

FOR FALCONBRIDGE NIKKELVERK A/S  
A/S SULFIDMALM

Project 905-17

Ground surveys and prospect-  
drilling at Havggjavrrre 1976,  
Masi

By

E. Kreivi

K. Taipale



## INTRODUCTION (Fig.1)

Havggajavrre-grid is situated on Carajavrre mapsheet (1833I) about 6 km west of the intersection of the old Kautokeino-Alta-highway and the Masi-road on Sturoaivve, and by a tractor-road to Sodnajavrre. The 3.5 km long and 800-1000 m wide grid was laid out in a N55°E direction starting from the northernmost end of the lake Havggajavrre. Its purpose was to locate HEM- and reconnaissance till-sampling-anomalies. The grid-area was prospected and mapped in detail, a VLF-EM- and Mag-survey was done on all the profiles with 100 m line-spacing, a Shoot-back-EM-survey was done across the VLF-EM-anomaly-zones and three prospecting drill-holes, totalling 120 m in length, were drilled to find a source of Shoot-back - EM and geochemical anomalies.

## GEOLOGY by Kalle Taipale (Fig.2)

### 1. General description

A several kilometers long, 300-400 m broad and 20-30 m high drumlin, cut by proglacial meltwater channels covers about one third of the grid area. Another third is covered with swamps and small ponds. The rest of the area consists of hillslopes with a little better exposure. In all the outcrop relations are not the best possible for a detailed geological study.

### 2. Petrography

Most of the area examined consists of mica rich schists. These schists seem to contain always more or less material of volcanic origin in the form of amphibole rich intercalations.

Above the mica schist there are basic volcanics and amphibolites.

Sulphide bearing horizons are connected with the contact zone of mica schists and volcanic series.

### 2.1. Mica schist

Mica schist is exposed along a steep slope north of lake Havggajavrre. It consists of dark mica, quartz and some feldspar. Pyrite occurs occasionally as thin bands (~1 mm) and disseminated, too. Quartz-carbonate veins, sometimes boudinated to lenses, conform with the bedding. Pyrite is often connected with these quartz-carbonate rich parts.

Contact with the greenschist is not sharp, but rather a gradual change with increasing amount of chlorite and decreasing amounts of mica and quartz.

### 2.2. Greenschist

Greenschist consists mainly of chlorite and amphibole and contains variable amounts of plagioclase. It can even change to amphibolite with increasing plagioclase.

### 2.3. Amphibolite

This rock type consists of greenish to black amphibole and plagioclase. In places plagioclase veins and lenses can be seen. The degree of metamorphism seems to have been quite high in this area.

#### 2.4. Chert and graphite schist

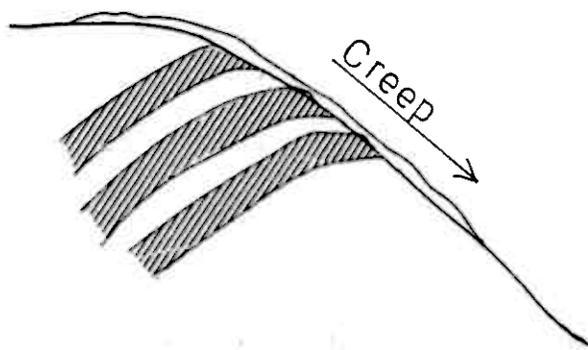
These rocks form the EM-conductive zones. On the Havggajavrre area thick gossan covers most of these rock types. In the only outcrops, the rock consists of quartz (grain size 0.5 - 1.0 mm) and some graphite with no sulphides.

#### 3. Structure

The most dominating tectonic feature of the area is a gentle flexural fold with the axis plunging  $5-10^{\circ}$  northwards. Minor folding occurs in the less competent rock types like mica schist and chlorite rich greenschists. The axes of minor folds seem to be parallel to the regional fold axis. Also another minor fold axis has been registered on this area. It plunges 15 to  $20^{\circ}$  westwards. This might be an evidence of another folding phase, younger than folding with N-S-axis.

Faulting and fracturing seem to have taken place along NW-side of lake Havggajavrre. The bid valley in which the grid is situated might as well be a big fracture zone. Two main joint directions occur in the region, one striking E-W and another about N60W, both dipping almost vertically. In some places the E-W-striking jointing is very dense resembling fracture cleavage and could represent the axial plane cleavage of folding with E-W-axial plane.

Bedding seems to strike E-W- to N45W and dips 10 to  $30^{\circ}$ N. The difference in dip between observed and geophysically measured values is possibly caused by soil creep which has caused bending of the beds at the steep hill slope, like the drawing shows:-



4. Block searching and till geochemistry

Block searching on this area was not very successful. Only a couple of blocks with some disseminated sulphides were found. The reason for the poor success in block searching was first the swampy landscape and thick drumlin and second the situation of the grid. The grid is almost straight across the ice flow direction and so the boulders should have been searched further to the north (see the geological map of Havggajavrre).

The biggest geochemical anomalies, along profile line 400N, have been caused by down hill flowing waters, which came over sulphide bearing horizons.

The zone of anomalous zinc values reaching from point 100N, 100W to the end of profile 700N with almost N-S-strike is situated on the upper part of a hill slope, where the overburden is very thin, (only a few decimetres). Most of these anomalous zinc values have come from the stream sediment samples, as well as most of the anomalous copper and nickel values. So it looks like the down-hill flowing waters should have enriched Zn, Cu and Ni and caused the anomalous values. The stream from which most of these anomalous samples have been taken flows across a very large gossan.

GEOPHYSICS (Fig.3)

A 400 m wide zone of VLF-EM-anomalies crosses the whole grid from the 0-profile until the 3500N-profile. Of these we can pick up 5 different horizons by Shoot-Back-EM with 50 ms coil-separation. Shoot-back-anomalies are strong, but difficult to interpret, because the conductive zones are so near each other. Mag-anomalies are very weak, up to 2200 gammas above the back-ground at 1000N/500W. The Mag-anomalies are conformable to the EM-anomalies.

GEOCHEMISTRY (Fig.4)

Till-samples were collected from the C-layer from a depth of 50 - 60 cms using a hand auger. The sample-interval was 25 m. Also stream sediment samples were collected. Atom Energy Laboratory assayed the samples for Ni, Cu, Co, Zn and Ag. A distinctive 900 m long and 400 m wide anomalous area was picked up between the profiles 0 and 900N on EM-conductors and near the contacts of volcanics with mica schists, in the area, where large gossan-areas were found. The highest values of assays were for:

Ni	1030 ppm	at	400N/350W
Cu	1240 ppm	at	700N/675W
Co	210 ppm	at	400N/275W
Zn	6700 ppm	at	600N/600W
Ag	4 ppm	at	100N/200W

DRILLING (Fig.5)

To find the source of the Shoot-Back-EM- and geochemical anomalies a contractor, called Terranor A/S, was used to drill three prospect holes, totalling 120 m:

1-H / 1776	60°/SE	30.30 m	at	700N/770W
2-H / 1776	60°/SE	39.60 m	at	600N/765W
3-H / 1776	60°/SE	<u>50.15 m</u>	at	400N/650W
		120.05 m		

In the core we found acid volcanics beds in basic volcanics with graphite-rich parts, which contained 10-20% sulphides, mainly pyrite with traces of sphalerite. The sulphides are impregnating as well as brecciating the rock.

