P-04-35

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Detailed fracture mapping of four outcrops at the Simpevarp peninsula and Ävrö

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March 2004

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Keywords: Detailed fracture mapping.

Sammanfattning

SKB utför platsundersökningar i Forsmark och Oskarshamn för att finna en plats att djupförvara använt kärnbränsle. Följande rapport beskriver en detaljkartering av sprickor och bergarter på fyra berghällar i området vid Simpevarphalvön, Oskarshamn.

Ändamålet för insamlande av sprickdata är att samla data för diskret sprickmodellering och statistisk sprickanalys.

Två av de undersökta berghällarna ligger ca 500 m öst respektive väst om kärnkraftsverkets reaktor nr 3 och en ligger strax sydväst om CLAB. Den fjärde berghällen är belägen i de centrala delarna av Ävrö.

Sprickornas geometri har karterats med en totalstation, där ett erforderligt antal punkter uppmätts längs sprickspåret i hällen. Om sprickan är rak och hällens topografi jämn, har endast de två ändpunkterna uppmätts. Om sprickan är undulerande eller om topografin varierar har mätpunkter etablerats på lämpliga ställen utmed sprickspåret. Samtliga sprickor med sprickspår längre än 0,5 m har karterats.

På respektive berghäll utfördes även linjekartering längs med två ca 10 m långa linjer i nord-sydlig respektive öst-västlig riktning, där samtliga sprickor med sprickspårslängd längre än 0,2 m har karterats. Alla inmätta geometriska data har konverterats till RT90-systemet.

Sprickornas strykning, stupning och övriga geologiska egenskaper har karterats för hand. För varje spricka beskrivs sprickavslut, relation till bergartsgränser, vidd, form, strävhet, rörelseindikationer, sprickmineral och vittring i enlighet med vad som beskrivs i metodbeskrivning SKB MD 132.003. En detaljerad bergartskartering utfördes på varje berghäll.

Resultatet från karteringarna visar att sprickfrekvens varierar från 1,7 till 5,5 sprickor per m^2 mellan de olika berghällarna. Häll ASM000025 har en yta av 419 m^2 och 917 karterade sprickor. Häll ASM000026 har en area på 523 m^2 och 877 karterade sprickor. Häll ASM000205 har en area på 215 m^2 och 1175 karterade sprickor. Häll ASM000206 har en area på 245 m^2 och 940 karterade sprickor.

All data redovisas i datafiler och ArcMap shape-filer. I SICADA-arkivet har hällarna ASM000025, ASM000026 och ASM000205 field note 108 och ASM000206 har field note 182.

Contents

1 Introduction

SKB performs site investigations in Forsmark and Oskarshamn for localisation of a deep repository for high level radioactive waste. This document reports the data gained during detailed fracture mapping of four outcrops at the Simpevarp peninsula and Ävrö in Oskarshamn. The outcrops ASM000025, ASM000026 and ASM000205 were mapped during May and June 2003 while the ASM000206 outcrop was mapped during September 2003. The bedrock mapping of the outcrops is presented in Appendix.

The detailed fracture mapping campaign was conducted according to the activity plan AP PS 400-03-020. The mapping was used to determine certain parameters, namely fracture relation to rock contacts, such as termination, crossing or coincidence. Cf. SKB MD 132-003 (SKB internal controlling document).

In the SICADA archive, the ASM000025, ASM000026 and ASM000205 outcrops has field note number 108 and the ASM000206 outcrop have field note number 182.

2 Objective and scope

The activity aimed at collecting fracture data to be used in discrete fracture analysis and discrete fracture modelling in the regional and local site investigation scale. The survey is expected to indicate the geometric properties for open and sealed fractures in the trace length interval between 0.5 m to 10 m at the sites. The results are indicative of the properties of the local fracture network and can provide important information of the variability of the fracturing between the sites. The variability and properties of the fractures may also depend on type of bedrock and its structures witch is presented in appendix**.**

The location of the four investigated outcrops can be seen in Figure 2-1. The outcrop ASM000025 was natural but the other three have been exposed from the soil cover prior to mapping. The area of the ASM000025, ASM000026, ASM000205 and ASM000206 outcrops are 419 m^2, 523 m^2, 215 m^2 and 245 m^2 respectively.

Figure 2-1. *Locations of outcrops ASM000025, ASM000026, ASM000205 and ASM000206 in the Simpevarp sub area.*

3 Equipment and methods

The fracture trace geometry was measured with a Geodimeter 640S Total Station. In theory, the survey instrument gives an accuracy of the position (x, y and z) of less than 3 mm. However, this accuracy is based on the assumption that the measuring lath is held in a perfectly vertical position. Since this is not always possible to achieve in typical field conditions the error is larger. Each measurement is therefore estimated to be performed with an x, y accuracy of 1 cm. The elevation accuracy is estimated to be less than 0.5 cm.

The number of points measured along each fracture trace varies between 2 and up to several points depending on the complexity of the trace and the rock surface. More measurements result in a better definition of the extent of the fracture trace. However, an increasing number of measurements slow down the survey substantially. The work was performed such that there was a balance between mapping speed and degree of detail of the mapped fracture traces.

The orientation and all the other fracture parameters were mapped by hand.

The mapping was performed using standardized protocols following methods described in method description for detailed fracture mapping at outcrops, SKB MD 132.003 (SKB internal controlling document).

4 Execution

4.1 Preparations

The survey instrument was positioned outside the outcrop and was calibrated against at least three fix points on each outcrop. These fix points have also been measured by the regional coordinate survey performed by SKB for outcrops ASM000025, ASM000026 and ASM000205 and by Golder Associates for outcrop ASM000206 and thus provided the coordinate translation to our local outcrop systems. The fix points are listed in Table 4-1. The survey instrument was calibrated against the fix points after each time data was downloaded from the instrument or at the beginning of each fieldwork session.

The instrument was also recalibrated to reflect temperature changes during the day.

The survey results were converted to the RT90 system after each completed survey.

Table 4-1. Fix points for outcrops ASM000025, ASM000026, ASM000205, ASM000206.

