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Oskarshamn site investigation

Simplified Boremap mapping of percussion boreholes HAV11, HAV12 and HAV13

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December 2005

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Abstract

Simplified Boremap mapping has been performed for percussion boreholes HAV11, HAV12 and HAV13 situated on the island Ävrö, in the north eastern part of the Simpevarp sub area at the site investigation Oskarshamn, Sweden.

The purpose of the activity reported here is to map the lithology and structural parameters in the percussion boreholes based on results from drilling in conjunction with digital BIPS-images (Borehole Image Processing System) of the borehole walls.

The dominating rock type of borehole HAV11 is quartz monzodiorite (approximately 73%), with minor amount of Ävrö granite, all cut by mainly thin dykes of fine-grained granite and granite (medium- to coarse-grained). HAV12 consists of Ävrö granite (approximately 51%) and fine-grained granite (approximately 42%) with minor amounts of fine-grained diorite-gabbro. HAV13 is dominated by Ävrö granite (approximately 97%) cut by minor dikes of fine-grained granite, but the mapping is uncertain because of poor visibility in the BIPS-image.

Alteration occurs mainly in the form of red staining (oxidation) in boreholes HAV11 and HAV12, while no alteration could be mapped in HAV13 because of poor visibility in the BIPS-image. HAV11 and HAV13 show more fractured rocks than HAV12. Water yielding zones occur in all three boreholes.

The present report comprises a description of the applied equipment and the performed activities, the observations, data delivery together with a presentation and discussion of the results.

Sammanfattning

Förenklad Boremap-kartering är utförd på hammarborrhål HAV11, HAV12 och HAV13 på Ävrö i nordöstra delen av Simpevarpsområdet, vid platsundersökningen Oskarshamn.

Syftet med aktiviteten som rapporteras här är att kartera litologiska och strukturella parametrar i hammarborrhålen baserad på resultaten från borrningen i förbindelse med digitala BIPS-bilder (Borehole Image Processing System) av borrhålsväggarna.

Den dominerande bergarten i borrhål HAV11 är kvartsmonzodiorit (ca 73 %), mindre mängder av Ävrögranit förekommer, allt klipps av i huvudsak tunna gångar bestående av finkornig granit och granit (medel- till grovkornig). HAV12 består av Ävrögranit (ca 51 %) och finkornig granit (ca 42 %) samt mindre mängder av finkornig diorit-gabbro. HAV13 domineras av Ävrögranit (ca 97 %) klippt av mindre mängder av finkornig granit, men karteringen är osäker på grund av dålig sikt i BIPS-bild.

Omvandling förekommer som rödfärgning (oxidering) i borrhål HAV11 och HAV12, medan ingen omvandling kunde karteras i borrhål HAV13 på grund av dålig sikt i BIPS-bilden. Borrhål HAV11 och HAV13 uppvisar starkare uppsprucket berg än HAV12. Vattenförande zoner förekommer i alla tre borrhålen.

Denna rapport beskriver använd utrustning och genomförd aktivitet, observationer, leverans av data samt en presentation och diskussion av resultaten.

Contents

1 Introduction

To investigate lineaments in the Simpevarp sub area of the Oskarshamn site investigation, see Figure 1-1, seven percussion boreholes were drilled in 2004: HSH04, HSH05, HSH06, HAV11, HAV12, HAV13 and HAV14 /2/.

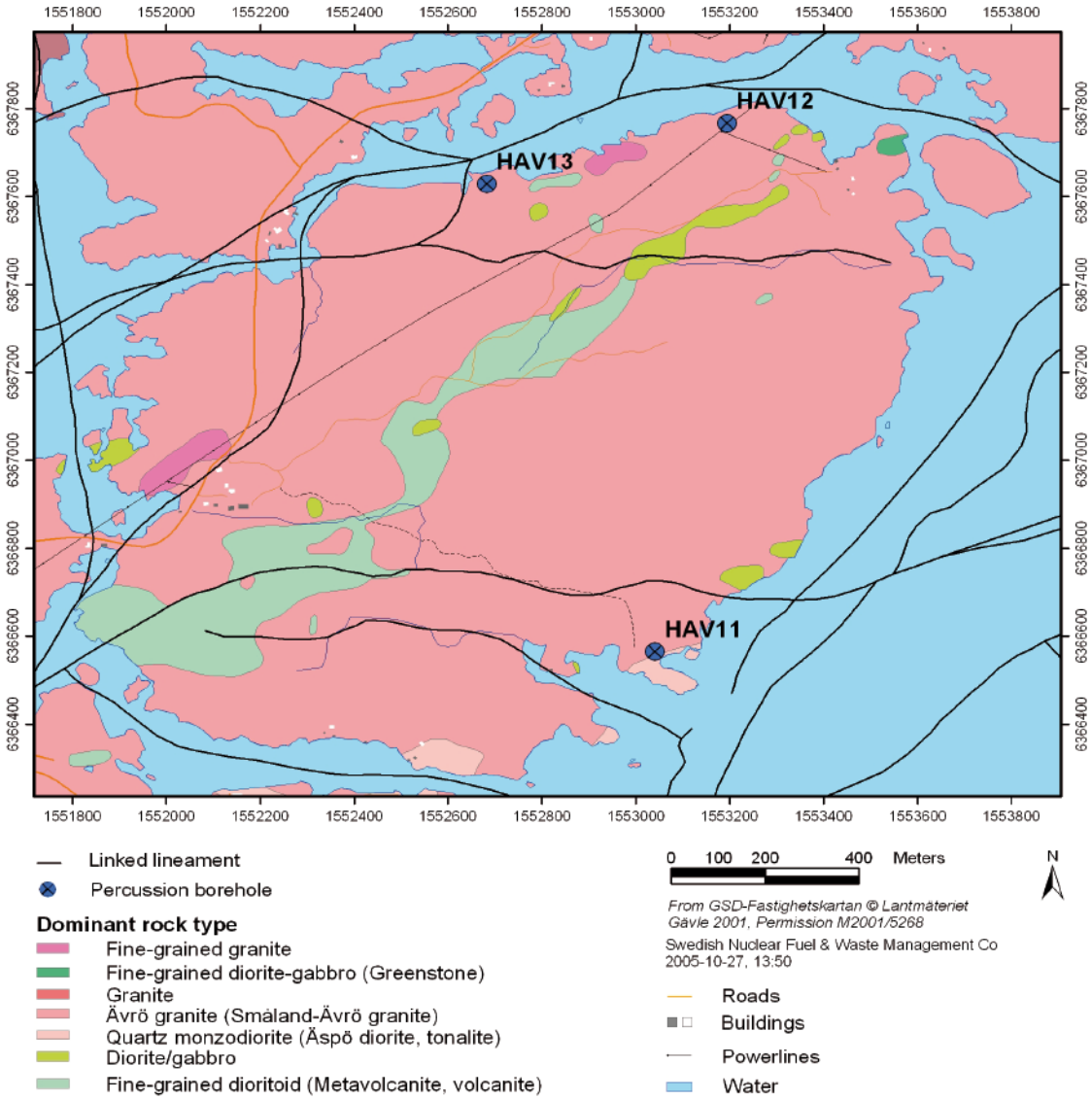


Figure 1-1. *Location of boreholes HAV11, HAV12 and HAV13 on Ävrö in the Simpevarp sub area. The map shows the bedrock geology, linked lineaments, power lines, roads and houses.*

This document reports data gained by Simplified Boremap mapping of percussion boreholes HAV11, HAV12 and HAV13 during the beginning of 2005. Boreholes HSH04, HSH05, HSH06 and HAV14 are not included in this report since no BIPS-images were made of those boreholes. The work was carried out in accordance with activity plan AP PS 400-04-030. Table 1-1 lists the controlling documents for performing this activity. Both activity plan and method description are SKB internal controlling documents.