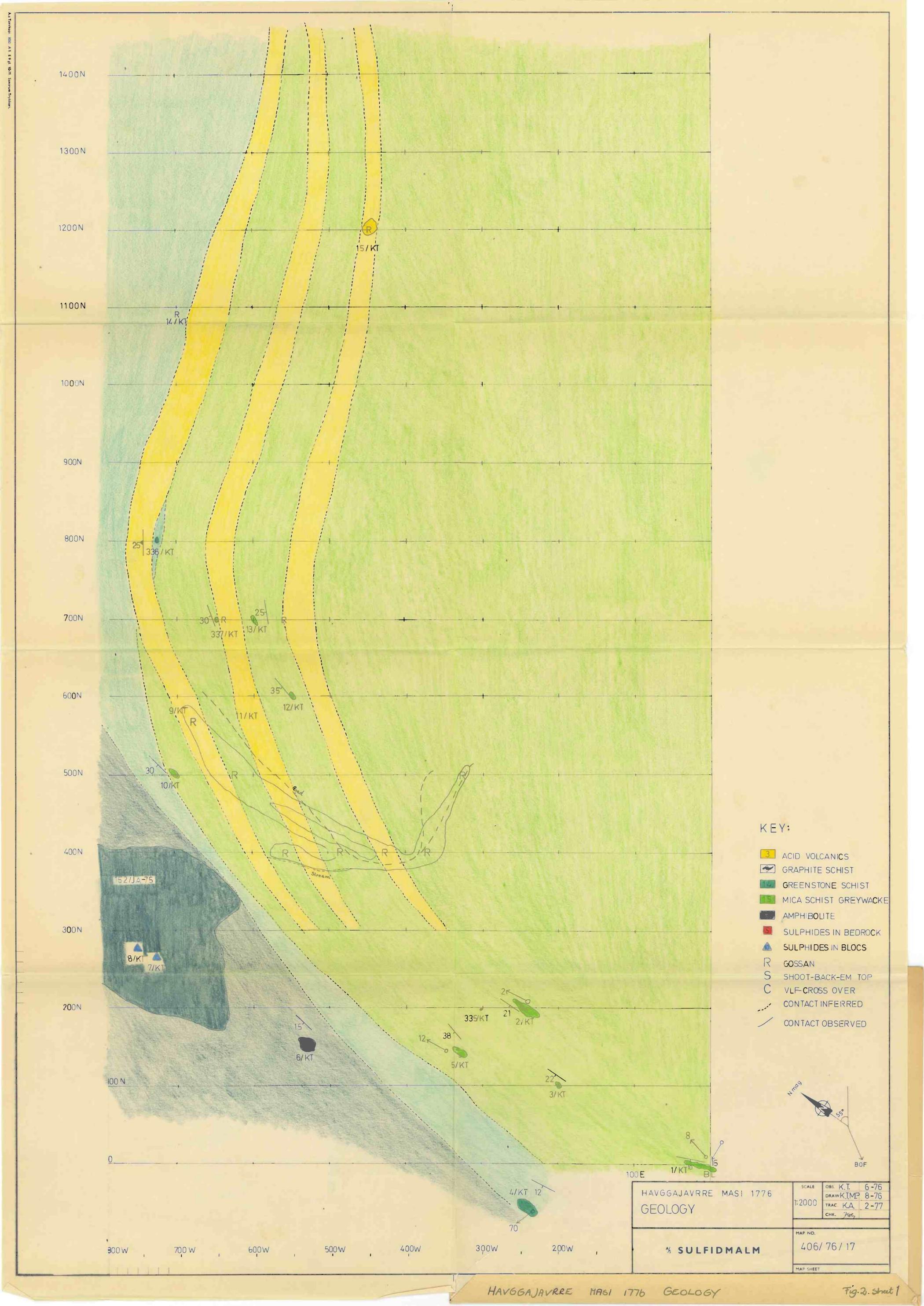
The highest assay for Zn was 0.75%/1m in the hole 2-H/1776 at 20-21 m. Cu-values are less than 0.05% and Ni less than 0.21% and Pb less than 0.10%.

## CONCLUSIONS

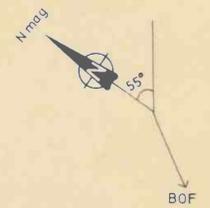
The holes were collared based on geological observations and the holes should have reached the horizons under the geochemical and EM-anomalies. According to the low assay-values of the core (max. 0.75% Zn) and comparing them with the high values in till (max. 6700 ppm Zn) one can assume that the holes did not reach the source-horizons. As mentioned by Taipale the observed dip values might be lower on the weathered surface than in solid rock because of soil creep at the steep hill-slope.





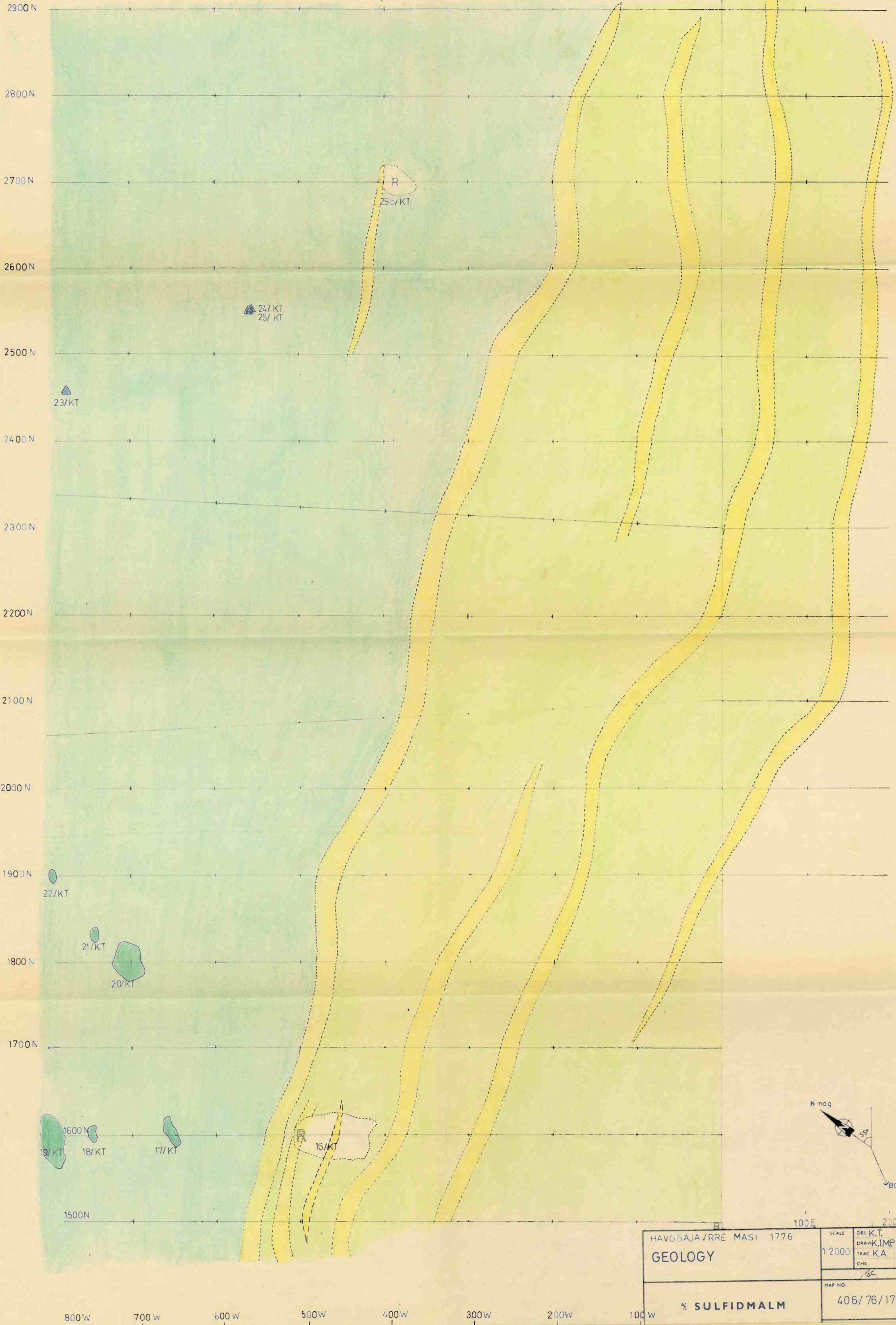


- KEY:
- ACID VOLCANICS
  - GRAPHITE SCHIST
  - GREENSTONE SCHIST
  - MICA SCHIST GREYWACKE
  - AMPHIBOLITE
  - SULPHIDES IN BEDROCK
  - SULPHIDES IN BLOCS
  - R GOSSAN
  - S SHOOT-BACK-EM TOP
  - C VLF-CROSS OVER
  - - - CONTACT INFERRED
  - CONTACT OBSERVED



HAVGGAJAVRRE MASI 1776		SCALE	OBS. K.T.	6-76
GEOLOGY		1:2000	DRAW. TIME	8-76
% SULFIDMALM			TRAC. KA	2-77
			CHK.	Jac
		MAP NO.	406/76/17	
		MAP SHEET		

Vertical Datum: ICB 1913



HAVGGAJAVRRE MASI 1776		SCALE	OBS. K.T.	6-76
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% SULFIDMALM



HAVGGAJAVRRE MASI 1776  
GEOLOGY

SCALE	OBS. KT	JUNE-76
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	TRAC.	
	CHK.	