PNR	X	Y	Z
ASM000025, Simpevarp			
1001	6365975.151	1552739.354	1.468
1002	6365967.752	1552663.785	1.847
1003	6365999.082	1552720.347	2.752
ASM000026, Ävrö			
1001	6367250.377	1553094.277	13.751
1002	6367258.124	1553068.456	13.374
1003	6367283.020	1553070.018	11.939
ASM000205, CLAB			
1001	6365318.792	1550958.952	8.869
1002	6365286.858	1550968.752	8.663
1003	6365304.137	1550947.033	7.573
ASM000206, Kraftledning			
1001	6365988.652	1551741.683	11.690
1002	6365953.449	1551750.163	10.191
1003	6365962.258	1551713.140	8.256

4.2 Execution of tests/survey

The methodology for mapping fractures follows the method presented in SKB MD 132.003 (SKB internal controlling document). The work process was conducted as follows:

1. An approximately square shaped 5x5 m pattern of plastic bands, c.f. Figure 5-1, was applied over the outcrop as a help to subdivide the outcrop in smaller sub domains during the mapping campaign. These squares have no imprint on the collected data.
2. The survey instrument was calibrated against known and appointed fix points in the vicinity to the outcrop.
3. Each fracture trace was marked with a metal marker at its starting (A) and ending (B) point on the outcrop to keep track of measured fractures. The used truncation length for mapping fracture traces was 0.5 m.
4. Each fracture location and length was measured with two or more points with the survey instrument. The number of measured points on each fracture was controlled by the complexity of the structure. Special attention was made to the ending of each fracture to capture fracture termination behaviour.
5. Each fracture was mapped with respect to the given geological parameters outlined in SKB MD 132-003 (SKB internal controlling document), also given in Tables 5-1, 5-2 and 5-3.
6. Scan line measurements were performed along two 10 m long, approximately orthogonal scan lines.
7. Fracture locations were measured along the scan line. The used truncation length for scan line measurements was 0.2 m.
8. Each fracture was mapped with respect to the geological parameters given in SKB MD 132-003 (SKB internal controlling document).
9. The outcrop was cleared from markers.
10. Digital conversion of survey instrument data to RT90-RHB70 coordinate data.
11. Construction of an ArcMap shape file of fracture traces, square pattern and outcrop boundary.
12. Quality control of the survey data and consistency check with survey instrument digital data with the mapping protocols.
13. Report production.

4.3 Data handling

The deliverables to SKB for the mapping of the ASM000025, ASM000026, ASM000205 and ASM000206 outcrops include:

1. Geological parameters for the areal mapping of the outcrops:
   Filenames: ASM000025.xls, ASM000026.xls, ASM000205.xls, ASM000206.xls

2. Geological parameters for the scan line mapping of the outcrops.
   Filenames: ASM000025.xls, ASM000026.xls, ASM000205.xls, ASM000206.xls

3. Coordinate points of each survey result of the fracture traces.
   Filenames: Trace_coord_ASM000025_kod.pxy, Trace_coord_ASM000026_kod.pxy, Trace_coord_ASM000205_kod.pxy, Trace_coord_ASM000206_kod.pxy

4. ArcMap shape files for the outcrop boundary and fracture traces. The shape trace map file has each fracture identified with its elevation (1st coordinate), ID number and length.
   Filenames: ASM000025_TRACES.shp,ASM000026_traces.shp, ASM000205_traces.shp, ASM000206_traces.shp

5. ArcMap shape files for outcrop extent and applied measurement grid
   Filenames: ASM000025_kontur.shp, ASM000026_kontur.shp, ASM000205_kontur.shp, ASM000206_kontur.shp, ASM000025_grid.shp, ASM000026_grid.shp, ASM000205_grid.shp, ASM000206_grid.shp

6. Digital photos and description from the outcrops
   Filenames: Fototexter.xls. This file contains filenames for all photos in photos.zip

7. Controlling document for metadata for GIS archiving
   Filenames: Metadatamall_Trace_coord_ASM00025_Kod_R14.dwg.xls, Metadatamall_Trace_coord_ASM000026_Kod_R14.dwg.xls, Metadatamall_Trace_coord_ASM000205_Kod_R14.dwg.xls, Metadatamall_Trace_coord_ASM000206_Kod_R14.dwg.xls Metadatamall_KONTUR_ASM000026_Kod_R14.dwg.xls, Metadatamall_KONTUR_ASM000205_Kod_R14.dwg.xls, Metadatamall_KONTUR_ASM000206_Kod_R14.dwg.xls Metadatamall_GRID_ASM000026_Kod_R14.dwg.xls, Metadatamall_GRID_ASM000205_Kod_R14.dwg.xls, Metadatamall_GRID_ASM000206_Kod_R14.dwg.xls

8. Report (this)
   Filename: Rapport_OskarshamnV2.0.doc

5 Results

The results of the fracture mapping campaign include data tables and ArcMap shapefiles of:

- Area fracture mapping.
- Scan line fracture mapping (only data, no shape files).

Based on experience from work in crystalline basement outcrops, it was prior to the field investigation estimated that there would be approximately two fractures (over the truncation trace length of 0.5 m) in each m^2 of the outcrop. The ASM000025 and ASM000026 outcrops contained 917 and 877 fractures respectively which represent approximately two fractures per m^2. The ASM000205 outcrop contained 1175 fractures which represent slightly less than six fractures per m^2 and the ASM000206 outcrop contained 940 fractures which represent slightly less than four fractures per m^2.

The scan line mapping was performed along two 10 m long lines in the centre of each outcrop, one along North and one along West in a perpendicular crosscutting pattern. The truncation length for fracture traces in the scan line survey was 0.2 m. The fracture frequency along the North trending lines is 4, 2.2, 4.7 and 3.4 fractures per meter for ASM000025, ASM000026, ASM000205 and ASM000206, respectively. Along the West trending lines, fracture frequency is 3, 2, 4.6 and 3 respectively.

Table 5-1, Table 5-2 and Table 5-3 present the mapped geological parameters on each fracture trace. The parameters have been coded according to a specified system that is appropriate for retrieving from SICADA, the SKB data base for the site investigations.

Figure 5-1 shows the outcrop survey pattern at site ASM000025 and Figure 5-2, Figure 5-3, Figure 5-4 and Figure 5-5 the actual trace maps of the outcrops.

Table 5-1. Bedrock codes and description. SKB code system has been used to describe rock, structure, grain size and color.

code	**Rock type** (two first digits relate to the Simpevarp site)
501036	Quartz monzodiorite (Äspö diorite, tonalite)
501044	Ävrö granite (Småland-Ävrö granite)
501061	Pegmatite
505102	Mafic rock, fine-grained
511058	Fine-grained granite
501030	Fine-grained dioritoid (metavolcanite, vulcanite)
code	structure
45	lineation
20	gneissic
98	metamorphic, unspecified
12	discordance
52	veined
53	banded
code	**appearance**
31	vein
code	**grain-size of matrix**
2	Fine-grained
3	Fine- to medium-grained
9	Medium-grained
4	Coarse-grained
code	**Colour**
11	light red
10	Red
19	grayish red
18	reddish grey
4	Grey
6	dark grey
13	Black
	Orientation (terminology applied on all structures in bedrock)
	Strike/dip (used for all planar structures)
	Bearing/plunge (used for all linear structures)

Table 5-2. Physical properties of fractures with codes.

