# Bergvesenet

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# Rapportarkivet

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Tittel

VLF -measurements in Sulitjelma area, 1974.

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| SuomenMalmi | 1974 | Sulitjelma Gruber A/S |

| ommune | Fylke | Bergdistrikt | 1: 50 000 kartblad | 1: 250 000 kartblad |
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| | | | | |

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Sammendrag

Området mellom Charlotta og Kobbertoppjuvet er målt med VLF. Både utgående ledere og grunne utgående ledere er påvist. Kvaliteter på disse er til en viss grad vurdert. Metodene egner seg godt til å kartlegge fortsettelsen av kjente ledere. Dypere enn 200 m er metoden uegna. Kobbertoppen.

015.008

# G E O P H Y S I C A L  R E P O R T

## VLF-MEASUREMENTS IN

## SULITJELMA AREA, 1974

Otaniemi 1974-08-06

Pekka Lappalainen
geophysicist

SUOMEN MALMI OY

# VLF MEASUREMENTS IN SULITJELMA AREA, 1974

## 1. General

According to the contract between Sulitjelma Gruber A/S and Geobor A/S, Suomen Malmi Oy (Finland) has carried out VLF ground measurements in the Sulitjelma Mine area (ca. 2.5 sq.km) during the period May 20 - 22th, 1974.

The purpose of these investigations was to find out:

1) if the VLF-method is capable to reveal the locations of mineral enrichments in the mineralized zone

2) the effectivity of the VLF-method compared to Turam-method

For this reason VLF measurements were carried out in such an area, where sulphide ore occurrences are known to exist and from where also geophysical Turam results are available.

The results from this survey are plotted as element maps on the topographical maps at a scale 1 : 10 000 (appendices 1, 2).

## 2. Measurements

The survey lines were tied to the base lines which the client has previously built up in the investigation area. Line spacing was about 200 m, point spacing being 20 m and the profile length 400 - 900 m. All the profiles were started from that side on what is geologically known to be Sulitjelma-amphibolite. The profiles crossed the schist zone and were ended within Furuland granite. The direction of the profiles was approximately perpendicular to the geological strike.

The measuring equipment used was the EM-16 (Geonics Ltd, Canada). The transmitter station was FUO (France) and the used frequency was 15.1 kHz. The intensity and direction of

⊗ Feil opptegnet i koordinatsystemet. + feilmåling av profilavstand.
MH.

the signal was suitable for these measurements. The observed components were the tangent of the tiltangle of the magnetic field (which is related to the real (in phase) component) and the phase-shift (which is related to the imaginary (out-of-phase) component).

## 3. Results

All the VLF data are filtered at first using "Fraser filtering" technique (see for example: D C Fraser: Contouring of VLF-EM data; Geophysics, December 1969) so that the results would be easier to visualize as contour maps. In this filtering technique the filtered value A is computed from four successive observations in the following way:

$$A = (a + b) - (c + d) \qquad (1)$$

where a, b, c, d are the four successive observations in the measurement direction etc.

The strong tiltangle gradient above a conductor will be transformed to a maximum in this filtering process. The departures from the zero level in the large scale structural formations will be also eliminated using this technique. The final output of the filtering process depends on the direction of filtering as well as on the observation spacing used. Thus, if a more detailed interpretation is needed, the original unfiltered data must be used.

As a general feature (appendices 1, 2, 3) it can be observed that there exist several parallel and very clearly observable conducting zones in the investigation area. On that side where the amphibolite occur and close to the schist zone, there exist a horizon, which produces at several locations a very intense anomaly. The most intense anomaly is found in the profile X 1000 (Y 1070). The real component has a value R = 302 %, the imaginary component being I = 14 %, respectively. There is evidently an exposure in that point.

However the best conductor, if the quality is concerned, can be found between $0 < X < 600$, where the imaginary component is negative ($I < 0$ %).

The lower depth to conductor cannot be estimated, because the parallel zones are disturbing each others and the topography in the area is disadvantageous as the measurement direction is concerned. It is not possible to distinquish the graphite zones from the sulphide zones using only VLF-measurements.