After completing a percussion borehole it is logged with a colour TV-camera to produce images of the borehole wall called a BIPS-image (Borehole Image Processing System) /1/. Mapping of the percussion borehole is then done according to the Simplified Boremap method, in accordance with method description SKB MD 143.006 (SKB internal document). Using the preliminary mapping of drill cuttings /2/ for comparison (see Chapter 4.1), the Simplified Boremap mapping is based on the BIPS-image where both petrography (rock types, rock occurrences and alteration) and structures (open fractures, crush zones and ductile deformation) of the bedrock that the borehole cuts through can be determined. In addition the mapping software (Boremap) calculates the orientation (strike and dip) of each marked planar feature.

All data were stored in the primary data base SICADA for Oskarshamn and are traceable by the activity plan number.

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

Activity plans	**Number**	**Version**
Översiktlig kartering av hammarborrhål för lineamentkontroll, Simpevarp, 2004	AP PS 400-04-030	1.0
Method description	**Number**	**Version**
Metodbeskrivning för Boremap-kartering	SKB MD 143.006	1.0

2 Objective and scope

The purpose of this survey is to map the lithology and structural parameters of percussion boreholes HAV11, HAV12 and HAV13 in greater detail than the preliminary mapping of drill cuttings and results of measurements made while drilling the percussion holes, by using the Simplified Boremap mapping method.

The mapped parameters of the Simplified Boremap mapping are:

- Rock types (> 1 m wide).
- Rock occurrences (> 0.2 to < 1 m wide).
- Rock contacts.
- Alteration (mainly the intensity of red coloured oxidation).
- Open fractures (including crush zones).
- Ductile structures (e.g. foliation, shear zones etc).

3 Equipment

3.1 Description of equipment/interpretation tools

Mapping of BIPS-images according to the Simplified Boremap method is done on desktop computer using the software Boremap (version 3.4.5), which shows the BIPS-image as can be seen in Figure 3-1. Boremap is loaded with SKB rock and mineral standard.

The accuracy of the Simplified Boremap mapping depends on several parameters.

- The clarity of the borehole water (i.e. the amount of material in suspension).
- The condition of the borehole walls (e.g. the amount of sedimentation on the borehole wall).
- The quality of the BIPS-image (i.e. the technical limitations of the image).

The BIPS-image quality varies /1/; the borehole walls of HAV11 are dark with poor visibility down to approximately 16 m, where the visibility is more or less good till the end of the hole. At approximately 123 m dirt can be seen at the bottom of the borehole and it covers from 10–50% of the borehole wall to the end of the hole.

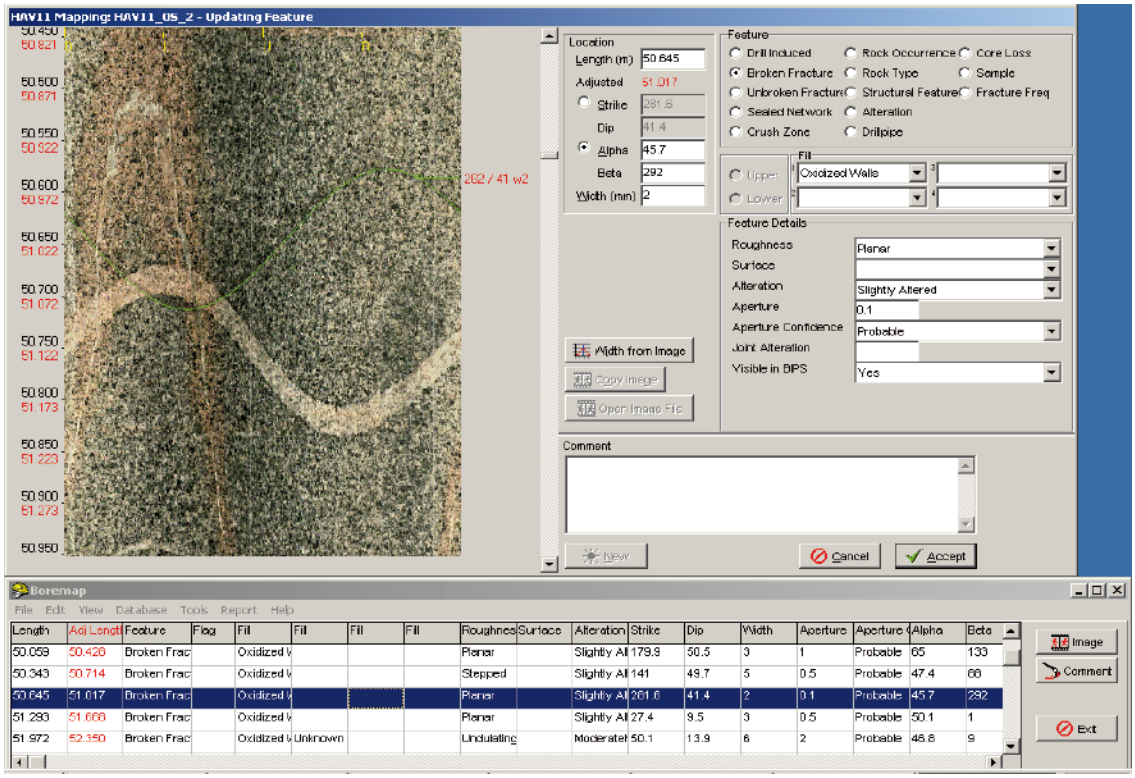


Figure 3-1. *Good quality BIPS-image as it is seen in Boremap. Borehole HAV11, showing unaltered (fresh), medium to coarse grained, massive Quartz monzodiorite with one open fracture marked (green line), as well as filled fracture with oxidized walls and fine-grained granite dike, neither of which are mapped with the Simplified Boremap mapping method (unmarked).*

HAV12 is of good quality /1/ from 11.2 m (adjusted length) until the end of BIPS-image at approximately 157.5 m. From bottom of casing at 6 m to 11.2 m the borehole walls are above groundwater level and therefore glitter in the BIPS-camera light, so the possibility of recognizing alteration and rock type is very limited, even open fractures are difficult to discern, see Figure 3-2 and Figure 4-1.

The BIPS-image of borehole HLX13 is of poor quality /1/ resulting in poor quality mapping, no alteration could be mapped and mapping of rock occurrence is uncertain. From bottom of casing at 9.1 m to approximately 15 m the borehole walls are very dark with light coloured mud on the bottom. Between approximately 15–27 m the visibility is a little better but still poor, rock types can be decided but not alteration, mud covers 50% or more of the borehole walls. From approximately 27 m to 62.7 m the visibility is poor and between 62.7–65.5 m there is no visibility at all because of mud in suspension. From 65.5 m to 68.1 m the visibility is very poor, and between 68.1–68.5 there is no visibility. Between 68.5–93.6 m there is very poor visibility and 93.6–140.8 m (end of BIPS-image) the visibility is very low to none, see Figure 3-3.