	Fracture trace = Visible length of the fracture in meters
code	**Fracture Termination**
	Right-hand rule. Fracture termination A is starting point and B ending point. At vertical dip, the strike (B-direction) is against the northern hemisphere (271–90 degrees). Horizontal fractures are defined with strike=0
o	Termination outside outcrop (under soil cover, water or vegetation)
p	Termination within outcrop, not against any other fracture
t	Termination against another fracture
y	Fracture terminates in a y-shape (one or several times)
x	Fracture terminates against a rock boundary. Rock code is given in column for rock termination, respectively
code	**Fracture relation to rock boundary** (except termination against, cf above)
a	Fracture crosses no rock boundary
b	Fracture crosses one rock boundary
c	Fracture crosses several rock boundaries
d	Fracture is oriented in a rock boundary (rock types given in ”comment” column)
code	**Fracture aperture**
o	Fracture appears to be open
s	Fracture appears to be closed
code	**Fracture shape**
t	Fracture is stepped up to approximately 1 cm (if the distance is greater, each part is mapped separately)
u	Fracture is undulating
p	Fracture is planar
code	**Fracture roughness**
r	Fracture surface is rough
s	Fracture surface is smooth
h	Fracture surface indicate movement (e.g. slickensides)
code	**Indication of movement**
0	There is an indication that movement have not occurred along the fracture (e.g. no displacement along a crossing rock boundary)
s	Sinistral
d	Dextral
1	Indication of movement with unknown direction
-	None of above indications has been observed

Table 5-3. Fracture mineralogy and chemistry with codes.

code	Fracture minerals
16	epidot
30	calcite
33	chlorite
36	quartz
106	zeolite (assumed)
104	jasper (red chalcedony)
45	other or unidentified fill
code	**Alteration of side-rock**
r	The rock in the vicinity of the fracture is red coloured <1 cm on each side, if its more wide see comments
rr	The rock in the vicinity of the fracture is deep red coloured <1 cm on each side, if its more wide see comments
0	No alteration (equivalent to ISRM** weathering class I)
1	County rock is discoloured, not red (ISRM weathering class II)
2	Weathering due to mineral hardness with no disintegration (ISRM weathering class III)

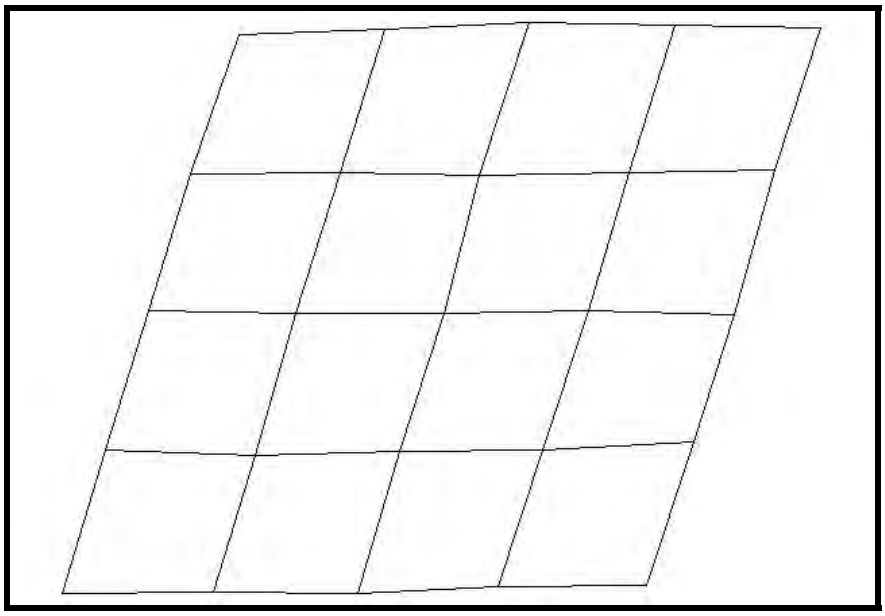

Figure 5-1. *Example of the pattern of plastic bands on the ASM000025 outcrop. Each grid cell is approximately 5x5 m.*