1/2 SULFIDMALM

MAP NO.	13-
	406 / 76 / 17

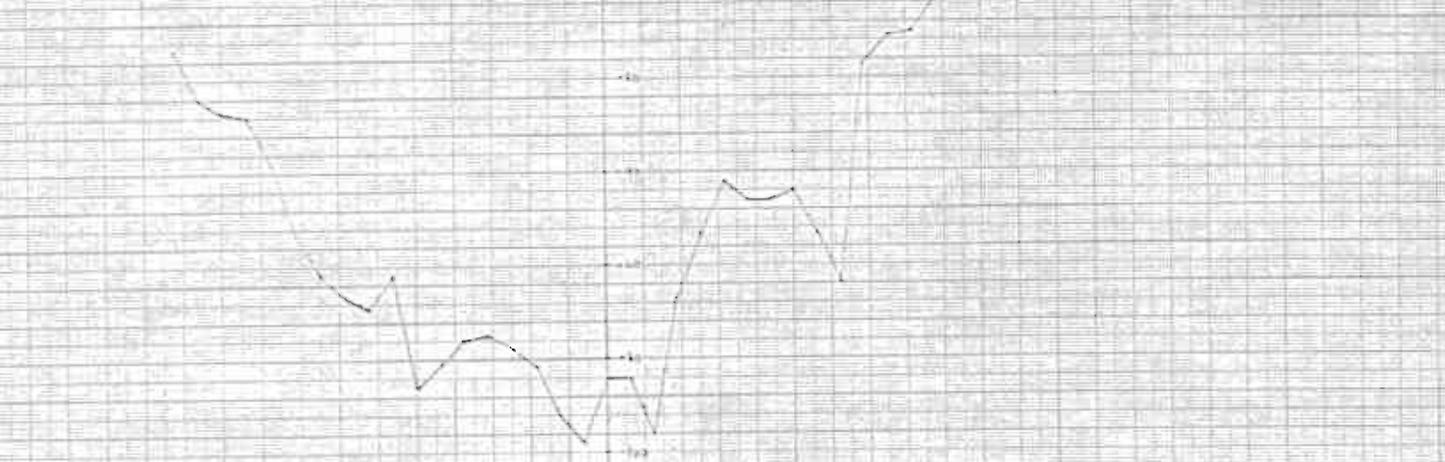
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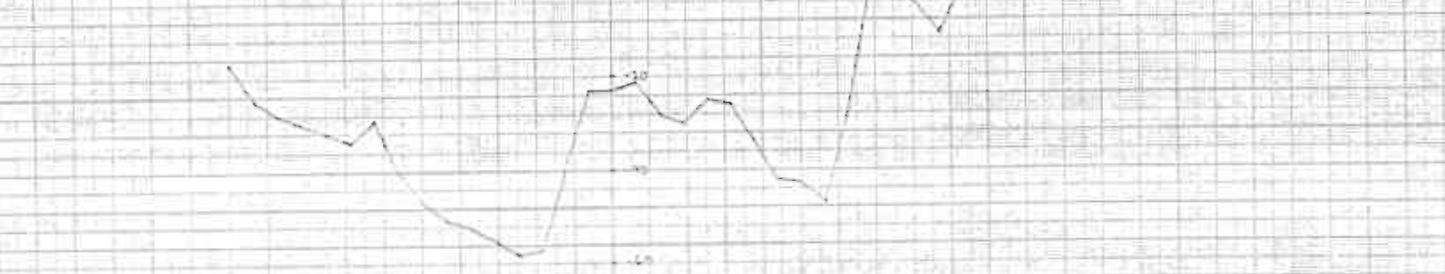
GEOPHYSICS

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270W 260W 250W 240W 230W 220W 210W 200W 190W 180W



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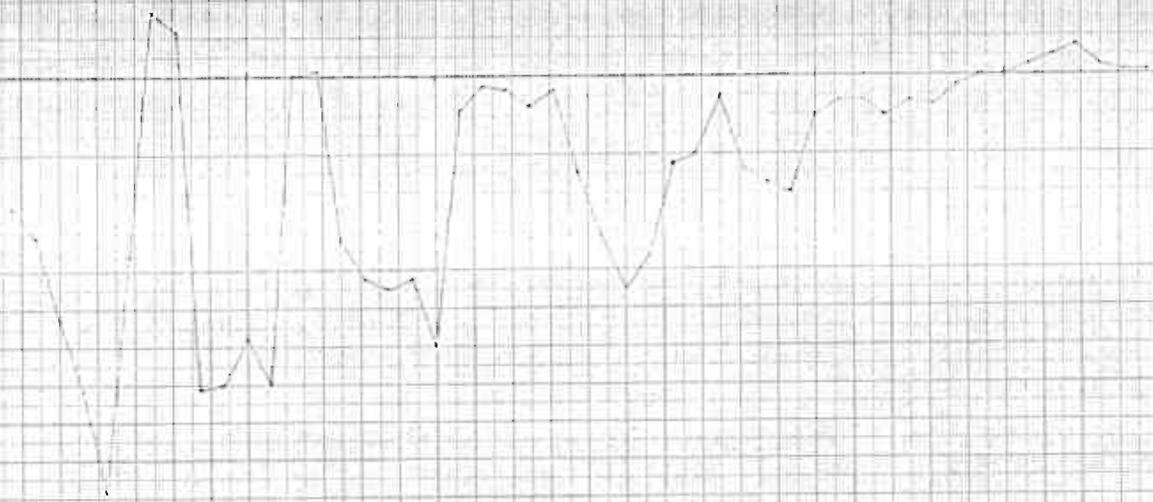
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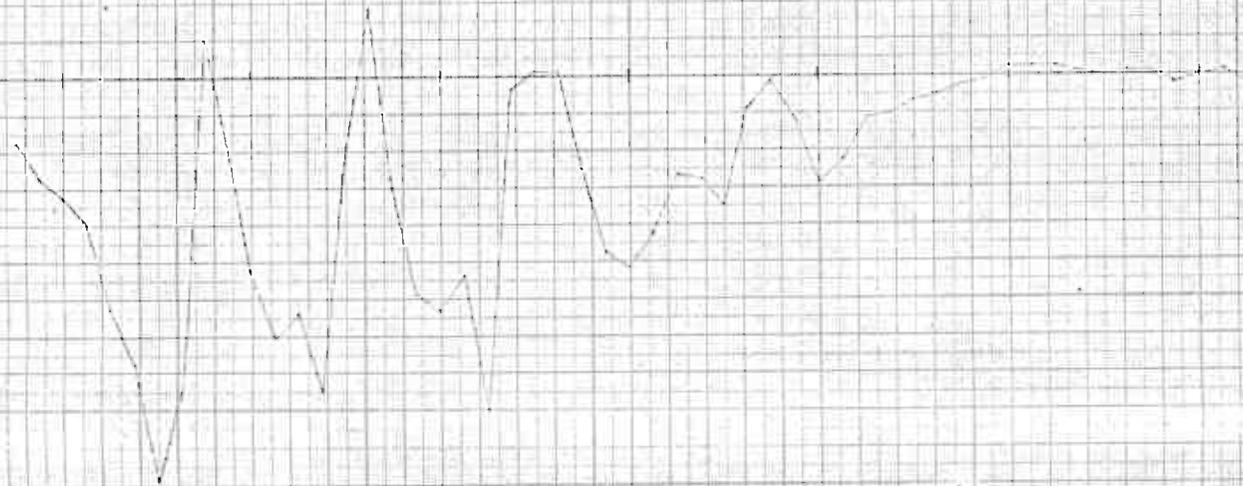
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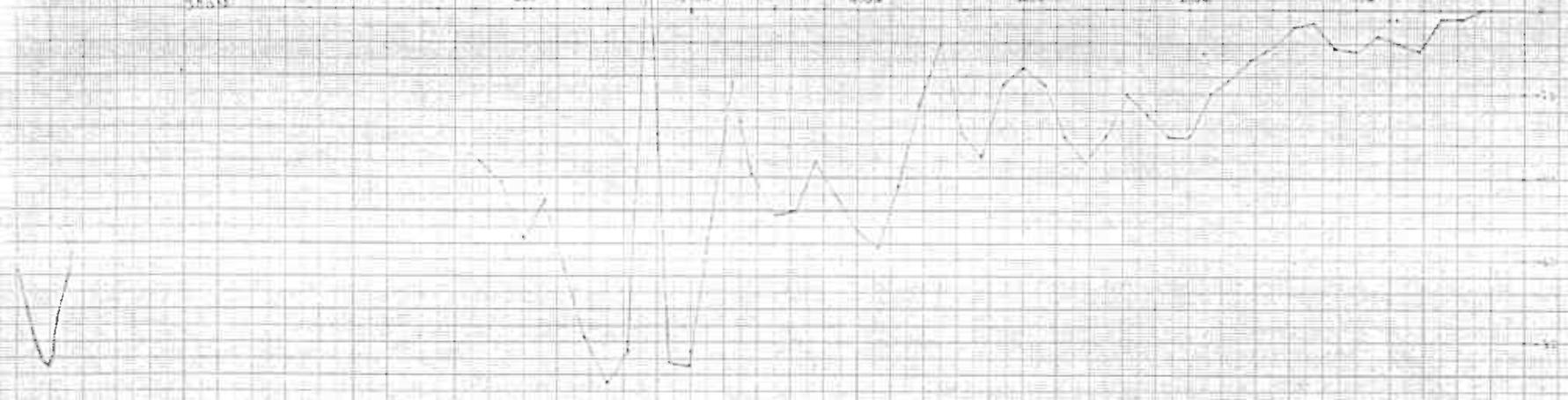
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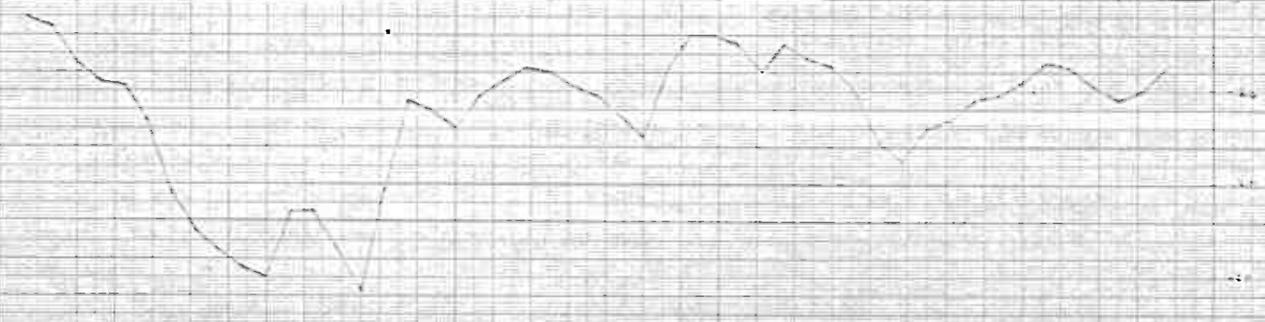
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2000 2001 2002 2003 2004 2005 2006 2007



