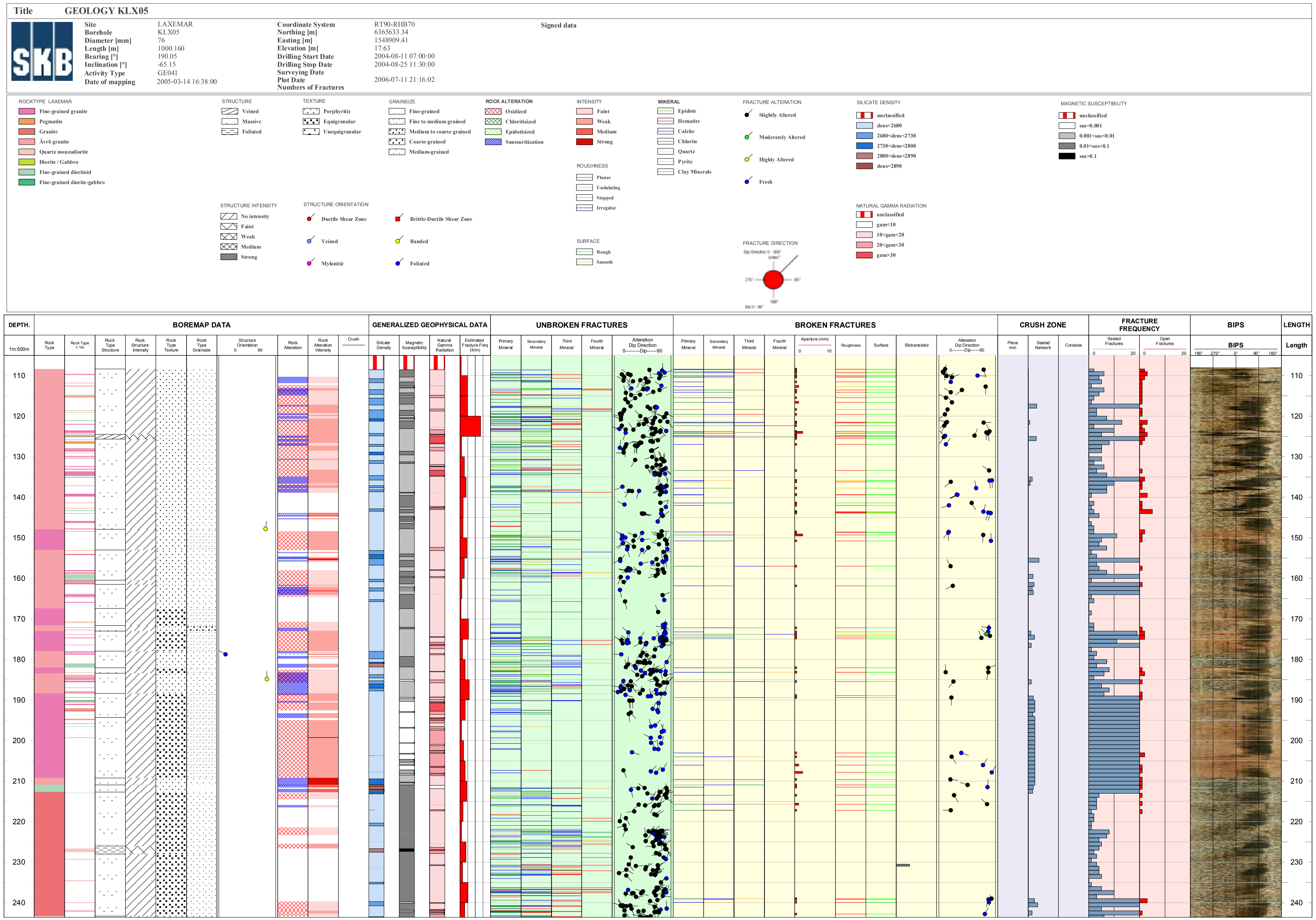

Figure 3-1. Example of WellCad plot (from borehole KLX05 in Laxemar) used as a basis for the single-hole interpretation.

4 Execution

4.1 General

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

Stage 1 in the working procedure is to study all types of data (rock type, rock alteration, silicate density, natural gamma radiation, etc) related to the character of the rock type and to merge sections of similar rock types, or sections where one rock type is very dominant, into rock units (minimum length of c 5 m). Each rock unit is defined in terms of the borehole length interval and provided with a brief description for inclusion in the WellCad plot. The frequencies of open and sealed fractures have been assessed in the identification procedure, and the character of the rock unit has been presented in stereo plot in appendices. Partly open fractures are included together with open fractures. The confidence in the interpretation of a rock unit is made on the following basis: 3 = high, 2 = medium, 1 = low and 0 = not estimated.

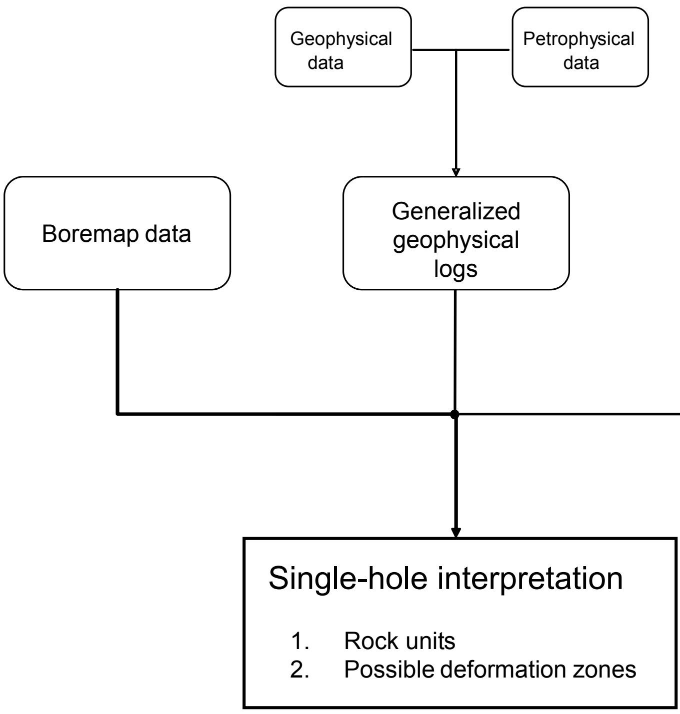

Figure 4-1. Schematic block-scheme of single-hole interpretation

Stage 2 in the working procedure is to identify deformation zones by visual inspection of the results of the geological mapping (fracture frequency, fracture mineral, aperture, alteration, etc) in combination with the geophysical logging and radar data. The section of each identified deformation zone is defined in terms of the borehole length interval and provided with a brief description for inclusion in the WellCad plot. The confidence in the interpretation of a deformation zone is made on the following basis: 3 = high, 2 = medium, 1 = low and 0 = not estimated.

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

Deformation zones that are brittle in character have been identified primarily on the basis of the frequency of fractures, according to the recommendations in /6/. Both the transitional part, with a fracture frequency in the range 4–9 fractures/m, and the cored part, with a fracture frequency > 9 fractures/m, have been included in each zone (Figure 4-2). The frequencies of open and sealed fractures have been assessed in the identification procedure, and the character of the zone has been described accordingly. Partly open fractures are included together with open fractures in the brief description of each zone. The presence of bedrock alteration, the occurrence and, locally, inferred orientation of radar reflectors, the resistivity, SPR, P-wave velocity, caliper and magnetic susceptibility logs have all assisted in the identification of the zones.