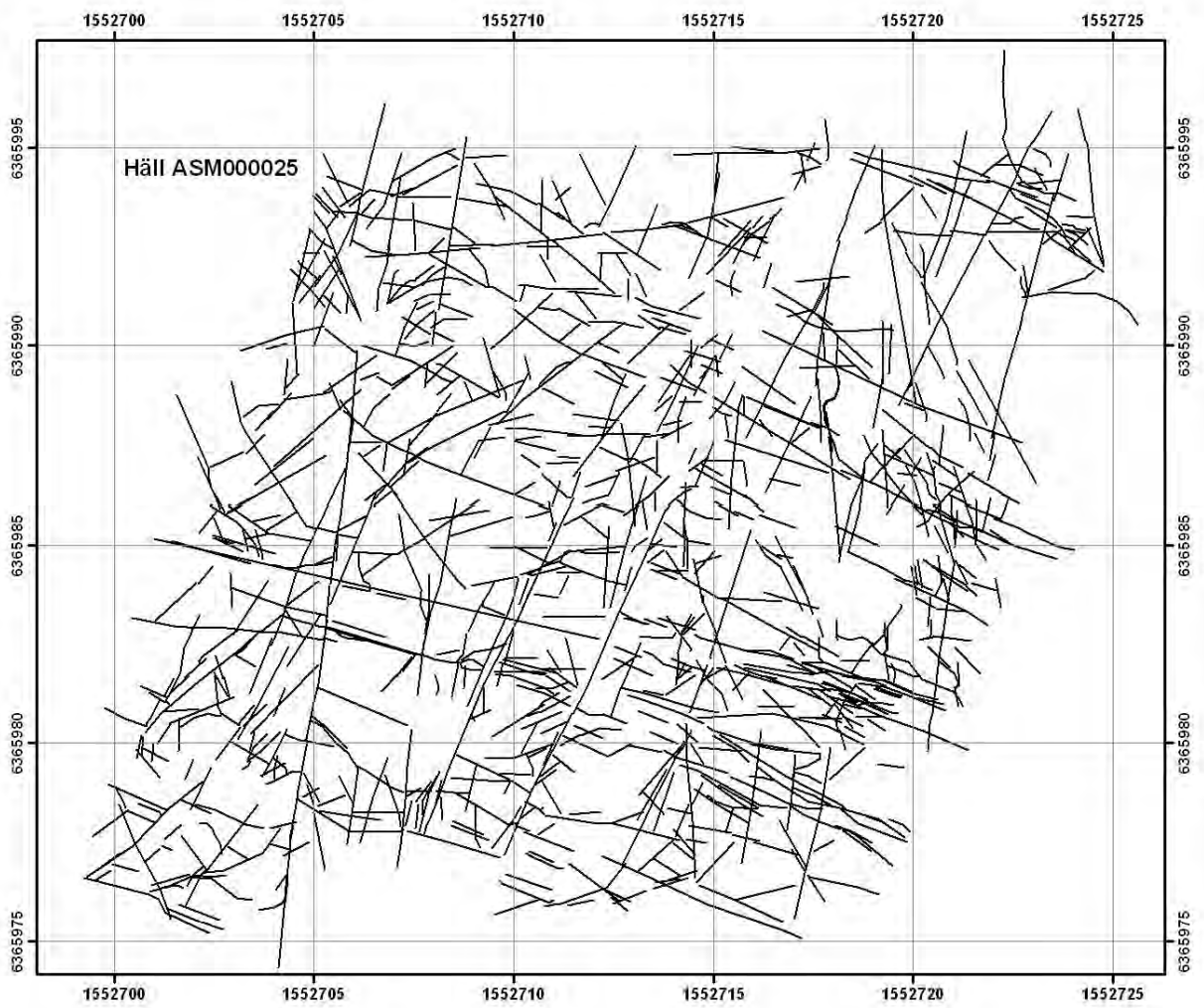

Figure 5-2. *Fracture trace map of the ASM000025 outcrop.*

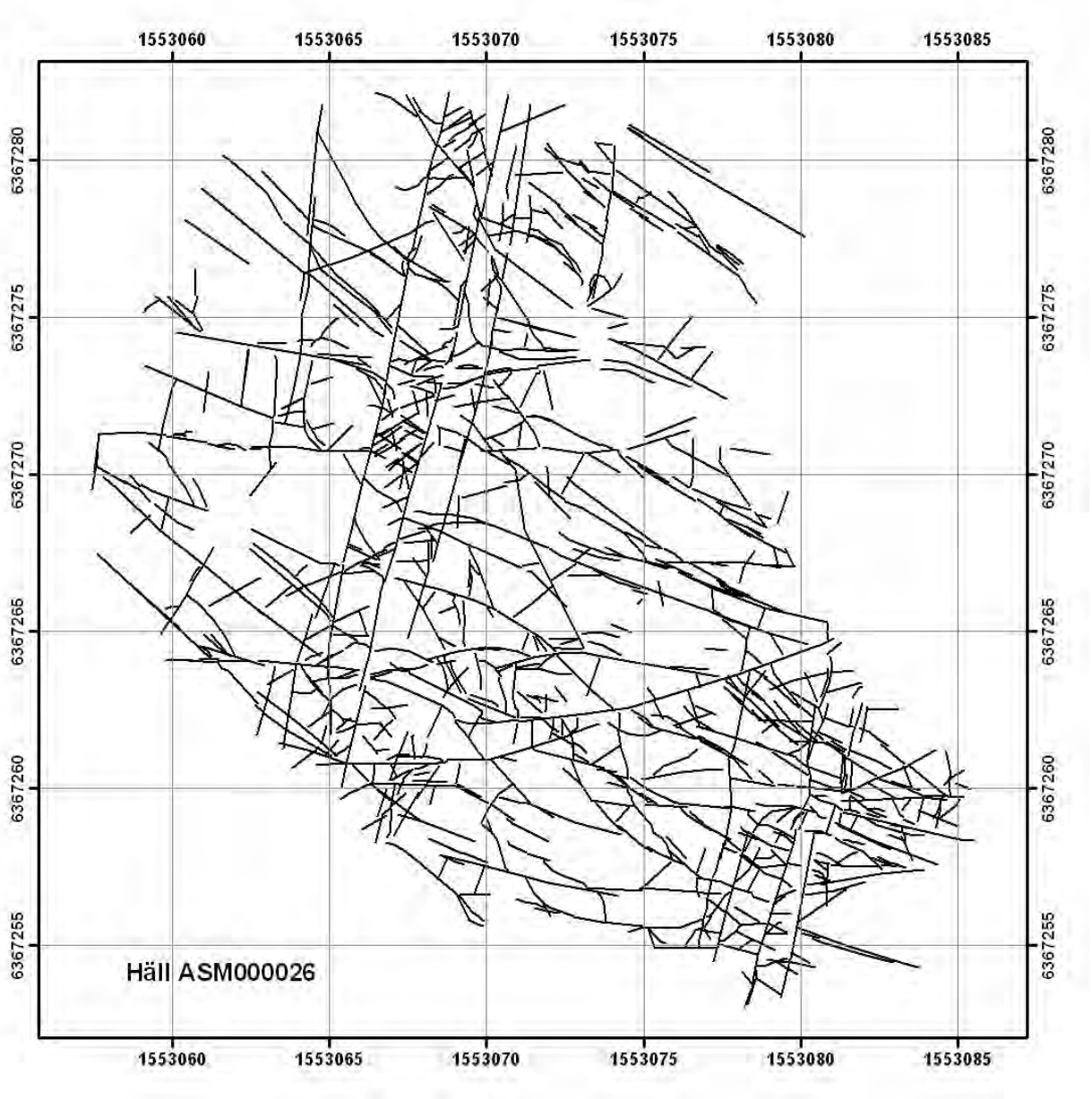

Figure 5-3. *Fracture trace map of the ASM000026 outcrop.*

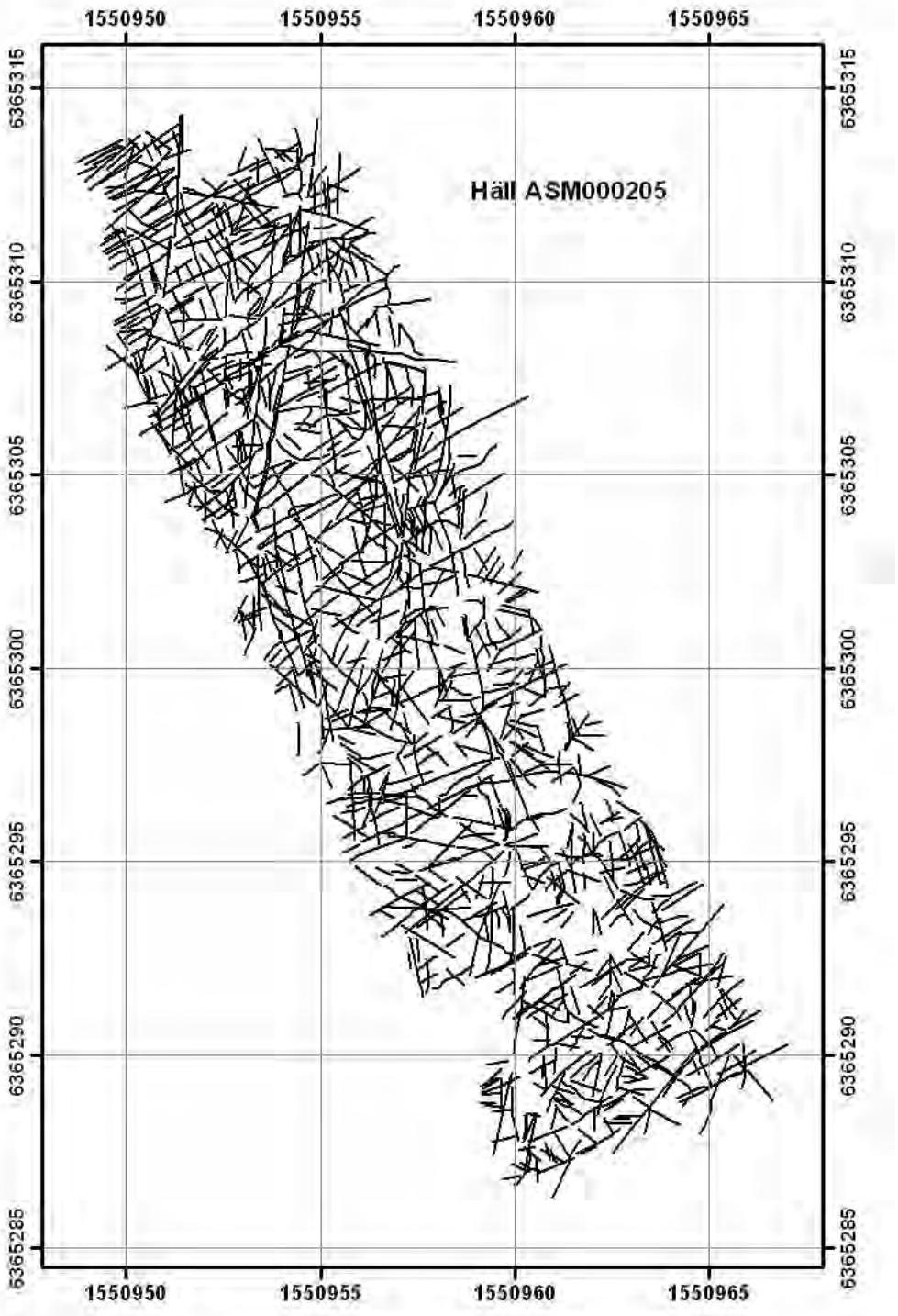

Figure 5-4. *Fracture trace map of the ASM000205 outcrop.*

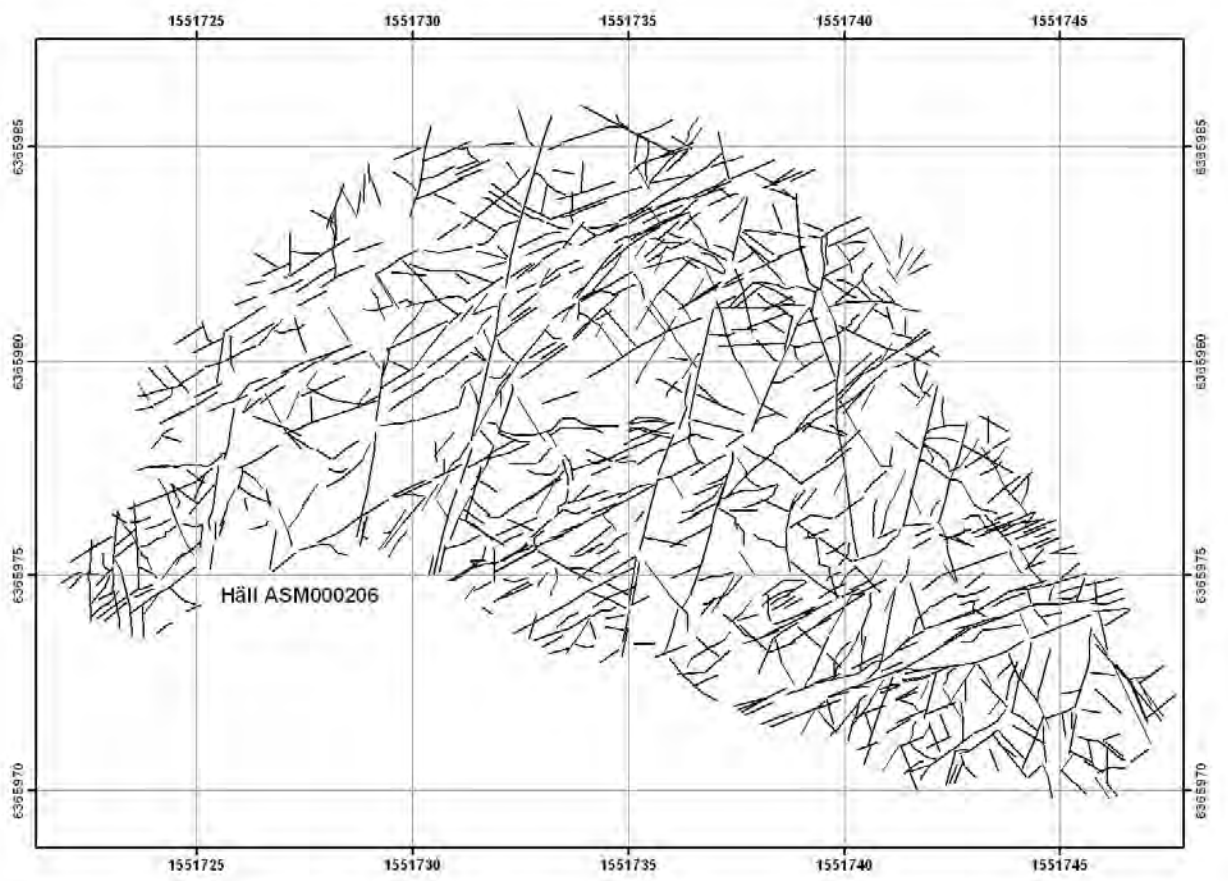

Figure 5-5. *Fracture trace map of the ASM000206 outcrop.*

Appendix

Detailed bedrock mapping at ASM000025, ASM000026, ASM000205 and ASM000206

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MIRAB Mineral Resources AB

November 2003

Detailed bedrock mapping of stripped outcrops has been performed at three outcrops at the Simpevarp peninsula (ASM000025, ASM000205, ASM000206) and one outcrop at Ävrö (ASM 000026). The aim of the activity was to obtain information on lithologies, contact relations and deformational structures at the outcrops that subsequently will be used for detailed fracture mapping. The areal distribution of lithologies was measured with a theodolite (see section 3 in the main text) and a complementary detailed bedrock mapping of the outcrops at the scale 1:50 has been performed. Schematic geological maps are compiled at the scale 1:50 and labelled "Outcrop ASM 000025, ASM 000026 ASM 000205 and ASM000206". The bedrock mapping was performed according to the methodology described in the method description for bedrock mapping, SKB MD 132.001 (SKB internal controlling document).

The bedrock at the Simpevarp peninsula and Ävrö consists of magmatic rocks belonging to the c. 1.81–1.76 Ga generation of the so called Transscandinavian Igneous Belt. Three main rock types occur:

