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A geophysical investigation of Kjølhauggruppen and Sulåmogruppen over two areas near Meråker, Norway

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RAPPORT

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Tittel:

A geophysical investigation of Kjølhauggruppen and Sulåmogruppen over two areas near Meråker, Norway

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Sammendrag:

Results of a helicopter geophysical survey in the Meråker area have been interpreted with the goal of locating mineralization. A comparision of geophysical data over known mines and showings has determined that mineralization is correlated with 70 ppm or greater EM anomalies in the high frequency channel. Associated magnetic anomalies are either weak (under 25 nT) or non-existent. Results indicate that two zones are favourable for mineralization. One is along the contact between Sulåmogruppen greenstones and meta-sandstones and the second is along an axis connecting Dudu gruve with Langsund gruve and extending north to Hammerskallen skjerp.

Emneord: Geofysikk	Tolkning	Malm
Helikoptermåling	Elektromagnetisk måling	Magnetometri
		Fagrapport

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Introduction

A helicopter electromagentic (HEM), magnetic, VLF and radiometric survey was flown over the Meråker area in 1991 by the Norwegian Geological Survey (NGU). The purpose of the survey was to extend geophysical coverage in the Nord-Trøndelag area as a part of the Nord-Trøndelag mapping program initiated and carried out by NGU. The survey consisted of lines flown in an east-west direction at a nominal spacing of 200 meters and a nominal height of 60 meters covering parts of map sheets 1722 II and III and map sheets 1721 I, II, III and IV. A description of the equipment used, data processing and results of this survey are presented in NGU report 92.153 (Mogaard, 1992).

One of the goals of the geophysical survey was to locate areas favourable for mineralization. Several of the mines which are or have been active in the area, and several showings are listed in the Appendix. However, a sound geologic model describing the formation of these deposits does not exist, because the factors influencing the location of the mineralization are not clear. Without such a model, it has been difficult to target areas of primary interest for mineral exploration, and in fact to determine which geophysical parameters/values to use when selecting anomalies for further scrutiny. As such, part of this report includes a study of geophysics over known and suspected mineralization in the area. However this study cannot by any measure considered to be complete, and more such work is definitely required.

This report focuses of two areas covered by the survey which contain several showings and mines. Because the area covered by the Meråker survey is quite extensive, the geology is quite varied, and an interpretation was required before the summer field season, it was impossible to complete a comprehensive interpretation of the entire survey. The areas discussed in this report were selected because of promising geology, geochemical anomalies, the presence of mines and showings, and the presence of electromagnetic anomalies. The report addresses the electromagnetic and magnetic signatures related to known showings in those areas. Enclosed maps show geophysical anomalies, mines, claims and showings, and suggests locations for further ground follow-up work.

Location

The areas examined lie to the east and south of Meråker. The area are bounded by the following UTM coordinates (see Figures 1 and 2):

	SOUTH	NORTH	WEST	EAST
AREA1	7029000N	7038000N	637000E	645000E
AREA2	7022000N	7029000N	635000E	641000E

Coordinates are in ED50, UTM zone 32.

Area 1 (see figure 1) lies completely in map sheet 1721 I, as is bounded by the village of Meråker on its northeast corner. It extends to the east roughly to the dam on Fjergen leading to the Kopperåa and from there southwards to Fjelldalshøgda.

Area 2 (see figure 2) lies to the south and east of area 1, and is bounded to the east roughly by Dalådalen and extends south to Litleva. Map sheets covering area 2 are 1721 I and 1721 IV.

Geology

The geology has been mapped at 1:250000 scale and is curently being remapped at 1:50000 scale. Strike varies from north-north east to northeast. The eastern part of the areas is thought to be dominated by phyllites, slates and intrusive gabbros of the Kjølhauggruppen. To the west, the Kjølhaugruppen is bounded by the Sulamågruppen greenstone, calcareous metasandstone and phyllite.

Figure 1: Area covered by Map 1. Coordinates are in ED-50, map sheet 1721 I.

