

Äspö Hard Rock Laboratory

**Ground magnetic survey at site for
planned facility for calibration of borehole
orientation equipment at Äspö**

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January 2012

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This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author. SKB may draw modified conclusions, based on additional literature sources and/or expert opinions.

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Abstract

This report presents survey description and results of ground magnetic measurements carried out by GeoVista AB at Äspö in December, 2011.

The purpose of the ground magnetic measurement was to measure variations in the earth magnetic field and to gain knowledge of the magnetization of the bedrock in an area where SKB plan to build a facility for calibration of equipment for measurements of borehole orientation.

A total of 312 data points were collected along three survey lines, 104 points/profile. The data show nice and smooth variations that appear to be natural. There is a clear consistency of the magnetic field variations between the three survey lines, which indicates that the variations in the magnetic field reflect geological variations related to lithology and content of magnetic minerals. There are no indications of artifacts or erroneous data. The anomaly field averages at -32 nT with peak values of $\text{Min} = -1,016$ nT and $\text{Max} = +572$ nT. The strongest anomalies occur at profile length c. 130–140 m. Adding the background field of $50,823$ nT, measured at a base station located close to the survey area, the total magnetic field averages at $50,791 \pm 226$ nT.

The ground magnetic measurement gives background information before the construction of the calibration facility. The magnetic anomaly at c. 130–140 m give possibilities to control disturbances of magnetic-accelerometer based instruments. The magnetic measurements show that it is possible to construct the facility at the site.

Sammanfattning

Föreliggande rapport presenterar genomförandet och resultaten av markbaserade magnetiska mätningar som GeoVista AB utförde på Äspö i december 2011.

Syftet med mätningarna var att registrera variationer i jordens magnetfält och få en bild av variationer i berggrundens magnetiska egenskaper i området. På platsen för mätningarna planerar SKB att bygga en anläggning för kalibrering av instrument för mätning av borrhålsorientering.

Totalt insamlades 312 st mätpunkter med data längs de tre profilerna, 104 mätvärden/profil. Variationerna i data är mjuka och naturliga och där finns en tydlig samstämmighet mellan de tre profilerna. Detta indikerar att data speglar variationer i berggrundens magnetisering kopplade till olika bergartstyper och dess innehåll av magnetiska mineral. Det finns inga indikationer på felaktiga data eller artefakter. Det magnetiska anomalifältet har ett medelvärde på -32 nT, med max/min-värden av $+572/-1\ 016$ nT. De största magnetiska anomalierna förekommer längs profilintervallet mellan ca 130–140 m. Om vi lägger till bakgrundsfältet som uppmättes vid en basstation nära profilområdet så är medelvärdet av det jordmagnetiska fältet inom mätområdet $50\ 791 \pm 226$ nT.

De magnetiska mätningarna ger bakgrundsinformation innan kalibreringsanläggningen konstrueras. Den magnetiska anomalin mellan ca 130–140 m ger möjlighet att kontrollera instrument baserade på magnetiska-accelerometer givare. De magnetiska mätningarna visar att det är möjligt att konstruera anläggningen på angiven plats.

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1 Introduction

This document reports the results gained from ground geophysical measurements of the magnetic total field at Äspö in December 2011 (Figure 1-1). The work was carried out in accordance with the activity plan AP TD ÄSYTT-11-090. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

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

Activity plan	Number	Version
Magnetmätning för kontroll- och kalibreringsanläggning av krökningsmätningar	AP TD ÄSYTT-11-090	1.0
Method descriptions	Number	Version
Metodbeskrivning för markbaserad magnetometri	SKB MD 212.004	1.0