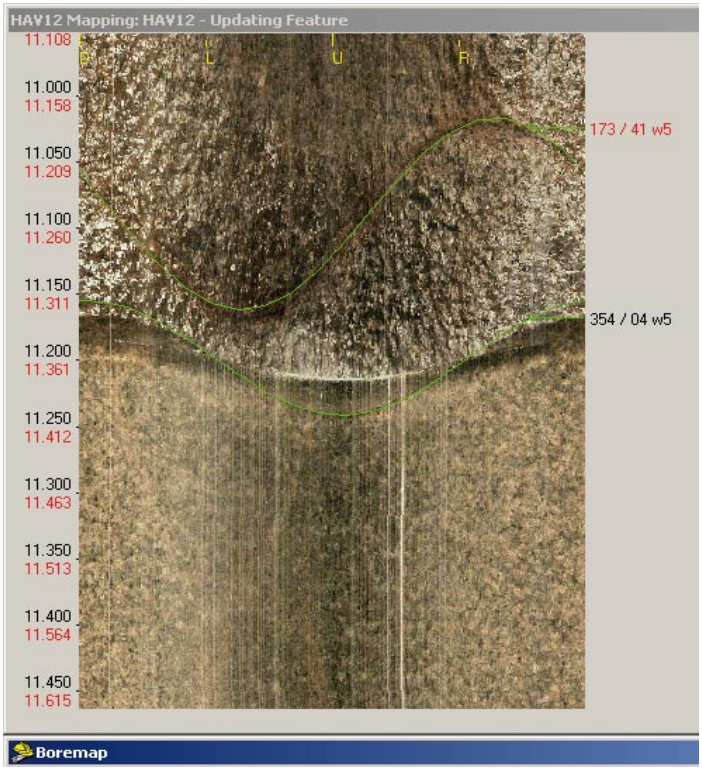


Figure 3-2. *BIPS-image as it is seen in Boremap. Borehole HAV12, showing the groundwater surface at approximately 11.4 m (adjusted length) and the sharp difference in visibility of the Ävrö granite in the borehole walls. Two open fractures are marked with green lines.*

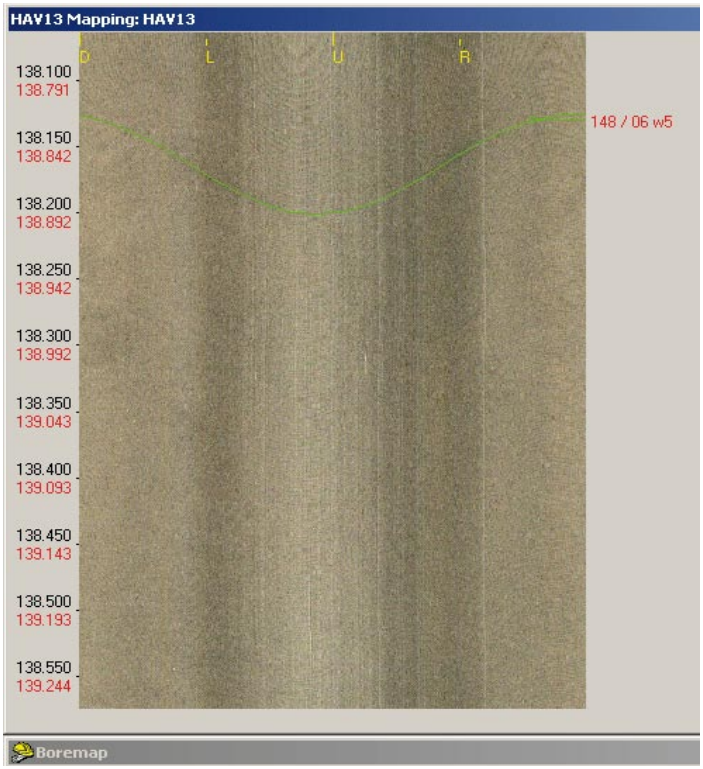


Figure 3-3. *BIPS-image as it is seen in Boremap. Borehole HAV13, showing the BIPS-image at 138.8–139.3 m adjusted length, with almost no visibility because of mud in suspension and on bottom of borehole wall, one possible (uncertain) open fracture marked (green line).*

4 Execution

4.1 General

Simplified Boremap mapping is comprised of data from:

- BIPS-image,
- preliminary mapping of drill cuttings /2/,
- results from percussion drilling /2/,
- available geophysical measurements and interpretations.

The BIPS-image is opened in Boremap where the observed appropriate parameters are marked and described. To increase the accuracy of the mapping comparisons are made with preliminary mapping of drill cuttings, drilling penetration rate and when available results from geophysical measurements.

4.2 Preparations

Data from the SKB database SICADA used for Simplified Boremap mapping are listed in Table 4-1. The length of the BIPS-image is adjusted from bottom of casing (Figure 4-1) to bottom of image according to a constant, the measured length registered in the BIPS-image deviates from the true length by a factor of approximately 0.5 m per 100 m and the last 0.3 m of the boreholes cannot be logged with BIPS.

The orientation of the borehole i.e. the azimuth and dip are the basis for calculating the strike and dip of the mapped planar structures. In this report the starting point of the borehole is used for the whole length as no measurements of borehole deviation have been made.

Table 4-1. Borehole data for HLX20 (values from top of casing). Data taken from SKB database SICADA and Boremap (adjusted length).

ID code	Northing	Easting	Bearing (°)	Inclination (°)	Dia-meter (mm)	Borehole length (m)	End of casing (m)	BIPS-image interval, adj length (m)
HAV11	6366565.254	1553040.898	113.471	–59.610	140	220.5	6.12	6.12–220.2
HAV12	6367765.872	1553194.416	0.274	–58.786	140	157.8	6.13	6.13–157.5
HAV13	6367627.858	1552682.157	0.077	–58.809	140	142.2	9.12	9.12–140.8

