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Tittel

Ground Geophysical surveys in South Pasvik, March 1977.

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Sammendrag

Sammenfatningskart for de vintergeofysiske målingene (Mag VLF-EM) i lokalgridene Korsvann, Villrenvann, Berit, Grete, Føllvann, Abborvann, Gjeddevann, Haukvann syd, Haukvann øst

A/S SULFIDMALM

INTER-OFFICE MEMORANDUM

Date: 12th October, 1977

To: Falconbridge Nikkelverk A/S

cc: W. D. Harrison, H. T. Berry, R. Jahnsen, F. Nixon, R. B. Band, B. Lieungh, E. Kreivi, Sydvaranger v/Sverdrup

From: J. B. Gammon

Subject:

Report No. 450/77/23. Winter geophysics, Pasvik 1977.

Please find attached a report covering this geophysical programme carried out in the winter of 1977. It was based on the results of the 1976 helicopter survey and was intended to define drill targets for the summer 1977 drill season. The rich boulder finds in S.Pasvik have caused this programme to be delayed.

J. B. Gammon

FOR FALCONBRIDGE NIKKELVERK A/S
A/S SULFIDMALM

Project 905-23

Ground Geophysical Surveys in S.Pasvik, March 1977

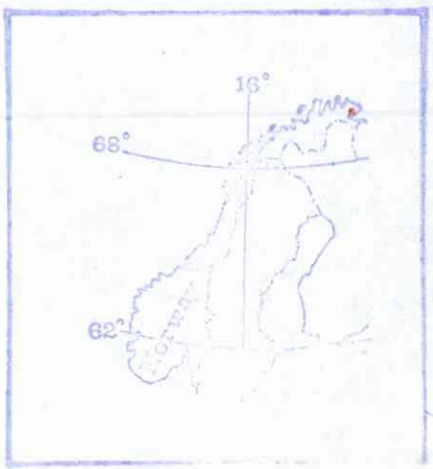
By

R. B. Band

B. Lieungh

E. Kreivi

L. Nessvoll



Report No. 450/77/23

1. INTRODUCTION

The 1977 ground geophysical programme in South Pasvik was a follow-up to the helicopter-borne mag-EM survey flown by NGU for the Pasvik joint-venture in June 1976. This airborne survey was the first step in exploring the Pre-Petsaamo Formation gneiss area to the south of the Skogfoss Arch, in search of nickel mineralization analogous to the Russian Allarachensk deposits. Targets outlined will be drill tested in the summer 1977 field season.

Ground follow-up work was concentrated on the northern of two airborne survey sheets (fig.1A). This decision was based in part on logisitic considerations and in part on the presence of abundant serpentinite float in the northernmost area.

During the month of March six grids were established with a total of 74 profile kms chained and measured by VLF and magnetometer. In addition 14 profile kms were surveyed using Crone horizontal-loop shootback EM to provide quantitative data over VLF indicated anomalies. Fig.1 shows the locations of the grids covered in 1977 together with the positions of grids surveyed by A/S Sydvaranger in 1976 and 1960 (1960 field work carried out by NGU). Results from these earlier surveys are included with this report.

2. INSTRUMENTS

Instruments used in 1977 were:

a) Crone Radem VLF unit, using Bordeau, France as transmitting station;

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b) McPhar M700 fluxgate magnetometer. A second M700 coupled to a Rustrak chart recorder was used as a fixed base station to monitor daily variations and as a check against erratic fluctuations;

c) Crone Shootback horizontal loop EM, used with a constant 50 m coil separation and a frequency of 1830 Hz.

The 1976 surveys were carried out with the following instruments:

a) Geonics EM-16 VLF unit, using Bordeaux, France as transmitting station.

b) McPhar M700 fluxgate magnetometer. This was not adjusted for base level in the field by Sydvaranger. The "local background" value is thus ca. 3500f on the two grids surveyed in compared to ca. 500 f for 1977.

The 1960 survey carried out by NGU used a total-field magnetometer and the Turam-EM system. Investigations elsewhere in Norway have shown that the Turam and VLF-EM systems give very similar responses and that anomaly patterns can be directly compared. Four check profiles over the 1960 Villrennvann grid confirmed this.