- A grey, fine-grained, unequigranular, intermediate magmatic rock (fine-grained dioritoid).
- A grey, medium-grained, equigranular to weakly porphyritic quartz monzodiorite, including subordinate quartz monzonite and monzodiorite.
- A suite of reddish grey to greyish red, medium-grained, sparsely porphyritic intrusive rocks that varies in composition between granite and quartz monzodiorite including quartz monzonitic and granodioritic varieties.

The contacts between the above mentioned main rock types are mostly diffuse in character, which indicates that they are more or less coeval and belong to the same generation of magmatic rocks.

Furthermore dykes and minor bodies of fine- to finely medium-grained granite and pegmatite are frequently occurring, as well as dykes, lenses and enclaves of a fine-grained mafic rock.

The classification of the main rock types in the area follows rock type nomenclature established for the site investigation in Oskarshamn (internal SKB document).

Bedrock geology at ASM000025

The mapped outcrop is c. 400 m^2 and constitutes a minor part of well-exposed bedrock along the southern shore of the easternmost part of the Simpevarp peninsula. The outcrop is dominated by granite to quartz monzodiorite with xenoliths of an intermediate magmatic rock (Figure A-1).

The granite to quartz monzodiorite occupies c. 83% of the outcrop, is reddish grey to greyish red, medium- to coarse-grained, massive and sparsely porphyritic with phenocrysts of greyish white feldspar. The phenocrysts are 1.5 to 2.5 cm in size and have a rectangular or rounded shape. Locally, and within a small zone (10x30 cm in size), a weakly developed foliation occurs. The foliation trends 300–305° and the dip is vertical.