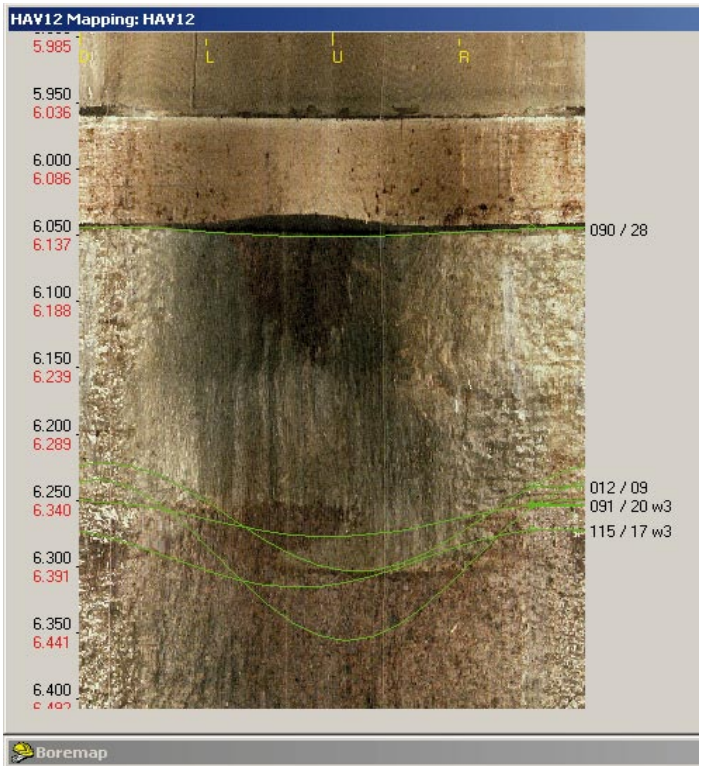


Figure 4-1. *BIPS-image as it is seen in Boremap. Borehole HAV12 showing the lowest part of casing pipe, some rests of concrete from the bottom plug and the borehole wall, which is above ground water level and therefore with very limited visibility of the borehole wall. Bottom of casing pipe is according to measured length 6.043 m while adjusted length is 6.130 m (from SICADA). Green lines mark rock type, alteration and possible (uncertain) open fractures respectively (from top to bottom of image).*

4.3 Execution of field work

BIPS-images make it possible to map features in percussion boreholes that are not discernible using rock cuttings and/or geophysical measurements. Planar structures such as open fractures, rock contacts, and deformational structures can be mapped accurately.

Below is a list of the parameters that are mapped with a short description and explanations for the WellCAD representation in Appendix 1–3:

- Lithology. Rock contacts, rock types (> 1 m wide) and rock occurrences (> 0.2 to < 1 m wide).
  - The lithological classification is sometimes difficult in the drill cuttings because of small fragment size of drill cuttings and the sometimes strong red oxidation of the rock, but usually not a problem when drill cuttings and BIPS-image can be compared.
  - Rock structure, texture and grain size is easily discerned in good quality BIPS-images, especially in medium to coarse grained rocks, while finer grained rocks often need to be seen in the drill cuttings. The WellCAD presentation shows these parameters for the rock types only, although they are also mapped for the rock occurrences.
  - Sharp rock contacts are easily mapped, but diffuse and undulating contacts of e.g. veins are often approximations. Rock contacts are shown as horizontal lines in the Well CAD presentations, regardless of their true orientation.

- Alteration and alteration intensity.
  - The only rock alteration that is mapped with some certainty in good quality BIPS-images are the red colouring of the rock (oxidation) and its intensity. Other alterations are normally difficult to identify in the BIPS-image, but can sometimes be recognized in the drill cuttings.
- Open fractures and crush zones.
  - Only fractures that show apertures in the BIPS-image are mapped. Their apparent aperture is measured in the image, if a fracture is less than 1 mm wide it is assigned an aperture of 0.5 mm (Open Fracture Aperture).
  - Roughness of open fractures is determined as planar, undulating or stepped and represented as coloured lines (Open Fracture Roughness).
  - The alteration intensity of open fractures are determined and represented as coloured dots (Open Fracture Alteration) in the WellCAD presentation. The strike and dip of each fracture is represented with the coloured dot marking the dip (0–90°) and a short line pointing to the direction (0–360°).
  - The number of open fractures is calculated by the software for each metre and represented in the column Open Fracture Frequency (fr/m).
  - Crush zones are also mapped from the BIPS-image, the average size of fragments is measured in mm (Natural Piece Size) and the alteration intensity is decided. The colouring is the same as the Open Fracture Alteration in the WellCAD representation. Two interpreted main fracture directions are also marked within each crush zone.

4.4 Data handling

The Simplified Boremap mapping of the percussion boreholes is performed on a local computer disk at the core storage facility and saved on back-up in SKB internal network. When a borehole has been mapped the file is quality checked by the author and by a computer routine in Boremap. The data is then submitted to SKB for exportation to SICADA.

4.5 Nonconformities

No formal nonconformities have been registered during the activity. The boreholes HSH04, HSH05, HSH06 and HAV14 where also drilled in the same period /2/ but are not included in this report since no BIPS-images were made of those boreholes. The BIPS-image of borehole HAV11 is dark with poor visibility down to approximately 16 m. In the upper part of borehole HAV12 from end of casing at 6.12 m to 11.2 m (adjusted length), see Figure 3-2, the BIPS-image is above ground water level and therefore of low quality, which results in greater uncertainties of the Boremap mapping. Because of the poor visibility in borehole HAV13 no alteration was mapped at all. From approximately 62.8 m until the end of BIPS-image at approximately 140.8 m the visibility varies from very poor to none at all, so the mapping there is of very limited quality.

5 Results

Below the results from mapping of lithology, alteration and open fractures are given for boreholes HAV11, HAV12 and HAV13. The percentages of different lithologies are given in Tables 5-1 to 5-3. The amount of alteration (oxidation) and intensity is listed in Table 5-4 and finally the number of open fractures and the fracture frequency per metre can be seen in Table 5-5.

HAV11

See Appendix 1 for WellCAD presentation of mapping results.

Lithology: The dominant rock type is quartz monzodiorite with some granite. Minor amounts of Ävrö granite occur also. Dykes and veins of fine-grained granite cut the rock types, see Figure 3-1. Small amounts of pegmatite and fine-grained diorite-gabbro occur also, see Table 5-1.

Table 5-1. Lithology of borehole HAV11. Percents calculated from adjusted length of BIPS-image.

Rock name	SKB rock code	%
Quartz monzodiorite	501036	72.6
Granite	501058	15.9
Ävrö granite	501044	5.3
Fine-grained granite	511058	5.1
Pegmatite	501061	0.7
Fine-grained diorite-gabbro	505102	0.3

Alteration: Approximately 90% of the rock shows some alteration (red staining/oxidation). Mostly weak, but medium intensity occurs also, see Table 5-4.

Open fractures: The number of mapped open fractures is 1,084, resulting in an average of 4.9 fractures per metre, see Table 5-5, with the highest frequency of open fractures between approximately 70–180 m. Water yield was measured at 21.9 m as approximately 2.5 l/min, it is not clear where the water comes in but a likely candidate is a crush zone that occurs between approximately 16.4–16.6 m, see Figure 5-1. Measurement at 145.2 m yields approximately 32 l/min, which is possibly due to a crush zone at 124.698–124.836 m (adjusted length) and/or open fractures at approximately 138.5 m (adjusted length). Next measurement is at 202.2 m yielding approximately 57 l/min, which is probably the result of open fracture at 200.2 m. The end measurement of water yield is approximately 116 l/min, which can be derived as probable influx from the crush zone at approximately 210 m (adjusted length).