Hugginsville Sta. 1215  
 Shot Back 50m  
 Profiles 2000, 2001  
 Scale 1:1000  
 SCS T&E 01-00-0000  
 Drawn AD 4-21



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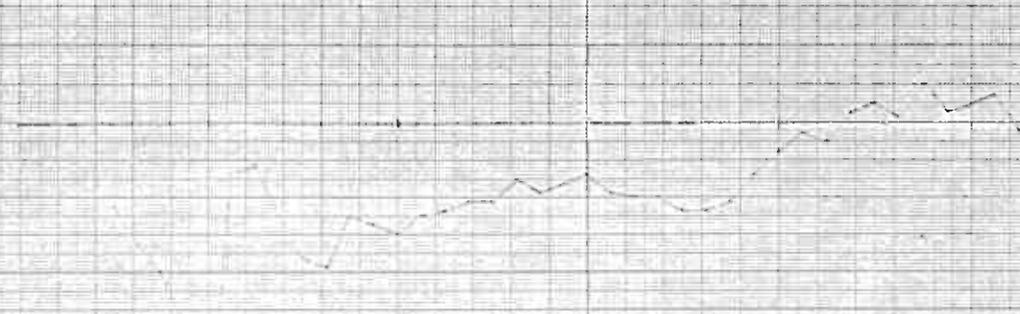
300W 500W 100W 100E 150E 150W 200W

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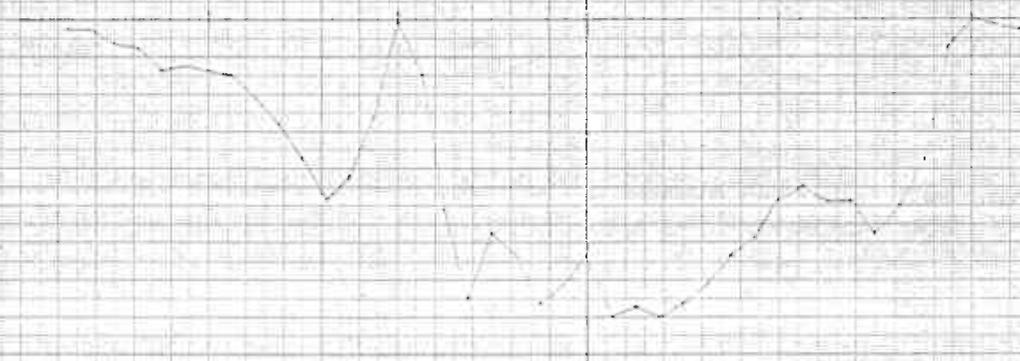
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33.4N