4.2 Nonconformities

KLX01 is mapped with Petrocore and not with the Boremap-system. Fracture data is from Petrocore while lithology is from the overview mapping performed with Boremap. Directional borehole radar was not logged in KLX01. Thus, only non-oriented radar data are available for this borehole. Also, there is no borehole radar data below 684 m in KLX01. Orientations from directional radar are presented as dip/strike using the right-hand rule.

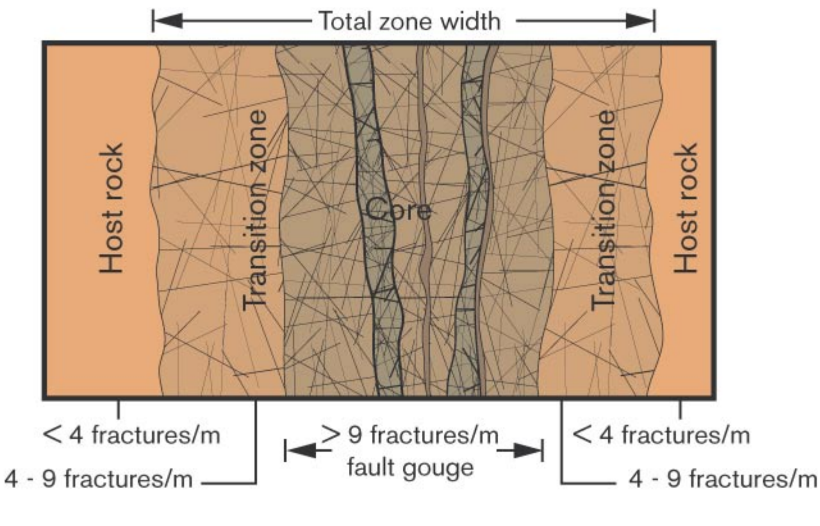

Figure 4-2. *Terminology for brittle deformation zones (after /6/).*

5 Results

The detailed results of the single-hole interpretation are presented as print-outs from the software WellCad (Appendix 1 for KAV04A, Appendix 2 for KAV04B and Appendix 3 for KLX01). The legend of the WellCad is presented in Chapter 6. In 5.1 to 5.3 all identified rock units and possible deformation zones in KAV04A, KAV04B, and KLX01 are presented.

5.1 KAV04A

The borehole can be divided into six rock units:

RU1: 100.950–289.141 m
Dominated by Ävrö granite. Subordinate rock types include fine-grained dioritoid, fine-grained granite, pegmatite and a few sections of granite. The Ävrö granite is vuggy in character in the section between 256 and 257.5 m. Scattered sections are foliated. Geophysical logs indicate that the silicate density is mainly in the range of 2,680–2,730 kg/m^3 and the natural gamma radiation is generally moderate to low, < 30 μR/h. A major minimum in the density log corresponds to the section with vuggy granite. Confidence = 3.

RU2: 289.141–606.026 m
Mixture of Ävrö granite and quartz monzodiorite. Subordinate rock types include ≤ 30 m long sections of fine-grained dioritoid, fine-grained granite, pegmatite, fine-grained diorite to gabbro and diorite to gabbro. Scattered sections are foliated. There are large variations in the silicate density log, mainly ranging from 2,680–2,890 kg/m^3, which indicate a varying mineral composition of the rocks. The natural gamma radiation is generally low, < 20 μR/h, and the magnetic susceptibility varies between 0.001 SI and 0.1 SI. Confidence = 3.

RU3: 606.026–690 m
Mixture of Ävrö granite and fine-grained granite. Quartz monzodiorite occurs in ≤ 20 m long sections. Subordinate rock types include fine-grained dioritoid, pegmatite, granite and fine-grained granite (in the other rock types). Scattered sections are foliated and these often correlate with sections of fine-grained granite. The natural gamma radiation is high (> 30 μR/h,) along the upper and lower parts of the unit. Along these sections, which correlate with sections of fine-grained granite, the silicate density is mainly < 2,680 kg/m^3. The central part of the section (c 630–680 m) is characterized by moderate natural gamma radiation and silicate density of 2,680–2,800 kg/m^3. Confidence = 3.

RU4: 690–862.940 m
Mixture of Ävrö granite and fine-granite. Subordinate rock types include granite, fine-grained granite (in remaining rock types), pegmatite and certain sections of fine-grained dioritoid. Foliated sections correlate with sections of fine-grained granite. This rock unit is characterized by an inhomogeneous brittle overprinting (increased amount of sections with crush and low magnetic susceptibility). The natural gamma radiation is high (> 30 μR/h,) along the upper and lower parts of the unit. Along these sections the silicate density is mainly < 2,680 kg/m^3. The central part of the section is characterized by moderate natural gamma radiation and silicate density of 2,680–2,800 kg/m^3. Confidence = 3.

RU5: 862.940–947.458 m
Totally dominated by fine-grained dioritoid. Subordinate rock types include fine-grained granite and pegmatite. This rock unit is characterized by an inhomogeneous brittle overprinting (increased amount of sections with crush and low magnetic susceptibility). The silicate density is mainly in the range of 2,800–2,890 kg/m^3, with minor sections of higher density. Confidence = 3.

RU6: 947.458–1,003.102 m
Inhomogeneous mixture of Ävrö granite, quartz monzodiorite, fine-grained dioritoid, fine-grained granite and fine-grained diorite to gabbro. This rock unit is characterized by an inhomogeneous brittle overprinting (increased amount of sections with crush). There are large variation in the silicate density, which indicates varying mineral composition, and there is a long section (c 975–995m) characterized by high natural gamma radiation. Confidence = 3.

One possible major deformation zone has been identified in KAV04A:

DZ1: 840–900 m
Increased number of crush zones. The deformation zone is characterized by an inhomogeneous brittle-cataclastic deformation. The focused resistivity (300) is markedly low along the section c 860–900 m, but no other geophysical logging methods indicate significant anomalies. Radar reflector occurs at 852 m with the orientation 25/180 and intersection angle 65° to borehole axis, at 859.3 m with an intersection angle of 67° to borehole axis, and at 873.5 m with the orientation 30/180 and intersection angle 55º to borehole axis. Confidence = 3.

5.2 KAV04B

The borehole is composed of one rock unit:

RU1: 11.0–100.50 m
Totally dominated by Ävrö granite with subordinate sections of fine-grained granite, pegmatite and granite. Geophysical data indicate a silicate density of 2,680–2,800 kg/m^3, mainly moderate natural gamma radiation and low to moderate magnetic susceptibility. Confidence = 3.

No deformation zone has been identified in KAV04B.

5.3 KLX01

The borehole can be divided into two rock units, one of which is recurrent in the borehole. For this reason, the borehole is divided into three rock sections:

RU1: 0.96–585 m
Totally dominated by Ävrö granite with subordinate sections of fine-grained diorite to gabbro, fine-grained granite, diorite to gabbro, granite and certain sections of pegmatite. There are large variations in the silicate density. Sections with fine-grained mafic rock generally correspond to high silicate density, low natural gamma radiation and also markedly low magnetic susceptibility. Confidence = 3.

RU2: 585–639.48 m
Dominated by Ävrö granite with subordinate sections of fine-grained granite and fine-grained diorite to gabbro. This rock unit is characterized by increased frequency of broken and unbroken fractures. Many sections are characterized by high natural gamma radiation, often correlated with low magnetic susceptibility. Confidence = 3.

