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Oskarshamn site investigation

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

Abstract

This report contains geological single-hole interpretation of the cored boreholes KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E and KLX11F at Laxemar. The 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 the borehole KLX09B is dominated by Ävrö granite (501044) which constitutes one rock unit (RU1). Subordinate rock types comprise fine-grained granite (511058), fine-grained diorite-gabbro (505102) and sparse occurrence of pegmatite (501061). Two possible deformation zones are identified in KLX09B (DZ1-DZ2).

Borehole KLX09C is dominated by Ävrö granite (501044) which constitutes one rock unit (RU1). Subordinate rock types comprise fine-grained granite (511058), fine-grained diorite-gabbro (505102) and very sparse occurrences of fine-grained dioritoid (501030), pegmatite (501061) and granite (501058). Two possible deformation zones are identified in KLX09C (DZ1-DZ2).

One rock unit (RU1) occurs in borehole KLX09D. The borehole is dominated by Ävrö granite (501044). Subordinate rock types comprise occurrences of fine-grained granite (511058), fine-grained diorite-gabbro (505102) and very sparse occurrences of pegmatite (501061), granite (501058) and fine-grained dioritoid (501030). Two possible deformation zones are identified in KLX09D (DZ1-DZ2).

Borehole KLX09E is dominated by Ävrö granite (501044) which constitutes one rock unit (RU1). Subordinate rock types comprise fine-grained diorite-gabbro (505102), fine-grained granite (511058) and very sparse occurrences of pegmatite (501061), fine-grained dioritoid (501030) and granite (501058). Two possible deformation zones are identified in KLX09E (DZ1-DZ2).

Borehole KLX09F is dominated by Ävrö granite (501044) which constitutes one rock unit (RU1). Subordinate rock types comprise fine-grained diorite-gabbro (505102), granite (501058), fine-grained granite (511058) and very sparse occurrences of pegmatite (501061) and fine-grained dioritoid (501030). Five possible deformation zones are identified in KLX09F (DZ1-DZ5).

The geological single-hole interpretation shows that the borehole KLX11B is dominated by quartz monzodiorite (501036) which constitutes one rock unit (RU1). Subordinate rock type comprises fine-grained granite (511058). Two possible deformation zones are identified in KLX11B (DZ1-DZ2).

One rock unit (RU1) occurs in borehole KLX11C. The borehole is dominated by quartz monzodiorite (501036). Subordinate rock types comprise occurrences of fine-grained granite (511058) and very sparse occurrences of fine-grained dioritoid (501030), granite (501058) and pegmatite (501061). No possible deformation zone has been identified in KLX11C.

Borehole KLX11D is dominated by quartz monzodiorite (501036) which constitutes one rock unit (RU1). Subordinate rock type comprises fine-grained granite (511058) and very sparse occurrences of pegmatite (501061) and fine-grained dioritoid (501030). Three possible deformation zones are identified in KLX11D (DZ1-DZ3).

Borehole KLX11E is dominated by quartz monzodiorite (501036) which constitutes one rock unit (RU1). Subordinate rock types comprise fine-grained granite (511058) and very sparse occurrences of granite (501058) and pegmatite (501061). Four possible deformation zones are identified in KLX11E (DZ1-DZ4).

The geological single-hole interpretation shows that the borehole KLX11F is dominated by quartz monzodiorite (501036) which constitutes one rock unit (RU1). Subordinate rock types comprise fine-grained granite (511058) and very sparse occurrence of pegmatite (501061). One possible deformation zone is identified in KLX11F (DZ1).

Sammanfattning

Denna rapport behandlar geologisk enhålstolkning av kärnborrhålen KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E och KLX11F i Laxemar. Den geologiska enhålstolkningen syftar till att utifrån den geologiska karteringen, tolkade geofysiska loggar och borrhålsradarmätningar identifiera olika litologiska enheters fördelning i borrhålen samt möjliga deformationszoners läge och utbredning.

Den geologiska enhålstolkningen visar att kärnborrhålet KLX09B domineras av Ävrögranit (501044) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig granit (511058), finkornig diorit-gabbro (505102) och smärre förekomster av pegmatit (501061). Två möjliga deformationszoner har identifierats i KLX09B (DZ1-DZ2).

Kärnborrhålet KLX09C domineras av Ävrögranit (501044) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig granit (511058), finkornig diorit-gabbro (505102) och smärre förekomster av finkornig dioritoid (501030), pegmatit (501061) och granit (501058). Två möjliga deformationszoner har identifierats i KLX09C (DZ1-DZ2).

En bergartsenhet (RU1) förekommer i borrhålet KLX09D. Borrhålet domineras av Ävrögranit (501044). Underordnade bergarter utgörs av finkornig granit (511058), finkornig diorit-gabbro (505102) och smärre förekomster av pegmatit (501061), granit (501058) och finkornig dioritoid (501030). Två möjliga deformationszoner har identifierats i KLX09D (DZ1-DZ2).

Kärnborrhålet KLX09E domineras av Ävrögranit (501044) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig diorit-gabbro (505102), finkornig granit (511058) och smärre förekomster av pegmatit (501061), finkornig dioritoid (501030) och granit (501058). Två möjliga deformationszoner har identifierats i KLX09E (DZ1-DZ2).

Kärnborrhålet KLX09F domineras av Ävrögranit (501044) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig diorit-gabbro (505102), granit (501058), finkornig granit (511058) och smärre förekomster av pegmatit (501061) och finkornig dioritoid (501030). Fem möjliga deformationszoner har identifierats i KLX09F (DZ1-DZ5).

Den geologiska enhålstolkningen visar att kärnborrhålet KLX11B domineras av kvartsmonzo-diorit (501036) vilken utgör en bergartsenhet (RU1). Underordnad bergart utgörs av finkornig granit (511058). Två möjliga deformationszoner har identifierats i KLX11B (DZ1-DZ2).

En bergartsenhet (RU1) förekommer i borrhålet KLX11C. Borrhålet domineras av kvarts monzodiorit (501036). Underordnade bergarter utgörs av finkornig granit (511058) och smärre förekomster av finkornig dioritoid (501030), granit (501058) och pegmatit (501061). Inga deformationszoner har identifierats i KLX11C.

Kärnborrhålet KLX11D domineras av kvartsmonzodiorit (501036) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig granit (511058) och smärre förekomster av pegmatit (501061) och finkornig dioritoid (501030). Tre möjliga deformationszoner har identifierats i KLX11D (DZ1-DZ3).

Kärnborrhålet KLX11E domineras av kvartsmonzodiorit (501036) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig granit (511058) och smärre förekomster av granit (501058) och pegmatit (501061). Fyra möjliga deformationszoner har identifierats i KLX11E (DZ1-DZ4).

Den geologiska enhålstolkningen visar att kärnborrhålet KLX11F domineras av kvartsmonzo diorit (501036) vilken utgör en bergartsenhet (RU1). Underordnade bergarter utgörs av finkornig granit (511058) och smärre förekomster av pegmatit (501061). En möjlig deformationszon har identifierats i KLX11F (DZ1).

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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 modeling in the 3D-CAD system Rock Visualization System (RVS). The end result of this procedure is a geological single-hole interpretation, which consists of integrated series of different loggings and accompanying descriptive documents (SKB MD 810.003 v.3.0, SKB internal controlling document).

This document reports the results gained by the geological single-hole interpretation of boreholes KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E and KLX11F 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 AP PS 400-07-060. The controlling documents for performing this activity are listed in Table 1-1. Both activity plan and method description are SKB's internal controlling documents. Rock type nomenclature that has been used is shown in Table 1-2.

Original data from the reported activity are stored in the primary database Sicada, where they are traceable by the Activity Plan number (AP PS 400-07-060). Only data in SKB's databases are accepted for further interpretation and modelling. The data presented in this report are regarded as copies of the original data. Data in the databases may be revised, if needed. Such revisions will not necessarily result in a revision of the P-report, although the normal procedure is that major data revisions entail a revision of the P-report. Minor data revisions are normally presented as supplements, available at www.skb.se.

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

Activity plan	Number	Version
Geologisk enhålstolkning av KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E och KLX11F	AP PS 400-07-060	1.0
Method description	**Number**	**Version**
Metodbeskrivning för geologisk enhålstolkning	SKB MD 810.003	3.0

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

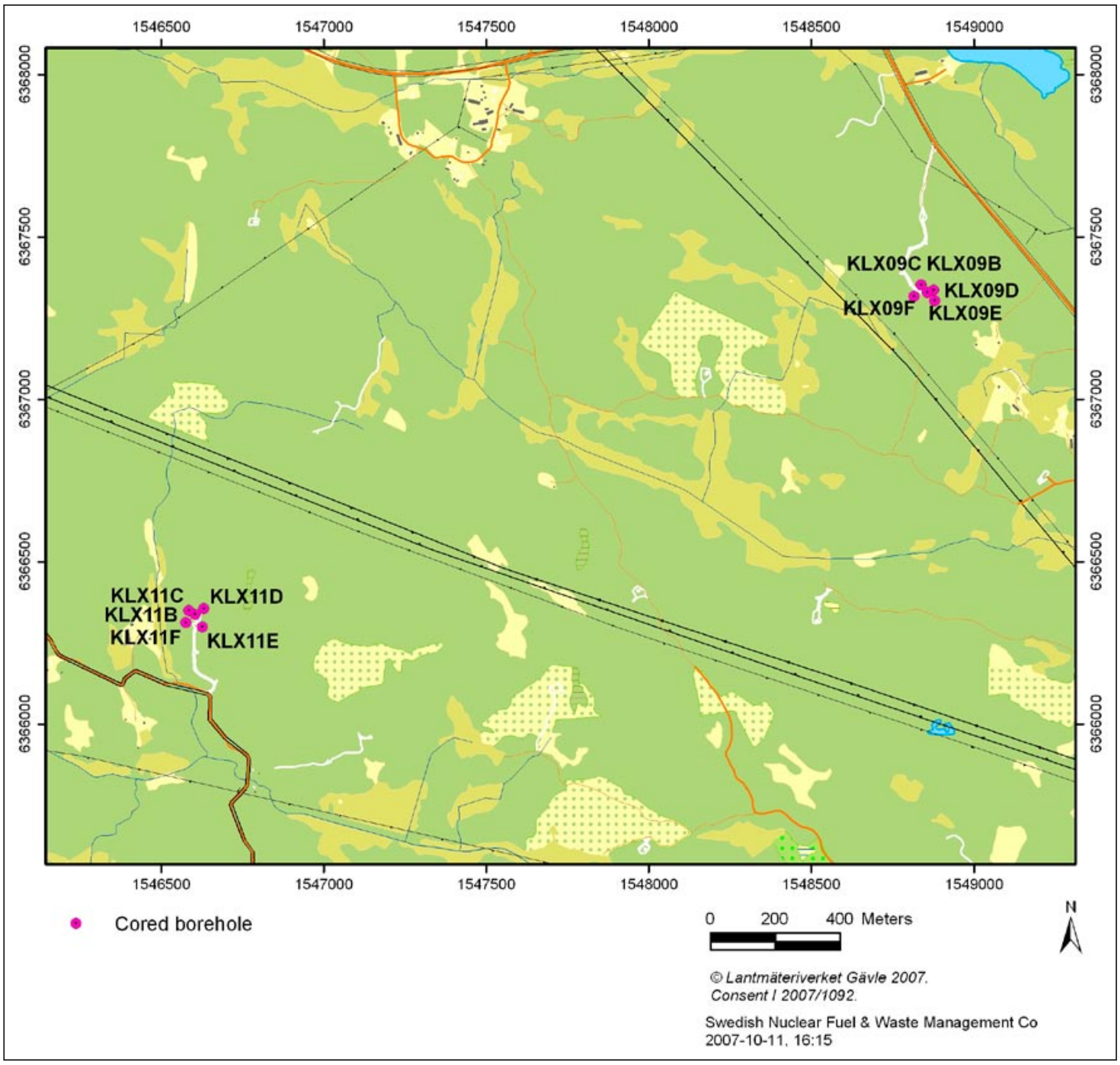

Figure 1-1. *Map showing the position of the cored boreholes KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E and KLX11F.*

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 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. The work reported here concerns stage 1 in the single-hole interpretation, as defined in the method description.

3 Data used for the geological single-hole interpretation

The following data have been used in the single-hole interpretation of boreholes KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E and KLX11F:

- Boremap data (including BIPS and geological mapping data) /2, 3/
- Generalized geophysical logs and their interpretation /4/
- Radar data and their interpretation /5, 6/

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 nine 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)
   6.2: Sealed network
   6.3: Core loss

7: Fracture frequency
   7.1: Sealed fractures
   7.2: Open fractures

8: BIPS

9: Length along the borehole

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 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.

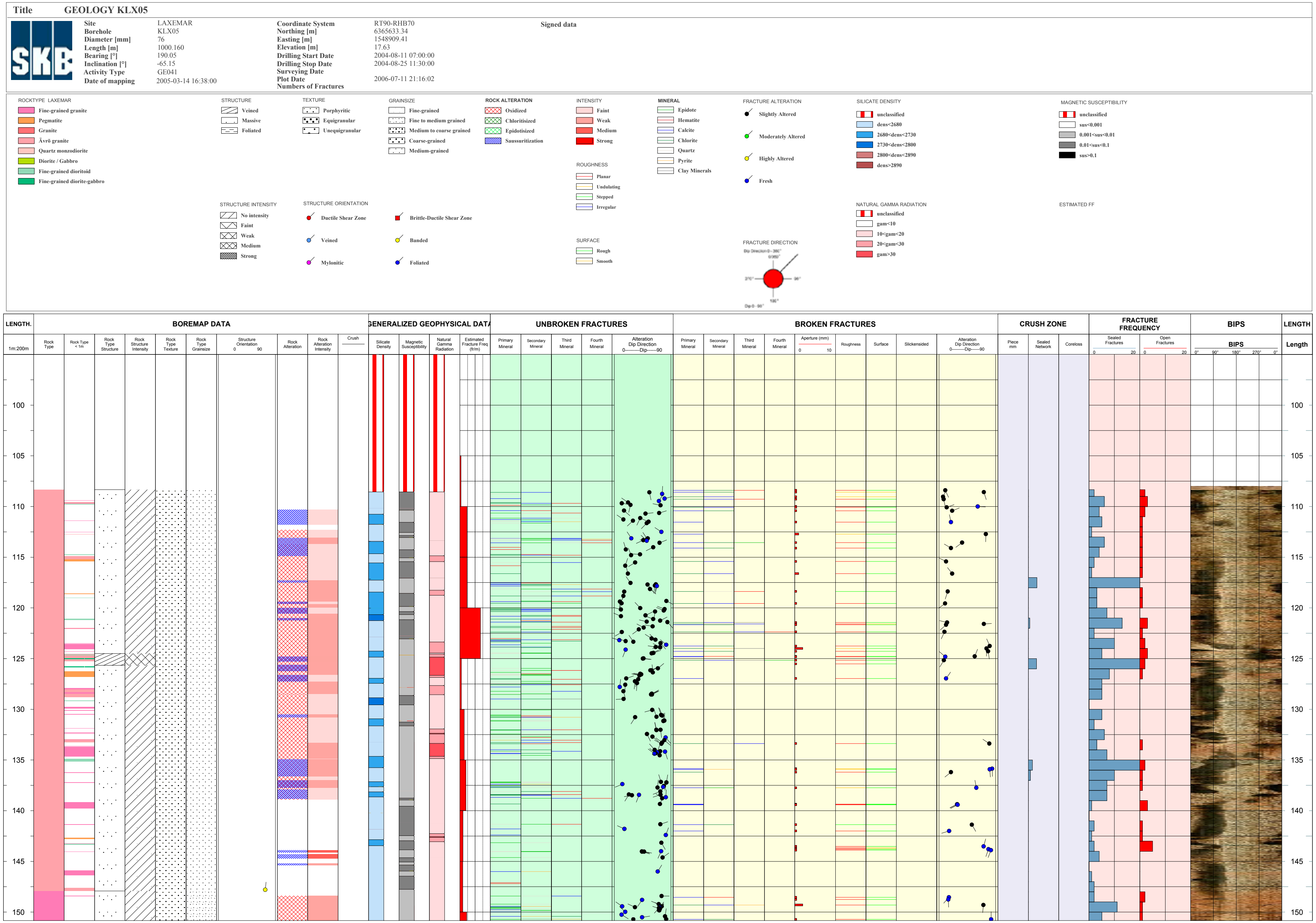

Figure 3-1. Example of WellCad plot (from borehole KLX05 in Laxemar) used as a basis for the single-hole interpretation.