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33.4N

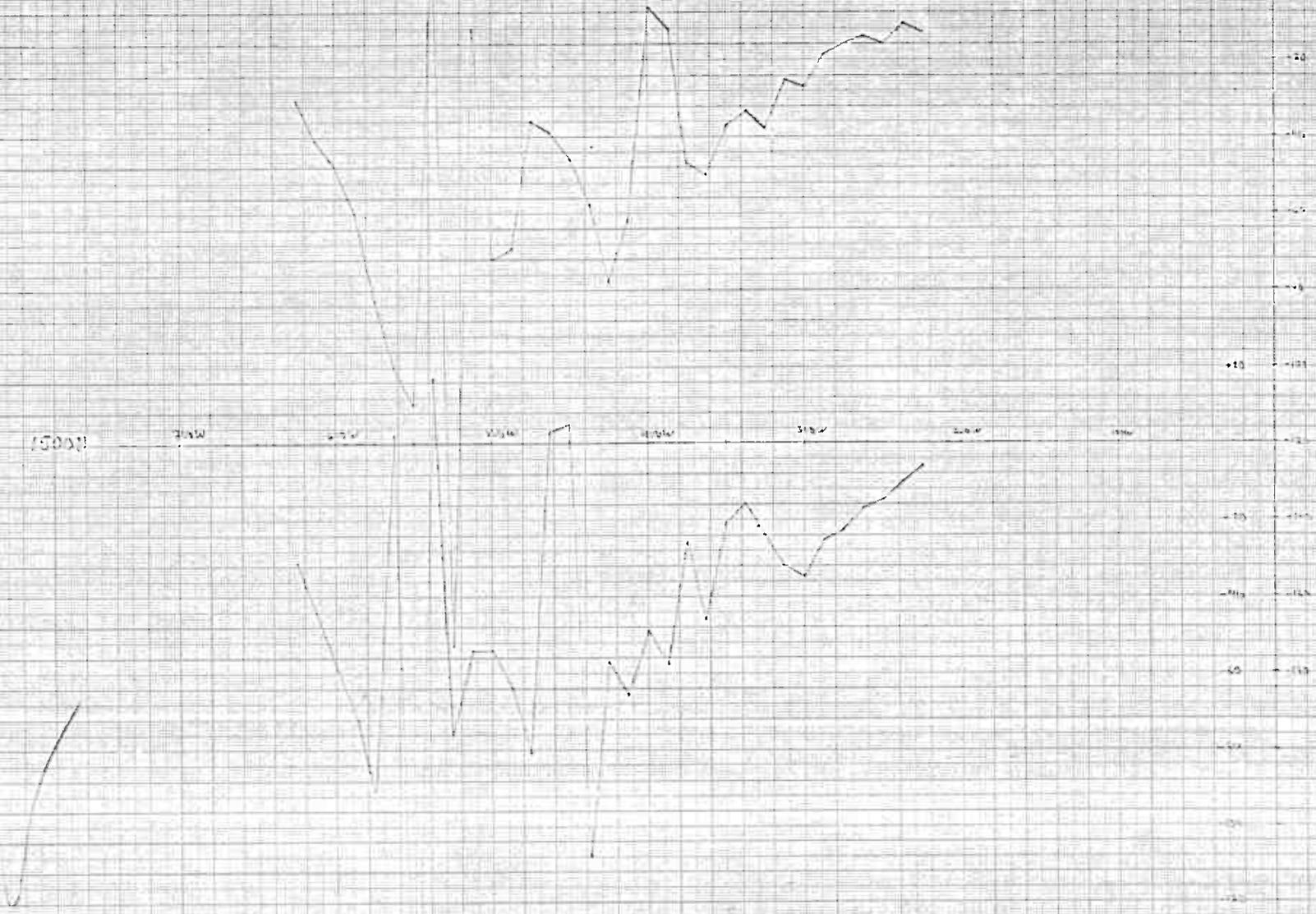


V

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 2.0W  
 1.0W  
 0E  
 1.0E  
 2.0E  
 3.0E

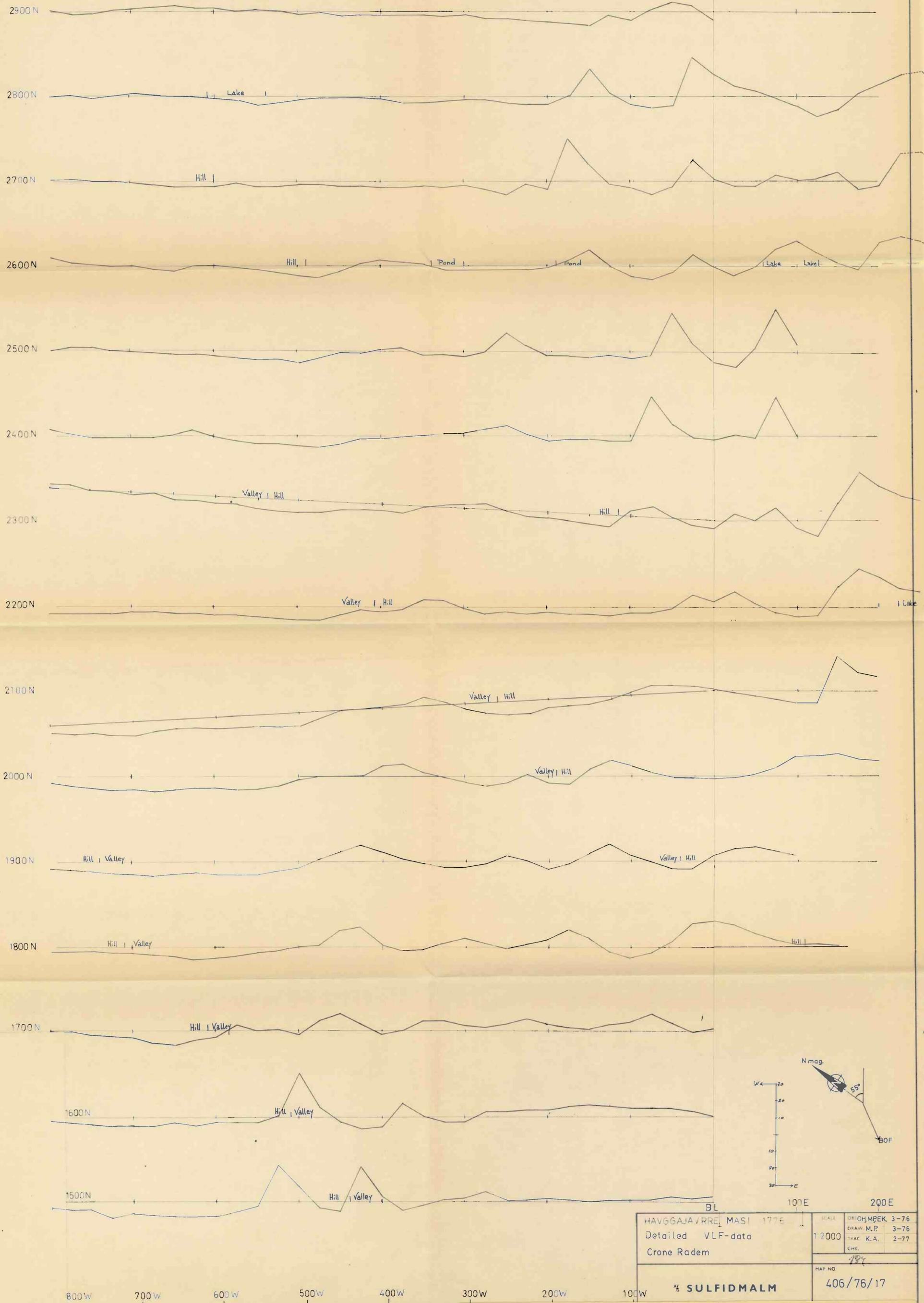
1500 N

1500 N

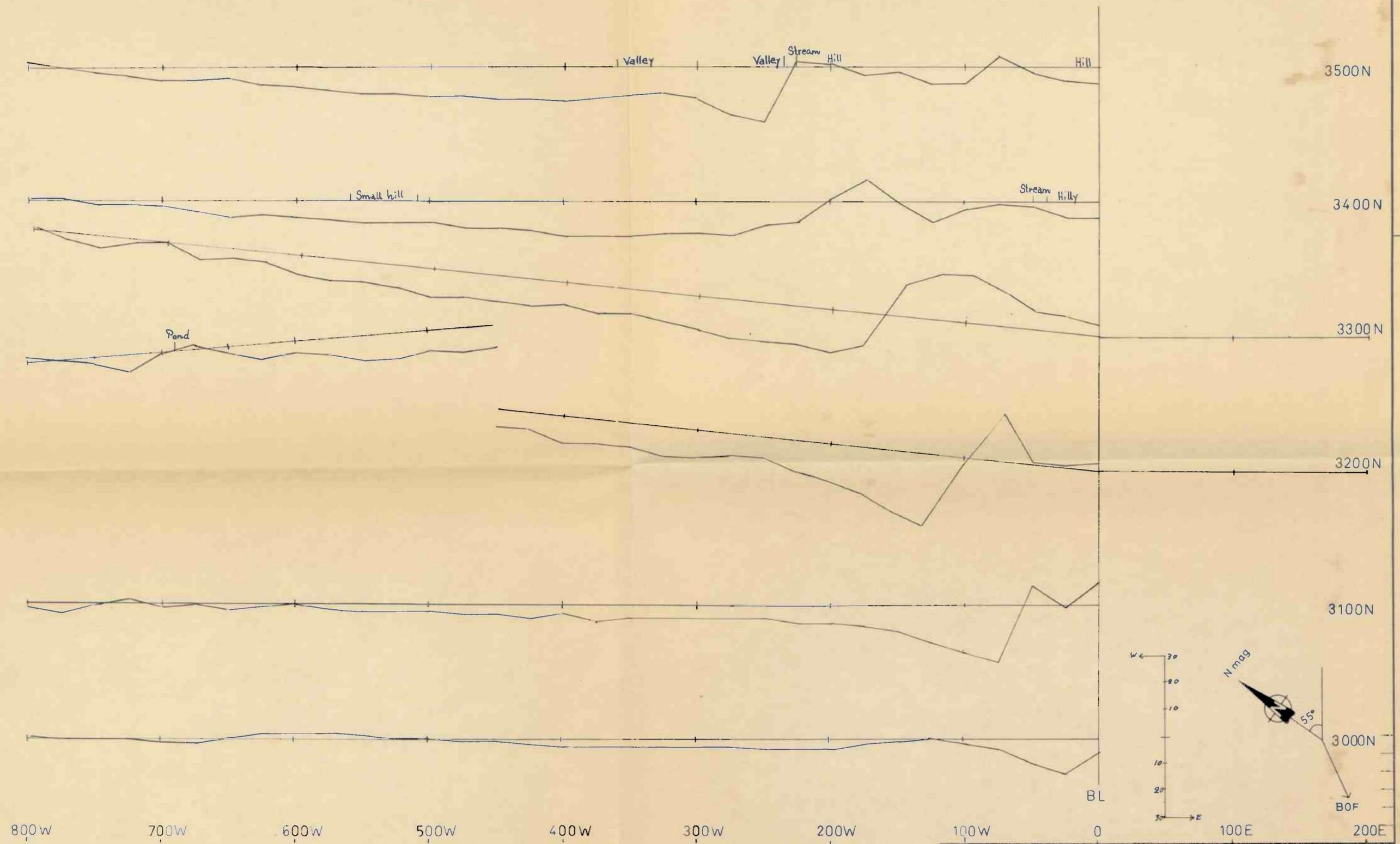


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HAVGGAJAVRRE MASI 1776, Detailed VLF-data, Crone Radem Fig. 3. Sheet 2