The total field magnetic data was standardized relative to a Zero "background level" by NGU and presented as both profiles and a contoured map. At the latitude of Pasvik (69°N) the vertical component should closely approximate the total magnetic field reading. Check profiles run across the Villrennvann grid using M700 fluxgate magnetometer showed a very good correlation with profiles measured in 1960, the main difference being a shift in base level of approximately +500f between the 1960 and 1977 data. It was thus possible to combine results from the Villrennvann grid (1960) with the adjacent Berit and Korsvann grids(1977) to give a single compilation map.

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3. RESULTS

Data for individual grids are presented in Appendix I. For most grids the following maps are presented: Contoured magnetic map; VLF dip-angle map; Contoured VLF-dip angle Fraser-values, Shoot-back EM profiles. Exceptions to this are: Aborvann Grid where, because of the grid orientation no VLF profiles were run; Haukvann East and Haukvann South grids where no Shootback profiles were run. Maps summarizing the data for the various grids are presented in figs. 2-9. A brief resumé of the results for each is given in section 4. Drilling targets are summarized in table 1.

4. RESUMÉ OF GEOPHYSICAL TARGETS

4.1. Korsvann - Villrennvann - Berit Grids (fig. 2 & 3).

This has emerged as the most significant target in S. Pasvik. Although measured as three separate grids these in fact overlap and form a single area. Fig.2 is a compilation of the geophysical results and also shows the location of two holes drilled by A/S Sydvaranger in 1971.

Briefly summarized fig.2 shows five roughly elliptical magnetic anomalies, 500 m to 900 m in lenth and with varying magnetic amplitude. DDH 2/71 tested the northernmost Villrennvann grid magnetic anomaly and intersected unmineralized serpentinite. The abundance of large angular serpentinite blocks noted during the March geophysical programme indicates that the remaining anomalies (ie. Berit and Villrennvann 3300S-4000S) are probably more deeply buried than the three higher amplitude anomalies.

../4

The magnetic anomalies may represent separate serpentinite bodies, but breaks in the magnetic and VLF anomalies are more suggestive of a series of NE to ENE block faults.

The VLF-Turam data show long parallel conductors both east and west of the "serpentinite" zone. These conductors seem to vary along strike since they could only locally be confirmed by lower frequency Shootback measurements. DDH 2/71 tested the western conductors in the extreme south of the Villrennvann grid. The long magnetic feature paralleling the conductor was shown to be due to amphibolite horizon, while the conductor was due to a chloritic breccia carrying barren pyrrhotite. Along strike these conductors run onto the Berit grid. A Stream sediment survey by Sydvaranger in 1976 showed the highest Cu values (max 400 ppm Cu) for the whole airborne survey area to occur in the two small streams draining Berit grid, apparently related to the northern end of the westernmost conductor.

The Villrennvann Turam survey did not pick up any conductors associated with the "serpentinite" magnetic anomalies. According to Sydvaranger there may be a technical explanation for this in that the energizing cable for the survey was laid out along the western edge of the Villrennvann grid, so that its effect would be considerably reduced at the east margin where the "serpentinites" occur. In addition they consider that the strong, western conductor, lying close to the energising cable, would probably have a masking effect on weaker conductors further to the east. A minor VLF survey will be run over the north-end of the middle Villrennvann magnetic anomaly to check this possibility.

VLF data from Korsvann grid show that the Korsvann magnetic anomaly (300S-100N) has weak conductors along both its east and west flanks (fig.3).

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This magnetic anomaly lies on a sulphide bearing horizon. It represents a very favourable drill target.

4.2. Aborvann Grid (fig.4)

This locality was originally selected because of the possible fold-structure indicated by the air-borne data. Sydvaranger's Haukvann South grid was found not to cover this structure. The target feature is a ca. 500 m long elliptical magnetic anomaly flanked by EM indications.

4.3. Gjeddevann (fig.5)

The main features of this grid are two parallel, strong conductors one of which is adjacent to a long, narrow magnetic anomaly. The Shootback profiles suggest that these anomalies are due to graphite. It is possible that the Gjeddevann anomaly is actually a tightly folded finger of the Petsaamo formation caught up in the Pre-Petsaamo gneisses. Boulder tracing and geological mapping should clarify this.