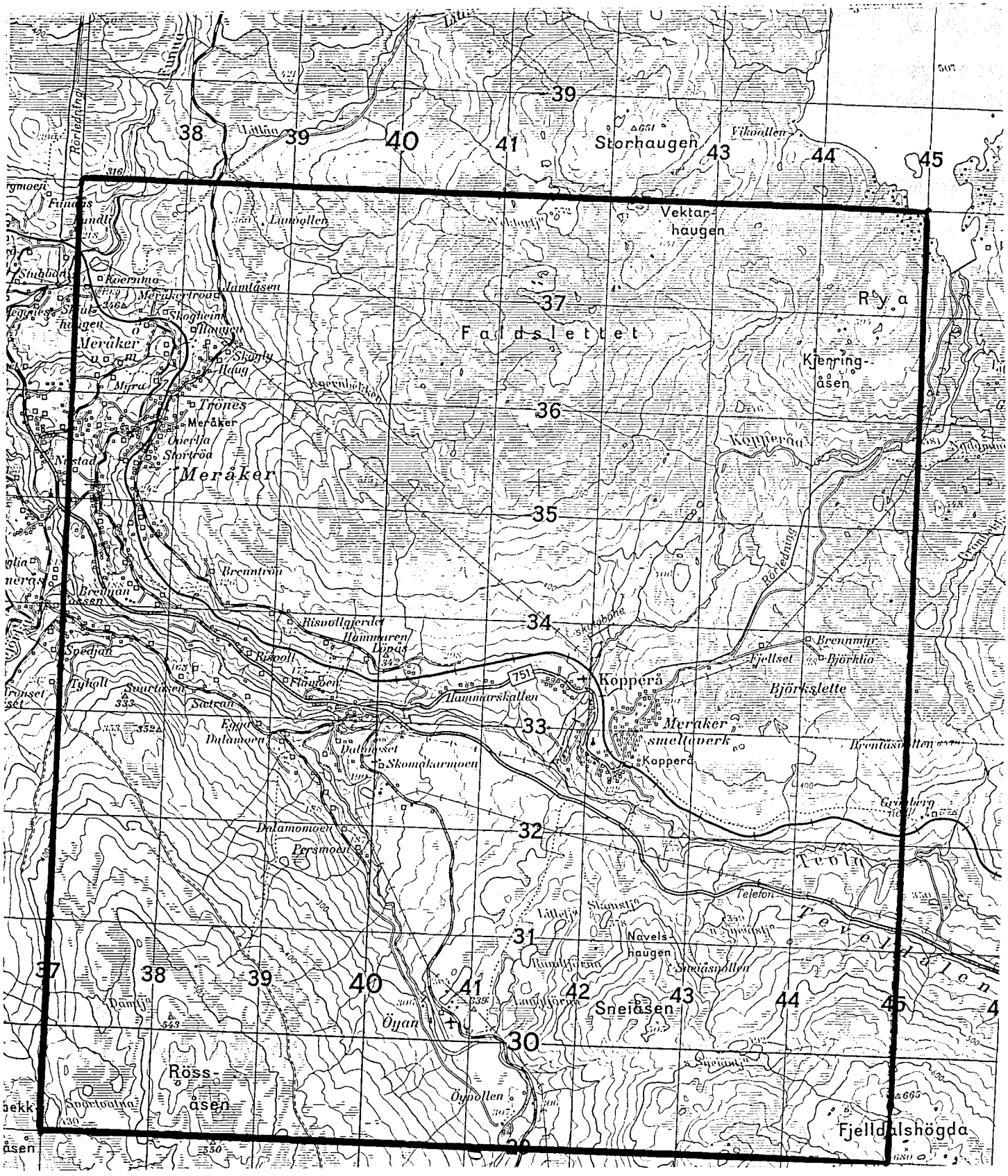