If the obtained VLF results are compared to those obtained by Turam-method, a clear difference is observed in the locations at the conducting zones. Evidently the reason lies in the error of line surveying in the previous measurements. The locations of the conducting zones obtained with VLF technique are shown in the appendix 3. Due to the fairly large line spacing (200 m), the unambiguous correlation between the zones was not possible.

## 4. Conclusions

In the investigation area, it has been possible with the VLF technique to locate such conductors which are exposing or which appear to situate close to the ground level. It has been possible also to estimate roughly the quality of these conductors (appendix 3). However, it was not possible to estimate the depth of the conductors nor the the thickness of the compact horizon (e.g. 0.2 m or 2 m).
This means that it is not possible with the VLF technique alone, as is the case also with other EM (electromagnetic) methods, to find economically enriched areas. VLF technique is suitable only to clarify the main trends in the general structure as well as to find and locate the continuation of the previously found sulphide occurrence in the direction of the strike of occurrence.

To locate the deeper ($h < 200$ m) situating orebodies from the sulphide horizon seems to be impossible in the Sulitjelma area

by using geophysical ground measurements (seismic methods is the only possibility). Instead the different kind of bore-hole measurements might give valuable additional information: for example by using the Mise-a-la-masse-method, it is possible to estimate the largeness of the conducting body from the observed potential maxima.