The intermediate magmatic rock occupies c.15% of the outcrop, and occurs as 1 to 3 m wide irregular bodies and is approximately trending 120°. It is dark, greyish green, fine-grained and massive (compare ASM000205).

The north-eastern contact between the intermediate magmatic rock and the granite to quartz monzodiorite is sharp and the dip varies between 60° to the SSW and vertical.

Close to the south-western contact, the intermediate magmatic rock has a coarser grain size and contains grains and aggregates of amphibole, 1–3 mm and 5–10 mm in size, respectively. It is also slightly altered and red coloured due to oxidation. The altered zone varies between 20 and 90 cm in width. The contact between the altered and unaltered rocks is sharp and dips 60° to the SSW. Furthermore, the contact between the altered volcanic rock and the granite to quartz monzodiorite is partly diffuse and the dip varies between 30 and 70° to the SSW.

Dykes and minor bodies of a fine- to finely medium-grained granite (about 2%) occur in the granite to quartz monzodiorite. The contact between the two rock types is sharp. The bodies are irregular in shape and the size varies from dm to m in size. The dykes are 1–5 m long and vary from a few cm to 10–15 cm in width. The main trend of the dykes is 325–340°/ 90° and 100°/ 40–75° (S).

A couple of quartz veins, 3–5 mm in width, intersect the granite to quartz monzodiorite and can be traced a couple of metres. The strike is 325°/ 90° and 250°/ 30° (NW).

Pegmatite (1%) occurs as irregular or curved bodies, sometimes with lenses of white quartz, and distinct dykes that cross cut all other rock types in the outcrop. Locally, the pegmatite dykes are unequigranular and aplitic zones occur. The pegmatites can be traced for several metres across the outcrop and the thickness varies from 0.5–1 to 15 cm. The main strike and dip are 30–35°/ 90–75° (SE), 160°/ 70° (WSW) and 220°/ 75° (NW).


1003s
6 365 999,08 1 552 720,35
N
Legend
Pegmatite
qz Quartz
Granite, fine- to finely medium-grained
Granite to quartz monzodiorite, generally porphyritic
Intermediate magmatic rock
Strike and dip of contact
Foliation, strike and dip
Contact covered by water
Outcrop ASM000025
Schematic geological map
Scale 1:50
MIRAB
K-A Sandahl 2003-11-21

Figure A-1

Bedrock geology at outcrop ASM000026

The stripped outcrop at Ävrö is c. 475 m^2 and is situated at the site for the cored borehole KAV01. The predominating rock (>97%) is reddish grey, medium- to coarse-grained, massive granite to quartz monzodiorite. It is generally porphyritic with 0.5–1.0 to 1.0–2.5 cm large phenocrysts of feldspar. This rock is the dominating rock type at Ävrö, and it is very similar to the dominating rock at ASM 000025 (Figure A-2).

Unevenly distributed enclaves of dark green and fine-grained mafic rock (<1%) occur in the granite to quartz monzodiorite. The shape of the enclaves is mostly rounded, ellipsoidal or somewhat irregular with sharp edges and the size varies from 1x2 cm to 5x20 cm. The contact between the enclaves and the granite to quartz monzodiorite is sharp and the enclaves are always deeper weathered and show a lower relief in comparison with the host rock.

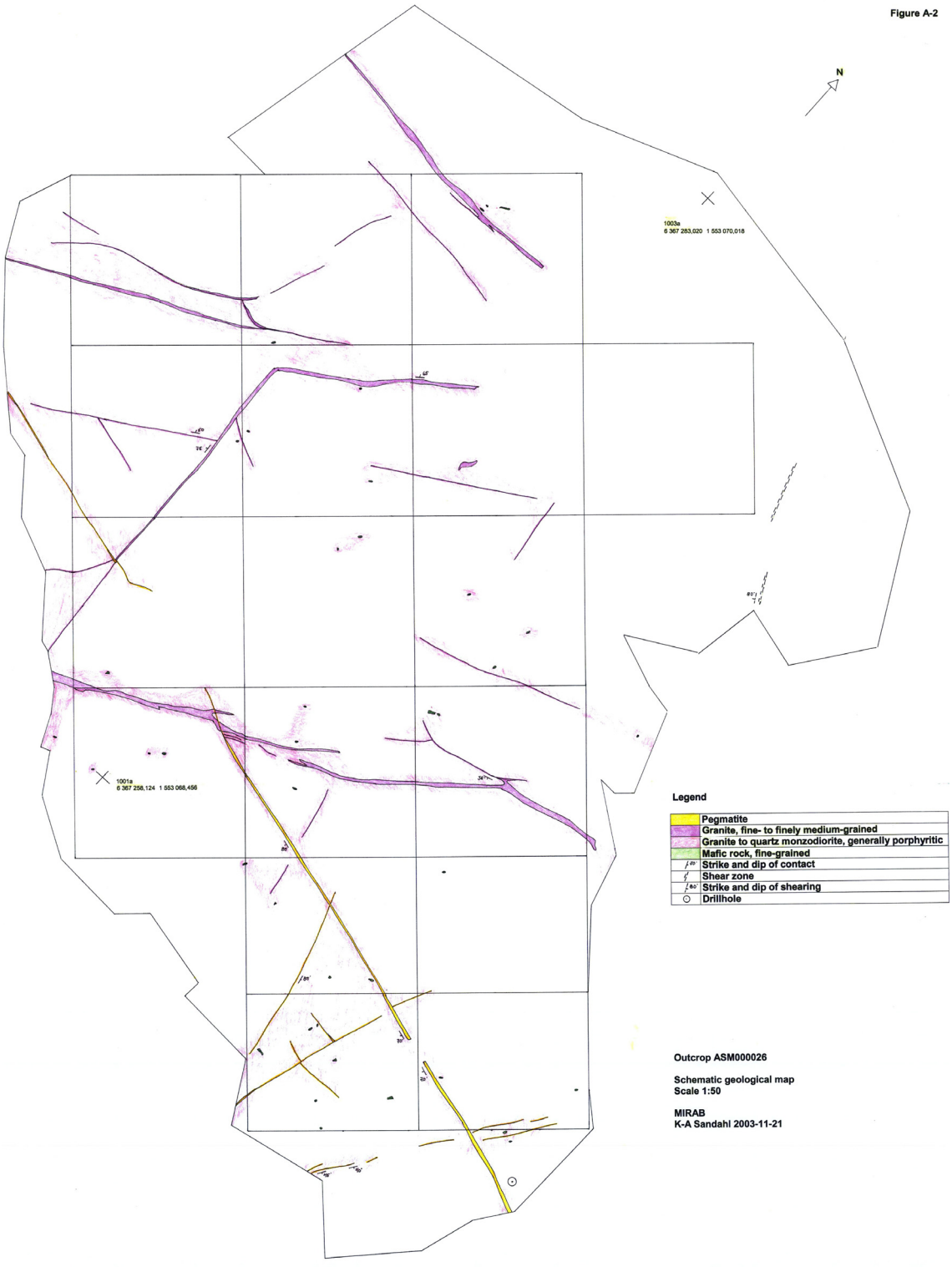
Subordinate rock types in the outcrop are dykes of granite (1%) and pegmatite (<1%). The granite is red, fine- to finely medium-grained and occurs as straight and sometimes curved or ramified dykes. The contacts between the dykes and the host rock are sharp and the dykes can be traced for several metres across the outcrop. The width varies from 1 to 20 cm. The strike and dip are very divergent, but the main strike and dip are 55–65°/ 35° (SE), 90–100°/ 85° (S) and 180°/ 75° (W).