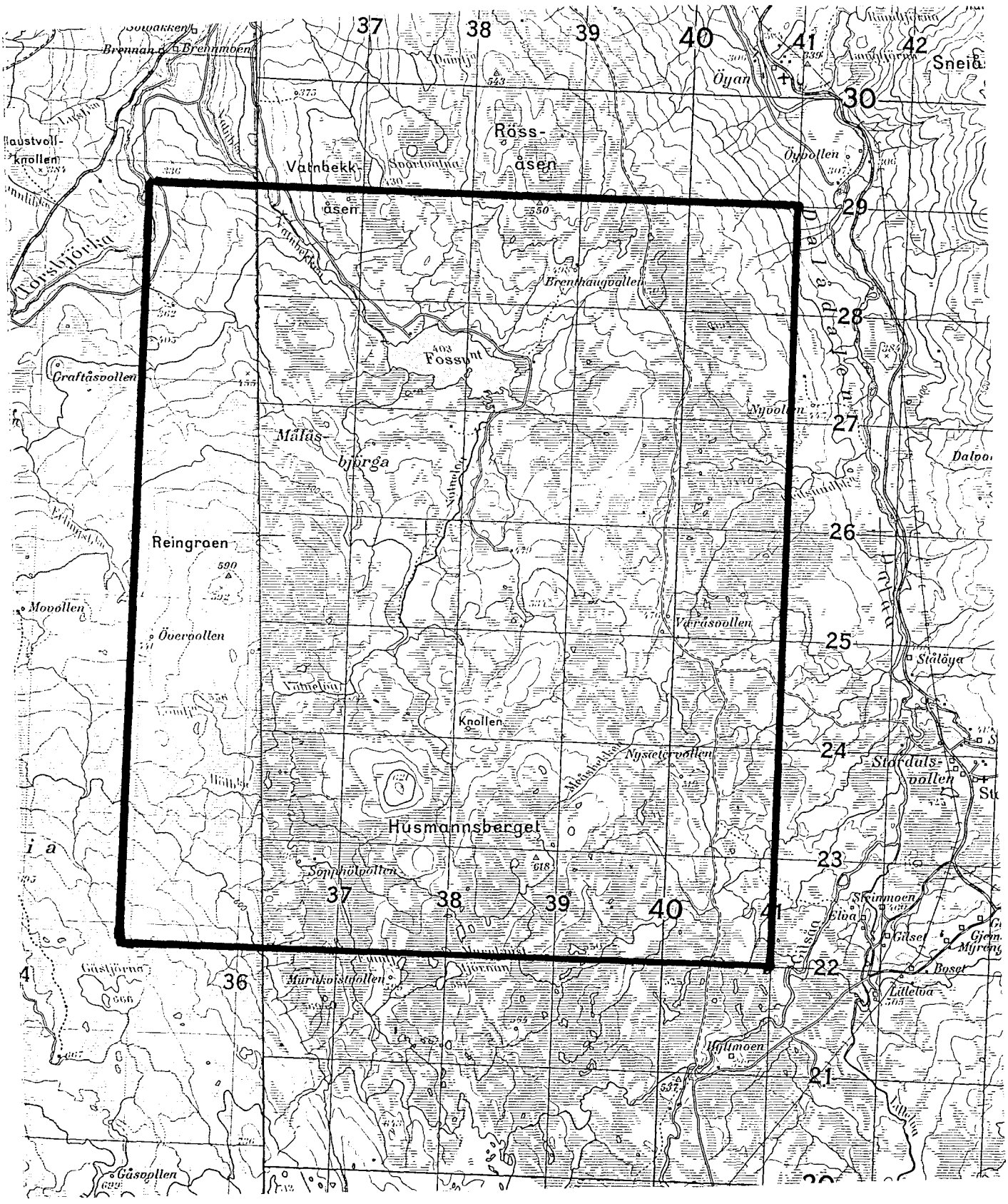