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. All data to be used (see Chapter 3) are visualized side by side in a borehole document extracted from the software WellCad. The working procedure is summarized in Figure 4-1 and in the text below.

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

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

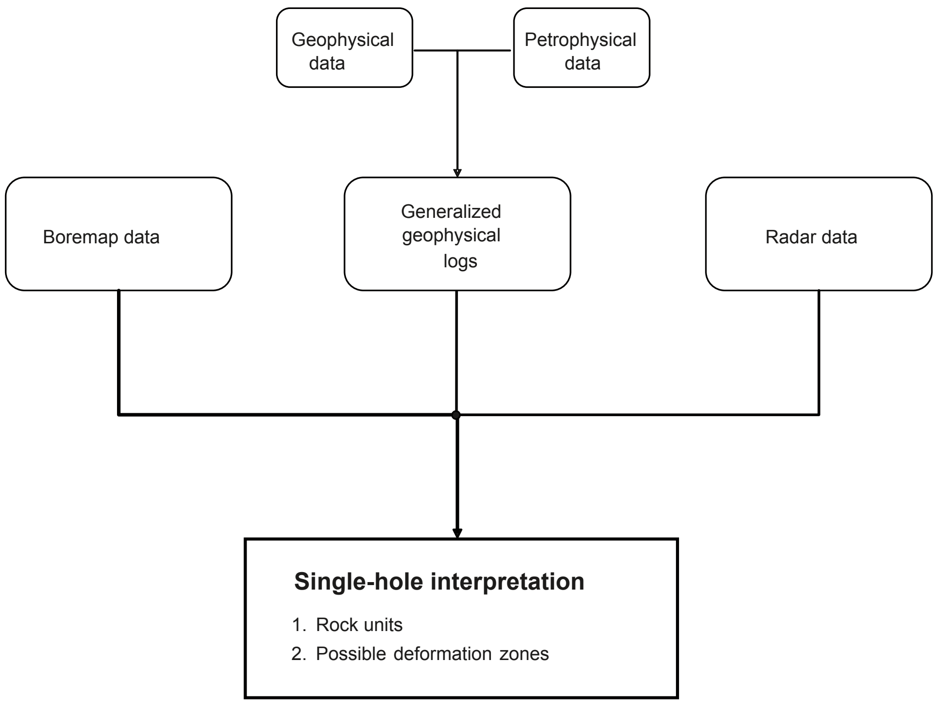

Figure 4-1. *Schematic block-scheme of single-hole interpretation*

Inspection of BIPS images is carried out whenever 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.

Possible deformation zones that are ductile or brittle in character have been identified primarily on the basis of occurrence of protomylonitic to mylonitic foliation and the frequency of fractures, respectively, according to the recommendations in /1/. Both the transitional parts and the core part have been included in each zone (Figures 4-2 to 4-4). The fracture/m values in Figure 4-4 may serve only as examples. 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 primarily the brittle structures.

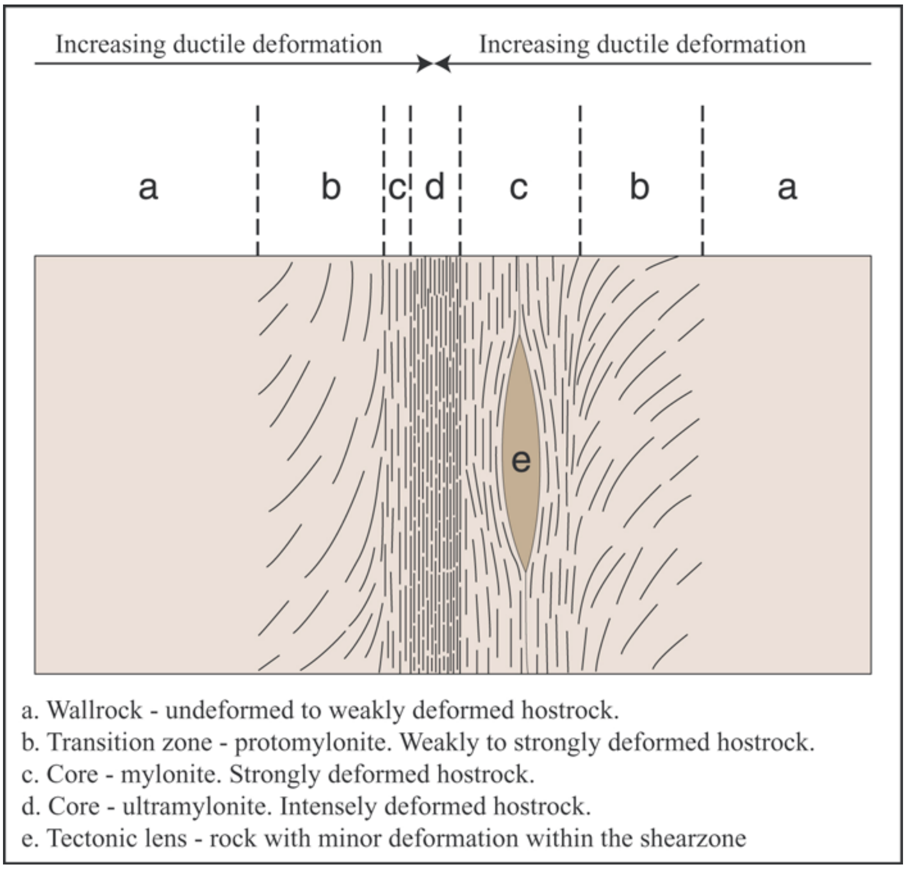

Figure 4-2. *Schematic example of a ductile shear zone. Homogeneous rock which is deformed under low- to medium-grade metamorphic conditions (after /1/).*

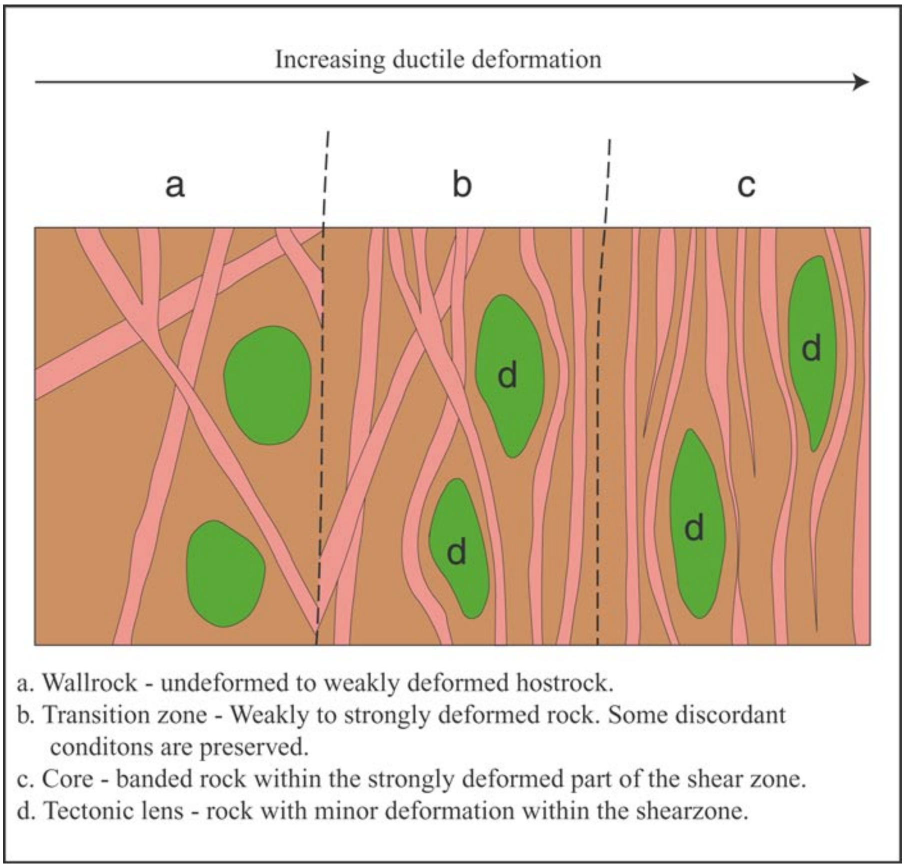

Figure 4-3. *Schematic example of a ductile shear zone. Heterogeneous rock which is deformed under low- to high-grade metamorphic conditions (after /1/).*

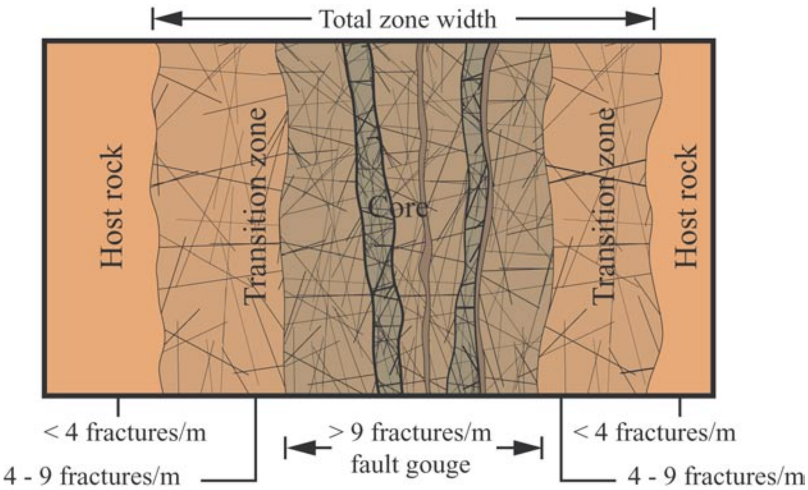

Figure 4-4. *Schematic example of a brittle deformation zone (after /1/).*

Since the frequency of fractures is of key importance for the definition of the possible deformation zones, a moving average plot for this parameter is shown for the cored boreholes KLX09B-F (Figures 4-5–4-9) and KLX11B-F (Figures 4-10–4-14). A 5 m window and 1 m steps have been used in the calculation procedure. The moving averages for open fractures alone, the total number of open fractures (open, partly open and crush), the sealed fractures alone, and the total number of sealed fractures (sealed and sealed fracture network) are shown in a diagram.

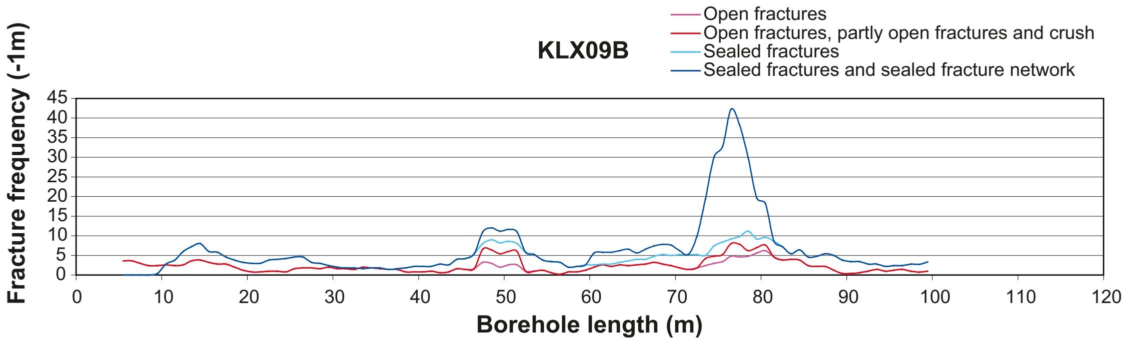

Figure 4-5. *Fracture frequency plot for KLX09B. Moving average with a 5 m window and 1 m steps.*

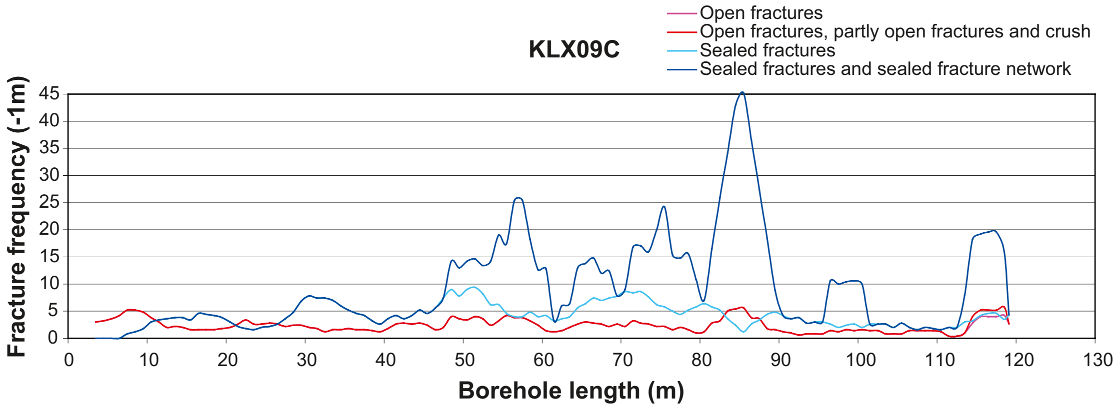

Figure 4-6. *Fracture frequency plot for KLX09C. Moving average with a 5 m window and 1 m steps.*