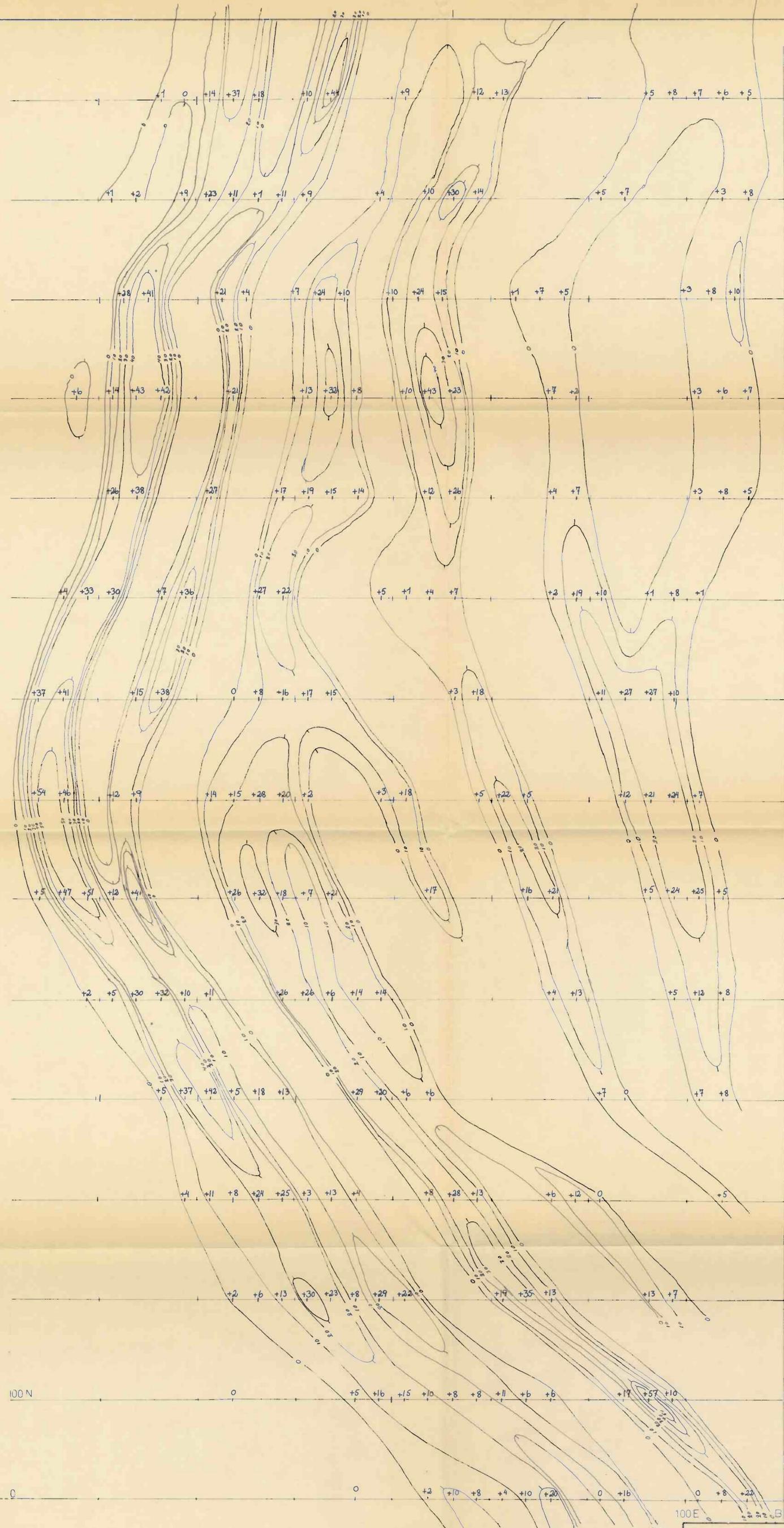


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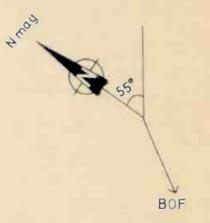
HAVGGAJAVRRE MASI 1776. Detailed VLF-data Crone Radem *Fig 3*  
Sheet 3

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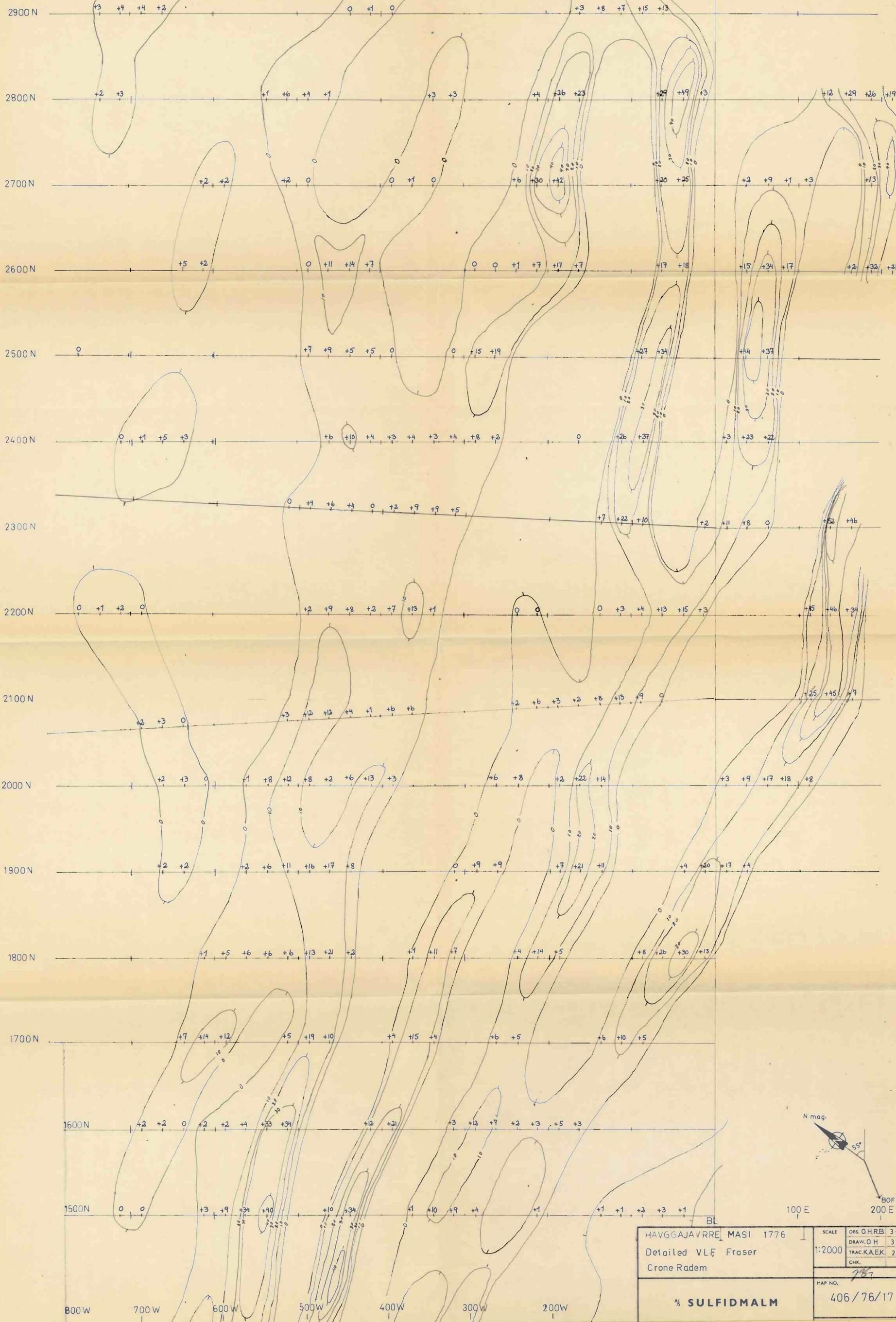
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300W 700W 600W 500W 400W 300W 200W