Figure 2: Areas covered by Map 2. Coordinates are in ED-50 on sheet 1721-I and in WGS-84 on map sheet 1721-IV.



Several mines and showings are present in the area. These mine and showings, and their locations, are as follows:

In area 1:			
16.	ØYAN SKJERP	640200E	7031500N
17.	SKOMAKEREN SKJERP	640820E	7032325N
18.	STADÅSEN GRUVE	641400E	7036100N
19.	HAMMERSKALLEN SKJERP	641150E	7033700N
In area 2:			
8.	DUDU GRUVE	637750E	7023650N
9.	ANNA SKJERP	637650E	7023900N
10.	EBBA SKJERP	637650E	7023400N
11.	KNOLL SYD	638450E	7024750N
12.	KNOLL NORD	638900E	7024875N
13.	LANGSUND GRUVE	638900E	7027250N
14.	BRENDTHAUGVOLLEN	638600E	7028550N
15.	SAGSKERPET	637875E	7028600N

The numbers in the left hand column refer to codes as currently used on the 1:50000 geological map which is currently under revision.

Interpretation

The geophysical data were interpreted using stacked profiles of the magnetic and electromagnetic channels. Using the locations of mines and showings, profiles were extracted in the vicinity of mineralized areas for closer scrutiny to obtain an idea about the nature of interesting mineralization. Results of that investigation yielded the following conclusions:

1: The strike extent of most of the mineralization, assuming a strike parallel to the geology, is usually less than 200 meters.

2: The mineralization often, but not always, occurs along weak magnetic anomalies trending in the north-south direction. These anomalies are typically of the order of between 10 and 25 gammas and 50 to 100 meters wide.

3: Mineralization is not associated with strong magnetic anomalies.

4: Mineralization is often reflected in the 32 KHz channel as a strong localized

peak in the in-phase and quadrature channels, or in the in-phase channel alone (often 70 ppm or more). Response in other EM channels may be present.
5: The extent of the electromagnetic anomalies across strike is approximately 100 meters.

As a part of the procesing report, magnetic grids were prepared at 50 meter intervals. However the weak magnetic anomalies associated with the mineralization are poorly defined on the grids because:

1: The grid interval is on the order of the spatial extent of the anomaly.
2: The anomalies are weak, and are superimposed on a large regional magnetic gradient.
3: The magnetic grids had significant herringbone patterns, perhaps caused by variations in flight height, and had to be decorrugated. Decorrugation probably eliminated the weaker magnetic signatures.
4: In many cases, magnetic anomaly patterns were matched from line to line, defined by their profile shapes with variation on the order of tens of meters. The gridded data set lacks this resolution.
5: The anomalies strike in a direction which is perpendicular to the flight line directions. Because the anomaly amplitudes are typically small, when gridded they will appear as localized blips or small variations in the regional gradient which may be hard to pick out as a distinct linear feature.

As a conclusion then, the gridded magnetic data are likely to be of little use in locating structures associated with mineralization. As an aside, computerized methods using such grids such as ARCINFO, are also not likely to be that useful in this instance. One should also note that in ARCINFO, when the data range is compressed into 8 bits (256 levels), small magnetic anomalies will be lost when large datasets, such as the Meråker data set, are viewed.

Resistivity maps from the electromagnetic data were not prepared because system drift was high and the base levels on line were therefore unreliable. Instead, anomalies were hand-picked from the electromagnetic profiles and were graded according to conductivity. These anomalies are marked as follows: by a point (low conductivity), by a point in a circle (medium conductivity), and by a cross in a circle (high conductivity). Areas marked with diagonally hatched areas may reflect surficial conductors.

Results of the interpretation are illustrated in map 92.270.01 (area 1) and map 92.270.02 (area 2). Of primary interest is the contact between the Sulåmogruppen

greenstones and calcareous meta-sandstone. The contact is defined by a weak magnetic anomaly and contains numerous strong electromagentic anomalies, and so has a signature which is typical of mineralization known to occur in the area. Since Stadåsen gruve and Sagskjerpet lie on the contact, the contact is known to be mineralized and should be viewed as having a high potential for further mineralization.

Also of interest is a linear feature which is associated with numerous mines, showings and strong electromagnetic anomalies associated with weaker magnetic anomalies. This linear feature runs sub-parallel to the local geologic strike, and is not correlated with any known geologic or topographic feature.

Areas Selected for Further Work

Areas considered to be favourable for mineralization have been selected following the conclusions stated in the previous section. The following areas are ordered in decreasing priority for areas 1 and 2 separately.