4.4. Follvann (fig.6)

The magnetic data show an eliptical anomaly with a very regular and symetrical fall off in values. Graphic interpretation of the ground and airborne magnetic data (Sydvaranger) indicates a source of a depth of 150-200 m. The VLF survey showed only very weak anomalies which correlate with topographic features such as swamps and small lakes.

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4.5. Grete (fig.7)

The magnetic data shows a 300 m x maximum 200 m anomaly of similar amplitude to the "serepentinite" anomalies at Villrenn-vann. The contour form suggests a possible fold structure. The VLF survey detected a weak conductor extending from the NE "arm" of the magnetic anomaly, but this could not be verified by Shootback measurements. It corresponds in position to a small lake and is probably a surficial, overburden effect. Because of the magnetic feature this is a target for detailed float prospecting, but it does not warrant drill testing.

4.6. Haukvann East (fig.8)

The main magnetic feature is a high amplitude elleptical anomaly, ca. 600 m x 300 m in the east of the grid. This has weak VLF anomalies located along its western flank.

The strong VLF anomaly zones in the west of the grid are probably due to graphite. Mapping and float prospecting will be carried out to verify this.

4.7. Haukvann South (fig.9)

The main feature is a strong magnetic anomaly in the south-west of the grid, again corresponding is amplitude to the Villrenn-vann "serpentinite" anomalies. It is cut by a north-west trending magnetic trough, with a coincident weak VLF indication which could represent a (mineralized?) fault zone.

The magnetic feature in the north-west of the grid is also picked up on the overlapping Abborvann grid.

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5. FUTURE PLANS

Table I summarizes targets which will be tested during the Summer 1977 drilling programme. Geological mapping, float prospecting and minor additional geophysics to be carried out prior to drilling will determine the final placing of the drill holes. The remaining targets will be covered by float-prospecting and geological mapping during the summer 1977 field season, as part of a wider programme covering both the North and south airborne survey map sheets.

Table 1. S. PASVIK DRILL TARGETS - 1977.

GRID		ANOMALY TYPE VLF	ANOMALY TYPE EM SHOOTBACK	ANOMALY TYPE MAG	TARGET COORDS	COMMENTS
KORSVANN					300S-200N	Detailed VLF-mag. coverage in June '77.
VILRENVANN	1				2400S-2800S 0 -200W	Detailed VLF-mag. coverage in June '77.
	2				1500S-1800S	Detailed VLF-mag. coverage in June '77.
BERIT	1				1200N/3000W	Stream sed. Cu anomaly
	2					
	3				1300N/50E	
ABORVANN					800W/250N	
HAUKVANN EAST					400S/225E	Second priority
HAUKVANN SOUTH					1000S/450W	


LOCATION MAP
Kirkenes
U.S.S.R.
FINLAND
Skogfoss Arch
Petsaamo formation
Airborne survey 1976
Ground follow-up 1977
GJEDDEVANN
HAUKVANN EAST
(Sydvaranger 1976)
ABBORVANN
FØLLVANN
HAUKVANN SOUTH
(Sydvaranger 1976)
GRETE
BERIT
Villrennvann Grid
(NGU 1960)
KORSVANN
1700N
1400W
700N
1500N
800N
400N
3500N
3000N
2000N
1000N
400S
KEY:
>53500 γ
53400-53500 γ
53200-53400 γ
<53100 γ
EM(Real)
Pos. real comp.
EM(Imag)
σ t. >20
20>σ t >10
10>σ t >2
CONDUCTIVITY THICKNESS
SURVEYED MARCH 1977
KOTEAVSTAND 100 GAMMA
FLYLINJE MED PLOTTET PUNKT
Location of Geophysical Grids
S. Pasvik
1:20000
1489-02

LOCATIONMAP

KEY:

MAG

BERIT/KORSVANN	VILLRENNVANN
> 4000 γ	> 4000 γ
2000 - 4000 γ	1500 - 4000 γ
1000 - 2000 γ	500 - 1500 γ
500 - 1000 γ	< - 500 γ
0 - 500 γ	< - 1000γ
÷500γ - 0γ	
< 500γ	

EM

VLF
- Fraser values 20-40
- " > 40
- check profiles
- Shoot-back profiles
- conductor

66/20 — x → Ni/Cu in stream sediment

DDH 1/71 Drill hole (projected upfoliation)

TURAM
- very strong conductor
- strong conductor
- weak conductor
- very weak conductor

- granitic gneiss
- garnet-amphibolite
- coarse amphibolite
- serpentinite

S.PASVIK
Summary map:
Villrennvann - Korsvann - Berit grids.