Otaniemi 1974-08-06

Pekka Lappalainen
geophysicist

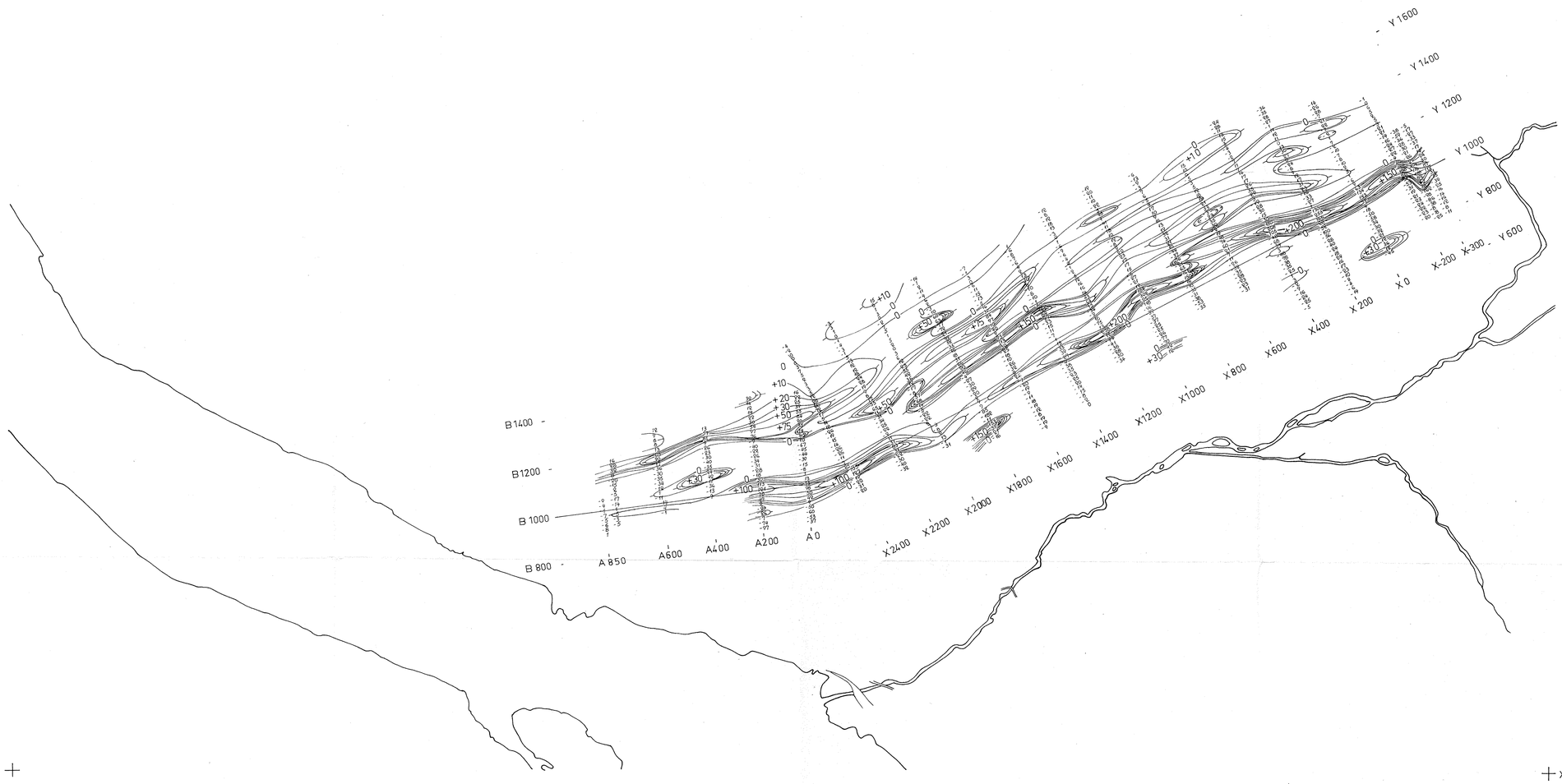
Appendices

1. VLF-map 1 : 10 000, Real component
2. VLF-map 1 : 10 000, Imaginary components
3. VLF-conductors 1 : 10 000

X 1022 400 + Y 38 400

+ Y 32 000

+ X 1022 400




CONTOURS: 0,+10,+20,+30,+50,+75,+100,+150,+200,+300 %

TRANSMITTER: FUO 15,1 kHz

INSTRUMENT: GEONICS EM-16

FRASER-FILTERED

X 1017 600 + Y 38 400

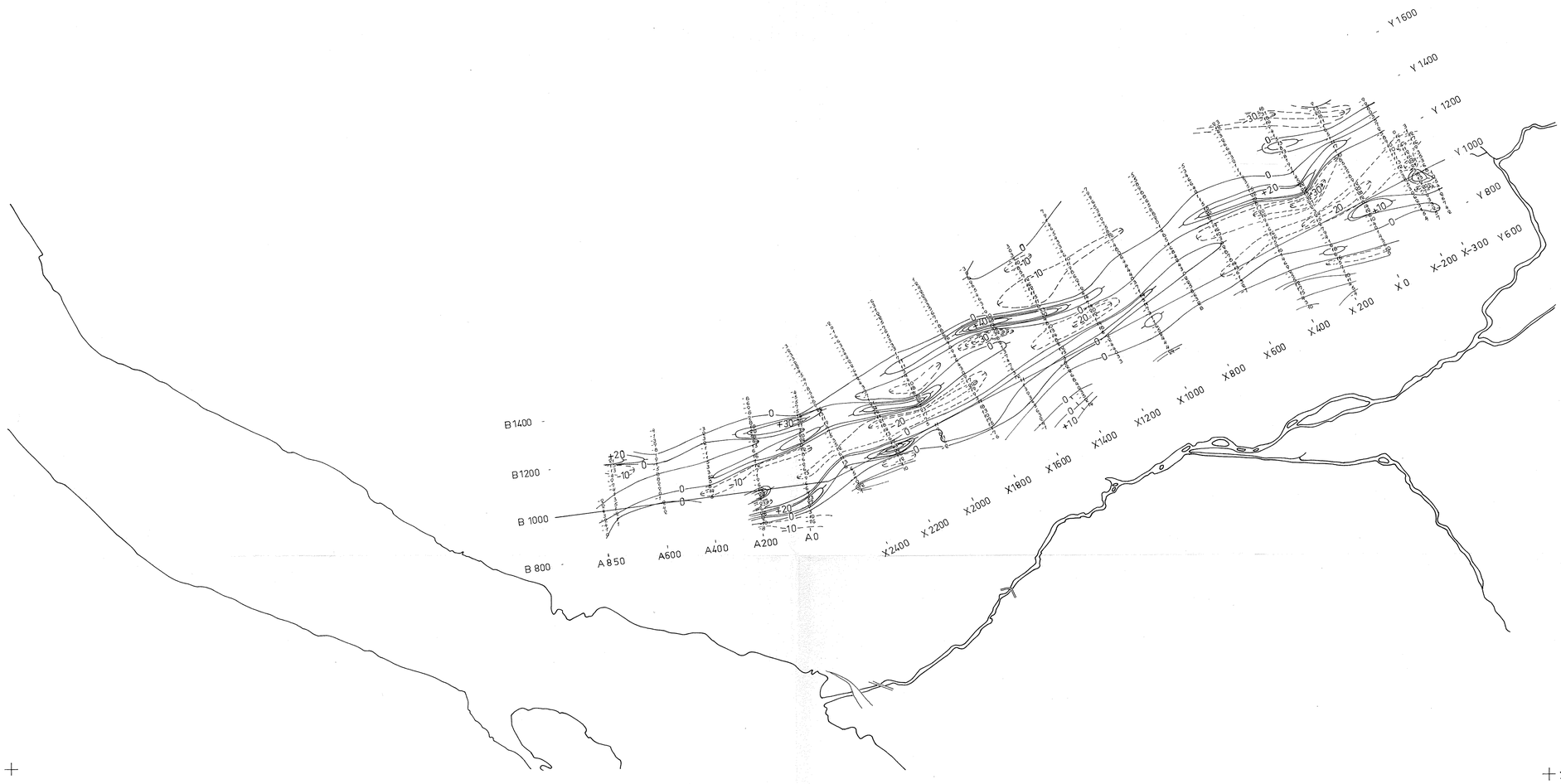
+ X 1017 600 Y 32 000

| | | | | | |
|---|---|---|---|---|---|
| SUOMEN MALMI OY | 1:10000 | Meas. | PHRK | 5.74 |
| | | Draw | AS | 7.74 |
| VLF-MAP<br>REAL COMPONENT | | | | |
| SULITJELMA | EH 213 | | | |

X 1022 400 + Y 38 400

+ Y 32000

+ X 1022 400




CONTOURS: -30, -20, -10, 0, +10, +20, +30, +40 %

TRANSMITTER: FUO 15,1 kHz

INSTRUMENT: GEONICS EM-16