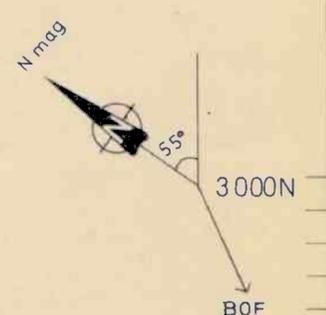
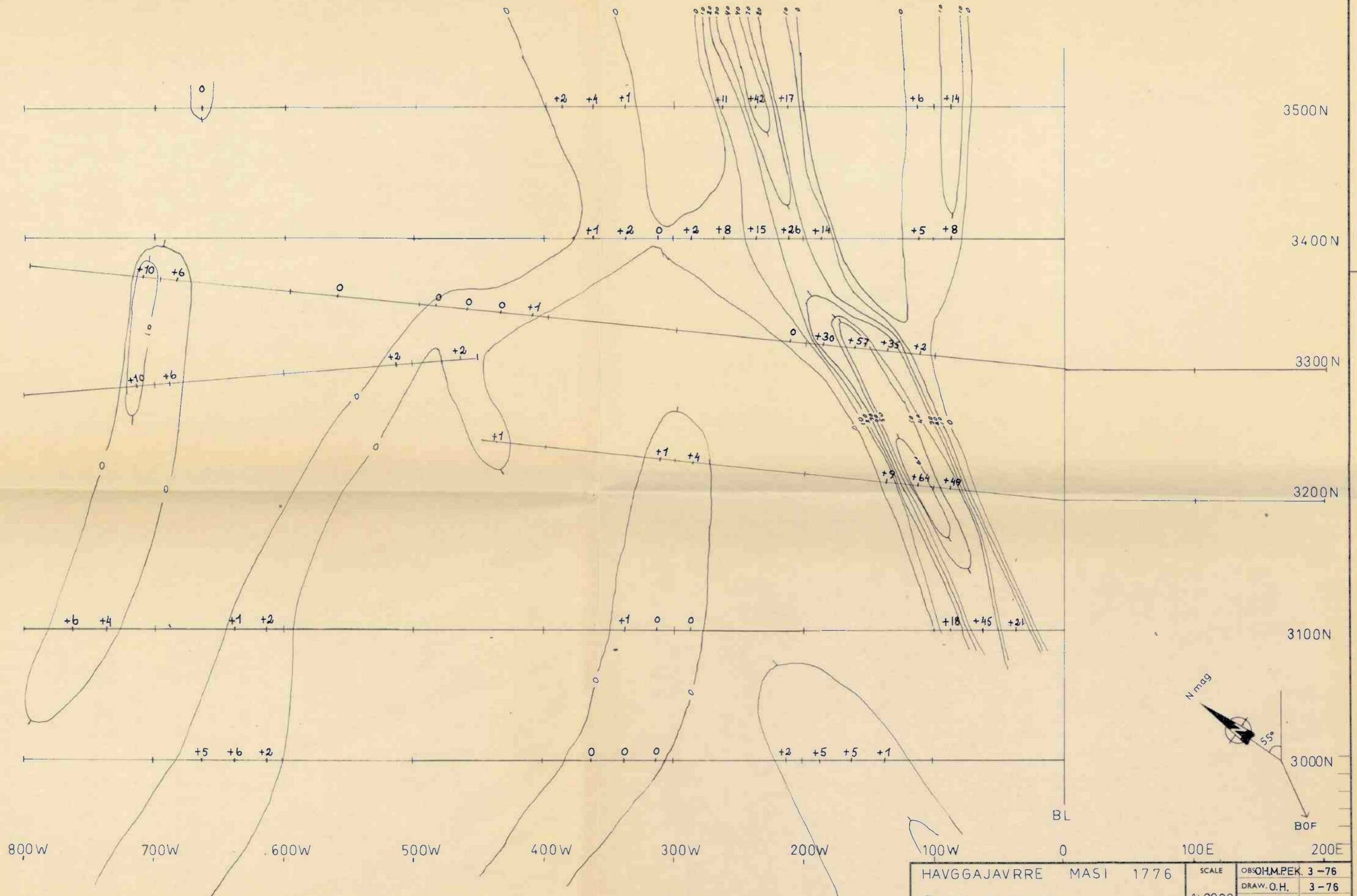
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% SULFIDMALM	MAP NO.	TRAC K.A.E.K.	2-77
	406/76/17	CHK.	185



HAVGGAJAVRRE MASI 1776		SCALE	1:2000	Obs. O.H.R.B.	3-76
Detailed VLF Fraser				Draw. O.H.	3-76
Crone Radem				Trac. K.A.E.K.	2-77
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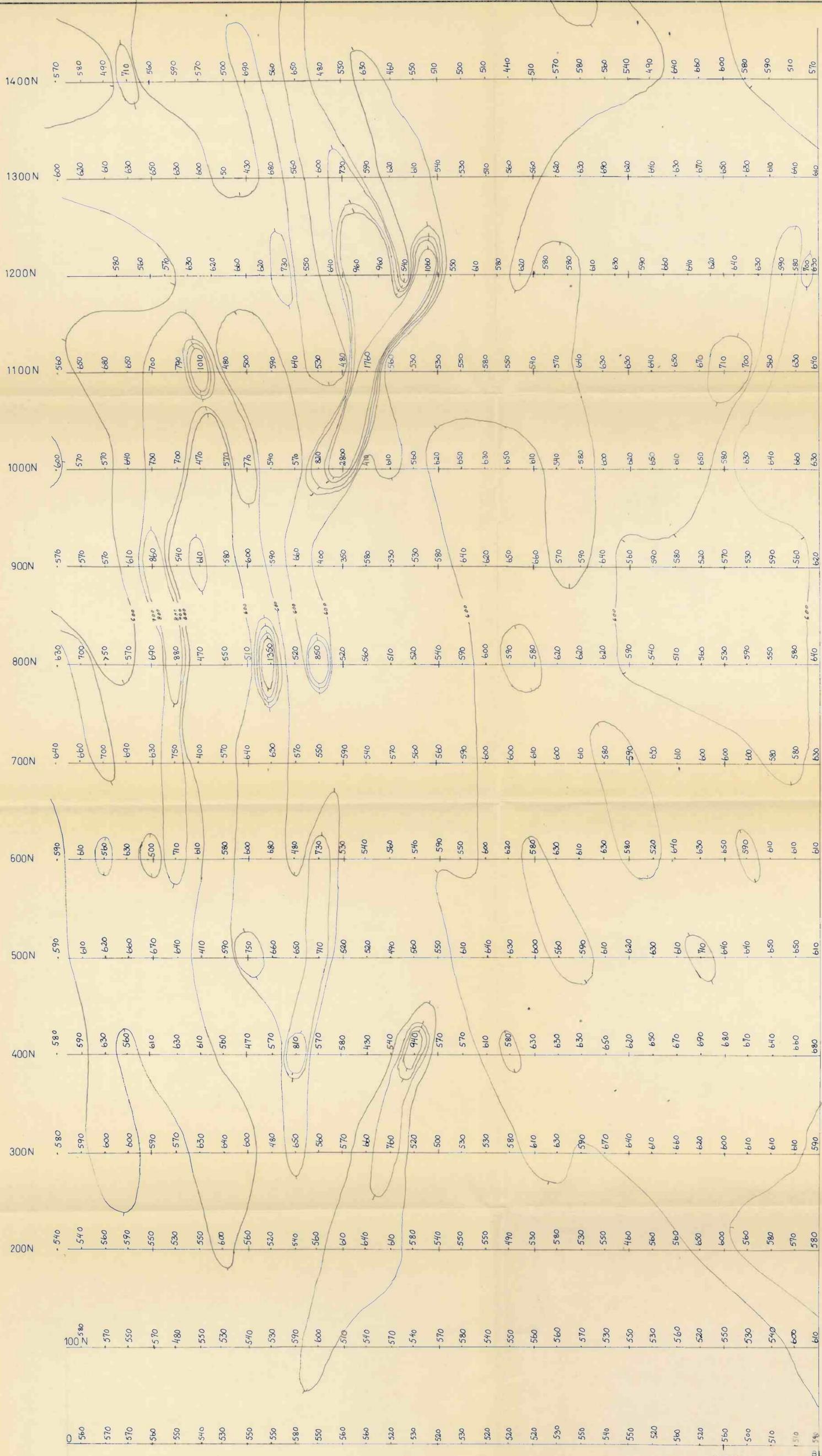
**SULFIDMALM**