SCALE 1:4000

OBS.
DRAW. R.B.B. B.L.
TRAC. R.B.B. B.L.
CHK.

½ SULFIDMALM

MAP NO. 450-77-23-2

MAP SHEET

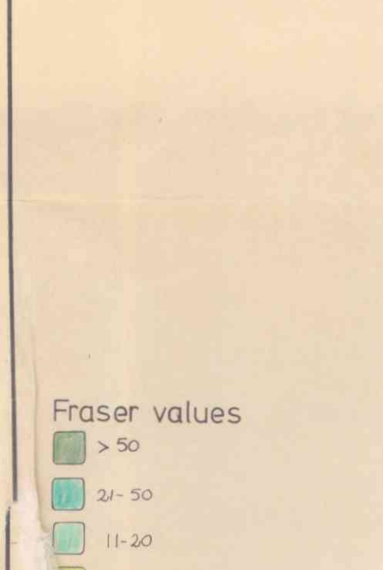
A.s Tørrkopi. 2000 A 2. E 9 gl. 10-71. Sentrum Trykkeri.

- 400 W
- 300 W
- 200 W
- 100 W
0
- 100 E
- 200 E
- 300 E

— 800 N
— 700 N
— 600 N
— 500 N
— 400 N
— 300 N
— 200 N
— 100 N
— 0
— 100 S
— 200 S
— 300 S

Fraser values
- > 50
- 21 - 50
- 11-20
- 5-10

- > 4000 γ
- 2000 – 4000 γ
- 1000 – 2000 γ
- 500 – 1000 γ
- 0 – 500 γ
- -500 γ – 0 γ
- < -500 γ