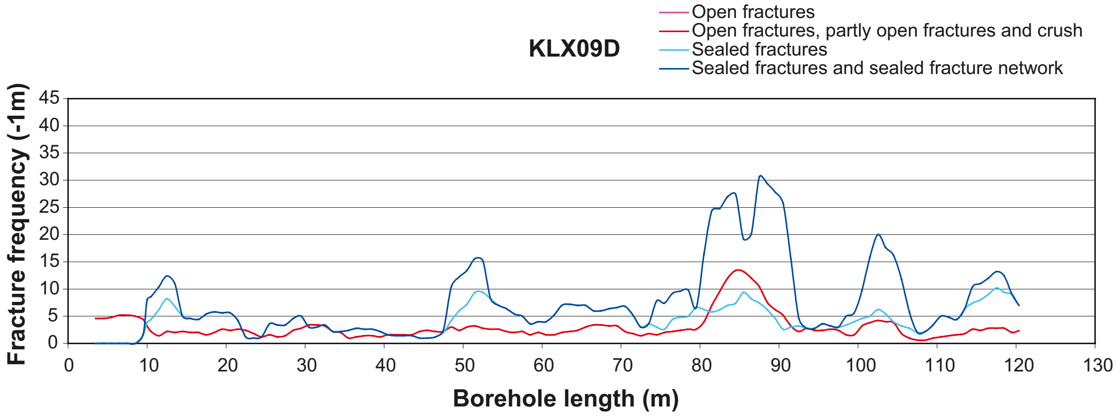

Figure 4-7. *Fracture frequency plot for KLX09D. Moving average with a 5 m window and 1 m steps.*

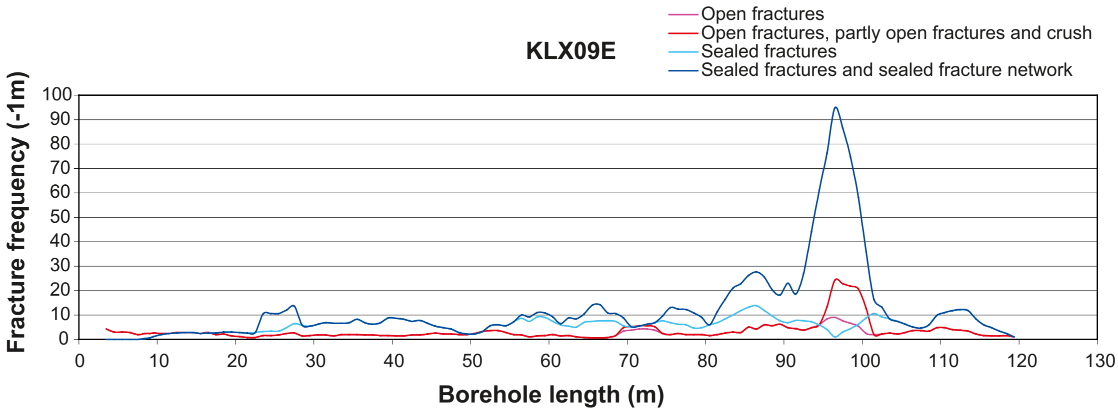

Figure 4-8. *Fracture frequency plot for KLX09E. Moving average with a 5 m window and 1 m steps.*

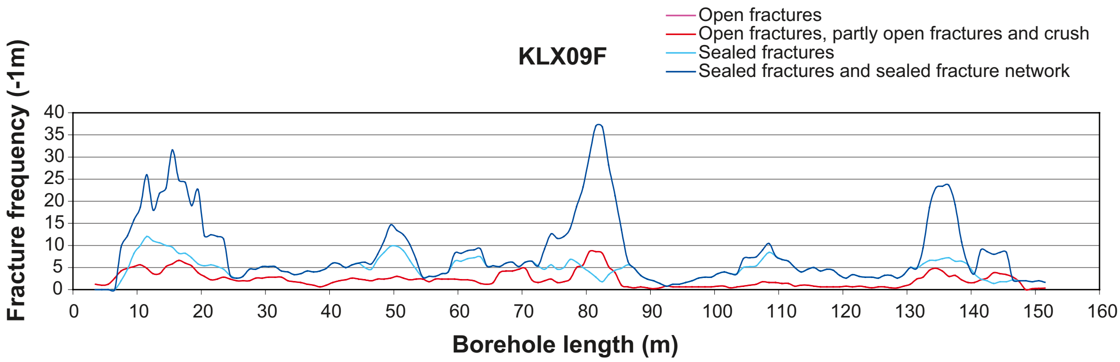

Figure 4-9. *Fracture frequency plot for KLX09F. Moving average with a 5 m window and 1 m steps.*

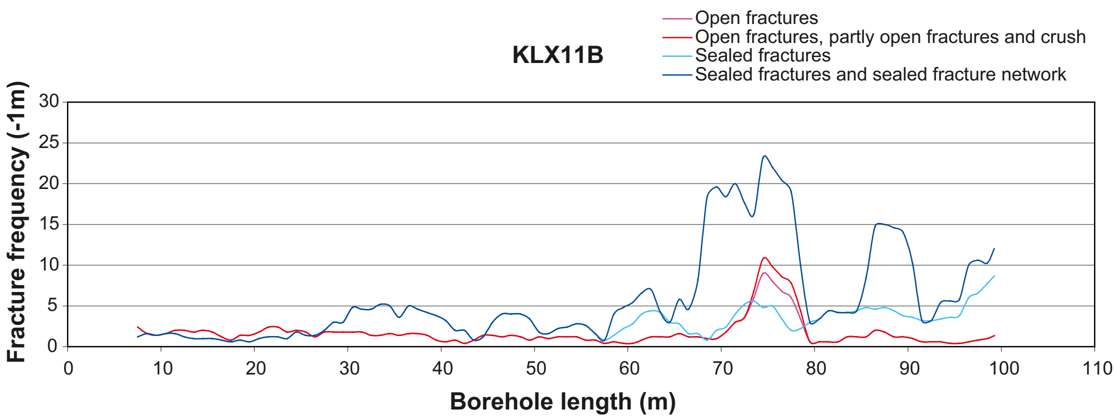

Figure 4-10. *Fracture frequency plot for KLX11B. Moving average with a 5 m window and 1 m steps.*

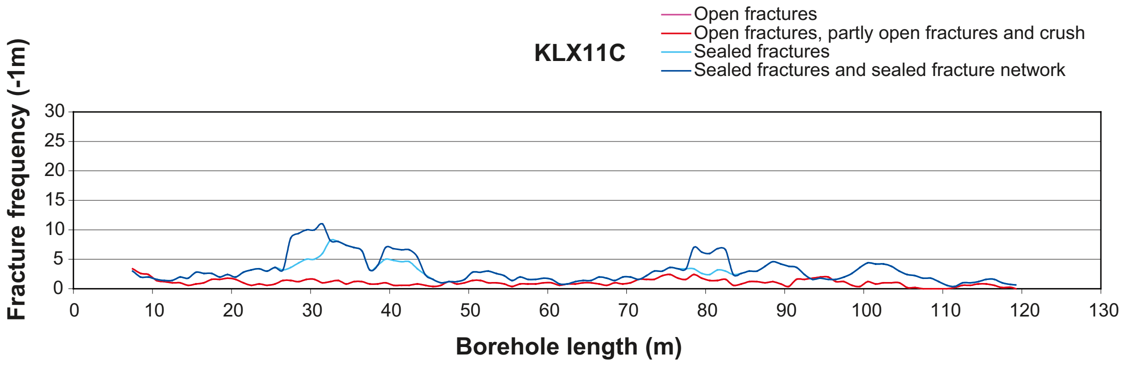

Figure 4-11. *Fracture frequency plot for KLX11C. Moving average with a 5 m window and 1 m steps.*

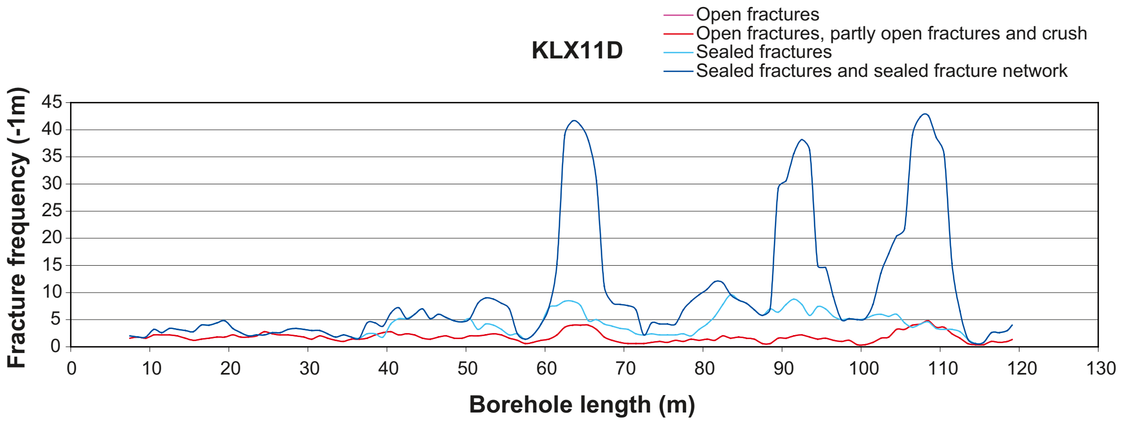

Figure 4-12. *Fracture frequency plot for KLX11D. Moving average with a 5 m window and 1 m steps.*

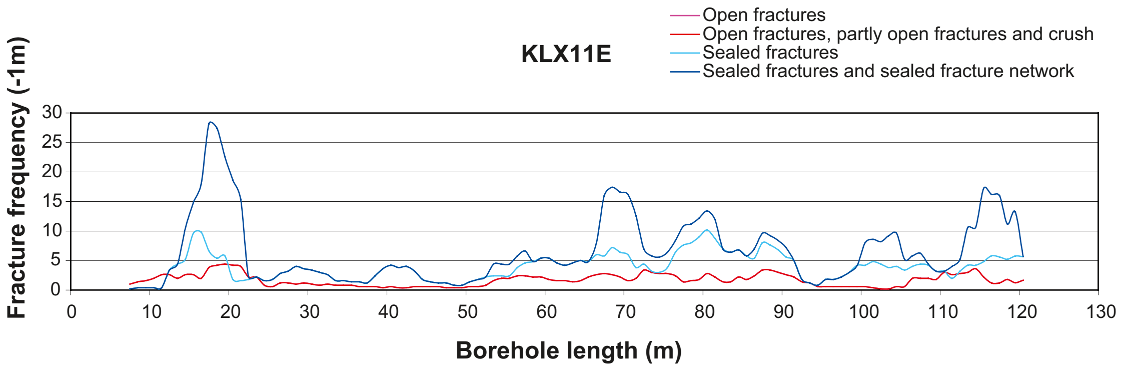

Figure 4-13. *Fracture frequency plot for KLX11E. Moving average with a 5 m window and 1 m steps.*

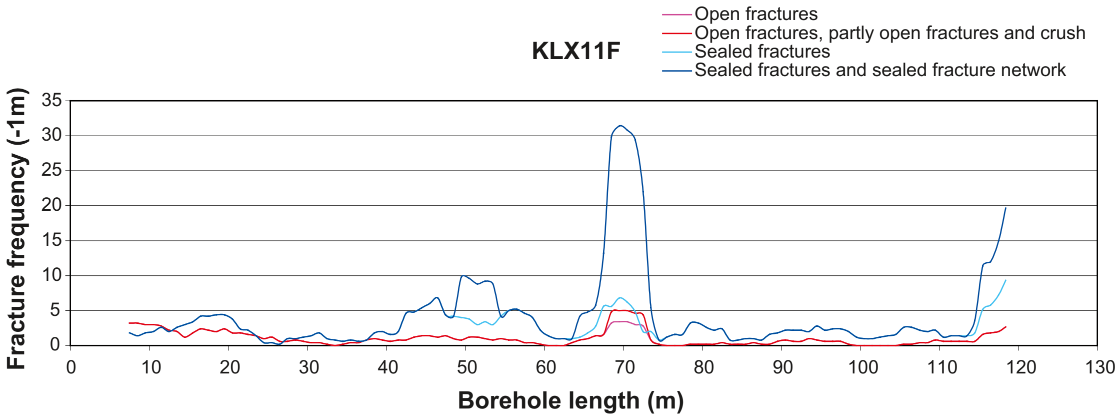

Figure 4-14. *Fracture frequency plot for KLX11F. Moving average with a 5 m window and 1 m steps.*

The occurrence and orientation of radar anomalies within these possible deformation zones are used during the identification of zones. Overviews of the borehole radar measurement in KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E and KLX11F are shown in Figures 4-15–4-24. A conductive environment causes attenuation of the radar wave, which in turn decreases the penetration. The effect of attenuation can be observed generally in borehole KLX09B, at 70–90 m in KLX09C, at 80–90 m in KLX09D and below 60 m in KLX11B. The effect of attenuation varies between the different antenna frequencies (20 MHz, 100 MHz, 250 MHz and 60 MHz directional antenna). In some cases, alternative orientations for oriented radar reflectors are presented. One of the alternatives is considered to be correct, but due to uncertainty in the interpretation of radar data, a decision concerning which of the alternatives that represent the true orientation cannot be made. Orientations from directional radar are presented as strike/dip using the right-hand-rule method, e.g. 040/80 corresponds to a strike of N40°E and a dip of 80° to the SE.