Red pegmatite occurs as short and thin dykes in the south-eastern part of the outcrop. The length and width vary from 2–2.5 m to 1–5 cm, respectively. The strike and dip are 350°/ 85° (E), 30°/ 40° (SE) and 90–105°/ 70–85° (S).

A 5–15 cm wide pegmatite dyke that strikes 105° and dips 70–85° (S) can be traced with some break across the outcrop. The pegmatite cross cuts the granite dykes and is consequently the youngest rock in the outcrop.

Locally and in the north-eastern part of the outcrop and in the granite to quartz monzodiorite a low-grade, ductile shear zone occurs. The zone is 10 cm wide and can with some break be traced for four metres. The strike and dip are 140–150°/ 80° (SW), and a dextral strike-slip component is indicated.

Figure A-2


N
1003a
6 367 283,020 1 553 070,018
1001a
6 367 258,124 1 553 068,456
Legend
Pegmatite
Granite, fine- to finely medium-grained
Granite to quartz monzodiorite, generally porphyritic
Mafic rock, fine-grained
Strike and dip of contact
Shear zone
Strike and dip of shearing
Drillhole
Outcrop ASM000026
Schematic geological map
Scale 1:50
MIRAB
K-A Sandahl 2003-11-21

Bedrock geology at outcrop ASM000205

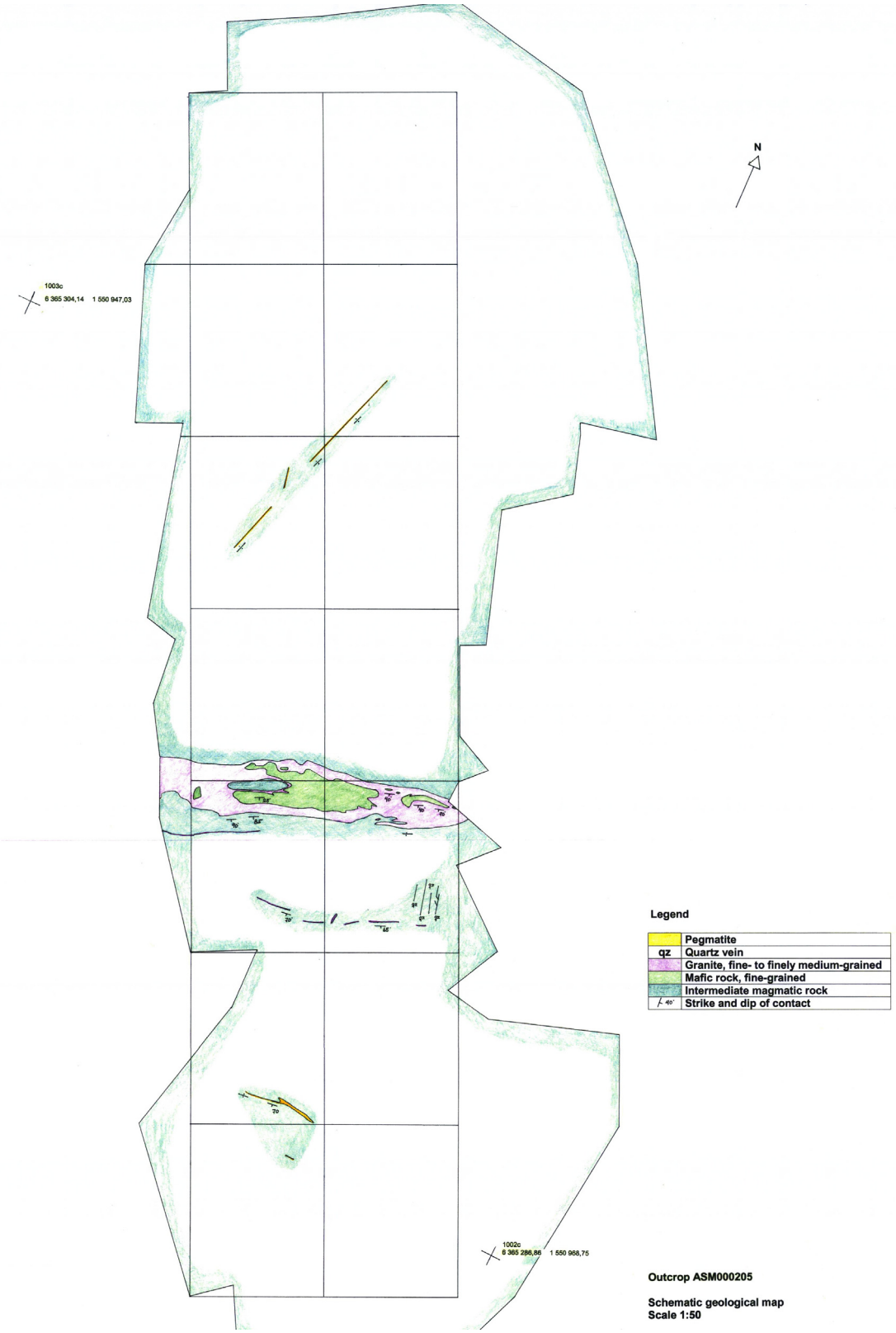
The stripped outcrop immediately west of CLAB at the Simpevarp peninsula is about 220 m^2 and is predominated by an intermediate magmatic rock (about 93% of outcrop). The intermediate and magmatic rock is dark greyish green, fine-grained and massive. The weathered surface is porous with numerous of secondary interstices, 1–3 mm in size (Figure A-3).

A composite dyke (>4% of outcrop) that is composed of red fine-grained granite and a dark green, fine-grained mafic rock with patches of hornblende and biotite, intersects the intermediate magmatic rock. The dyke trends 60–65°and the north-western and south-eastern contacts are sharp, irregular and dips 75° and 65° to the south-east, respectively. The mafic rock occurs as irregular bodies inside the granite and the contact between the two rock types is sharp and dips 25–40° to the south-east.

A lens-shaped xenolith of the intermediate magmatic rock occurs in the composite dyke. The size of the xenolith is 10–25x160 cm and the orientation is 55°/ 90°.

Thin and short dykes of red fine-grained granite (<1%) intersect the intermediate magmatic rock. The strike and dip of the dykes vary between 55°/ 90° and 70°/ 65–70° (SSE). Furthermore, a couple of pegmatite veins (<1%), both irregular and straight, intersect the intermediate magmatic rock. The irregular pegmatite veins trend 75–85°/90 and the straight veins 15°/90°.