FRASER-FILTERED

X 1017 600 +

Y 38 400

+ X 1017 600

Y 32000

| | | | | | |
|---|---|---|---|---|---|
| SUOMEN MALMI OY | 1:10000 | Meas. | PHRK | 5.74 |
| | | Draw. | AS | 7.74 |
| VLF-MAP<br>IMAGINARY COMPONENT | | | | |
| SULITJELMA | EH 213 | | | |

X 1022 400 + Y 38 400

+ Y 32 000

+ X 1022 400

(DEEP LYING)

(DEEP LYING ?)

B 1400

B 1200

B 1000

B 800

A 850 A 600 A 400 A 200 A 0

X 2400 X 2200 X 2000 X 1800 X 1600 X 1400 X 1200 X 1000 X 800 X 600 X 400 X 200 X 0 X -200 X -300

Y 1600 Y 1400 Y 1200 Y 1000 Y 800 Y 600

VERY GOOD CONDUCTOR

GOOD CONDUCTOR

WEAK OR DEEP LYING CONDUCTOR

X 1017 600 + Y 38 400

+ X 1017 600 Y 32 000

| | | | | |
|---|---|---|---|---|
| SUOMEN MALMI OY | 1:10000 | | P L | 7.74 |
| | | Draw | A S | 8.74 |
| VLF-CONDUCTORS | | | | |
| SULITJELMA | EH 213 | | | |