RU1: 639.48–1,077.99 m
Totally dominated by Ävrö granite with some ≤ 35 m long sections of fine-grained diorite to gabbro and scattered sections of fine-grained granite. There are no geophysical data below c 690 m borehole length. Confidence = 3.

One possible deformation zone has been identified in KLX01

DZ1: 1,000–1,020 m
Oxidation, high fracture frequency, narrow sections with crushed rock, several chlorite or calcite sealed fractures. Confidence = 3.

6 Comments

The result from the geological single-hole interpretation of KAV04A, KAV04B and KLX01 are presented in WellCad plots (Appendix 1–3). The WellCad plots consist of the following columns:

In data Boremap

1: Depth (length along the borehole)

2: Rock type

3: Rock alteration

4: Sealed fractures

5: Open and partly open fractures

6: Crush zones

In data Geopysics

7: Silicate density

8: Magnetic susceptibility

9: Natural gamma radiation

10: Estimated fracture frequency

Interpretations

11: Description: Rock unit

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

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

14: Description: Possible deformation zone

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

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

7 References

/1/ **Ehrenborg J, Steiskal V, 2004.** Oskarshamn site investigation. Boremap mapping of core drilled boreholes KAV04A and KAV04B. SKB P-05-22, Svensk Kärnbränslehantering AB.

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/5/ **Niva B, Gabriel G, 1988.** Borehole radar measurements at Äspö and Laxemar – Boreholes KAS02, KAS03, KAS04, KLX01, HAS02, HAS03 and HAV07. SKB PR 25-88-03, Svensk Kärnbränslehantering AB.

/6/ **Munier R, Stenberg L, Stanfors R, Milnes A G, Hermanson J, Triumf CA, 2003.** Geological site descriptive model. A strategy for the model development during site investigations. SKB R-03-07, Svensk Kärnbränslehantering AB.

Geological single-hole interpretation of KAV04A

Appendix 1

Title SINGLE HOLE INTERPRETATION KAV04A

Site	ÄVRÖ	**Inclination [°]**	-84.90	**Elevation [m.a.s.l.]**	10.28	**Signed data**
Borehole	KAV04A	**Date of mapping**	2004-06-01 08:47:00	**Drilling Start Date**	2003-10-06 09:00:00	
Diameter [mm]	76	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2003-11-01 10:00:00	
Length [m]	1004.000	**Northing [m]**	6366794.94	**Surveying Date**		
Bearing [°]	77.03	**Easting [m]**	1552475.05	**Plot Date**	2006-07-13 21:14:56	

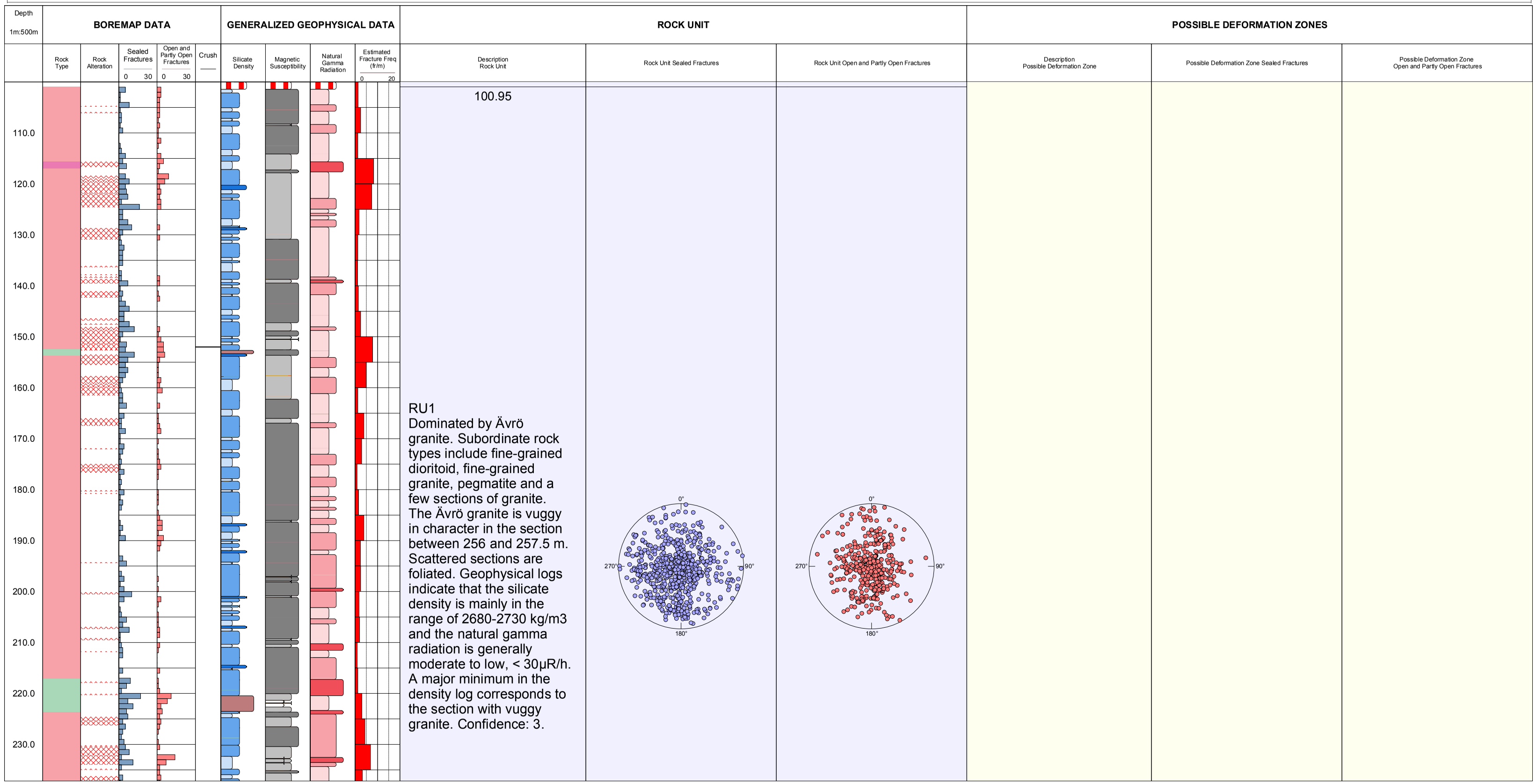
ROCKTYPE ÄVRÖ
- Fine-grained granite
- Pegmatite
- Granite
- Ävrö granite
- Quartz monzodiorite
- Diorite / Gabbro
- Fine-grained dioritoid
- Fine-grained diorite-gabbro