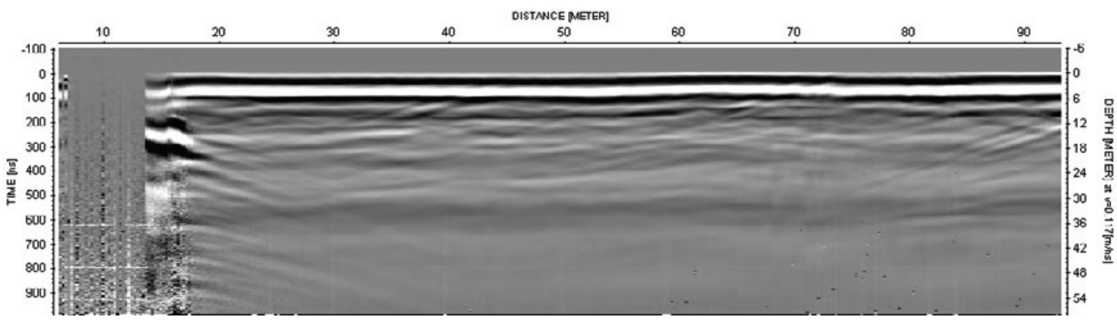

Figure 4-15. *Overview (20 MHz data) of the borehole radar measurement in KLX09B.*

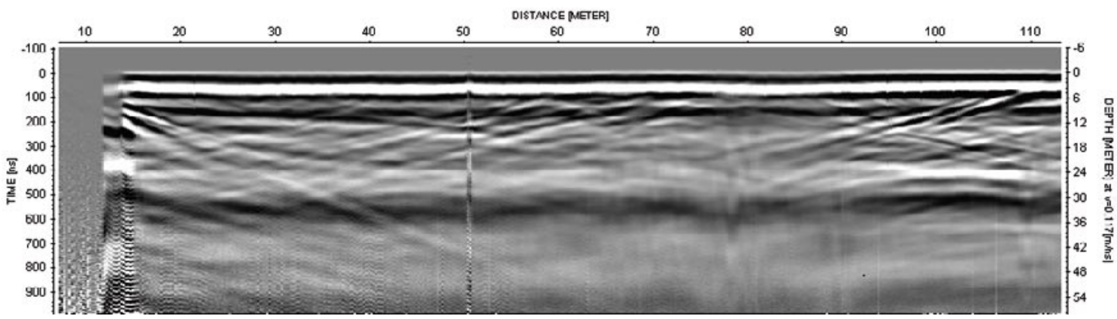

Figure 4-16. *Overview (20 MHz data) of the borehole radar measurement in KLX09C.*

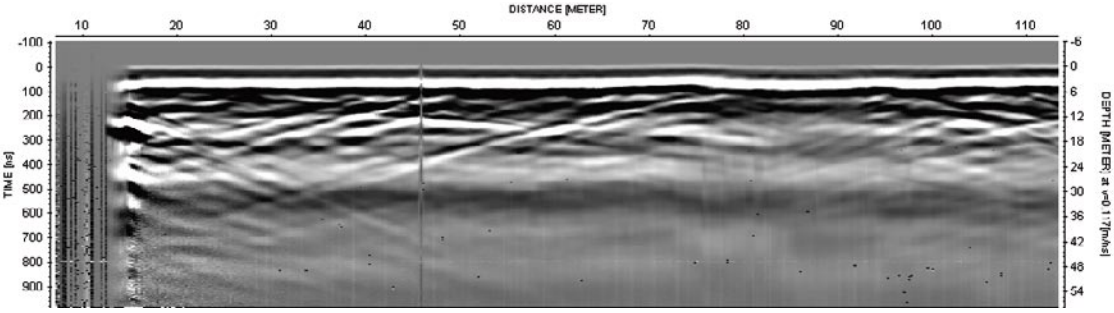

Figure 4-17. Overview (20 MHz data) of the borehole radar measurement in KLX09D.

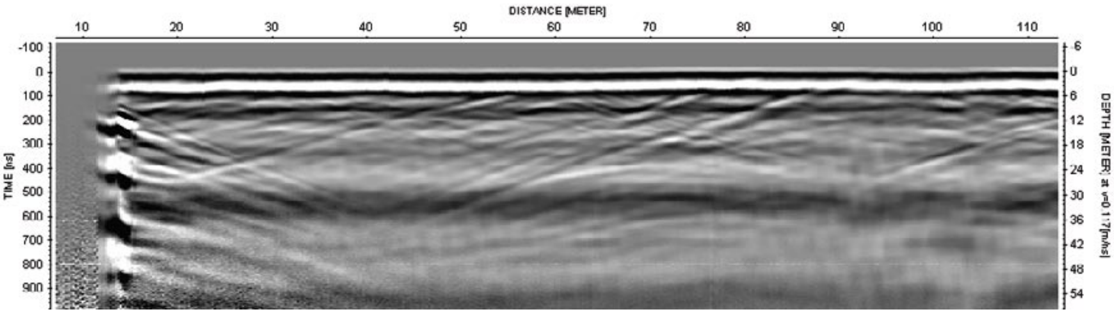

Figure 4-18. Overview (20 MHz data) of the borehole radar measurement in KLX09E.

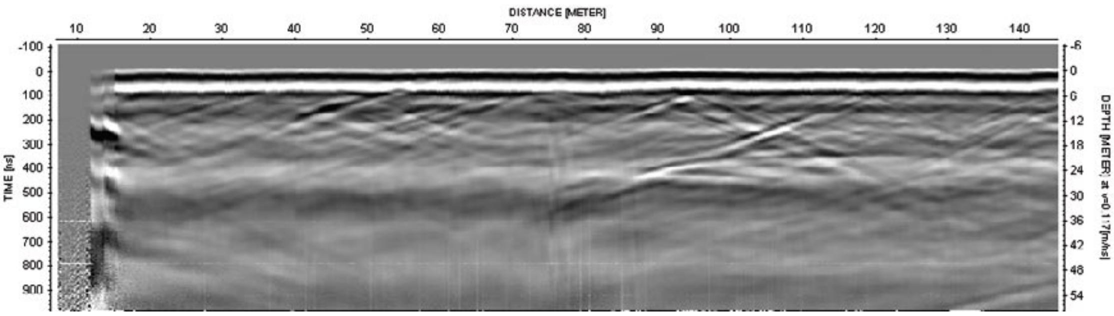

Figure 4-19. Overview (20 MHz data) of the borehole radar measurement in KLX09F.

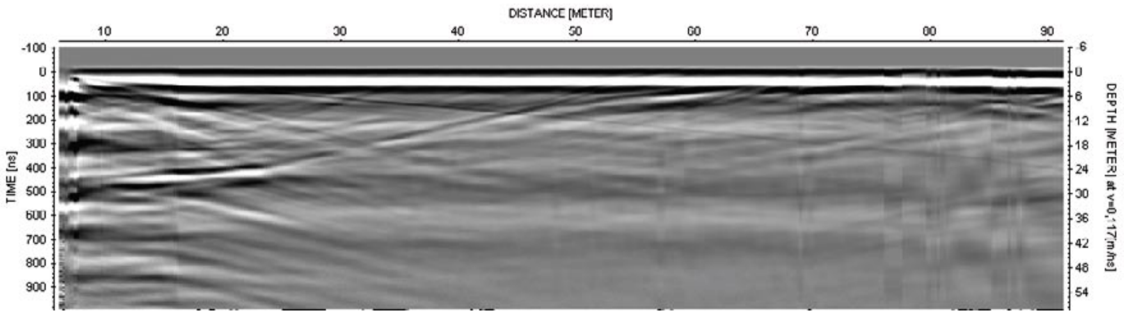

Figure 4-20. Overview (20 MHz data) of the borehole radar measurement in KLX11B.

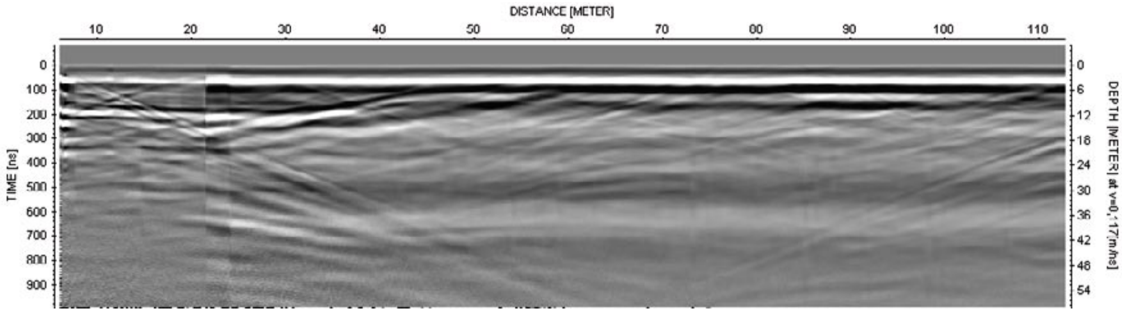

Figure 4-21. *Overview (20 MHz data) of the borehole radar measurement in KLX11C.*

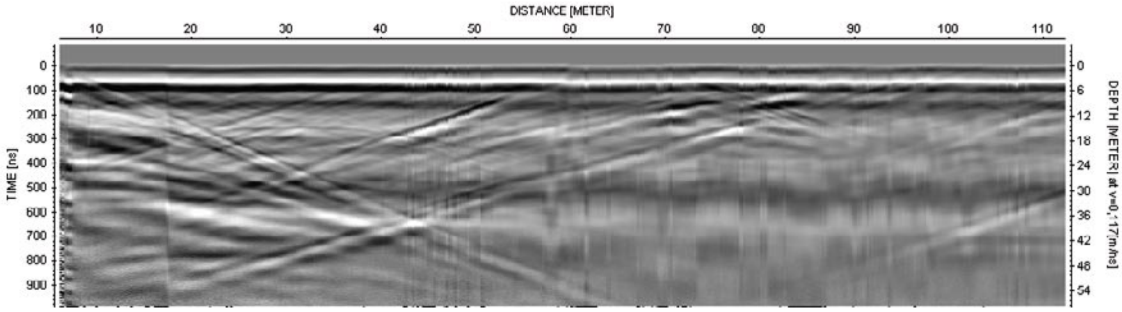

Figure 4-22. *Overview (20 MHz data) of the borehole radar measurement in KLX11D.*

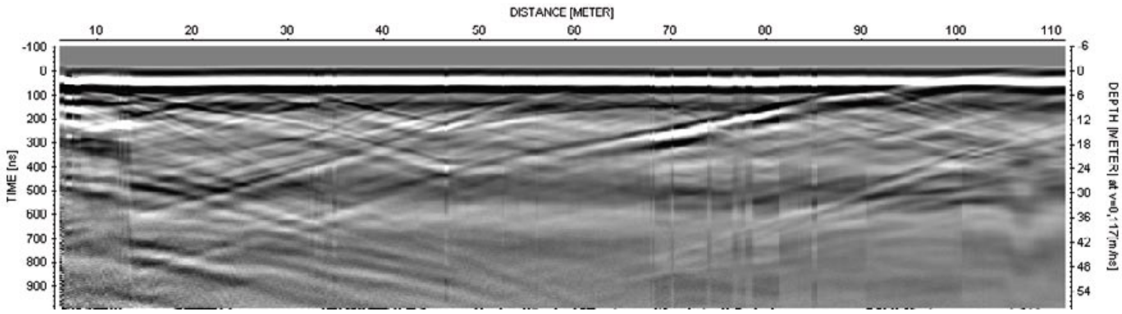

Figure 4-23. *Overview (20 MHz data) of the borehole radar measurement in KLX11E.*

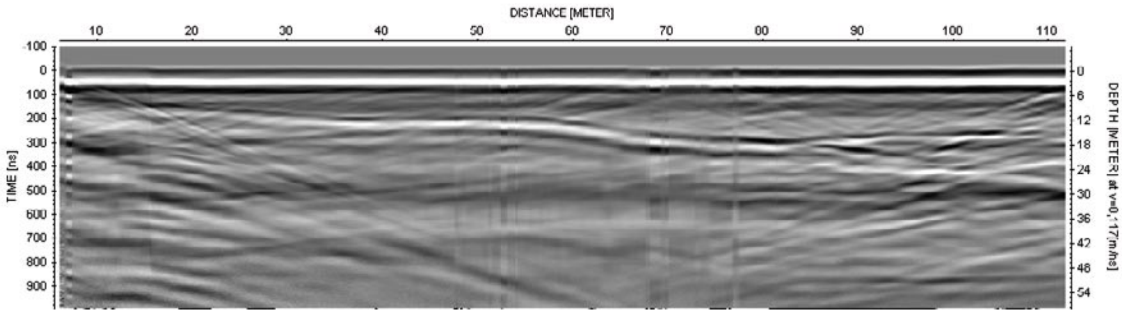

Figure 4-24. *Overview (20 MHz data) of the borehole radar measurement in KLX11F.*

4.2 Nonconformities

Geophysical borehole logging has not been performed in boreholes KLX09C, KLX09E, KLX11C, KLX11D, KLX11E and KLX11F.

5 Results

The detailed result of the single-hole interpretation is presented as print-out from the software WellCad (Appendix 1 for KLX09B, Appendix 2 for KLX09C, Appendix 3 for KLX09D, Appendix 4 for KLX09E, Appendix 5 for KLX09F, Appendix 6 for KLX11B, Appendix 7 for KLX11C, Appendix 8 for KLX11D, Appendix 9 for KLX11E and Appendix 10 for KLX11F).

5.1 KLX09B

Rock units

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

11.05–99.91 m

RU1: Totally dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058), fine-grained diorite-gabbro (505102) and sparse occurrence of pegmatite (501061). The fine-grained diorite-gabbro (505102) usually constitutes composite intrusions together with fine-grained granite (511058). The fine-grained granite (511058) primarily occurs in sections < 1 m in length. The major part of the rock unit is faintly to weakly foliated. The Ävrö granite (501044) has a density in the range 2,720–2,750 kg/m^3 in the section 17–58 m and 2,660–2,710 kg/m^3 in the section 58–100 m. Confidence level = 3.

Possible deformation zones

Two possible deformation zones have been recognised with a high degree of confidence in KLX09B (DZ1-DZ2).

49.14–49.65 m

DZ1: Brittle deformation zone characterized by increased frequency of open and sealed fractures, weak red staining and one crush zone. Decreased resistivity, magnetic susceptibility and partly decreased P-wave velocity. The host rock is dominated by fine-grained granite (511058). Confidence level = 3.

74.55–79.30 m

DZ2: Inhomogeneous low-grade ductile shear zone overprinted by brittle deformation. Increased frequency of particularly sealed but also open fractures, faint to strong red staining, two crush zones, large apertures, slickensides and mylonitic sections. The most intensely deformed sections (cores) are 74.75–75.06 m and 77.58–78.15 m. Significantly decreased resistivity, magnetic susceptibility and partly decreased P-wave velocity. At c 78.0 m there is a major drop in fluid water resistivity, which is most likely related to a water bearing structure. One strong radar reflector occurs at 78.9 m with the orientation 288/18 or 108/18. Low radar amplitude at 75–80 m. The host rock is dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058) and fine-grained diorite-gabbro (505102). Confidence level = 3.

5.2 KLX09C

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

9.08–119.20 m

RU1: Totally dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058), fine-grained diorite-gabbro (505102) and very sparse occurrences of fine-grained dioritoid (501030), pegmatite (501061) and granite (501058). The fine-grained diorite-gabbro (505102) usually constitutes composite intrusions together with fine-grained granite (511058). The major part of the rock unit is faintly to weakly foliated. Confidence level = 3.

Possible deformation zones

Two possible deformation zones have been recognised with a high degree of confidence in KLX09C (DZ1-DZ2).

81.30–86.30 m

DZ1: Low-grade ductile shear zone overprinted by brittle deformation. Increased frequency of sealed fractures and a slight increase in open fractures, large apertures and mylonitic sections. The most intensely deformed section (core) is 82.81–85.63 m. One non-oriented radar reflector occurs at 82.9 m with the angle 72° to borehole axis and one reflector at 86.3 m with the orientation 238/11 or 253/53. Low radar amplitude at 85–90 m. The host rock is totally dominated by Ävrö granite (501044). Subordinate rock type comprises very sparse occurrence of pegmatite (501061). Confidence level = 3.