KORSVANN South
MAGNETIC TARGET
SUMMARY MAP

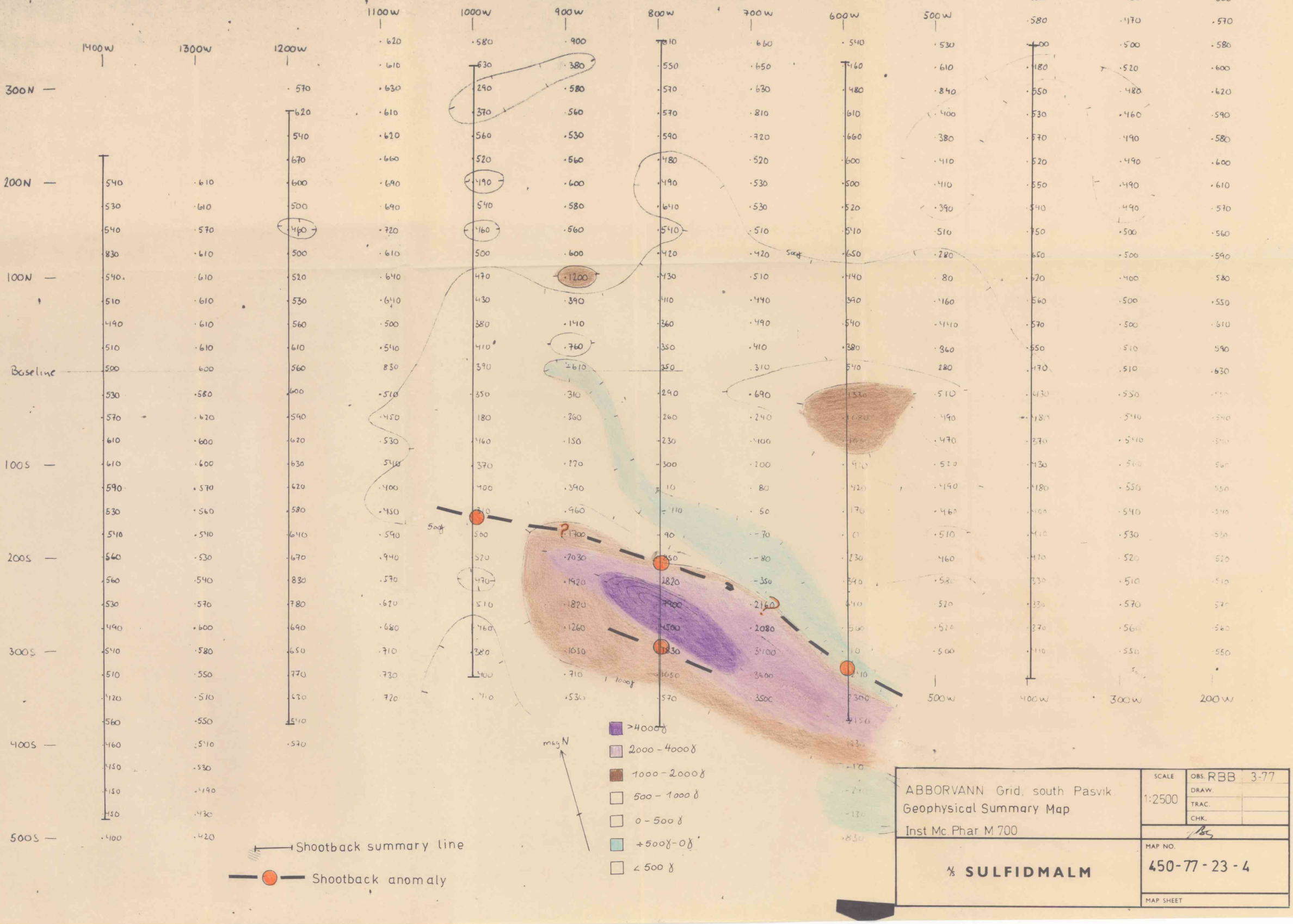
SCALE 1:2500

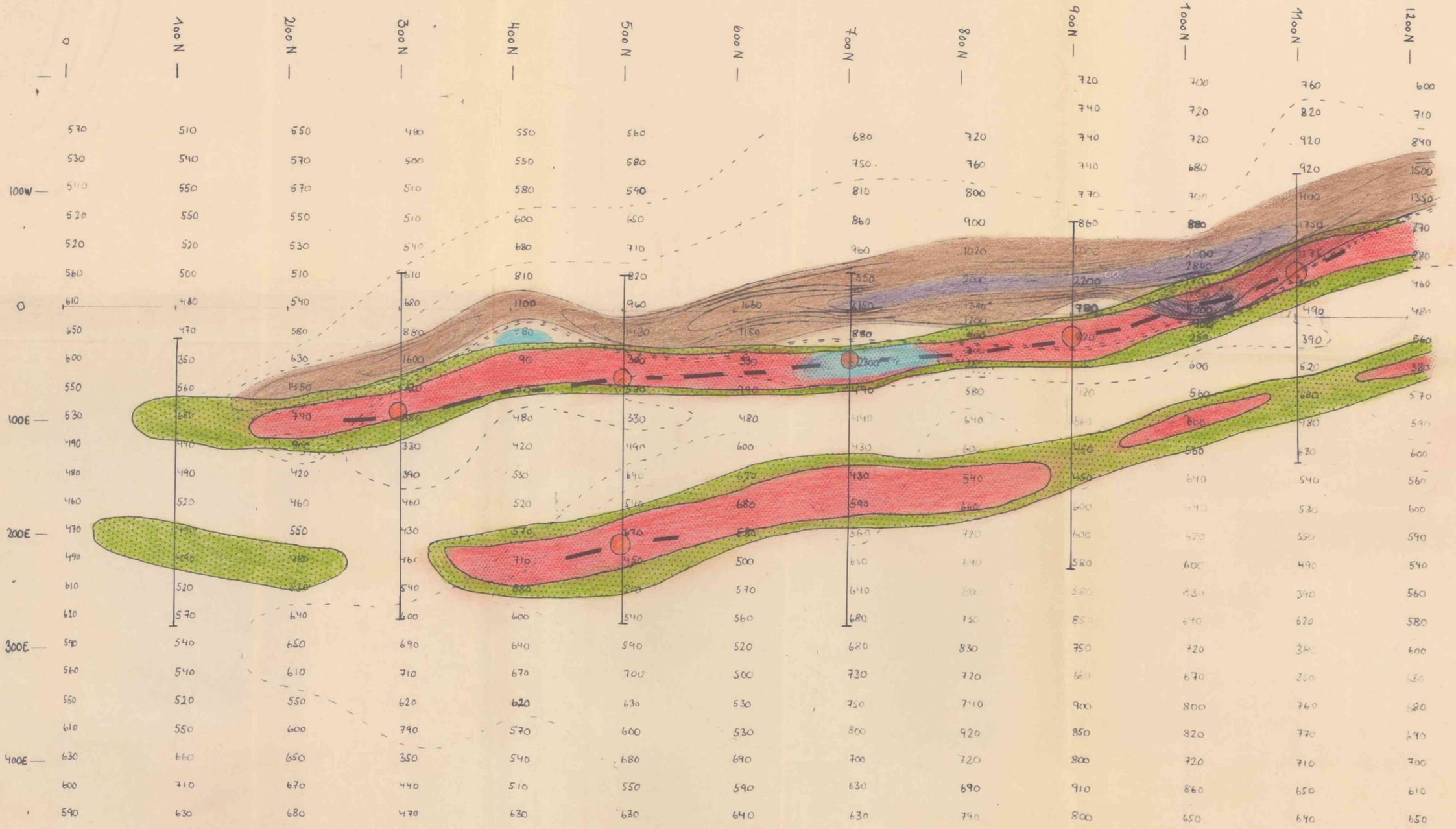
OBS.
DRAW R.B. 5-77
TRAC. K.A. 6-77
CHK.