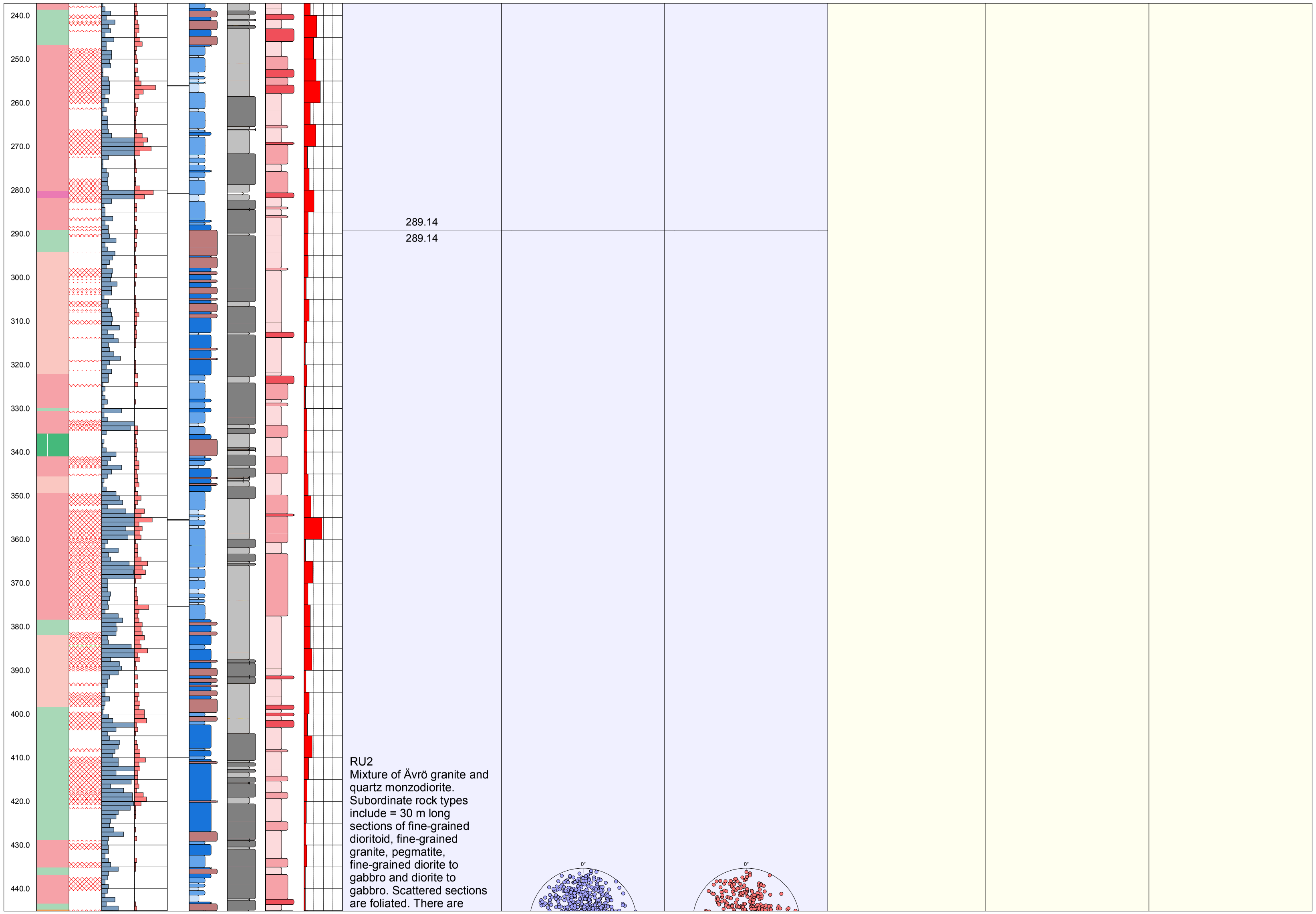
ROCK ALTERATION
- Oxidized
- Epidotisized

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

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

NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<30
- gam>30




240.0
250.0
260.0
270.0
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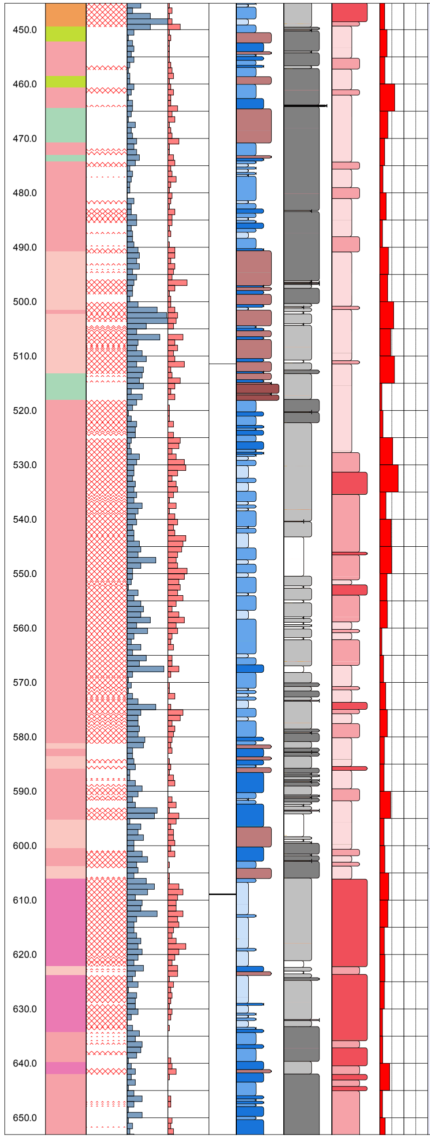
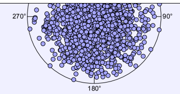
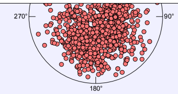
290.0
300.0
310.0
320.0
330.0
340.0
350.0
360.0
370.0
380.0
390.0
400.0
410.0
420.0
430.0
440.0
289.14
289.14
RU2
Mixture of Ävrö granite and
quartz monzodiorite.
Subordinate rock types
include = 30 m long
sections of fine-grained
dioritoid, fine-grained
granite, pegmatite,
fine-grained diorite to
gabbro and diorite to
gabbro. Scattered sections
are foliated. There are



large variations in the silicate density log, mainly ranging from 2680-2890 kg/m3, which indicate a varying mineral composition of the rocks. The natural gamma radiation is generally low, < 20μR/h, and the magnetic susceptibility varies between 0.001 SI and 0.1 SI. Confidence: 3.

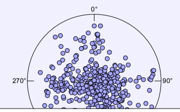


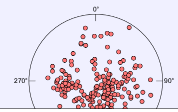


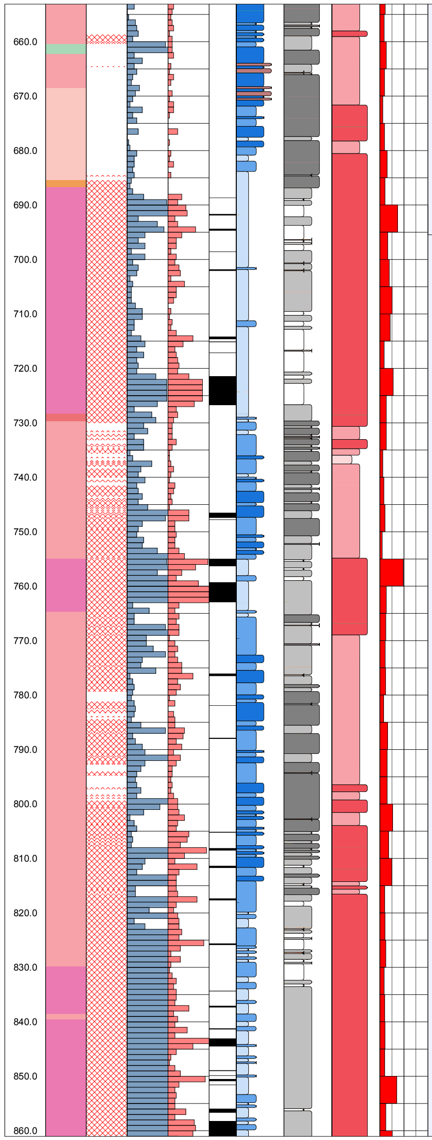
606.03

606.03

RU3
Mixture of Ävrö granite and fine-grained granite. Quartz monzodiorite occurs in = 20 m long sections. Subordinate rock types include fine-grained dioritoid, pegmatite, granite and fine-grained granite (in the other rock types). Scattered sections are foliated and these often correlate with sections of fine-grained granite. The natural gamma radiation is high (> 30mR/h,) along the upper and lower parts of