AREA 1

1: Promising magnetic and electromagnetic anomalies are located to the west and north of Hammerskallen skjerp. These anomalies may lie along a continuation of the magnetic anomaly associated with Stådasen gruve and the contact between the Sulåmogruppen greenstone and meta-sandstone. The area of primary interest has been outlined as is labelled A1-1.

2: Anomalies A1-2, A1-3, A1-4 and A1-5 lie along the greenstone / meta-sandstone horizon which was targeted in A1-1, and may also reflect mineralization.

3: Area A1-6 outlines a series of 3 conductors associated with magnetic anomalies are located in the nortwest part of area 1. The center conductor is associated with a weak magnetic anomaly, and as such may be of greater interest than the eastern and western conductors. These anomalies lie outside the horizon defined by A1-1 to A1-5.

4: A series of anomalies lie to the east of Skomakeren skjerp. The western most anomalies are not associated with a magnetic anomaly, and are the most promising. This area is outlined as A1-7.

AREA 2

1: A2-1 follows the contact between the Sulåmogruppen greenstones and the meta-sandstone along a zone of strong electromagnetic anomalies. Of particular interest is the break in the magnetic anomaly where the electromagnetic anomaly strengthens. This break is located approximately 1 km south of the northern border of this area.

2: A2-2 contains mineralization in the Dudu gruve, Ebba skjerp and Anna skjerp. Strong electromagnetic anomalies are associated with, but offset from, weak magnetic anomalies.

Conclusions

Mineralization in these two areas is reflected by 70 ppm anomalies in the 32 KHz EM channel which may be associated with weak or non-existant magnetic anomalies. The extent of the anomalies perpendicular to strike is rarely greater then 100 meters. Interpretation of such small anomalies has been difficult because line-to-line correlation is poor, mainly due to the large line spacing relative to the size of the target bodies. Lines spaced at 100 meters would have greatly improved the geophysical interpretation.

Two major zones of which potentially host mineralization have been identified. These are the contact between the greenstone and calcareous meta-graywakke in Sulåmogruppen, and a linear feature running from Dudu gruve to Hammerskallen skjerp. Three areas, A1-1, A2-1 and A2-2 which lie along these zones have been identified as primary targets for follow-up work. Several other areas have been identified as favourable for mineralization based on the geophysical signatures of known mineralization in the area.

The volume of data and its dynamic range make interpreting 1:50000 scale surveys difficult when the geologic targets are small and the anomalies subtle. Areas of the scale of the Meråker survey should be sub-divided and interpreted at scales of 1:20000 to successfully identify such regions. In addition, profiled data should not be neglected since gridded data lack the spatial resolution required to identify subtle anomalies. Gridded data have often been heavily filtered, and grids are sampled at an interval reflecting the line spacing rather than the extent of anomalies along the line, and so often do not contain the subtle information required to identify weak features with one

dimension on the order of a grid interval.

Ground geophysical follow-up work during the summer of has been reported in Dalsegg and Lauritsen (1993), while geological follow-up has been reported by Birkeland (1993). EM anomalies were found principally to be caused by pyrites, chalcopyrites and pyrrhotite bearing black schists. Magnetic anomalies were attributed to magnetite concentrations on the edges of gabbros.

References

Birkeland, A., 1993, Malmgeologiske undersøkelser i det østlige Meråker feltet, Nord-Trøndelag, *NGU Rapport 93.014*

Dalsegg, E. and Lauritsen, T., 1993,Geofysiske undersøkelser Meråkerfeltet- øst, Meråker, Nord-Trøndelag, *NGU Rapport 93.001*

Mogaard, J.O., 1992, Geofysiske målinger fra helikopter over Meråkerfeltet, Nord-Trøndelag, *NGU Rapport 92.153*