MAP NO. 450 - 77 - 23 - 3

MAP SHEET

1/5 SULFIDMALM


1400W
1300W
1200W
1100W
1000W
900W
800W
700W
600W
500W
400W
300W
200W
300N
200N
100N
Baseline
100S
200S
300S
400S
500S
Soaf
1000f
mag N
>4000 γ
2000 - 4000 γ
1000 - 2000 γ
500 - 1000 γ
0 - 500 γ
± 500γ-0γ
< 500 γ
Shootback summary line
Shootback anomaly
ABBORVANN Grid, south Pasvik
Geophysical Summary Map
Inst Mc Phar M 700
SCALE 1:2500
OBS. RBB 3-77
DRAW.
TRAC.
CHK.
% SULFIDMALM
MAP NO. 450-77-23-4
MAP SHEET



Gjeddevann grid, S.Pasvik.

Geophysical Summary Map

SCALE	1:2500
OBS. RB-BjL	3-77
DRAW. BjL	3-77
TRAC.	
CHK.	

⅛ SULFIDMALM

MAP NO. 450-77-23-5

MAP SHEET

PL 3

Øyre Pasvik 1976
Haukvann øst
Vestre del
Magnetiske målinger
O-nivå = 3600 γ
M. 1:2000
3/11-76 AL

Fraser values
--- 0-10
10-40
40-100
> 100

Magnetic anomalies
4000 - 5000 γ
5000 - 6000 γ
6000 - 7000 γ
7000 - 8000 γ

obs. Sydvaranger 7/77

HAUKVANN EAST Grid S.Pasvik	SCALE	OBS. Sya	7-77
SUMMARY MAP	1:2000	DRAW Syd	7-77
Inst. Mc Phar M 700 (Zero level apore x		TRAC.	
Inst. Geonics EM 16 3000 γ)		CHK.	
⅛ SULFIDMALM		MAP NO.	
		MAP SHEET	


Eraser values
10-20
20-40
> 40
Magnetic anomalies
4000-5000 γ
5000-6000 γ
6000-7000 γ
7000-8000 γ
S.Pasvik, HAUKVANN south grid.
Summary map
Inst. Mc Phar M 700 (Zero level aprox 3000 γ)
Inst. Geonics EM 16
SULFIDMALM
SCALE
1:2.000
OBS. Sydvaranger 7-77
DRAW.
TRAC.
CHK.
MAP NO.
MAP SHEET

Føllvann grid, south Pasvik.

GEOPHYSICAL SUMMARY MAP.