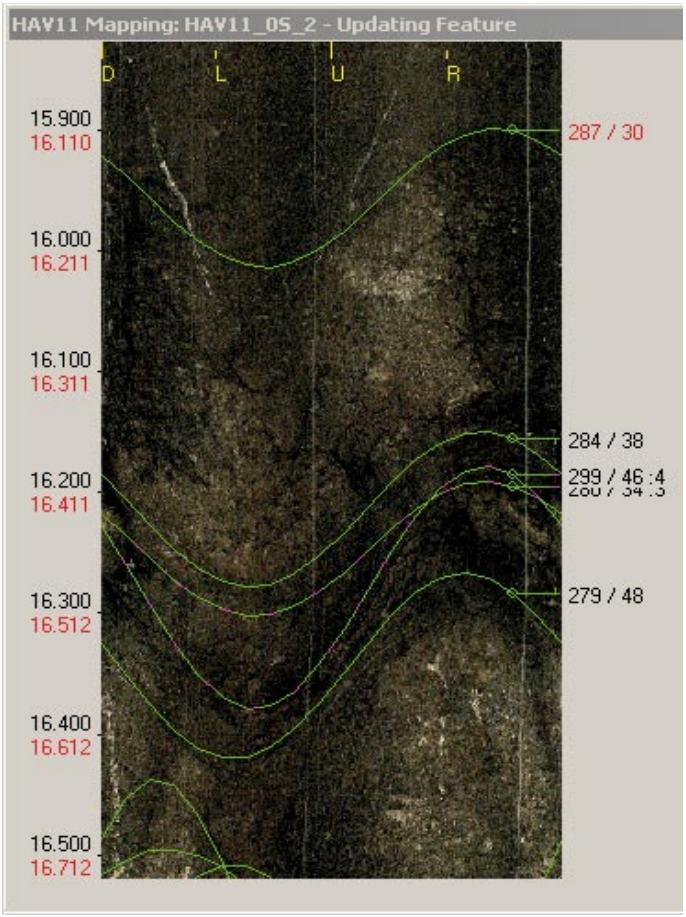


Figure 5-1. *BIPS-image as it is seen in Boremap. Borehole HAV11 showing dark borehole walls (low visibility). Contact between quartz monzodiorite at top and Ävrö granite (contact marked with green line 287/30) can be seen. Crush zone at 16.425–16.556 m (adjusted length) that is possibly water yielding (approximately 2.5 l/min) is also marked.*

Ductile structures: Four foliations are measured here, one of medium intensity and three of weak intensity, at approximately 82.7 m length striking ca 195° and dipping ca 81° to the west, approximately 111.3 m length striking ca 174° and dipping ca 71° to the west, approximately 113.3 m length striking ca 171° and dipping ca 88° to the west, and approximately 113.9 m length striking ca 190° and dipping ca 90°, see Table 5-6 and Figure 5-5.

HAV12

See Appendix 1 for WellCAD presentation of mapping results.

Lithology: The main rock type is Ävrö granite with considerable amounts of fine-grained granite. Minor enclaves of fine-grained diorite-gabbro occurs also as well as small amounts of pegmatite, see Table 5-2.

Table 5-2. Lithology of borehole HAV12. Percents calculated from adjusted length of BIPS-image.

Rock name	SKB rock code	%
Ävrö granite	501044	51.1
Fine-grained granite	511058	42.0
Fine-grained diorite-gabbro	505102	6.7
Pegmatite	501061	0.1

Alteration: Approximately 73% of the rock shows some alteration. Mostly weak oxidation (red staining), but medium intensity occurs also, see Table 5-4.

Open fractures: The number of mapped open fractures is 595, resulting in an average of 2.9 per metre, see Table 5-5. Water yield was measured at 44.9 m as approximately 1.5 l/min, most probably from open fractures at approximately 44.6 m (adjusted length), see Figure 5-2. Measurement at 112.2 m yields approximately 2.5 l/min, it is not clear where the water comes in but a possible candidate is an open fracture at 105.7 m (adjusted length). Next measurement is at 148.2 m yielding approximately 37.5 l/min, which is probably from many open fractures in fine-grained granite between approximately 146.7–148 m. The end measurement of water yield is approximately 75 l/min, which can not be connected to any specific open fractures.

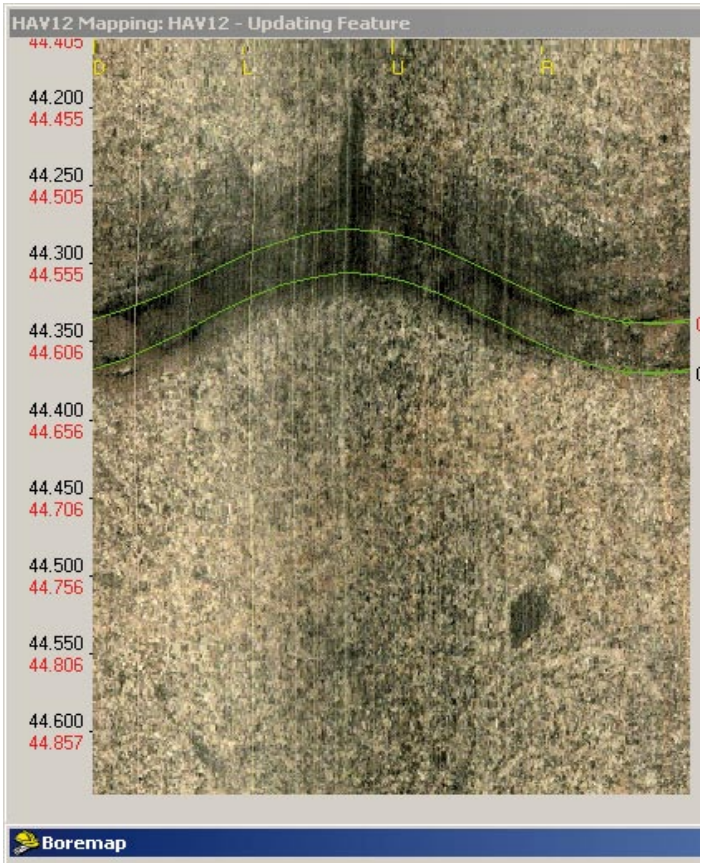


Figure 5-2. *BIPS-image as it is seen in Boremap. Borehole HAV12 showing weakly altered Ävrö granite with open fractures at 44.563 m (adjusted length) possibly water yielding, approximately 1.5 l/min.*

HAV13

See Appendix 1 for WellCAD presentation of mapping results.

Lithology: The mapping is uncertain because of bad visibility in BIPS-image, but the dominant rock type is Ävrö granite cut by minor dikes and/or veins of fine-grained granite, see Table 5-1 and Figure 5-3.

Table 5-3. Lithology of borehole HAV13. Percents calculated from adjusted length of BIPS-image.

Rock name	SKB rock code	%
Ävrö granite	501044	96.8
Fine-grained granite	511058	3.2

Alteration: No alteration is mapped in HAV13 because of the poor visibility in the BIPS-image. When there is no mud in suspension it covers much of the borehole walls and where the rock walls cat be seen it is not possible to see any difference in colour because the BIPS-image of the rock is so dark, see Figure 5-3 and Figure 5-4.