114.85–117.00 m

DZ2: Brittle deformation zone characterized by increased frequency of sealed and open fractures, one crush zone and slickensides. One strong non-oriented radar reflector occurs at 117.4 m (just below DZ2) with the angle 40° to borehole axis. Low radar amplitude occurs at 115–120 m. The host rock is dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained diorite-gabbro (505102), fine-grained granite (511058) and pegmatite (501061). Confidence level = 3.

5.3 KLX09D

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

10.01–120.72 m

RU1: Totally dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058), fine-grained diorite-gabbro (505102) and very sparse occurrences of pegmatite (501061), granite (501058) and fine-grained dioritoid (501030). The fine-grained diorite-gabbro (505102) usually constitutes composite intrusions together with fine-grained granite (511058). The fine-grained granite (511058) primarily occurs in sections < 1 m in length. The major part of the rock unit is faintly to weakly foliated. The Ävrö granite (501044) has a density in the range 2,710–2,750 kg/m^3 in the section 10–66 m, 2,670–2,690 kg/m^3 in the section 66–79 m, 2,700–2,730 kg/m^3 in the section 79–102 m and 2,670–2,700 kg/m^3 in the section 102–121 m. Confidence level = 3.

Possible deformation zones

Two possible deformation zones have been recognised with a high degree of confidence in KLX09D (DZ1-DZ2).

81.40–89.52 m

DZ1: Low-grade ductile shear zone overprinted by brittle deformation. Increased frequency of sealed and open fractures, faint to medium red staining, large apertures, slickensides and mylonitic sections. Significantly decreased bulk resistivity and bulk magnetic susceptibility. Partly decreased P-wave velocity. Two non-oriented radar reflectors occur at 83.5 m and 84.0 m with the angle 59° and 26° to borehole axis, respectively. Also, one radar reflector occurs at 88.1 m with the orientation 017/44 or 335/21. Low radar amplitude occurs at 80–90 m. The host rock is dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058) and sparse occurrences of pegmatite (501061) and granite (501058). Confidence level = 3.

101.15–104.00 m

DZ2: Brittle deformation zone characterized by increased frequency of sealed fractures and a slight increase in open fractures, medium red staining and slickensides. Significantly decreased resistivity and magnetic susceptibility. One non-oriented radar reflector occurs at 103.9 m with the angle 67° to borehole axis. The host rock is totally dominated by Ävrö granite (501044). Confidence level = 3.

5.4 KLX09E

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

9.08–119.70 m

RU1: Totally dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained diorite-gabbro (505102), fine-grained granite (511058) and very sparse occurrences of pegmatite (501061), fine-grained dioritoid (501030) and granite (501058). The fine-grained diorite-gabbro (505102) usually constitutes composite intrusions together with fine-grained granite (511058). The fine-grained granite (511058) primarily occurs as thin sections < 1 m in length. The major part of the rock unit is faintly to weakly foliated. Confidence level = 3.

Possible deformation zones

Two possible deformation zones have been recognised with a high degree of confidence in KLX09E (DZ1-DZ2).

71.20–72.35 m

DZ1: Brittle deformation zone characterized by increased frequency of open fractures and a slight increase in sealed fractures and one crush zone. One non-oriented radar reflector occurs at 71.5 m with the angle 32° to borehole axis. The host rock is totally dominated by Ävrö granite (501044). Confidence level = 3.

76.15–105.45 m

DZ2: Brittle deformation zone overprinting ductile shear zones. Increased frequency of sealed fractures and partly also of open fractures, faint to medium red staining, one c 0.75 m thick crush zone, one breccia and slickensides. The most intensely deformed sections (cores) are 87.40–87.80 m, 89.00–89.80 m and 96.30–99.60 m. Two oriented radar reflectors occur, one at 83.2 m with the orientation 342/61 and one at 97.6 m with the orientation 133/47 or 010/53, the latter of which is strong. Seven non-oriented radar reflectors occur with angles between 40° and 55° to borehole axis. Low radar amplitude occurs at 95–105 m. The host rock is totally dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058) and sparse occurrences of fine-grained diorite-gabbro (505102) and granite (501058). Confidence level = 3.

5.5 KLX09F

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

9.01–151.99 m

RU1: Totally dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained diorite-gabbro (505102), granite (501058), fine-grained granite (511058) and very sparse occurrences of pegmatite (501061) and fine-grained dioritoid (501030). The fine-grained diorite-gabbro (505102) usually constitutes composite intrusions together with fine-grained granite (511058). The fine-grained (511058) granite primarily occurs as thin sections < 1 m in length. The major part of the rock unit displays foliation which is faint to medium in character. The Ävrö granite (501044) has a density in the range 2,680–2,720 kg/m^3. Confidence level = 3.

Possible deformation zones

Five possible deformation zones have been recognised with a high degree of confidence in KLX09F (DZ1-DZ5).

7.86–21.70 m

DZ1: Brittle deformation zone characterized by increased frequency of sealed fractures and partly a slight increase of open fractures, scattered sections of faint to medium red staining, cataclasites, one breccia and slickensides. Decreased resistivity, magnetic susceptibility and partly decreased P-wave velocity. Two non-oriented radar reflectors occur at 14.9 m and 17.9 m with the angle 56° and 25° to borehole axis, respectively. Low radar amplitude at 0–10 m. The host rock is dominated by Ävrö granite (501044). Subordinate rock types comprise particularly fine-grained diorite-gabbro (505102), and also sparse occurrence of fine-grained granite (511058). Confidence level = 3**.**

67.90–68.75 m

DZ2: Brittle deformation zone characterized by increased frequency of open fractures, faint to weak red staining and slickensides. Decreased resistivity, magnetic susceptibility and partly decreased P-wave velocity. One strong non-oriented radar reflector at 68.8 m with the angle 34° to borehole axis. The host rock is dominated by Ävrö granite (501044). Subordinate rock type comprises fine-grained granite (511058). Confidence level = 3**.**

79.45–84.40 m

DZ3: Brittle deformation zone overprinting ductile structures. Increased frequency of particularly sealed fractures but also of open fractures, faint to weak red staining, slickensides, mylonitic and brittle-ductile sections. Significantly decreased resistivity and bulk magnetic susceptibility. One minor caliper anomaly but partly *increased* P-wave velocity. Two non-oriented radar reflectors at 81.1 m and 82.7 m with the angle 59° and 55° to borehole axis, respectively. Low radar amplitude at 75–85 m. The host rock is dominated by Ävrö granite (501044). Subordinate rock types comprise fine-grained granite (511058), fine-grained diorite-gabbro (505102) and very sparse occurrence of pegmatite (501061). Confidence level = 3.

133.10–136.20 m

DZ4: Brittle deformation zone characterized by increased frequency of sealed fractures and slickensides. Mylonitic and brittle-ductile sections occur. The most intensely deformed section (core) is 134.94–135.80 m. Partly decreased resistivity. Two non-oriented radar reflectors at 133.5 m and 135.5 m with the angle 41° and 42° to borehole axis, respectively. Low radar amplitude at 135 m. The host rock is dominated by Ävrö granite (501044). Subordinate rock type comprises fine-grained diorite-gabbro (505102). Confidence level = 3.

144.32–145.07 m

DZ5: Brittle deformation zone characterized by increased frequency of sealed fractures. Decreased resistivity and magnetic susceptibility and caliper anomalies in the section c 142.5–145.5 m (Note! Also outside zone interval). The host rock is totally dominated by Ävrö granite (501044). Confidence level = 3.

5.6 KLX11B

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

4.00–99.50 m

RU1: Totally dominated by quartz monzodiorite (501036). Subordinate rock type comprises fine-grained granite (511058). The fine-grained granite (511058) primarily occurs in sections < 1 m in length. Scattered < c 5 m long sections are faintly to weakly foliated. The quartz monzodiorite (501036) has a density in the range 2,750–2,800 kg/m^3. Confidence level = 3.

Possible deformation zones

Two possible deformation zones have been recognised with a high degree of confidence in KLX11B (DZ1-DZ2).

75.18–76.87 m

DZ1: Brittle deformation zone characterized by increased frequency of open and sealed fractures, faint red staining, two crush zones and slickensides. Decreased resistivity and magnetic susceptibility. Partly decreased P-wave velocity and minor caliper anomalies. One non-oriented radar reflector at 75.6 m with the angle 66° to borehole axis. The host rock is totally dominated by quartz monzodiorite (501036). Confidence level = 3.

86.30–88.70 m

DZ2: Brittle deformation zone characterized by increased frequency of sealed fractures, medium red staining, two breccias. Decreased resistivity and magnetic susceptibility. Partly decreased P-wave velocity and minor caliper anomalies. The host rock is totally dominated by quartz monzodiorite (501036). Confidence level = 3.

5.7 KLX11C

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

4.00–119.43 m

RU1: Totally dominated by quartz monzodiorite (501036). Subordinate rock types comprise fine-grained granite (511058) and very sparse occurrences of fine-grained dioritoid (501030), granite (501058) and pegmatite (501061). The fine-grained granite (511058) occurs in sections < 1 m in length. Scattered sections up to 17 m in length are faintly to weakly foliated, but subordinate sections display stronger foliation. Confidence level = 3.

Possible deformation zones

No possible deformation zones have been recognised in KLX11C.

5.8 KLX11D

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

4.00–119.20 m

RU1: Totally dominated by quartz monzodiorite (501036). Subordinate rock types comprise fine-grained granite (511058) and very sparse occurrences of pegmatite (501061) and fine-grained dioritoid (501030). The fine-grained granite (511058) primarily occurs in sections < 1 m in length. Scattered sections < c 3 m in length are faintly foliated. Confidence level = 3.

Possible deformation zones

Three possible deformation zones have been recognised with a high degree of confidence in KLX11D (DZ1-DZ3).

61.93–65.36 m

DZ1: Brittle deformation zone characterized by increased frequency of sealed fractures, a slight increase in open fractures and faint to medium red staining. One strong radar reflector at 62.7 m with the orientation 017/70, and one non-oriented radar reflector at 63.8 m with the angle 63° to borehole axis. Low radar amplitude at 60–65 m. The host rock is totally dominated by quartz monzodiorite (501036). Subordinate rock types comprise very sparse occurrences of fine-grained dioritoid (501030) and fine-grained granite (511058). Confidence level = 3.

90.44–97.70 m

DZ2: Brittle deformation zone characterized by increased frequency of sealed fractures, a slight increase in open fractures and faint to medium red staining. Three non-oriented radar reflectors at 90.6 m, 95.2 m and 97.1 m with the angle 53°, 42° and 42° to borehole axis, respectively. Low radar amplitude at 90–100 m. The host rock is totally dominated by quartz monzodiorite (501036). Subordinate rock type comprises very sparse occurrence of fine-grained granite (511058). Confidence level = 3.

106.67–110.60 m

DZ3: Brittle deformation zone characterized by increased frequency of sealed fractures, a slight increase in open fractures, faint to weak red staining and slickensides. One very strong radar reflector at 107.4 m with the orientation 013/82, and two non-oriented radar reflectors at 107.4 m and 109.5 m, with the angle 37° and 42° to borehole axis, respectively. Low radar amplitude at 105–110 m. The host rock is totally dominated by quartz monzodiorite (501036). Subordinate rock type comprises very sparse occurrence of fine-grained granite (511058). Confidence level = 3.

5.9 KLX11E

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

4.02–121.00 m

RU1: Totally dominated by quartz monzodiorite (501036). Subordinate rock types comprise fine-grained granite (511058) and very sparse occurrences of granite (501058) and pegmatite (501061). The fine-grained granite (511058) primarily occurs in sections < 1 m in length. The major part of the rock unit displays foliation which is faint to medium in character. Confidence level = 3.

Possible deformation zones

Four possible deformation zones have been recognised with a high degree of confidence in KLX11E (DZ1-DZ4).

15.56–20.05 m

DZ1: Brittle deformation zone characterized by increased frequency of sealed fractures, a slight increase in open fractures, faint to weak saussuritization, faint to weak red staining, one slickenside and apertures up to 10 mm. The brittle deformation is overprinting minor brittle-ductile and ductile shear zones. One radar reflector at 19.4 m with the orientation 162/44 or 018/74, and one non-oriented radar reflector at 16.4 m with the angle 61° to borehole axis. The host rock is totally dominated by quartz monzodiorite (501036). Subordinate rock type comprises sparse occurrence of fine-grained granite (511058). Confidence level = 3.

39.00–61.42 m

DZ2: Inhomogeneous low-grade ductile deformation zone. Two oriented radar reflectors occur, one at 41.0 m with the orientation 155/45 and one at 55.8 m with the orientation 013/21 or 086/47, the latter of which is strong. Five non-oriented radar reflectors occur with angles between 36° and 65° to borehole axis. The host rock is totally dominated by quartz monzodiorite (501036). Subordinate rock types comprise sparse occurrences of fine-grained granite (511058) and very sparse occurrence of granite (501058). Confidence level = 3.

74.11–74.53 m

DZ3: Brittle deformation zone characterized by increased frequency of sealed and open fractures. The host rock is totally dominated by quartz monzodiorite (501036). Confidence level = 3.

112.48–114.80 m

DZ4: Brittle deformation zone characterized by slightly increased frequency of sealed fractures and open fractures, weak to medium red staining and one slickenside. One very strong radar reflector occurs at 113.7 m with the orientation 336/62 or 130/73. Low radar amplitude occurs at 110–115 m. The host rock is totally dominated by quartz monzodiorite (501036). Confidence level = 3.

5.10 KLX11F

Rock units

One rock unit (RU1) occurs in the borehole. The rock unit has been recognized with a high degree of confidence.

4.00–118.83 m

RU1: Totally dominated by quartz monzodiorite (501036). Subordinate rock types comprise fine-grained granite (511058) and very sparse occurrence of pegmatite (501061). The fine-grained granite (511058) primarily occurs as thin sections < 1 m in length. Scattered sections up to 10 m in length are faintly to weakly foliated. Confidence level = 3.

Possible deformation zones

One possible deformation zone has been recognised with a high degree of confidence in KLX11F (DZ1).

69.60–72.00 m

DZ1: Brittle deformation zone characterized by increased frequency of sealed and open fractures, faint to weak red staining, two crush zones and one slickenside. One non-oriented radar reflector occurs at 70.9 m with the angle 37° to borehole axis. Low radar amplitude at 70 m. The host rock is totally dominated by quartz monzodiorite (501036). Confidence level = 3.

6 Comments

The results from the geological single-hole interpretation of boreholes KLX09B, KLX09C, KLX09D, KLX09E, KLX09F, KLX11B, KLX11C, KLX11D, KLX11E and KLX11F are presented in WellCad plots (Appendices 1–10). The WellCad plot consists of the following columns:

In data Boremap	1:	Depth (Length along the borehole)
	2:	Rock type
	3:	Rock alteration
	4:	Frequency of sealed fractures
	5:	Frequency of open and partly open fractures
	6:	Crush zones
In data Geophysics	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

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/4/ **Mattsson H, Keisu M, 2006.** Oskarshamn site investigation. Interpretation of geophysical borehole measurements from KLX18A, KLX20A, KLX09B, KLX09D, KLX09F, KLX11B, HLX38, HLX39, HLX40, HLX41 and interpretation of petrophysical data from KLX20A. SKB P-06-292, Svensk Kärnbränslehantering AB.