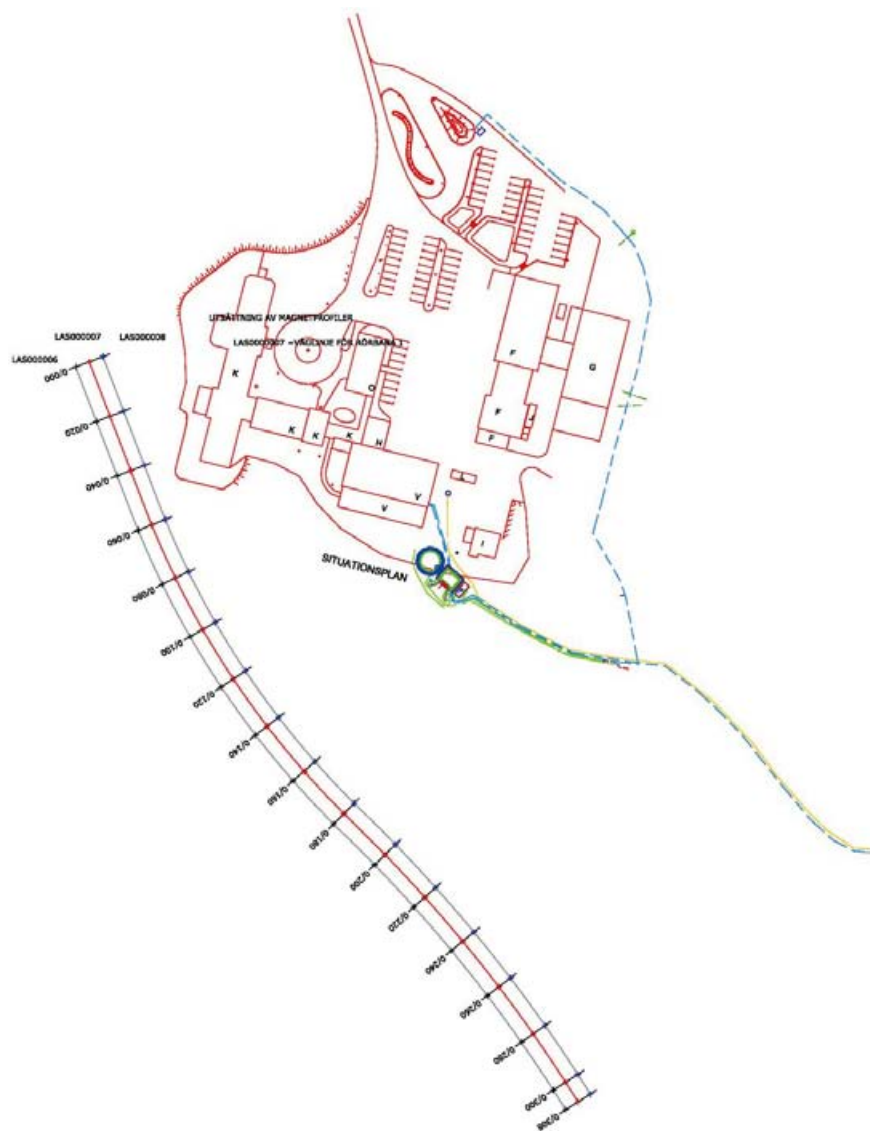


Figure 1-1. Sketch (top view) over the Äspö laboratory showing the locations of the three survey lines LAS000006, LAS000007 and LAS000008.

2 Objective and scope

The purpose of the ground magnetic measurement is to map variations in the earth magnetic field and to gain knowledge of the magnetization of the bedrock in an area where SKB plan to build a facility for calibration of borehole orientation equipment. Highly magnetic rocks (generally magnetite bearing) give rise to large anomalies in the earth magnetic field. Measurements of the total magnetic field will indicate if there are large variations in the magnetic field close to the proposed location of the facility for calibrating equipment for measuring borehole orientation. The results will also indicate if there are any highly magnetized rocks in the area.

3 Equipment

The measurements of the magnetic field were performed with two magnetometers Gem Systems GSM-19 of where of one was used as a diurnal base station. The magnetometers used were calibrated at the factory and a quality controlled performance of them was assured by following method descriptions and the internal quality plan of the activity as presented to SKB before the survey started.

The processing, interpretation and reporting included the use of the following software:

Grapher v7 (Golden Software)
MapInfo Professional 10.5 (MapInfo Corporation)
Discover 12.0 (Encom Technology)
Microsoft Excel (Microsoft Corp.)
Microsoft Word (Microsoft Corp.)
Adobe Acrobat and Adobe Distiller (Adobe Systems Inc.).