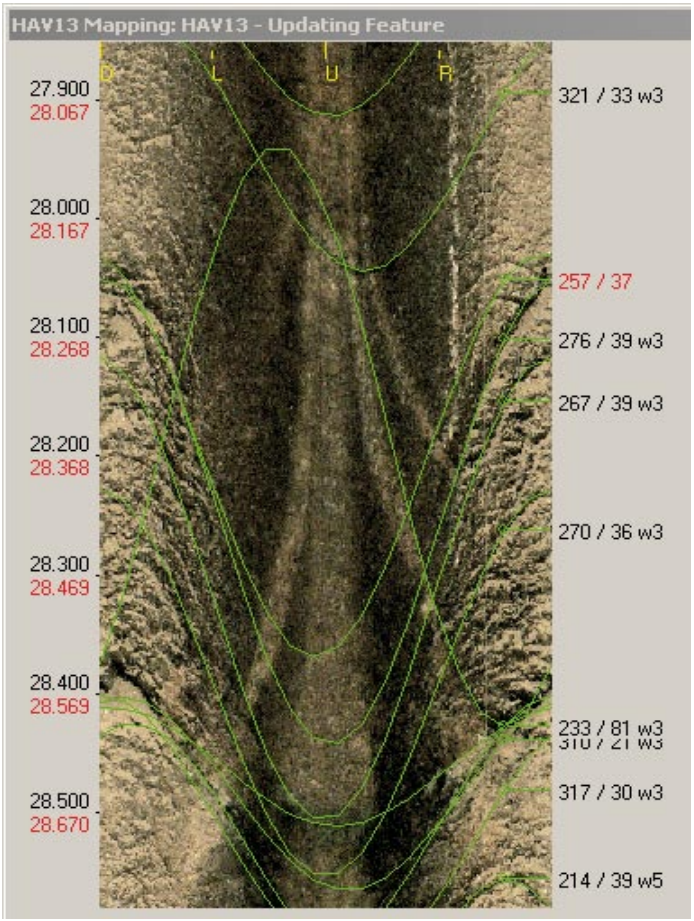


Figure 5-3. *BIPS-image as it is seen in Boremap. Borehole HAV13 showing Ävrö granite cut by fine-grained granite dyke. Image of rock is dark (very poor visibility). Light colored mud on bottom of borehole wall. Uncertain contact, rock occurrence inferred from pattern of fractures.*

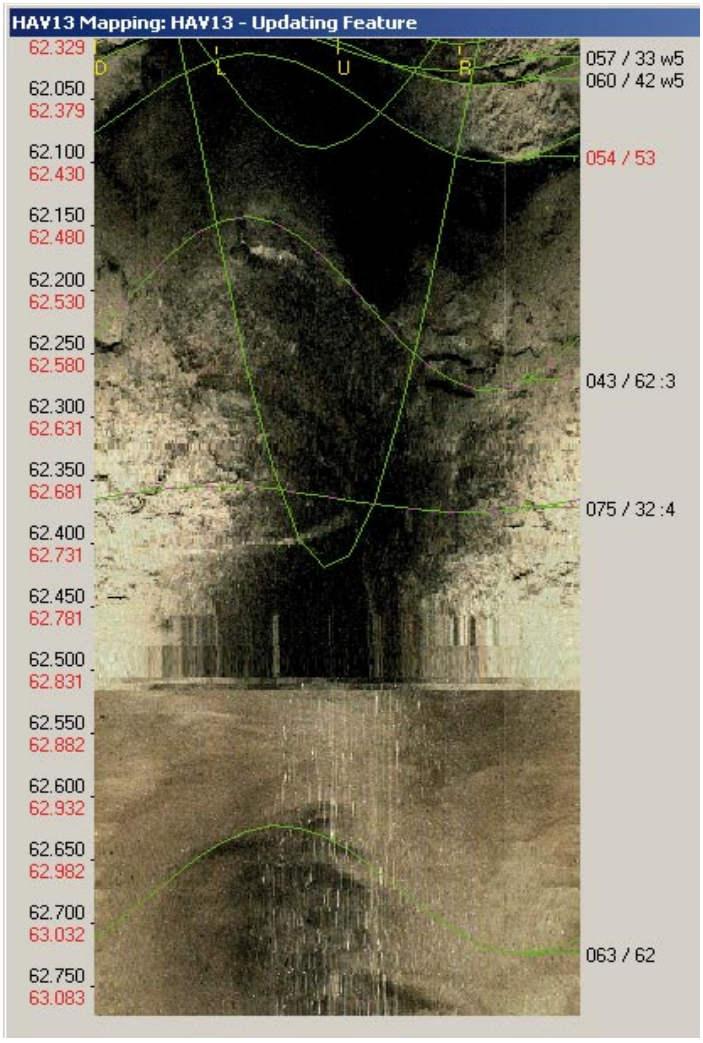


Figure 5-4. *BIPS-image as it is seen in Boremap. Borehole HAV13 showing crush zone at 62.385–63,006 (adjusted length). The image of rock is very dark (very poor visibility), partly because of light colored mud on bottom of borehole wall (covers > 50% of borehole wall). There is mud in suspension at bottom of crush zone making the lower end of the zone very uncertain, so width of crush zone is uncertain.*

Open fractures: Mapping of open fractures is also uncertain because of the poor visibility in the BIPS-image. The number of mapped open fractures is 968, resulting in an average of 6.8 per metre, see Table 5-5, with the highest frequency of open fractures between approximately 28–61 m and 70–93 m. Water yield was measured at 93.3 m as approximately 18 l/min, at 117.3 m as approximately 60 l/min, at 121.3 m as approximately 150 l/min and at 135 m as more than 200 l/min. The poor visibility of the BIPS-image makes the location of the water yielding open fractures very uncertain, see Figure 5-4. Two very uncertain crush zones are marked from the BIPS-image, at approximately 62.4 m and 93.9 m (adjusted length) and both are more or less covered by mud in suspension.

Table 5-4. Total alteration seen in BIPS-image of percussion boreholes HAV11, HAV12 and HAV13.

Alteration	Intensity	HAV11 (%)	HAV12 (%)	HAV13 (%)
Oxidation	Weak	60	63	Not mapped
	Medium	30	10	Not mapped

Table 5-5. Total number of open fractures in BIPS-image of percussion boreholes HAV11, HAV12 and HAV13.

Borehole ID	Total number of open fractures	Fractures/metre
HAV11	1,084	4.897
HAV12	595	2.933
HAV13	968	6.788

Table 5-6. Structural measurements in percussion boreholes HLX26 and HLX28.

Borehole	Length	Structure	Intensity	Strike	Dip
HAV11	82.669	Foliated	Medium	194.9	80.9
HAV11	111.313	Foliated	Weak	174.4	71.0
HAV11	113.343	Foliated	Weak	171.1	87.9
HAV11	113.912	Foliated	Weak	189.6	89.8

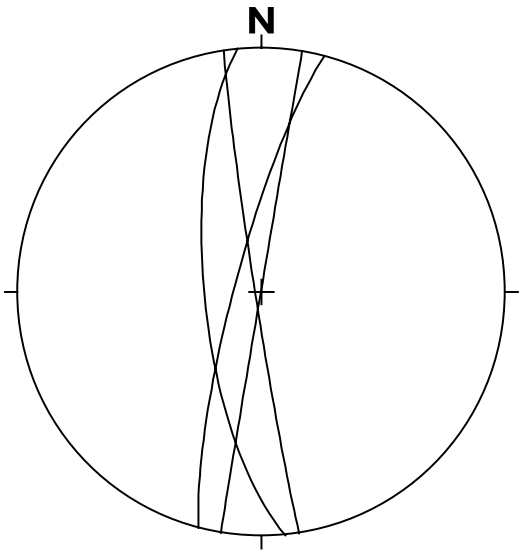


Figure 5-5. *Stereogram showing structural measurements (foliations) from borehole HAV11 as foliation planes.*

6 Summary and discussions

The lithology dominating the BIPS-image of borehole HAV11 is quartz monzodiorite, while both HAV12 and HAV13 are dominated by Ävrö granite. The borehole HAV11 is drilled towards the southeast from the southern coast of the island Ävrö and verifies that the quartz monzodiorite domination of the southern part of the Simpevarp area continues. Both HAV12 and HAV13 are drilled towards the north from the northern coast of the island Ävrö in an area dominated by the Ävrö granite.