/5/ **Gustafsson J, Gustafsson C, 2006.** Oskarshamn site investigation. RAMAC, BIPS and deviation logging in boreholes KLX09B, KLX09C, KLX09D, KLX09E, KLX09F and KLX09G. SKB P-06-99, Svensk Kärnbränslehantering AB.

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Appendix 1

Geological single-hole interpretation of KLX09B

Title	SINGLE HOLE INTERPRETATION KLX09B					
Site	LAXEMAR	Inclination [°]	-89.82	Elevation [m.a.s.l.]	23.55	Signed data
Borehole	KLX09B	Date of mapping	2006-02-16 09:19:00	Drilling Start Date	2006-01-16 14:00:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-01-26 12:00:00	
Length [m]	100.220	Northing [m]	6367328.25	Surveying Date		
Bearing [°]	21.25	Easting [m]	1548859.05	Plot Date	2007-11-13 22:03:06	

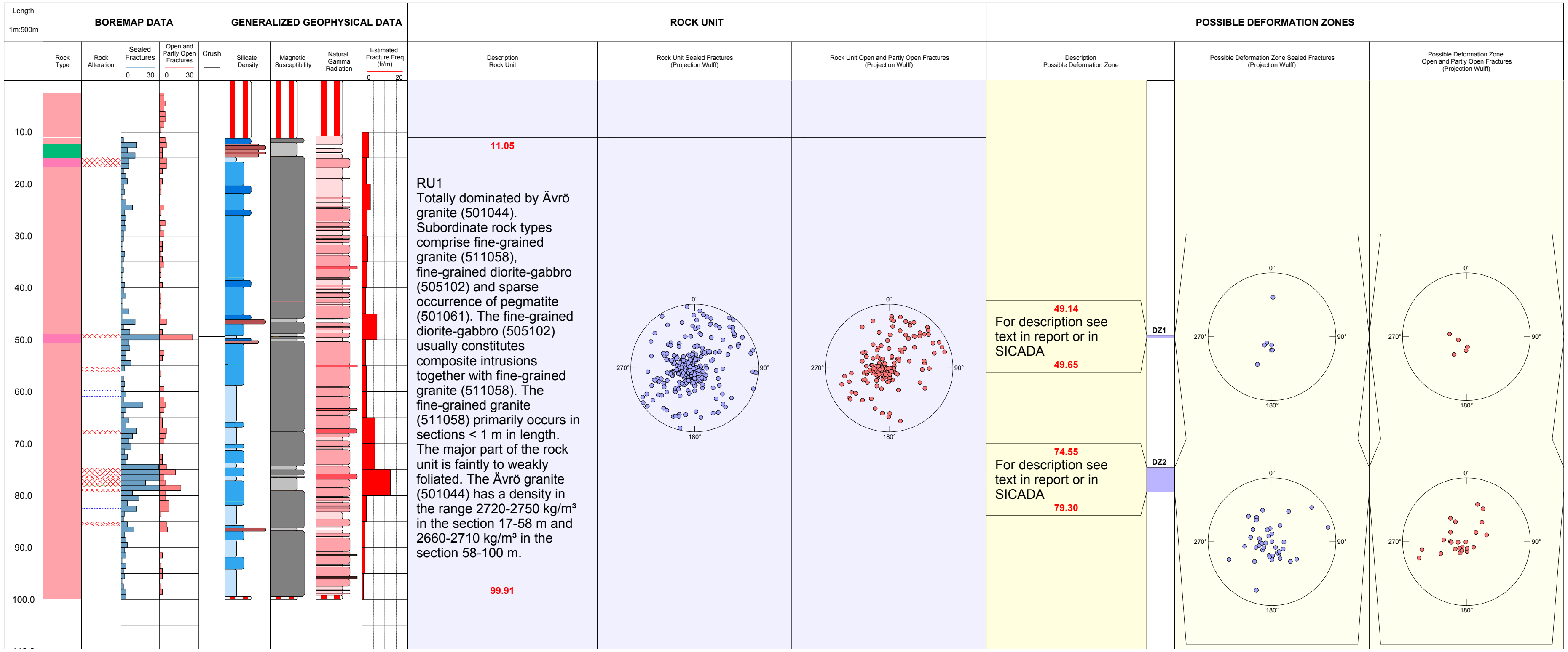
ROCKTYPE LAXEMAR
- Fine-grained granite
- Ävrö granite
- Fine-grained diorite-gabbro

ROCK ALTERATION
- Oxidized
- Epidotisized
- Saussuritization

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

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

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



Appendix 2

Geological single-hole interpretation of KLX09C

Title	SINGLE HOLE INTERPRETATION KLX09C					
Site	LAXEMAR	Inclination [°]	-59.51	Elevation [m.a.s.l.]	23.68	Signed data
Borehole	KLX09C	Date of mapping	2006-02-16 09:31:00	Drilling Start Date	2006-01-07 11:00:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-01-15 12:00:00	
Length [m]	120.050	Northing [m]	6367352.62	Surveying Date		
Bearing [°]	160.39	Easting [m]	1548838.87	Plot Date	2007-11-13 22:03:06	

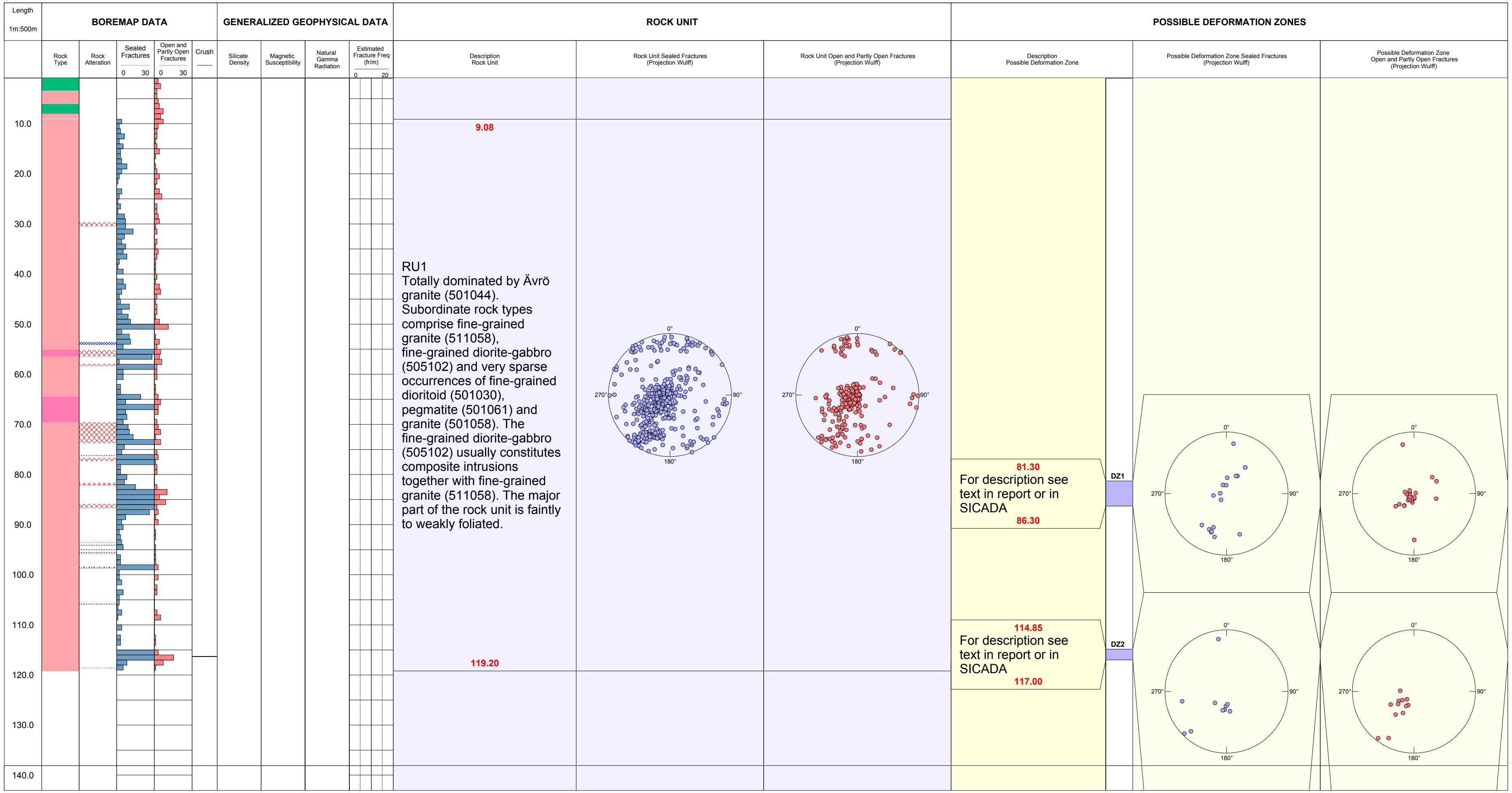
ROCKTYPE LAXEMAR
- Fine-grained granite
- Ävrö granite
- Fine-grained diorite-gabbro

ROCK ALTERATION
- Oxidized
- Epidotisized
- Silicification
- Saussuritization

SILICATE DENSITY

SUSCEPTIBILITET

NATURAL GAMMA



Geological single-hole interpretation of KLX09D

Title SINGLE HOLE INTERPRETATION KLX09D

Site	LAXEMAR	**Inclination [°]**	-60.24	**Elevation [m.a.s.l.]**	23.03	**Signed data**
Borehole	KLX09D	**Date of mapping**	2006-02-16 09:32:00	**Drilling Start Date**	2005-11-05 06:00:00	
Diameter [mm]	76	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2005-11-17 14:00:00	
Length [m]	121.020	**Northing [m]**	6367336.18	**Surveying Date**		
Bearing [°]	270.15	**Easting [m]**	1548878.27	**Plot Date**	2007-11-13 22:03:06	

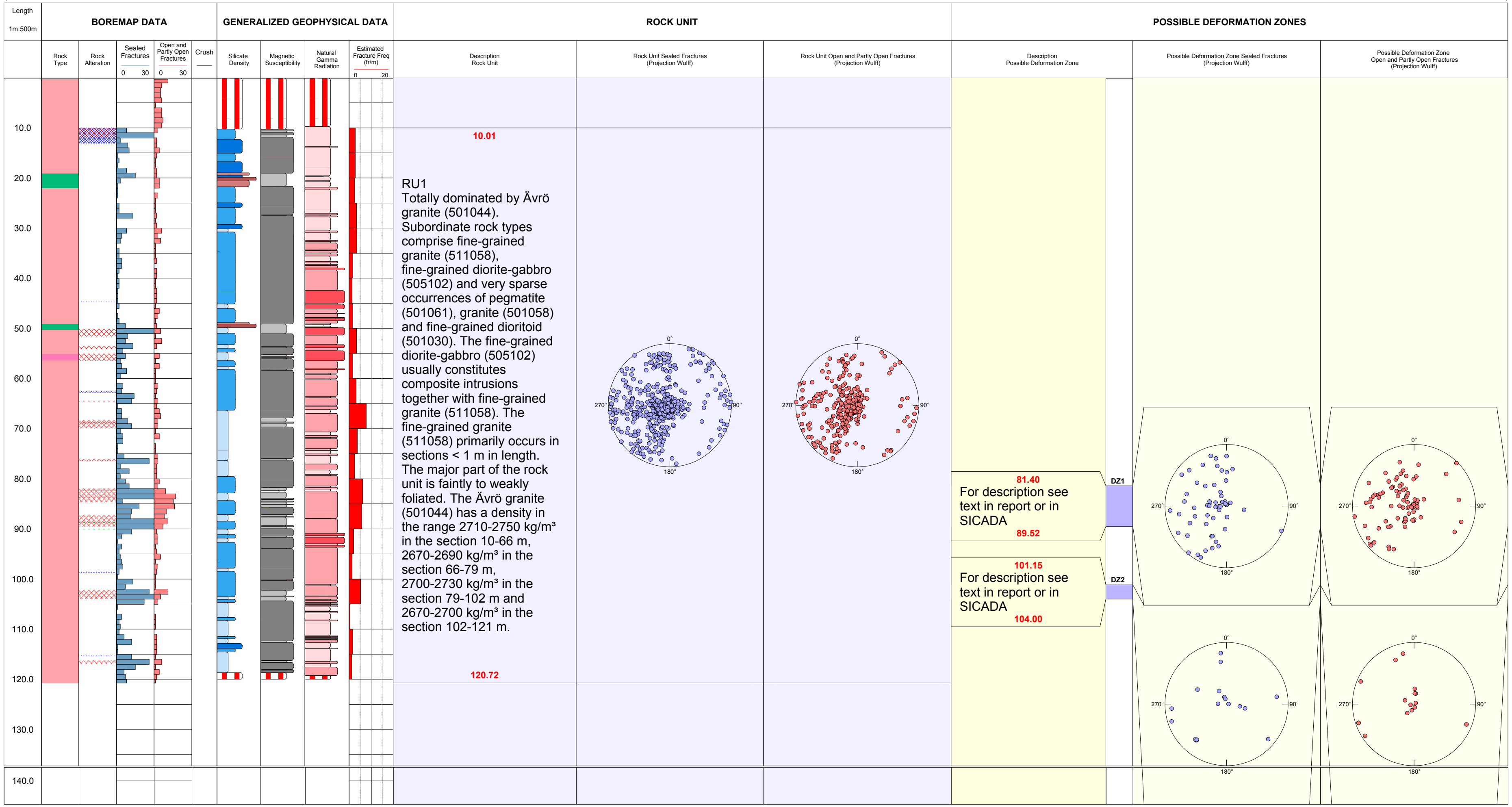
ROCKTYPE LAXEMAR
- Fine-grained granite
- Ävrö granite
- Fine-grained diorite-gabbro

ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized
- Silicification
- Saussuritization

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



Geological single-hole interpretation of KLX09E

Title SINGLE HOLE INTERPRETATION KLX09E

Site	LAXEMAR	**Inclination [°]**	-59.95	**Elevation [m.a.s.l.]**	22.09	**Signed data**	
Borehole	KLX09E	**Date of mapping**	2006-02-16 09:33:00	**Drilling Start Date**	2005-11-23 08:25:00		
Diameter [mm]	76	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2005-12-05 07:00:00		
Length [m]	120.000	**Northing [m]**	6367303.63	**Surveying Date**			
Bearing [°]	338.90	**Easting [m]**	1548880.42	**Plot Date**	2007-11-13 22:03:06		