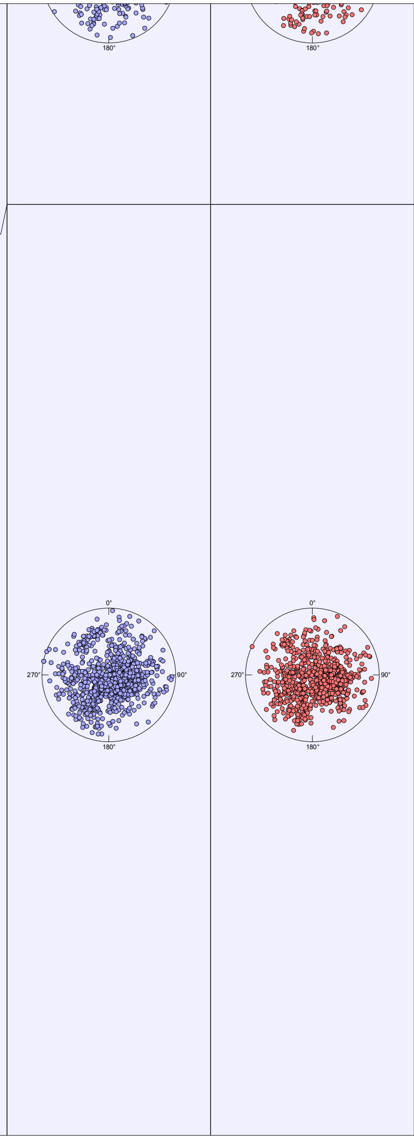
the unit. Along these sections, which correlate with sections of fine-grained granite, the silicate density is mainly < 2680 kg/m3. The central part of the section (c. 630-680 m) is characterized by moderate natural gamma radiation and silicate density of 2680-2800 kg/m3. Confidence: 3.

690.00

690.00

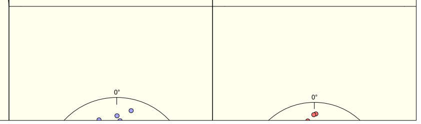
RU4
Mixture of Ävrö granite and fine-grained granite. Subordinate rock types include granite, fine-grained granite (in remaining rock types), pegmatite and certain sections of fine-grained dioritoid. Foliated sections correlate with sections of fine-grained granite. This rock unit is characterized by an inhomogeneous brittle overprinting (increased amount of sections with crush and low magnetic susceptibility). The natural gamma radiation is high (> 30µR/h,) along the upper and lower parts of the unit. Along these sections the silicate density is mainly < 2680 kg/m3. The central part of the section is characterized by moderate natural gamma radiation and silicate density of 2680-2800 kg/m3. Confidence: 3.

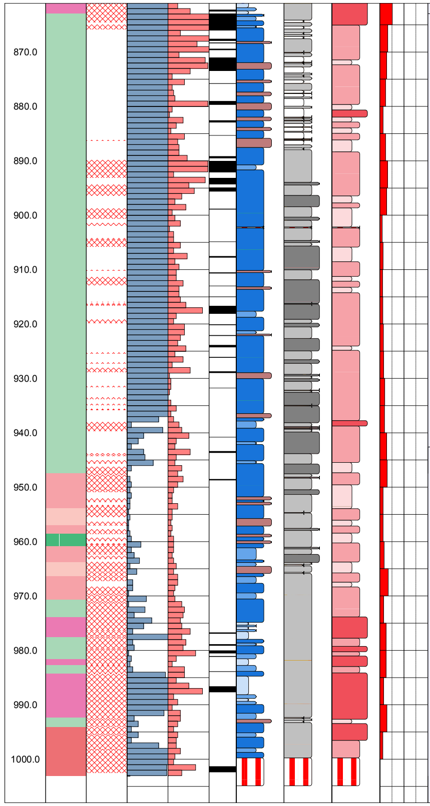
862.94



840.00

DZ1
840-900 m. Increased number of crush zones. The deformation zone is characterized by an inhomogeneous brittle-cataclastic deformation. The focused resistivity (300) is markedly low along the





862.94

862.94

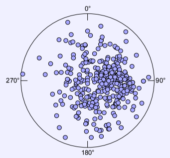
RU5
Totally dominated by fine-grained dioritoid. Subordinate rock types include fine-grained granite and pegmatite. This rock unit is characterized by an inhomogeneous brittle overprinting (increased amount of sections with crush and low magnetic susceptibility). The silicate density is mainly in the range of 2800-2890 kg/m3, with minor sections of higher density. Confidence: 3.

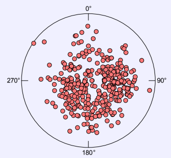
947.46

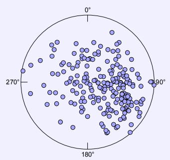
947.46

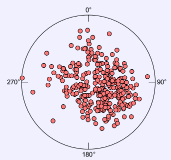
RU6
Inhomogeneous mixture of Ävrö granite, quartz monzodiorite, fine-grained dioritoid, fine-grained granite and fine-grained diorite to gabbro. This rock unit is characterized by an inhomogeneous brittle overprinting (increased amount of sections with crush). There are large variation in the silicate density, which indicates varying mineral composition, and there is a long section (c. 975-995m) characterized by high natural gamma radiation. Confidence: 3.

1003.10



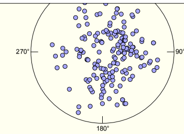


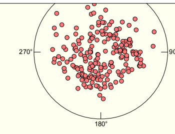




section c. 860-900 m, but no other geophysical logging methods indicate significant anomalies. Radar reflector occurs at 852 m with the orientation 25/180 and intersection angle 65º to borehole axis, at 859.3 m with an intersection angle of 67º to borehole axis, and at 873.5 m with the orientation 30/180 and intersection angle 55º to borehole axis. Confidence: 3.

900.00





Geological single-hole interpretation of KAV04B

Appendix 2

Title	SINGLE HOLE INTERPRETATION KAV04B					
Site	ÄVRÖ	Inclination [°]	-89.83	Elevation [m.a.s.l.]	10.35	Signed data
Borehole	KAV04B	Date of mapping	2004-08-13 11:36:00	Drilling Start Date	2004-05-12 07:20:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2004-05-18 07:31:00	
Length [m]	101.030	Northing [m]	6366795.64	Surveying Date		
Bearing [°]	134.27	Easting [m]	1552474.47	Plot Date	2006-07-13 21:14:56	