4 Execution

4.1 Ground magnetic survey

The magnetic total field survey was conducted with two Gem Systems GSM-19 magnetometers whereof one was used as a diurnal base station. One reading at the base station was registered every 10 seconds and was used to make a diurnal correction of the data collected with the mobile magnetometer. The magnetometers were time synchronized before starting the survey.

Magnetic readings were taken along profiles with a station interval of 3 metres; the profile separation was 5 m.

Base station position was 15 51 538 m east and 63 67 625 m north in the RT90 2.5 gon west standard coordinate projection system. The measurements of the magnetic total field were carried out according to the method description (Metodbeskrivning för markbaserad magnetometri, SKB MD 212.004, version 1.0, SKB internal document).

4.2 Data processing

The processing performed on the magnetic data was the removal of diurnal variations recorded by the base magnetometer. This procedure results in a magnetic anomaly field. The average total magnetic field recorded at the base station was then added to the anomaly field.

4.3 Analyses and interpretations

No analyses or interpretations were carried out.

4.4 Nonconformities

No nonconformities are reported.

5 Results

5.1 Results of the ground magnetic survey

The results of the ground magnetic survey along the profiles LAS000006, LAS000007 and LAS000008 are shown in Figure 5-1. A total of 312 data points were collected along three survey lines, 104 points/profile. The data show nice and smooth variations that appear to be natural. There is a clear consistency of the magnetic field variations between the three survey lines, which indicates that the variations in the magnetic field reflect geological variations related to lithology and content of magnetic minerals. There are no indications of artifacts or erroneous data. The anomaly field averages at -32 nT with peak values of $\text{Min} = -1,016$ nT and $\text{Max} = +572$ nT. The strongest anomalies occur at profile length c. 130–140 m. Adding the background field of $50,823$ nT, measured at a base station located close to the survey area, the total magnetic field averages at $50,791 \pm 226$ nT.

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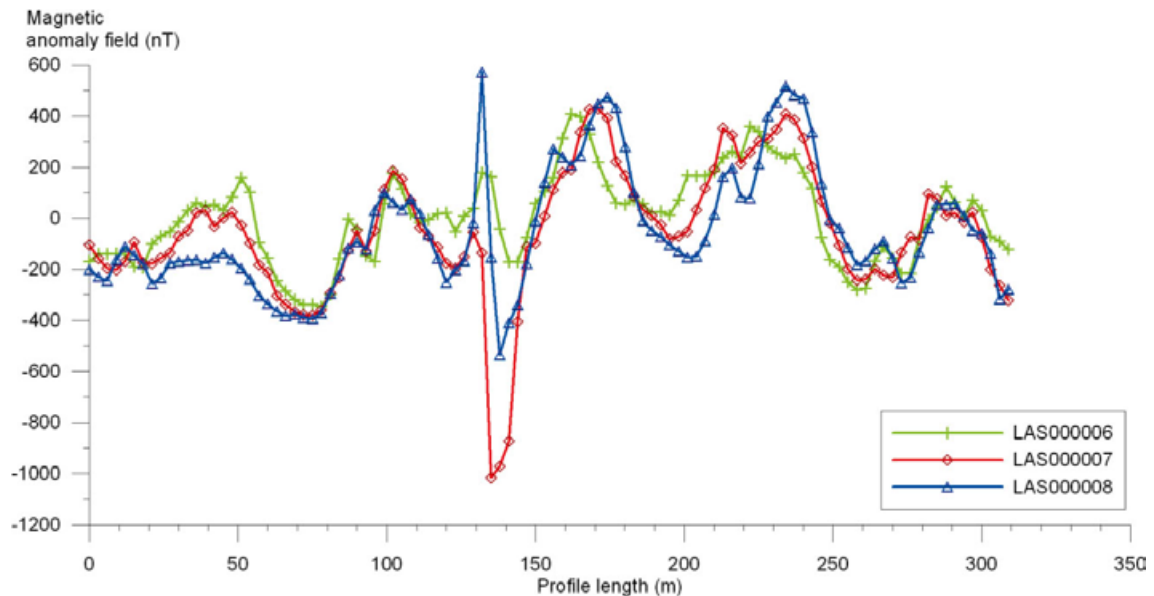


Figure 5-1. Diagram showing the magnetic anomaly field (nT) along the three survey lines.