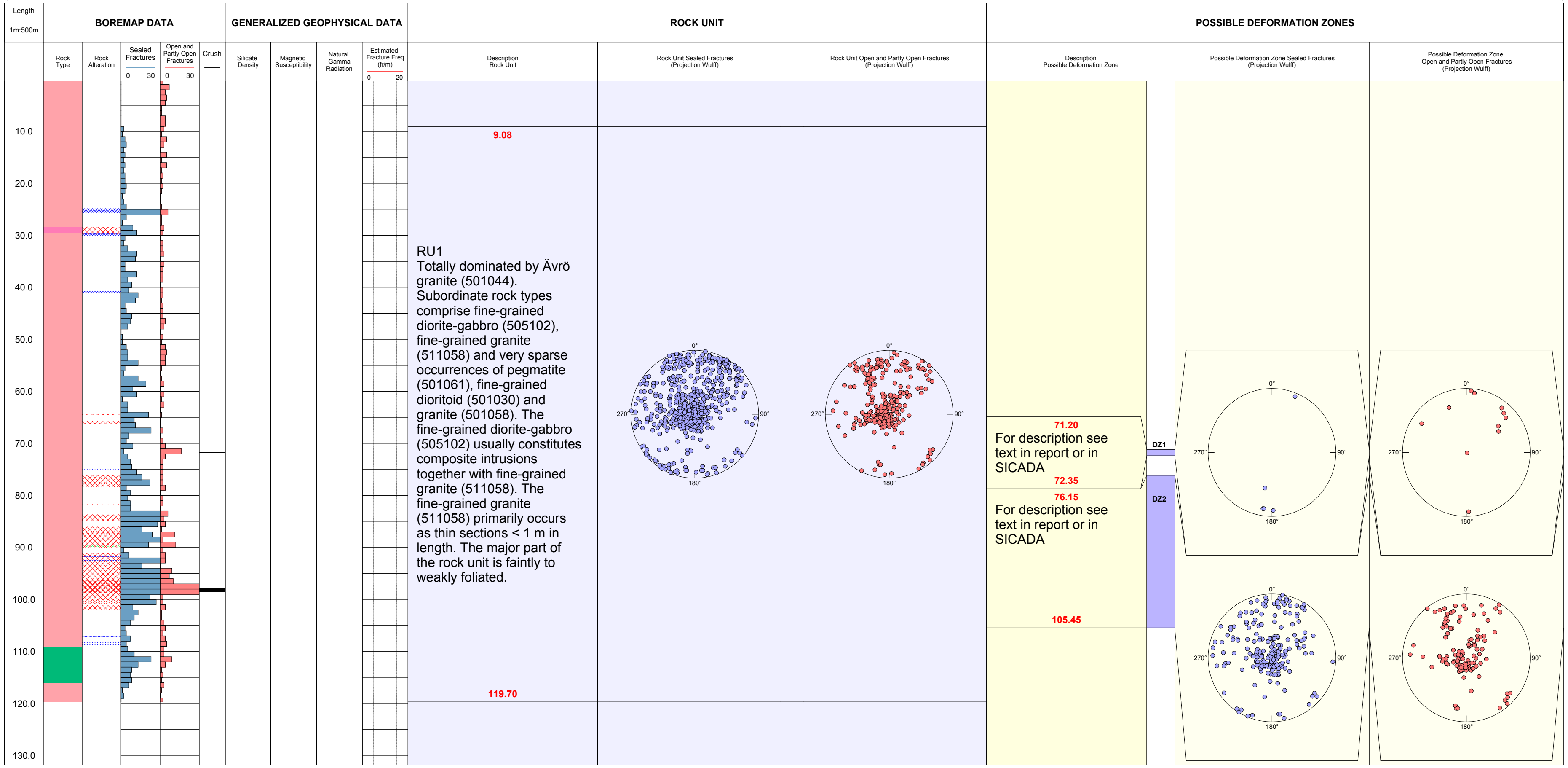
ROCKTYPE LAXEMAR
- Fine-grained granite
- Ävrö granite
- Fine-grained diorite-gabbro

ROCK ALTERATION
- Oxidized
- Epidotisized
- Saussuritization

SILICATE DENSITY

SUSCEPTIBILITET

NATURAL GAMMA



Geological single-hole interpretation of KLX09F

Title	SINGLE HOLE INTERPRETATION KLX09F					
Site	LAXEMAR	Inclination [°]	-59.73	Elevation [m.a.s.l.]	19.54	Signed data
Borehole	KLX09F	Date of mapping	2006-02-14 11:07:00	Drilling Start Date	2005-12-06 09:00:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-01-06 13:00:00	
Length [m]	152.300	Northing [m]	7327.87	Surveying Date		
Bearing [°]	102.49	Easting [m]	-520.63	Plot Date	2007-11-13 22:03:06	

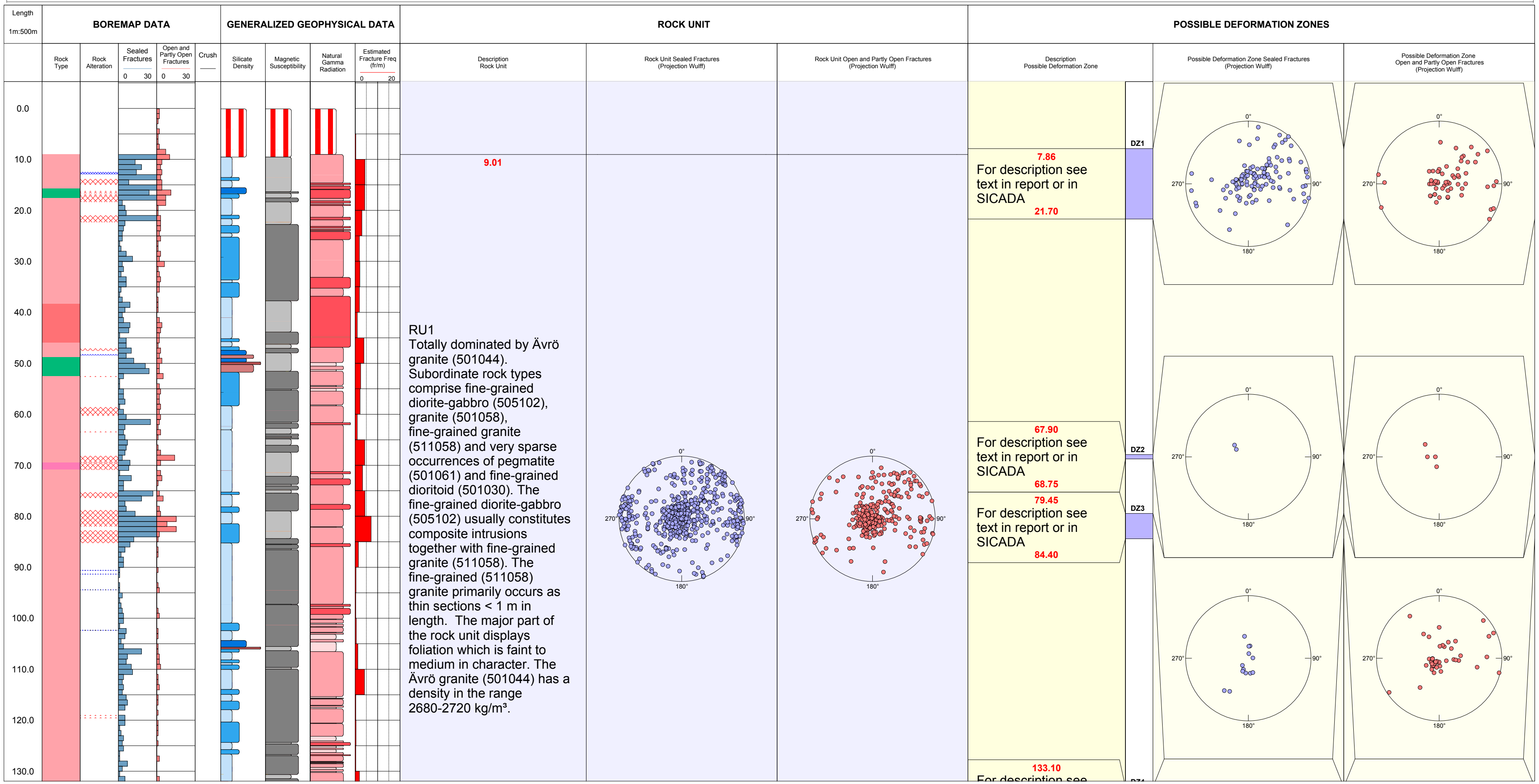
ROCKTYPE LAXEMAR
- Fine-grained granite
- Granite
- Ävrö granite
- Fine-grained diorite-gabbro

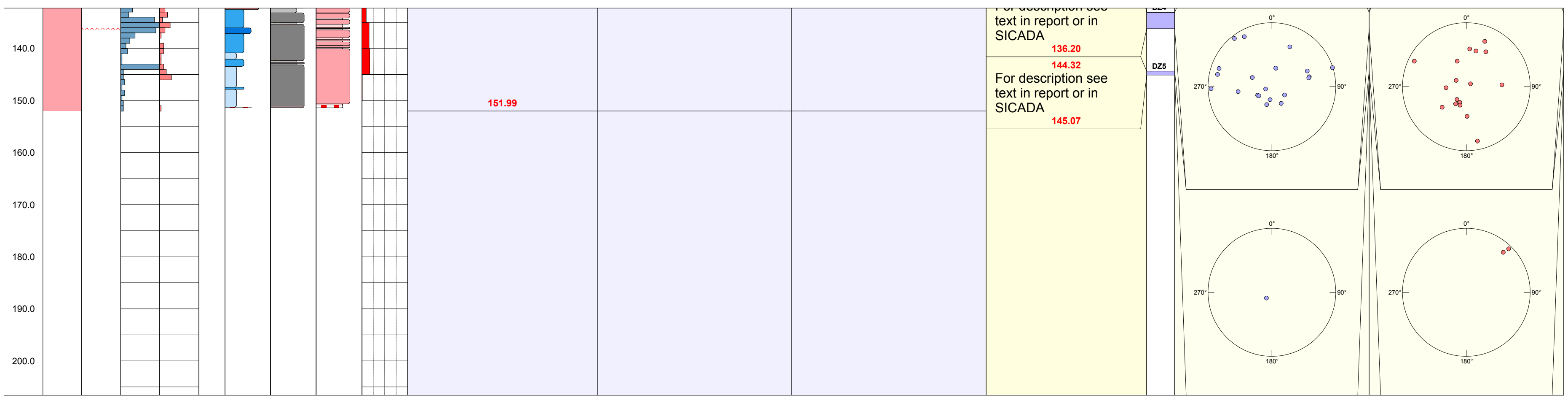
ROCK ALTERATION
- Oxidized
- Silicification
- Saussuritization

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

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

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

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136.20
144.32
For description see
text in report or in
SICADA
145.07
DZ5
0°
90°
180°
270°

Geological single-hole interpretation of KLX11B

Title	SINGLE HOLE INTERPRETATION KLX11B					
Site	LAXEMAR	Inclination [°]	-89.92	Elevation [m.a.s.l.]	27.20	Signed data
Borehole	KLX11B	Date of mapping	2006-06-29 16:56:00	Drilling Start Date	2006-04-22 16:00:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-04-28 08:50:00	
Length [m]	100.200	Northing [m]	6366338.69	Surveying Date		
Bearing [°]	136.16	Easting [m]	1546604.94	Plot Date	2007-11-13 22:03:06	

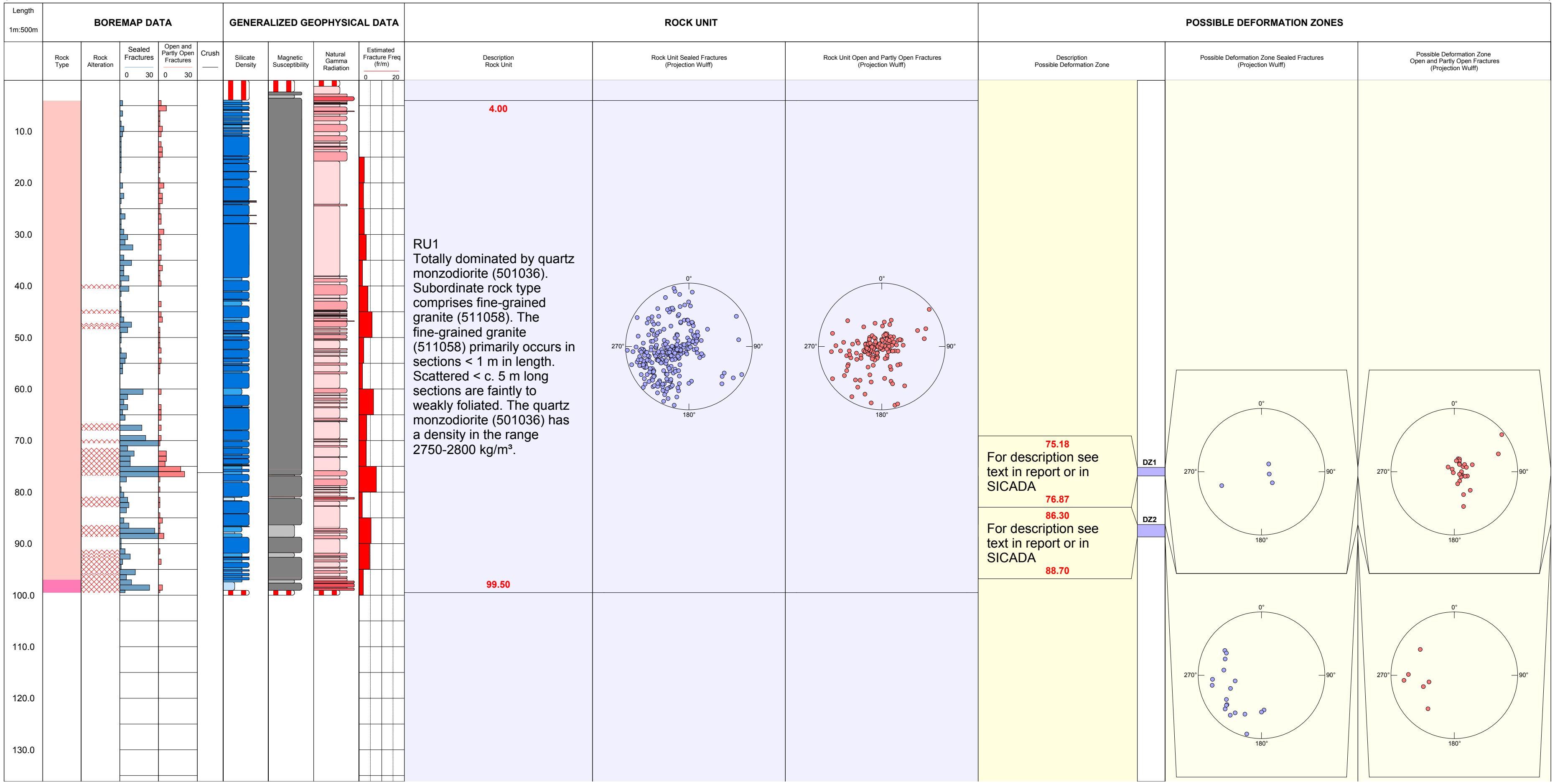
ROCKTYPE LAXEMAR
- Fine-grained granite
- Quartz monzodiorite