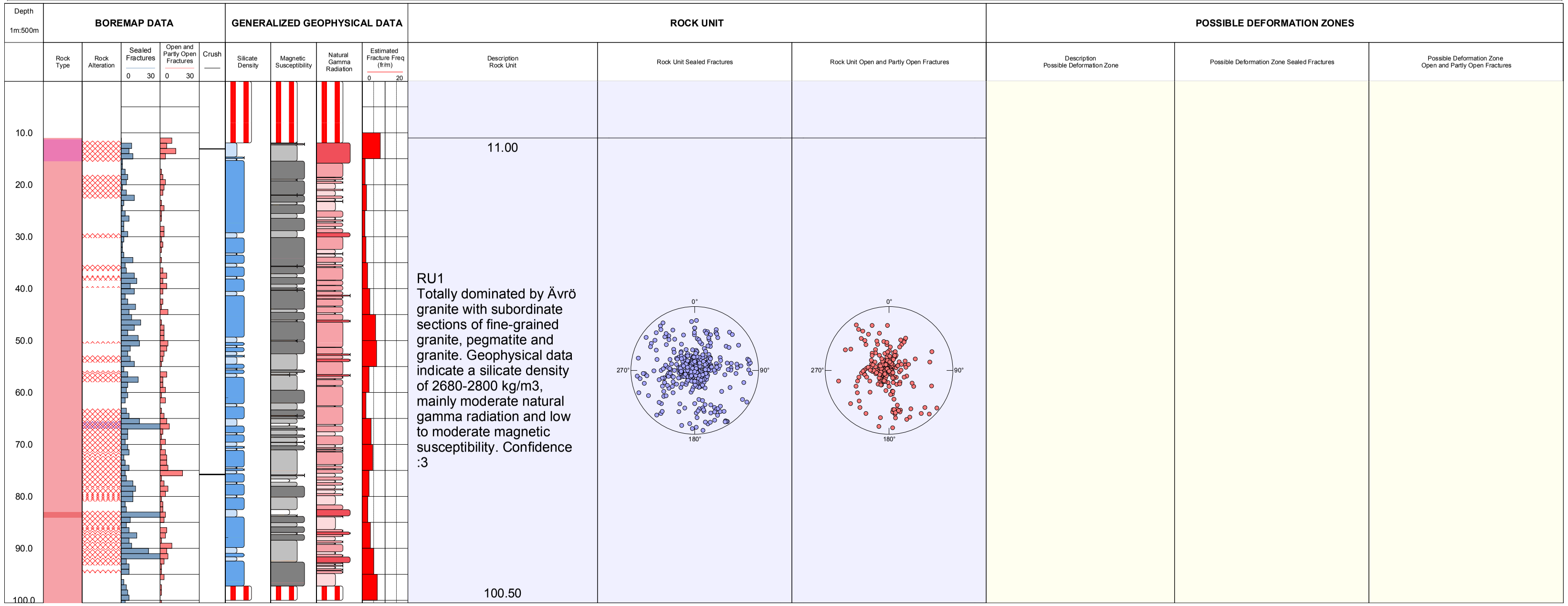
ROCKTYPE ÄVRÖ
- Fine-grained granite
- Granite
- Ävrö granite

ROCK ALTERATION
- Oxidized
- Quartz dissolution

SILICATE DENSITY
- unclassified
- dens<2680 (Granite)
- 2680<dens<2730 (Granodiorite)

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

NATURAL GAMMA
- unclassified
- gam<20
- 20<gam<30
- gam>30



Geological single-hole interpretation of KLX01

Appendix 3

Title	SINGLE HOLE INTERPRETATION KLX01					
Site	LAXEMAR	Inclination [°]	-85.29	Elevation [m.a.s.l.]	16.77	Signed data
Borehole	KLX01	Date of mapping	2004-06-01 15:56:00	Drilling Start Date	1987-12-05 00:00:00	
Diameter [mm]	56	Coordinate System	RT90-RHB70	Drilling Stop Date	1990-08-04 00:00:00	
Length [m]	1077.990	Northing [m]	6367485.52	Surveying Date		
Bearing [°]	346.73	Easting [m]	1549923.09	Plot Date	2006-07-13 21:14:56	

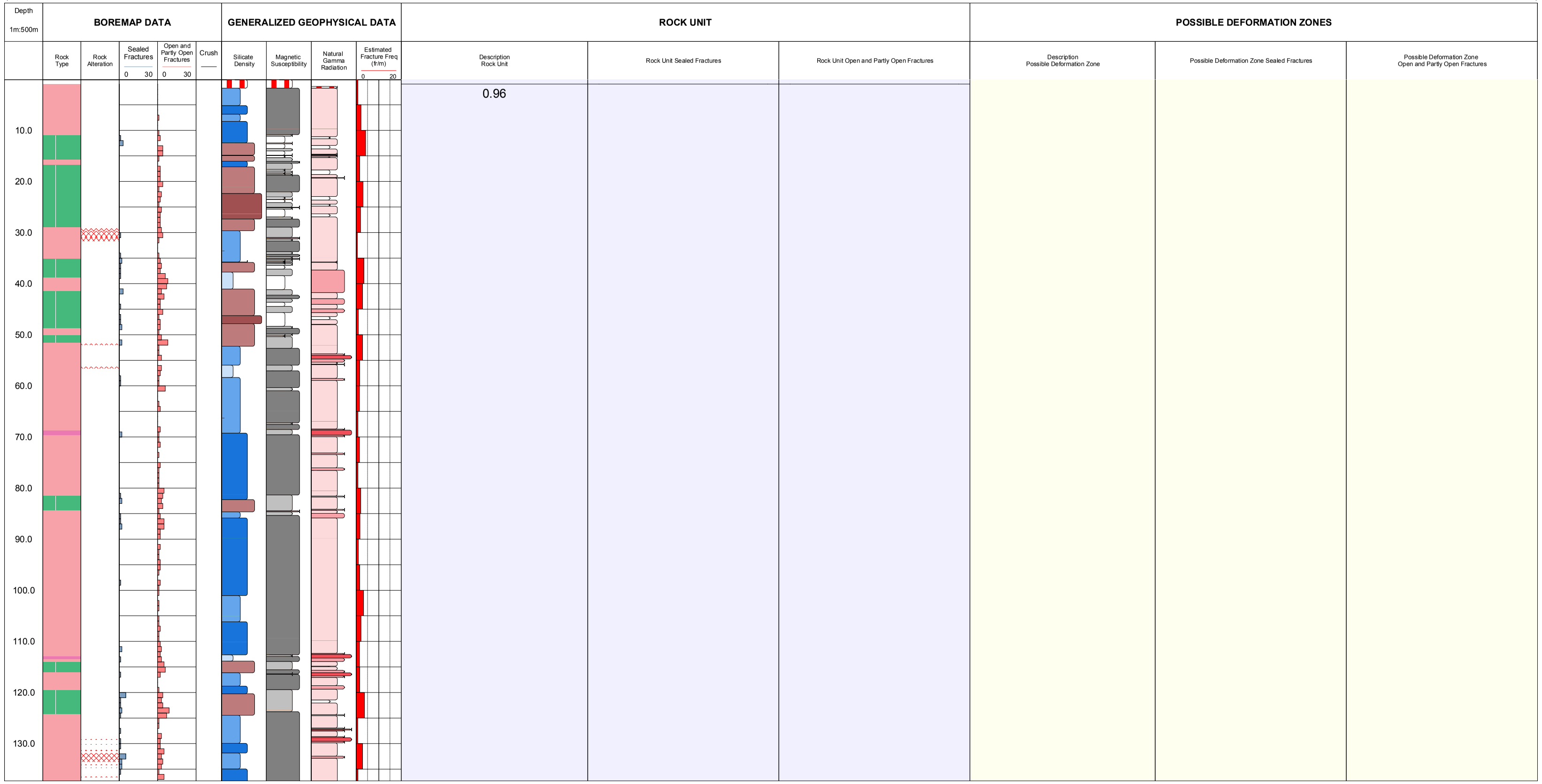
ROCKTYPE LAXEMAR
- Fine-grained granite
- Pegmatite
- Ävrö granite
- Diorite / Gabbro
- Fine-grained diorite-gabbro