Some veins and fracture fillings of quartz (<1%) occur in the intermediate magmatic rock. The maximum size is 1x85 cm and the orientation is 340°/ 90°.


N
1003c
6 365 304,14 1 550 947,03
1002c
6 365 286,86 1 550 968,75
Legend
Pegmatite
qz
Quartz vein
Granite, fine- to finely medium-grained
Mafic rock, fine-grained
Intermediate magmatic rock
Strike and dip of contact
Outcrop ASM000205
Schematic geological map
Scale 1:50

Bedrock geology at ASM000206

The stripped outcrop adjacent the power station at Simpevarp peninsula is c. 240 m^2 in size, but c. 1 m^2 is covered by a stump. The predominating rock (>80%) is a grey, medium-grained, equigranular quartz monzodiorite (quartz monzonite to monzodiorite) (Figure A-4). However, irregular parts of the rock display a secondary reddish staining due to hydrothermal alteration. The altered quartz monzodiorite displays a lower magnetic susceptibility than the unaltered variety (Table A-1).

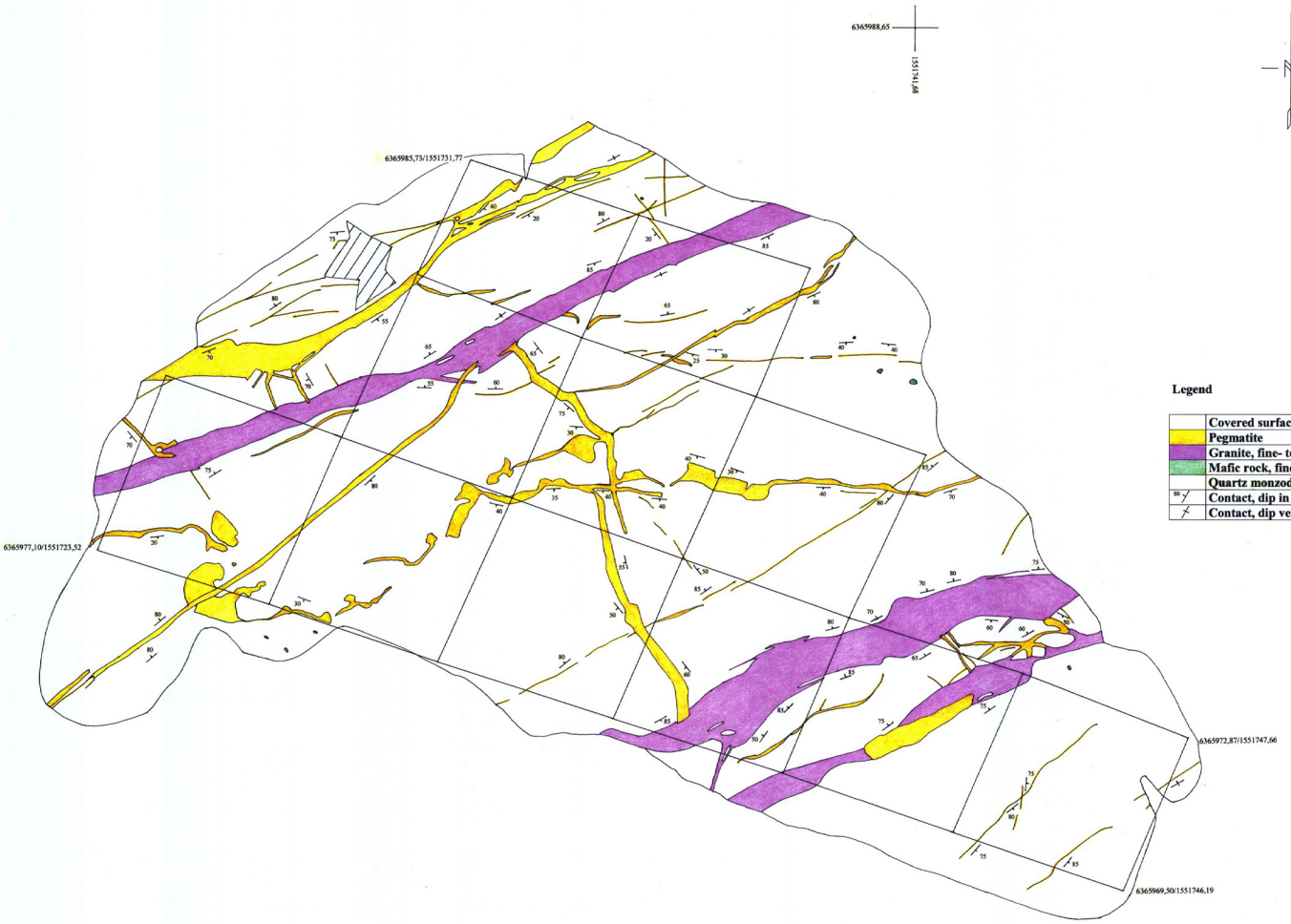
A few enclaves of a dark green and fine-grained mafic rock occur in the quartz monzodiorite. The shape is rounded and the size varies from 2 to 10 cm.

The quartz monzodiorite is intruded by a red, fine- to finely medium grained granite. The granite occurs as ENE-WSW trending and partly ramified dykes (10% of outcrop). The dykes can be traced across the outcrop and the width varies between 0.2 to 1 m. The contacts between the host rock and the dykes are sharp and it is often composed of open fractures (Figure A-5). The dip varies between 65° to the N and vertical, in exceptional cases the dip is 60–85° to SSE.

Red pegmatite with irregular aplitic zones intrudes the quartz monzodiorite and the granite dykes. The pegmatite occurs as straight or winding and partly ramified dykes (<10% of outcrop) with a main trend between ENE-WSW to E-W and vertical to subvertical dips.

Some of the pegmatite dykes are dipping 20–40° to the south and are parallel with the weathered surface of the outcrop and, consequently the main part of these pegmatite dykes occurs as irregular thin sheets. These gently to moderately dipping dykes are also intersected by the ENE-WSW-trending and steeply dipping pegmatite dykes, which suggests two generations of pegmatite dykes.

Figure A-4



Legend

	Covered surface
	Pegmatite
	Granite, fine- to finely medium-grained
	Mafic rock, fine-grained
	Quartz monzodiorite
80	Contact, dip in degrees
	Contact, dip vertical

Outcrop ASM000206

Schematic gelogical map
Scale 1:50

MIRAB
K-A Sandahl 2003-11-21

Table A-1. Magnetic susceptibility (SI-units*10^{-5}) of principal lithologies at ASM000206.

Quartz monzodiorite, unaltered	5500, 6000, 7000, 7500, 8000, 8000, 8000, 9000
Quartz monzodiorite, altered	1000, 2000, 3000, 3500, 3500, 3500, 4000, 4500
Granite dyke	15, 15, 20, 25, 30, 40, 50, 65
Pegmatite	20, 20, 30, 30, 45, 55, 75, 85

Figure A-5. *Photograph from the southern margin of the ASM000206 outcrop, showing the contact between quartz monzodiorite and a granite dyke. Note the secondary red staining along certain fractures.The ruler is 30 cm.*