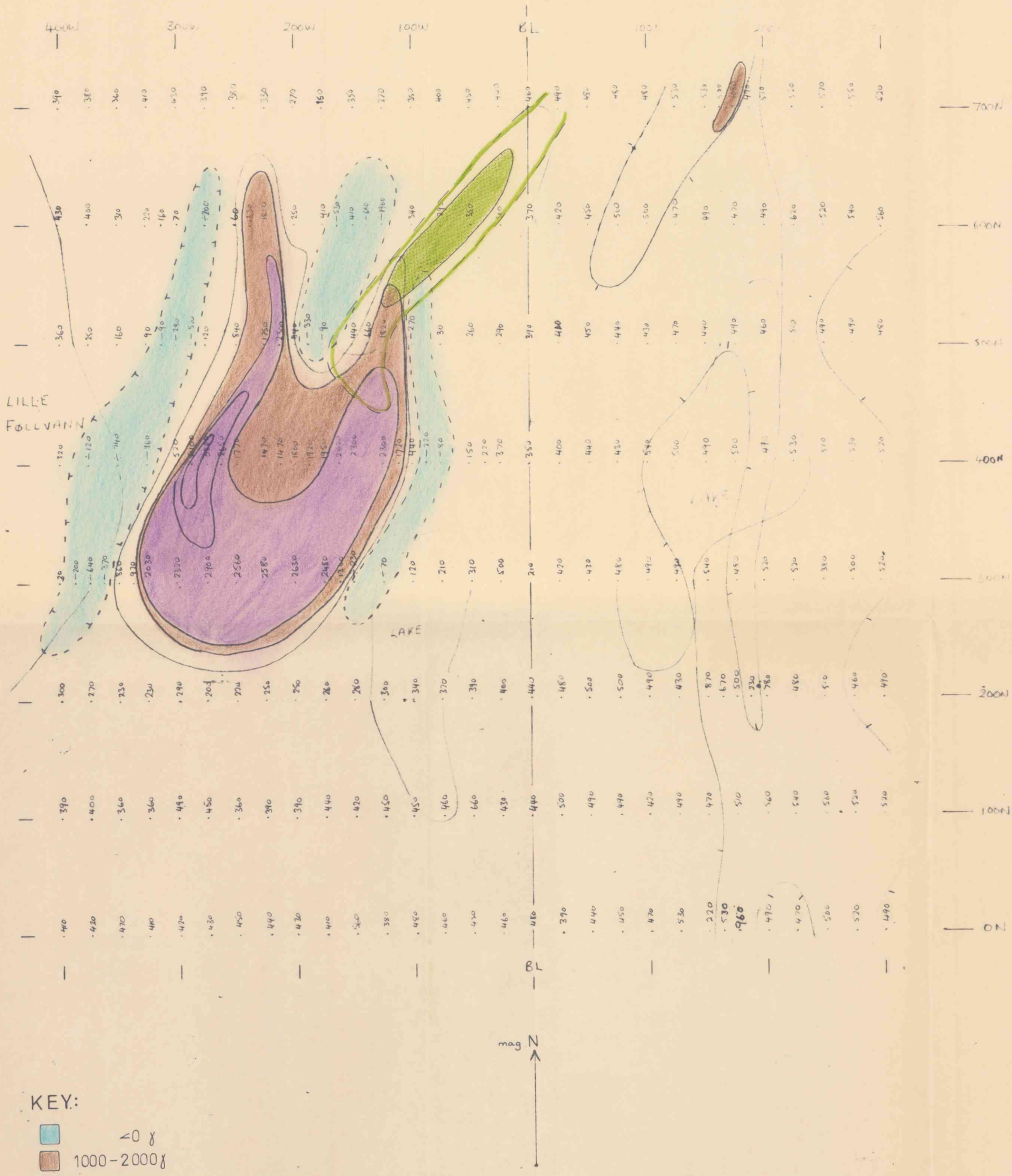
SCALE		
1:2500	OBS. RBB	3-77
	DRAW. "/BjL	–"–
	TRAC. BB	4-77
	CHK.	

A/S SULFIDMALM

MAP NO. 450-77-23-6

MAP SHEET

A/s Terrkopi. 3000. A 1. E 9 gl. 10-71. Sentrum Trykkeri.



KEY:

- <0 γ
- 1000 – 2000 γ
- >2000 γ

- 10-20
- 20-40

VLF-Fraser values.

Shoot-Back profile.

Grete grid, south Pasvik. GEOPHYSICAL SUMMARY MAP.	SCALE 1:2500	OBS. RBB	3-77
		DRAW. RBB	-"-
		TRAC.	
		CHK.	
⅛ SULFIDMALM	MAP NO. 450-77-23- 7		
	MAP SHEET		