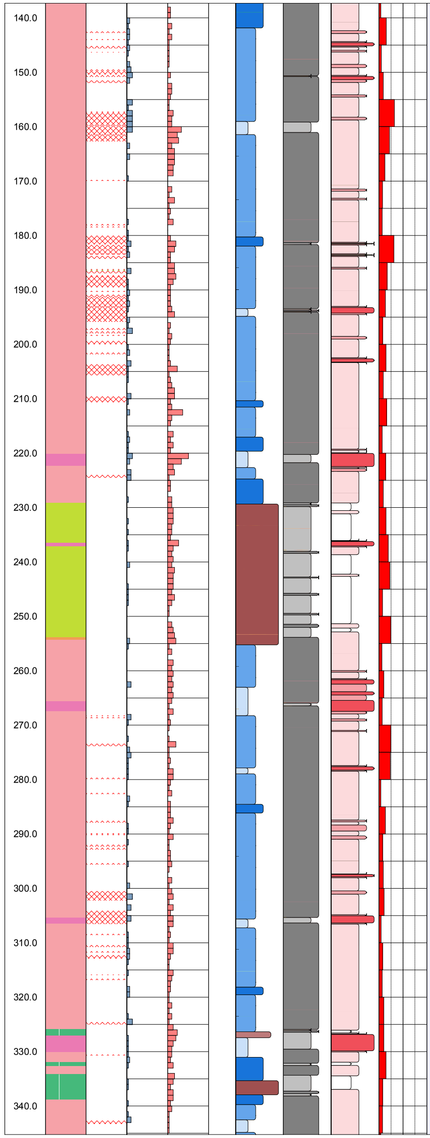
ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized
- Sericitisized

SILICATE DENSITY
- unclassified
- dens<2680
- 2680<dens<2730
- 2730<dens<2800
- 2800<dens<2890
- dens>2890

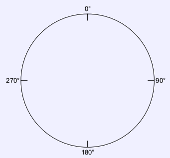
SUSCEPTIBILITET
- unclassified
- sus<0.001
- 0.001<sus<0.01
- 0.01<sus<0.1

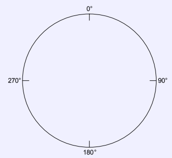
NATURAL GAMMA
- unclassified
- gam<10
- 10<gam<20
- 20<gam<30
- gam>30