APPENDIX

MINES AND SHOWINGS

KJOLHAUGGRUPPEN - METAGRAYWAKKE

1.	GILSÅ GRUVE	639550E	7012950N
2.	DRONNINGENS GRUVE	642200E	7014625N
3.	DRONNINGENS SKJERP	642400E	7014150N
5.	LILLEFJELL GRUVE	639000E	7016750N
6.	LILLEFJELL SKJERP	638800E	7016500N
7.	SVARTÅTJERN	637900E	7019250N
8.	DUDU GRUVE	637750E	7023650N
9.	ANNA SKJERP	637650E	7023900N
11.	KNOLL SYD	638450E	7024750N
12.	KNOLL NORD	638900E	7024875N
13.	LANGSUND GRUVE	638900E	7027250N
16.	ØYAN SKJERP	640200E	7031500N
17.	SKOMAKEREN SKJERP	640820E	7032325N
19.	HAMMERSKALLEN SKJERP	641150E	7033700N

SLÅGÅNGRUPPEN - PHYLLITE

10.	EBBA SKJERP	637650E	7023400N

SULÅMOGRUPPEN - CALCIUM BEARING METASANDSTONE

4.	PEDER BENDTZ SKJERP	638750E	7015925N
15.	SAGSKERPET	637875E	7028600N

SULÅMOGRUPPEN - GREENSTONE

14.	BRENDTHAUGVOLLEN	638600E	7028550N
18.	STADÅSEN GRUVE	641400E	7036100N

FUNNSJØGRUPPEN - CONGLOMERATE

20.	KONGENS GRUVE	628100E	7021400N
21.	SKRØYDALEN	627000E	7026150N
22.	SONVANN GRUVE	626350E	7027900N
24.	? SKJERP	630000E	7027300N

FUNNSJØGRUPPEN - GREENSCHIST

23.	TORSBJØRK GRUVE	631950E	7026400N
25.	GAMLE MANNFJELL	631400E	7028800N
26.	MANNFJELL GRUVE	632450E	7029350N
27.	LOVLIBEKK GRUVE	633500E	7033450N
28.	ØYTRØ GRUVE	632900E	7034350N
29.	GAMMEL FONNFJELL GRUVE	633700E	7034450N
30.	SYNKEN FONNFJELL GRUVE	633450E	7034700N
31.	NYE FONNFJELL	633600E	7034900N
32.	TORGERSKUREN SKJERP	632400E	7034750N
33.	MOABEKK SKJERP	633900E	7035050N
34.	SKJERP VED KROGSTADÅA	634950E	7037975N
35.	KROGSTADÅA SKJERP	636200E	7040500N

638000
703700

644000
7037000

A1-6

Stadåsen gruve

Hammerskallen skjerp

A1-1

A1-2

Skomakeren skjerp

A1-3

A1-7

Øyan skjerp

638000
7030000

644000
7030000

A1-4

A1-5

LEGEND

- CONTACT BETWEEN SULÅMOGRUPPEN GREENSTONE AND META SANDSTONE
- AXIS FAVOURING MINERALIZATION
- ZONE FOR FURTHER GROUND WORK
- WEAK EM ANOMALY
- MEDIUM EM ANOMALY
- STRONG EM ANOMALY
- WEAK MAGNETIC ANOMALY
- STRONG MAGNETIC ANOMALY
- SURFICIAL EM CONDUCTOR
- ØYAN SKJERP - LOCATION OF MINES AND SHOWINGS