Both HAV11 and HAV13 show fractured rock and although the visibility in the BIPS-image of HAV13 is very poor, the open fracture mapping is considered to be of acceptable quality. HAV12 shows the highest fracture frequency between approximately 45 m to approximately 90 m. HAV13 shows fractured rock from the beginning, with possible crush zones at ca 60 and 95 m lengths. Borehole HAV11 shows increase of fracture frequency from approximately 60 m until approximately 180 m, a trend of gradually decreasing dip can be seen with increased length in the WellCAD diagram.

Water yielding zones occur in all three boreholes resulting in premature stopping of drilling in all cases. The existence of water yielding open fracture zones does not proof the existence of a deformational zone, but it suggests one possible explanation of the linked lineament at the point of intersection with the borehole.

No deviation measurements were conducted for HAV11, HAV12 and HAV13 so the measurements from top of casing are used for the entire length of the borehole.

The parameters not represented in the WellCAD representations are either uncommon or difficult to map from the BIPS-image. As an example fracture minerals which sometimes occur in open fractures are all labelled as unknown mineral, because of the difficulties in identifying them accurately from the BIPS-image. In the rock cuttings secondary minerals are identified when possible, but can normally not be assigned to a specific fracture. Only one alteration type of open fractures is identified in the BIPS-image i.e. red colouring of rims, but they can rarely be verified in the rock cuttings.

Ductile structures (foliations) were measured in borehole HAV11. They indicate ductile zones striking approximately north-south and dipping steeply to the west, see Figure 5-5.

References

/1/ **Gustafsson J, Gustafsson C, 2004.** Oskarshamn site investigation. RAMAC and BIPS logging in boreholes KLX03, HAV11 to HAV13 and HLX21 to HLX25. SKB P-04-275. Svensk Kärnbränslehantering AB.

/2/ **Sigurdsson O, Ekström L, 2005.** Oskarshamn site investigation. Percussion drilling of boreholes HSH04, HSH05, HSH06, HAV11, HAV12, HAV13 and HAV14. SKB P-05-194. Svensk Kärnbränslehantering AB.

Appendix 1

Simplified geology HAV11

Site	ÄVRÖ	**Coordinate System**	RT90-RHB70
Borehole	HAV11	**Northing [m]**	6366565.25
Diameter [mm]	140	**Easting [m]**	1553040.90
Length [m]	220.500	**Elevation [m.a.s.l.]**	2.38
Bearing [°]	113.47	**Drilling Start Date**	2004-06-07 14:50:00
Inclination [°]	-59.60	**Drilling Stop Date**	2004-06-14 09:00:00
Date of mapping	2004-12-13 16:42:00	**Plot Date**	2005-09-26 00:19:34

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

ROCK OCCURRENCE
- Fine-grained granite
- Pegmatite
- Quartz monzodiorite
- Fine-grained diorite-gabbro