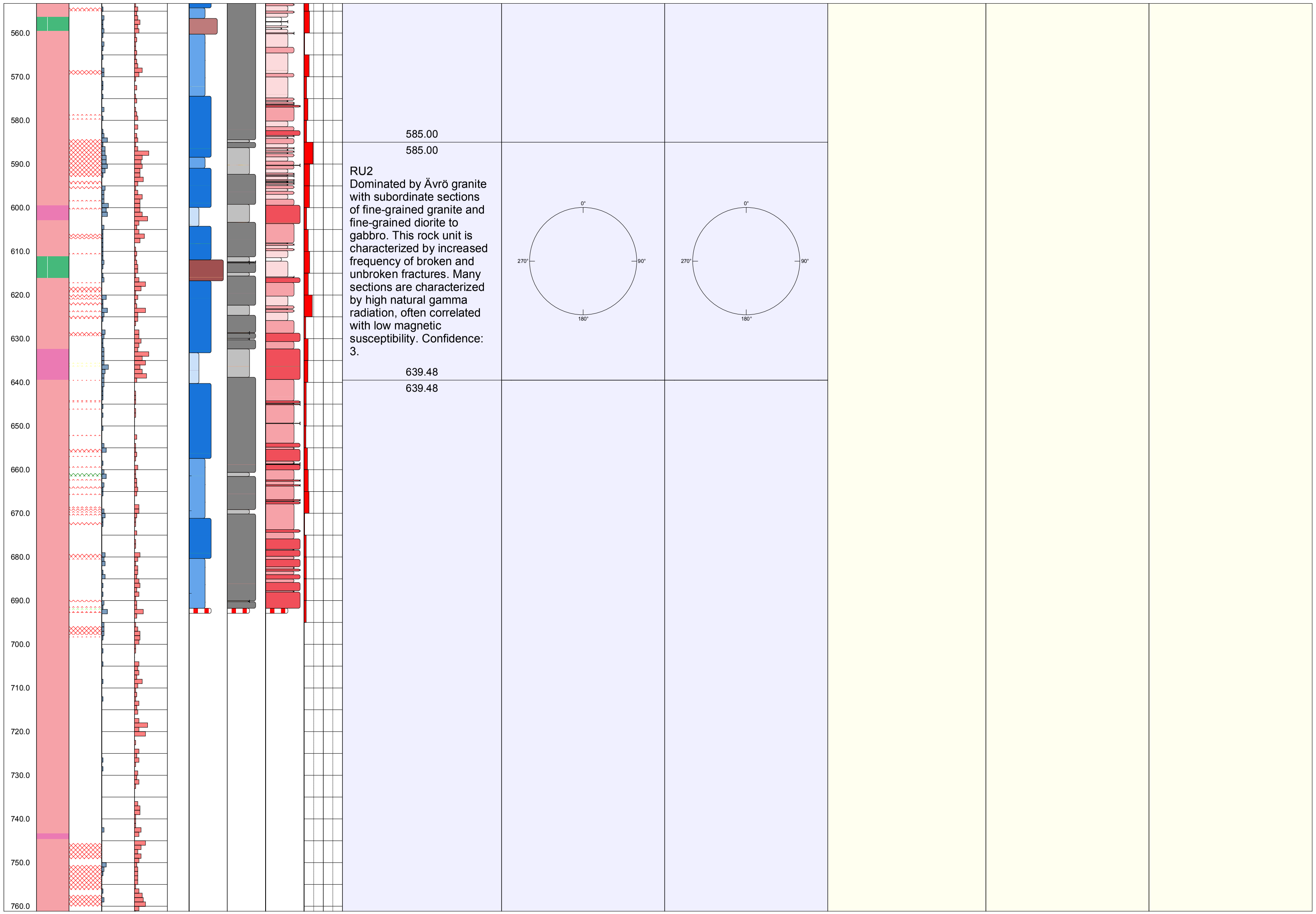


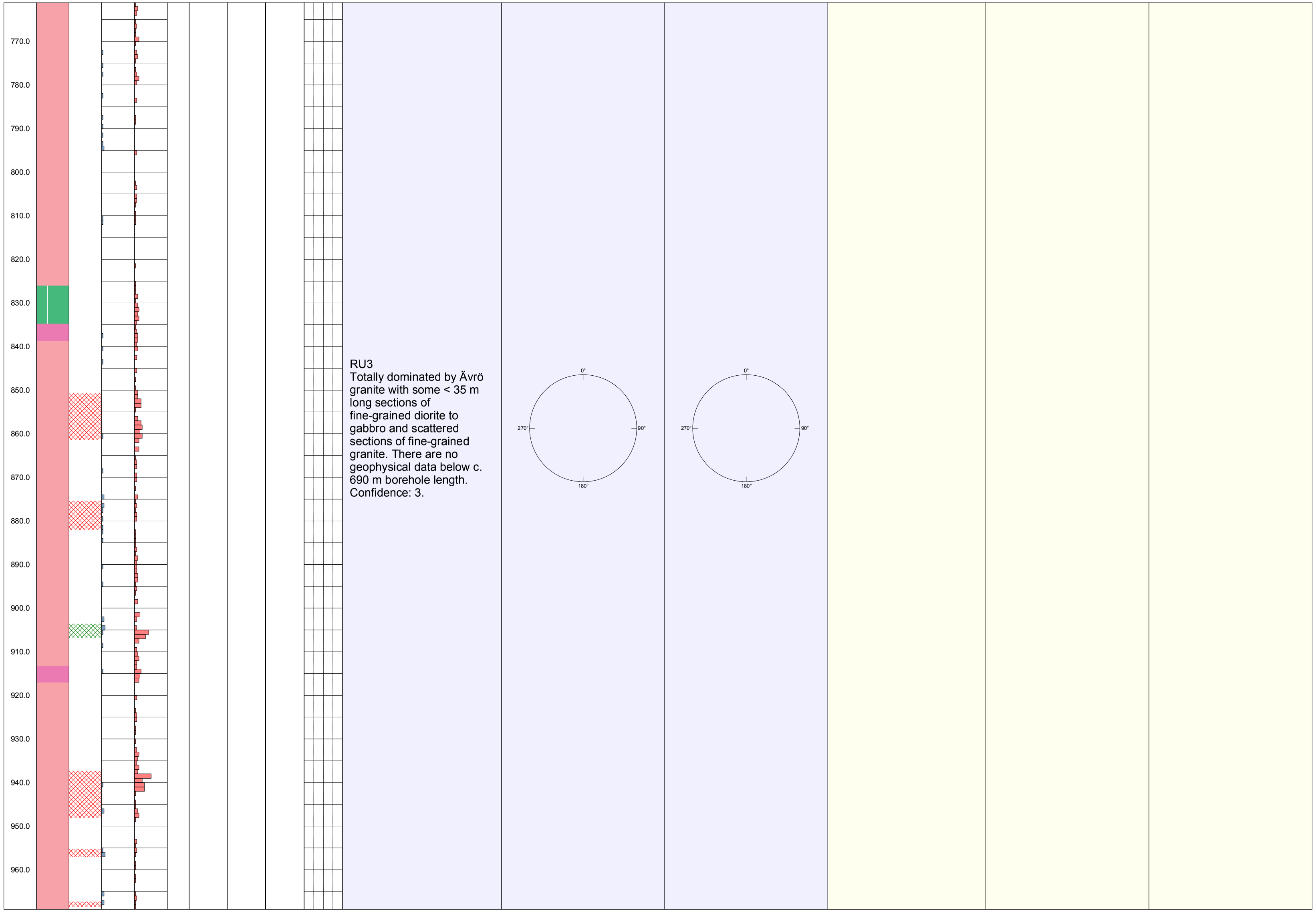
RU1
Totally dominated by Ävrö granite with subordinate sections of fine-grained diorite to gabbro, fine-grained granite, diorite to gabbro, granite and certain sections of pegmatite. There are large variations in the silicate density. Sections with fine-grained mafic rock generally correspond to high silicate density, low natural gamma radiation and also markedly low magnetic susceptibility. Confidence :3.

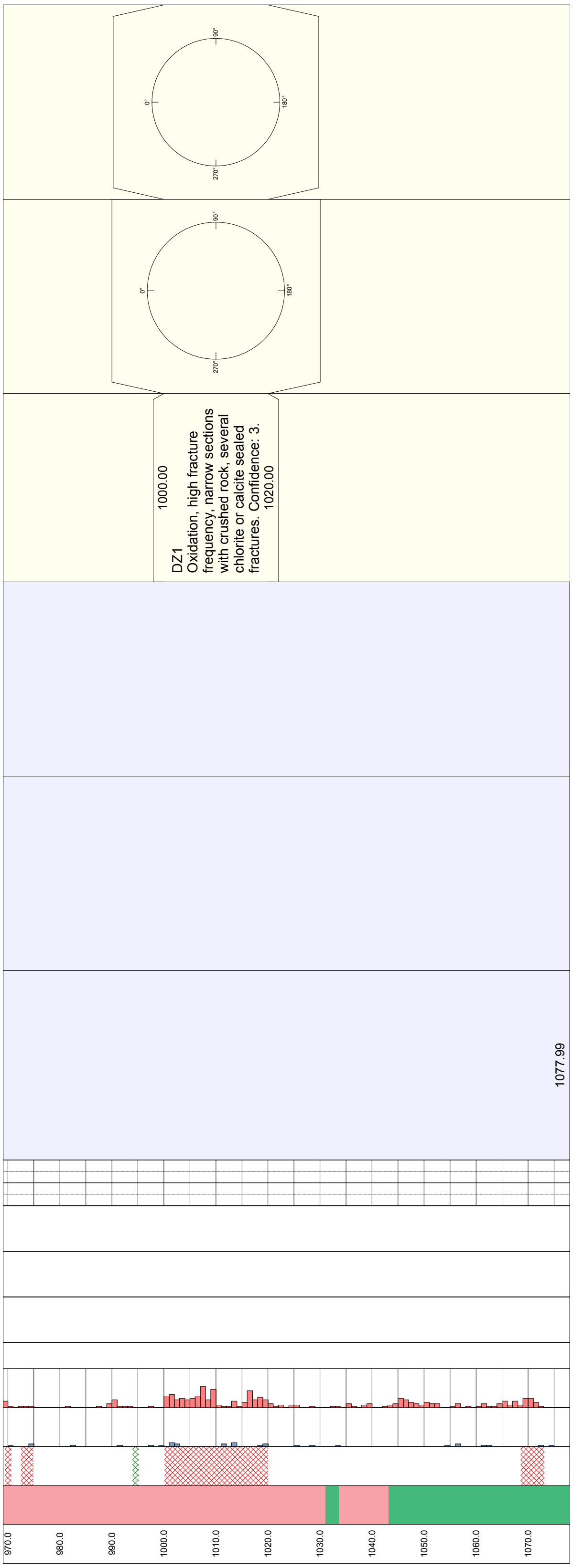





350.0
360.0
370.0
380.0
390.0
400.0
410.0
420.0
430.0
440.0
450.0
460.0
470.0
480.0
490.0
500.0
510.0
520.0
530.0
540.0
550.0


560.0
570.0
580.0
590.0
600.0
610.0
620.0
630.0
640.0
650.0
660.0
670.0
680.0
690.0
700.0
710.0
720.0
730.0
740.0
750.0
760.0
585.00
585.00
RU2
Dominated by Ävrö granite with subordinate sections of fine-grained granite and fine-grained diorite to gabbro. This rock unit is characterized by increased frequency of broken and unbroken fractures. Many sections are characterized by high natural gamma radiation, often correlated with low magnetic susceptibility. Confidence: 3.
639.48
639.48


770.0
780.0
790.0
800.0
810.0
820.0
830.0
840.0
850.0
860.0
870.0
880.0
890.0
900.0
910.0
920.0
930.0
940.0
950.0
960.0
RU3
Totally dominated by Ävrö granite with some < 35 m long sections of fine-grained diorite to gabbro and scattered sections of fine-grained granite. There are no geophysical data below c. 690 m borehole length. Confidence: 3.
0°
90°
180°
270°
0°
90°
180°
270°


0°
90°
180°
270°
0°
90°
180°
270°
1000.00
DZ1
Oxidation, high fracture frequency, narrow sections with crushed rock, several chlorite or calcite sealed fractures. Confidence: 3.
1020.00
1077.99
970.0
980.0
990.0
1000.0
1010.0
1020.0
1030.0
1040.0
1050.0
1060.0
1070.0