ROCK ALTERATION
- Oxidized
- Epidotisized

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

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

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



Appendix 7

Geological single-hole interpretation of KLX11C

Title	SINGLE HOLE INTERPRETATION KLX11C					
Site	LAXEMAR	**Inclination [°]**	-60.72	**Elevation [m.a.s.l.]**	27.12	**Signed data**
Borehole	KLX11C	**Date of mapping**	2006-06-29 16:57:00	**Drilling Start Date**	2006-03-30 06:00:00	
Diameter [mm]	76	**Coordinate System**	RT90-RHB70	**Drilling Stop Date**	2006-04-05 14:30:00	
Length [m]	120.150	**Northing [m]**	6366349.44	**Surveying Date**		
Bearing [°]	159.34	**Easting [m]**	1546586.93	**Plot Date**	2007-11-13 22:03:06	

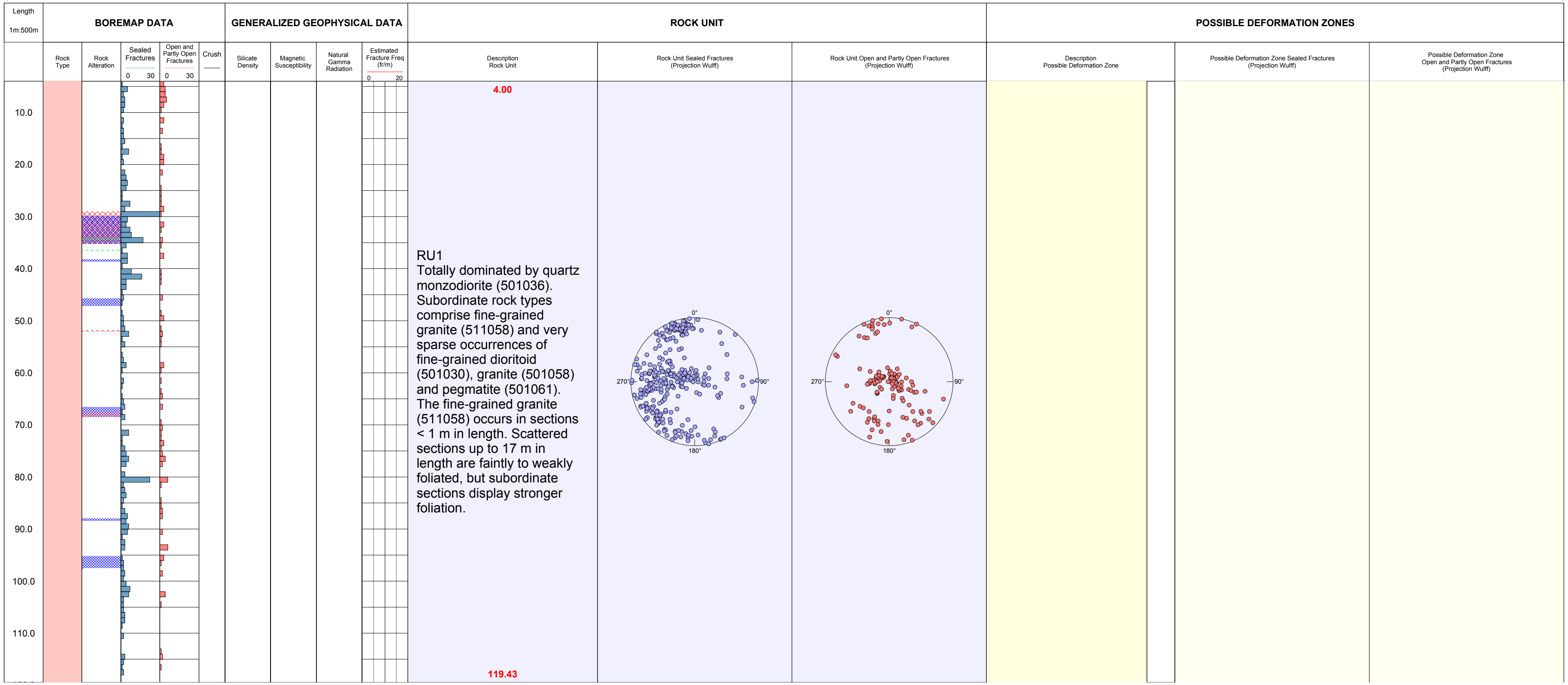
ROCKTYPE LAXEMAR
Quartz monzodiorite

ROCK ALTERATION
Oxidized
Epidotized
Saussuritization

SILICATE DENSITY

SUSCEPTIBILITET

NATURAL GAMMA



Geological single-hole interpretation of KLX11D

Title SINGLE HOLE INTERPRETATION KLX11D

Site	LAXEMAR	Inclination [°]	-58.99	Elevation [m.a.s.l.]	25.50	Signed data
Borehole	KLX11D	Date of mapping	2006-06-29 16:57:00	Drilling Start Date	2006-04-06 06:00:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-04-13 08:00:00	
Length [m]	120.350	Northing [m]	6366356.55	Surveying Date		
Bearing [°]	268.70	Easting [m]	1546631.46	Plot Date	2007-11-13 22:03:06	

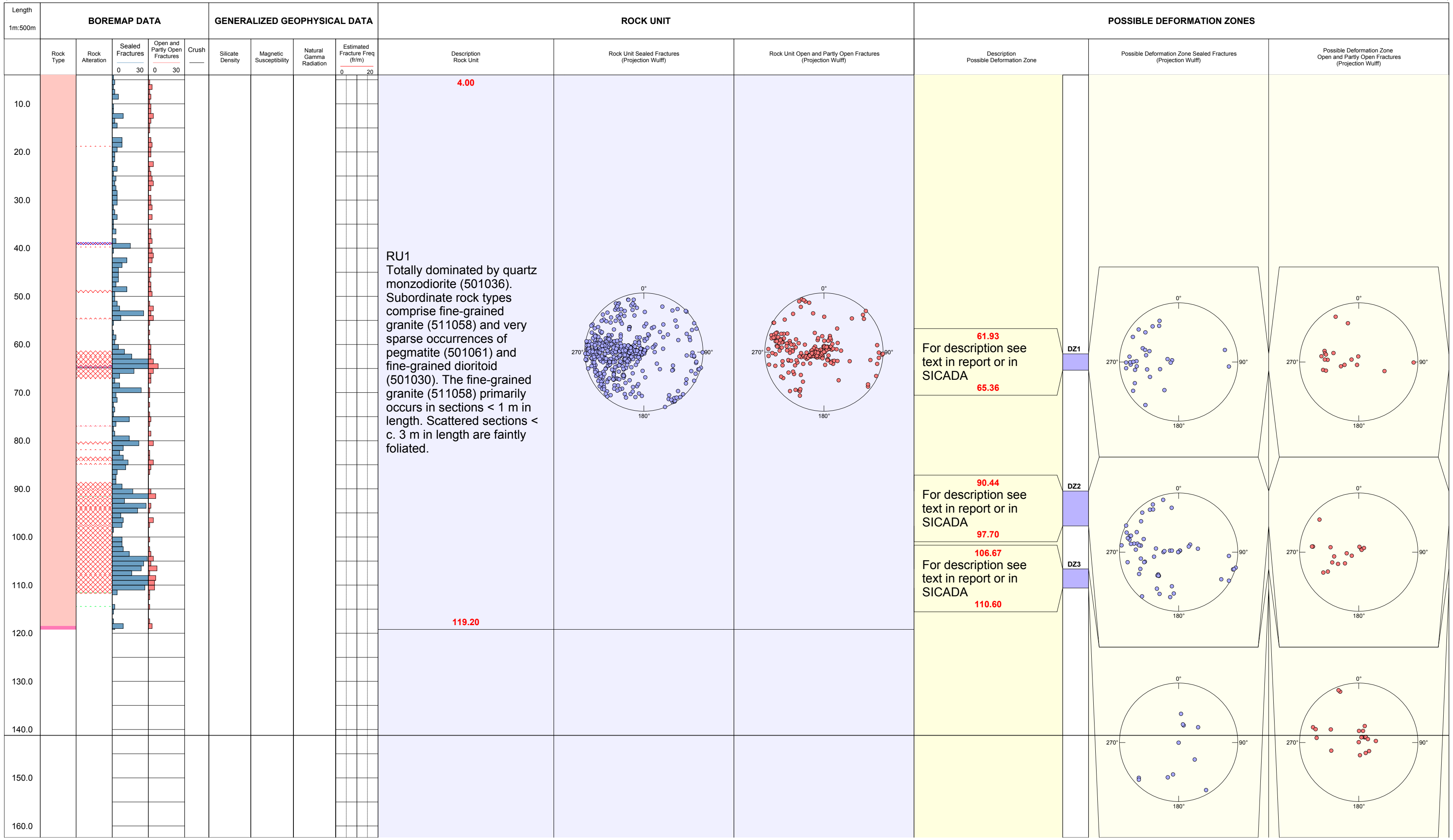
ROCKTYPE LAXEMAR
- Fine-grained granite
- Quartz monzodiorite

ROCK ALTERATION
- Oxidized
- Epidotized
- Quartz dissolution
- Albitization
- Carbonatization
- Saussuritization

SILICATE DENSITY

SUSCEPTIBILITET

NATURAL GAMMA



Appendix 9

Geological single-hole interpretation of KLX11E

Title	SINGLE HOLE INTERPRETATION KLX11E						
Site	LAXEMAR	Inclination [°]	-60.91	Elevation [m.a.s.l.]	22.58	Signed data	
Borehole	KLX11E	Date of mapping	2006-06-29 16:58:00	Drilling Start Date	2006-04-13 08:00:00		
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-04-21 14:08:00		
Length [m]	121.300	Northing [m]	6366299.57	Surveying Date			
Bearing [°]	336.17	Easting [m]	1546627.28	Plot Date	2007-11-13 22:03:06		

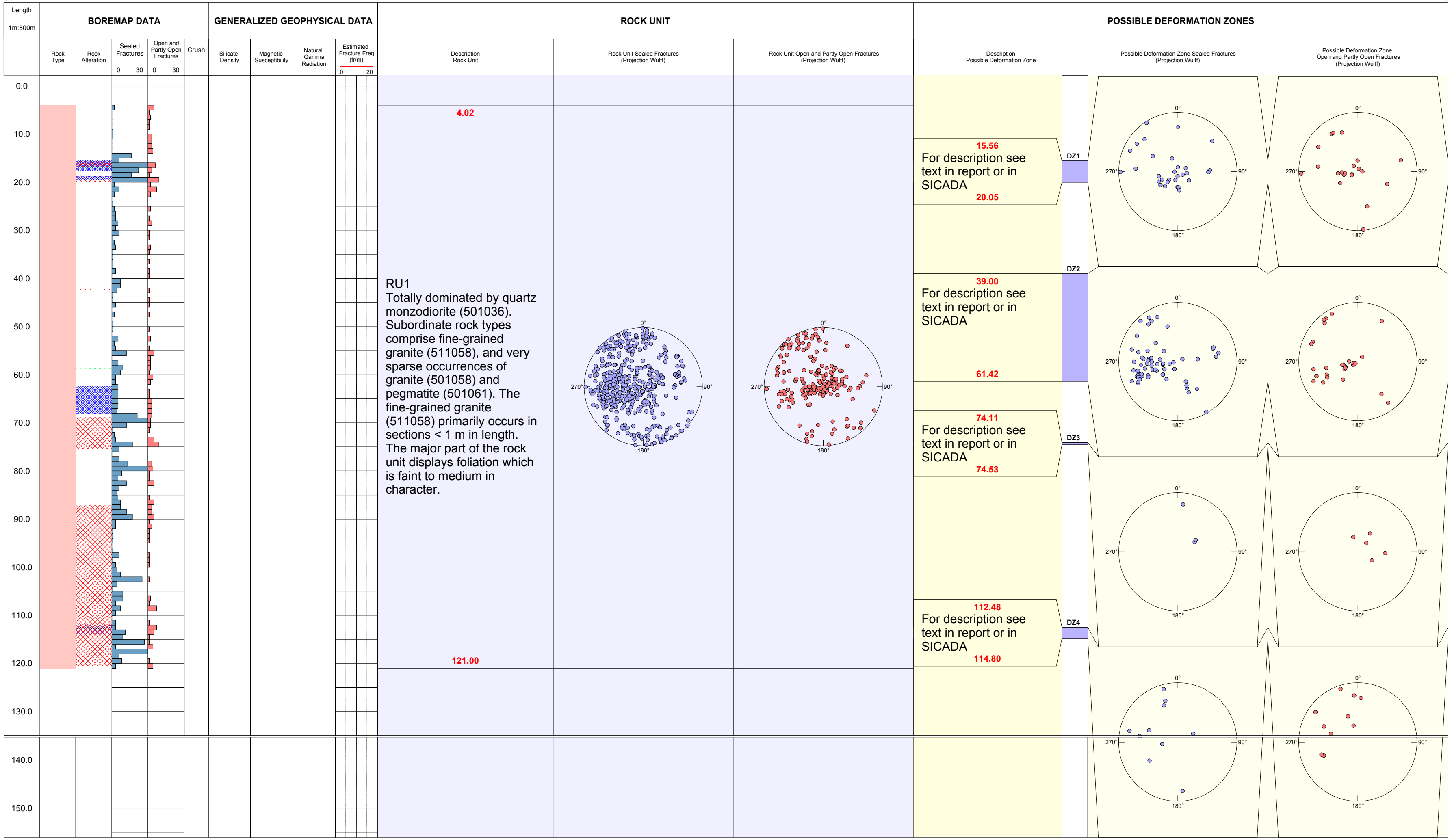
ROCKTYPE LAXEMAR
- Quartz monzodiorite

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

SILICATE DENSITY

SUSCEPTIBILITET

NATURAL GAMMA



Appendix 10

Geological single-hole interpretation of KLX11F

Title SINGLE HOLE INTERPRETATION KLX11F

Site	LAXEMAR	Inclination [°]	-61.13	Elevation [m.a.s.l.]	24.44	Signed data
Borehole	KLX11F	Date of mapping	2006-06-29 16:59:00	Drilling Start Date	2006-03-14 06:00:00	
Diameter [mm]	76	Coordinate System	RT90-RHB70	Drilling Stop Date	2006-03-17 18:00:00	
Length [m]	120.050	Northing [m]	6804.03	Surveying Date		
Bearing [°]	100.43	Easting [m]	-2918.13	Plot Date	2007-11-13 22:03:06	

ROCKTYPE LAXEMAR
- Fine-grained granite
- Quartz monzodiorite

ROCK ALTERATION
- Oxidized
- Chloritisized
- Epidotisized
- Saussuritization

SILICATE DENSITY

SUSCEPTIBILITET

NATURAL GAMMA