NGU - NORD-TRØNDELAGSPROGRAMMET
TOLKNINGSKART – EM OG MAGNETOMETRI
MERÅKER, OMRÅDE 1
NORD-TRØNDELAG

MÅLESTOKK 1:20000

MÅLT
TEGN
TRAC T.H.
KFR

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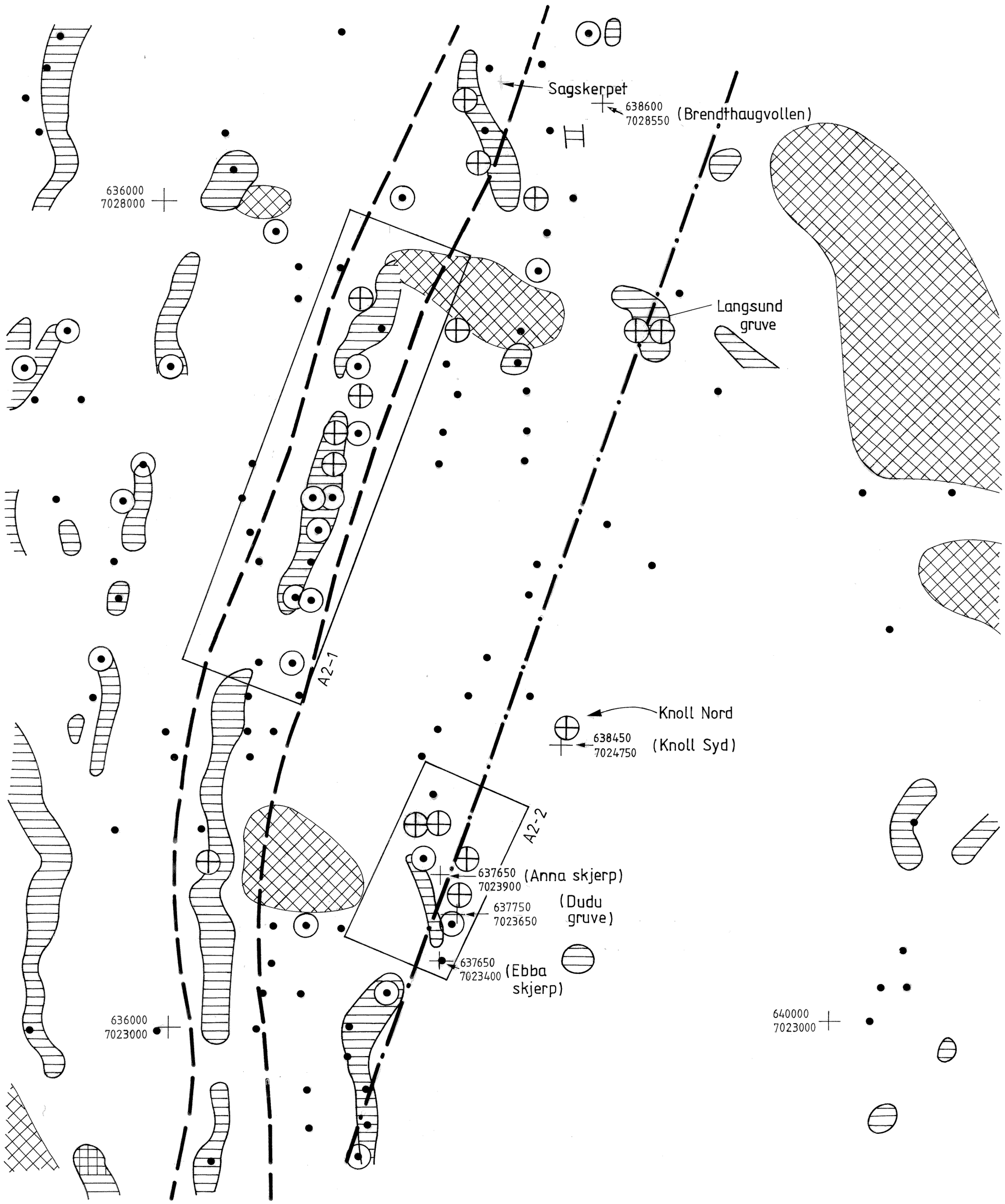
TRONDHEIM

TEGNING NR. 92,270-01

KARTBLAD NR. 1721 I



LEGEND

- CONTACT BETWEEN SULÅMOGRUPPEN GREENSTONE AND META SANDSTONE
- AXIS FAVOURING MINERALIZATION
- ZONE FOR FURTHER GROUND WORK
- WEAK EM ANOMALY
- MEDIUM EM ANOMALY
- STRONG EM ANOMALY
- WEAK MAGNETIC ANOMALY
- STRONG MAGNETIC ANOMALY
- SURFICIAL EM CONDUCTOR
- DUDU GRUVE - LOCATION OF MINES AND SHOWINGS

NGU - NORD-TRØNDELAGSPROGRAMMET
TOLKNINGSKART - EM OG MAGNETOMETRI
MERÅKER, OMRÅDE 2
NORD-TRØNDELAG

MÅLESTOKK 1:20000

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