ROCK STRUCTURE
- Massive

FRACTURE ALTERATION
- Slightly Altered
- Moderately Altered

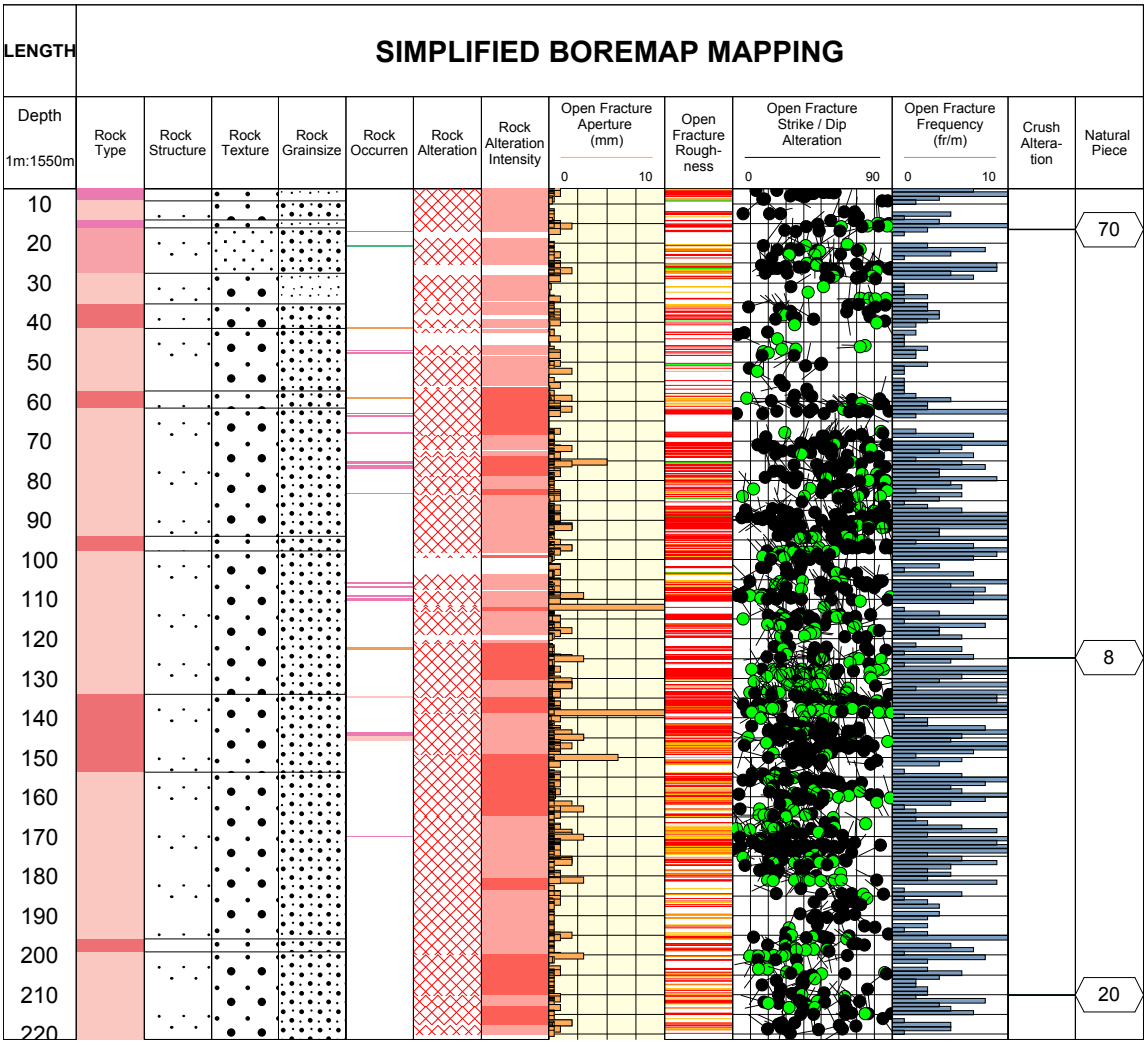
ROCK ALTERATION
- Oxidized

ROCK TEXTURE
- Porphyritic
- Unequigranular

ROCK GRAINSIZE
- Fine to medium grained
- Medium to coarse grained

INTENSITY
- Weak
- Medium

ROUGHNESS
- Planar
- Undulating
- Stepped



Simplified geology HAV12

Site	ÄVRÖ	**Coordinate System**	RT90-RHB70
Borehole	HAV12	**Northing [m]**	6367765.87
Diameter [mm]	140	**Easting [m]**	1553194.42
Length [m]	157.800	**Elevation [m.a.s.l.]**	9.40
Bearing [°]	0.27	**Drilling Start Date**	2004-05-12 06:00:00
Inclination [°]	-58.78	**Drilling Stop Date**	2004-05-19 08:00:00
Date of mapping	2005-04-07 16:29:00	**Plot Date**	2006-01-17 01:17:23
		Signed data	

ROCKTYPE ÄVRÖ
- Fine-grained granite
- Ävrö granite
- Fine-grained diorite-gabbro

ROCK STRUCTURE
- Veined
- Massive

ROCK ALTERATION
- Oxidized

INTENSITY
- Weak
- Medium

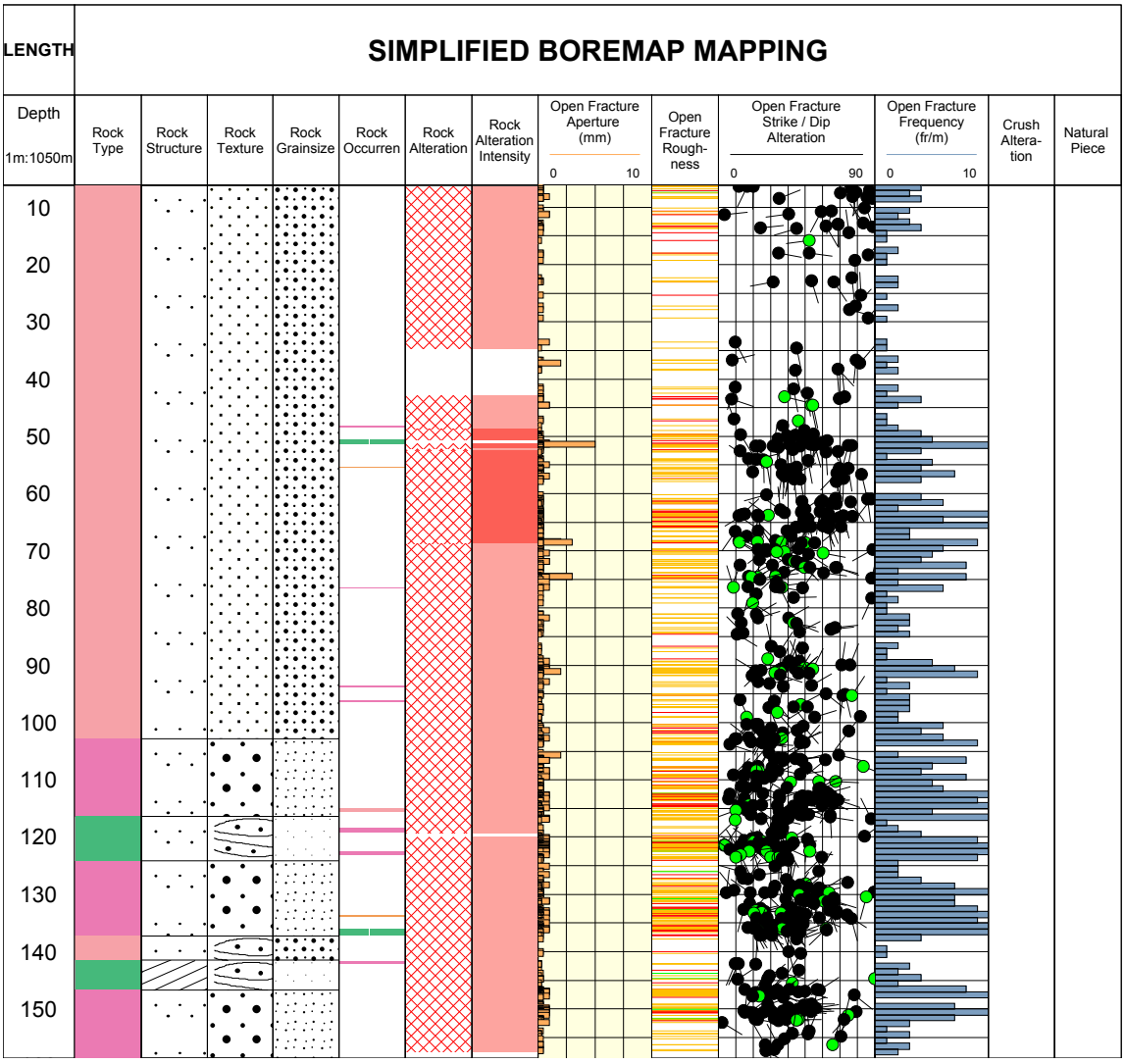
FRACTURE ALTERATION
- Slightly Altered
- Moderately Altered

ROCK TEXTURE
- Porphyritic
- Unequigranular
- Metamorphic

ROCK GRAINSIZE
- Fine-grained
- Fine to medium grained
- Medium to coarse grained

ROUGHNESS
- Planar
- Undulating
- Stepped

ROCK OCCURRENCE
- Fine-grained granite
- Pegmatite
- Ävrö granite
- Fine-grained diorite-gabbro



Simplified geology HAV13

Site	ÄVRÖ	**Coordinate System**	RT90-RHB70
Borehole	HAV13	**Northing [m]**	6367627.86
Diameter [mm]	140	**Easting [m]**	1552682.16
Length [m]	142.200	**Elevation [m.a.s.l.]**	2.22
Bearing [°]	0.08	**Drilling Start Date**	2004-05-24 08:00:00
Inclination [°]	-58.80	**Drilling Stop Date**	2004-05-27 13:00:00
Date of mapping	2005-04-12 17:04:00	**Plot Date**	2006-01-17 01:17:23
		Signed data	

ROCKTYPE ÄVRÖ
- Fine-grained granite
- Ävrö granite

ROCK STRUCTURE
- Massive

ROCK ALTERATION

INTENSITY

ROCK TEXTURE
- Porphyritic
- Unequigranular

ROUGHNESS
- Planar
- Undulating
- Stepped

FRACTURE ALTERATION
- Slightly Altered
- Moderately Altered

ROCK OCCURRENCE
- Fine-grained granite

ROCK GRAINSIZE
- Fine to medium grained
- Medium to coarse grained