HAVGGAJAVRRE MASI 1776. Detailed VLF Fraser Crone Radem Fig 3. sheet 5



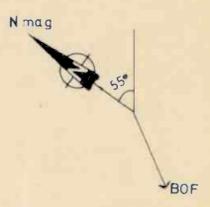
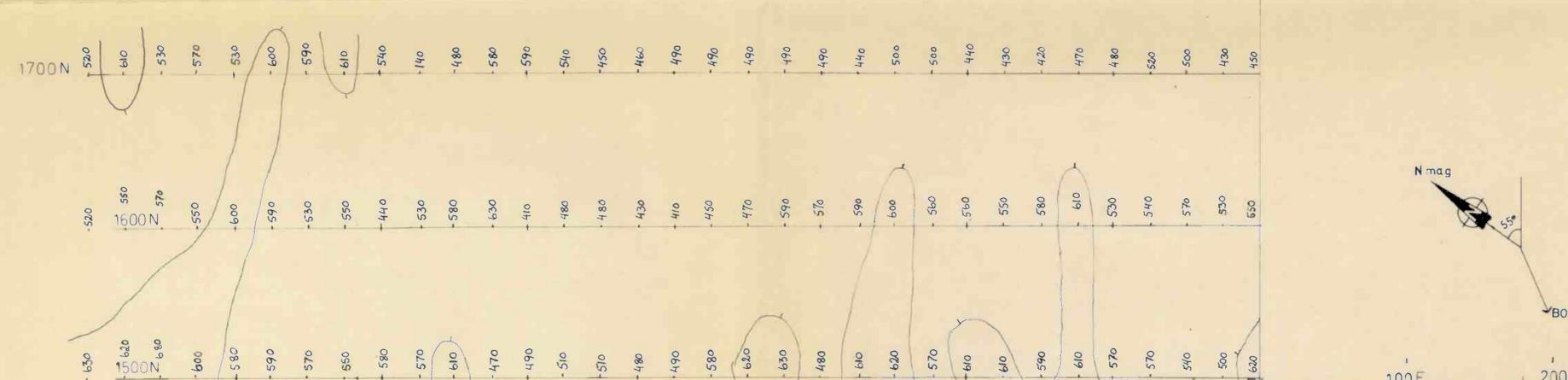
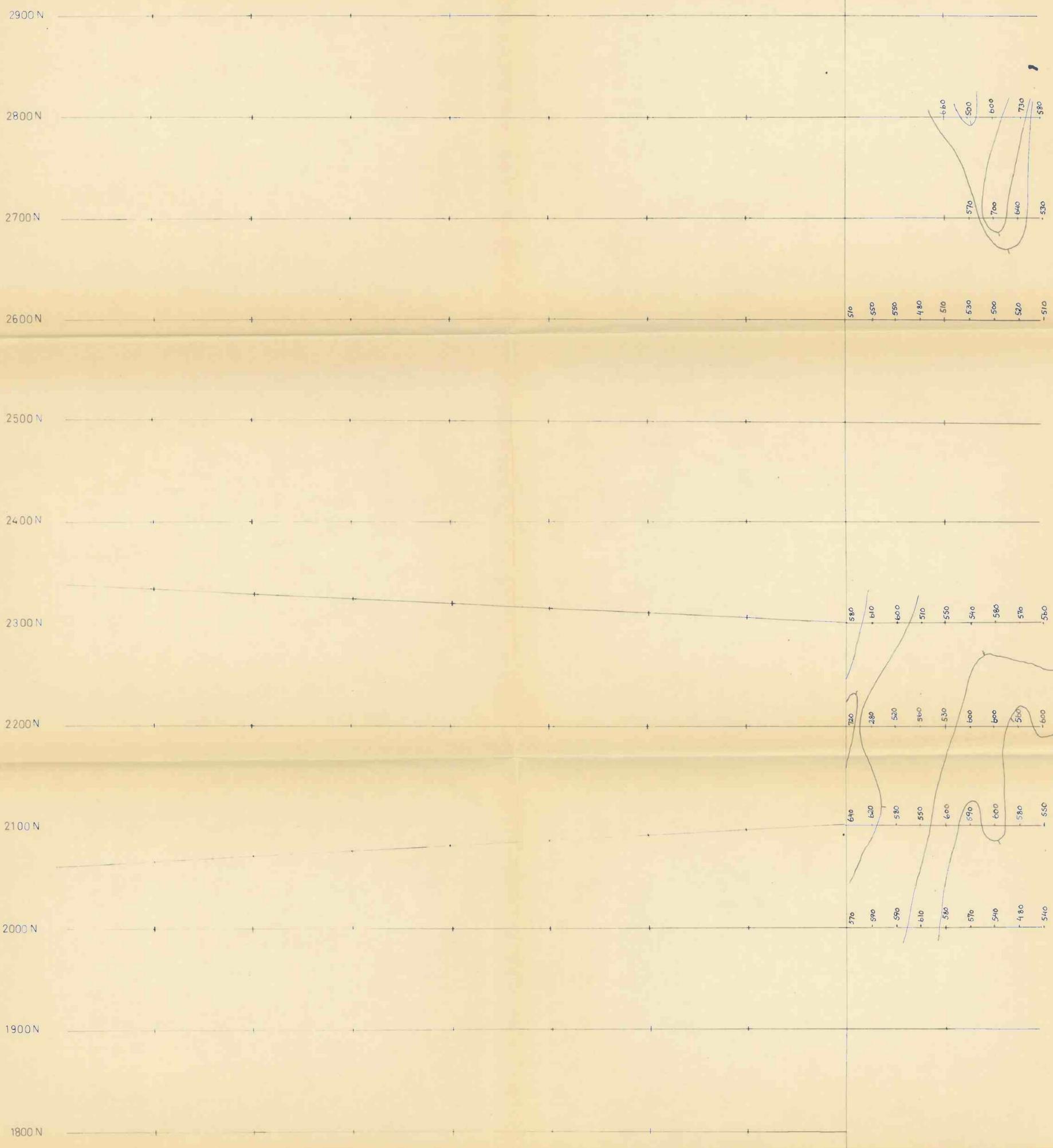
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Crone Radem			TRAC. K.A.EK. 2-77
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<b>1/2 SULFIDMALM</b>		MAP NO.	
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HAVGGAJAVRRE MASI 1776, Detailed VLF, Fraser Crone Radem sheet 6. Fig. 3



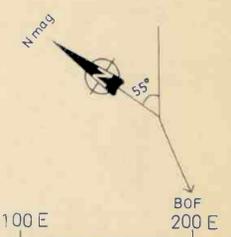
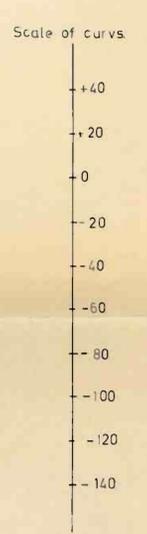
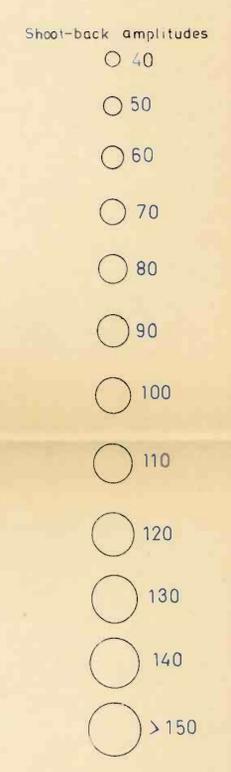
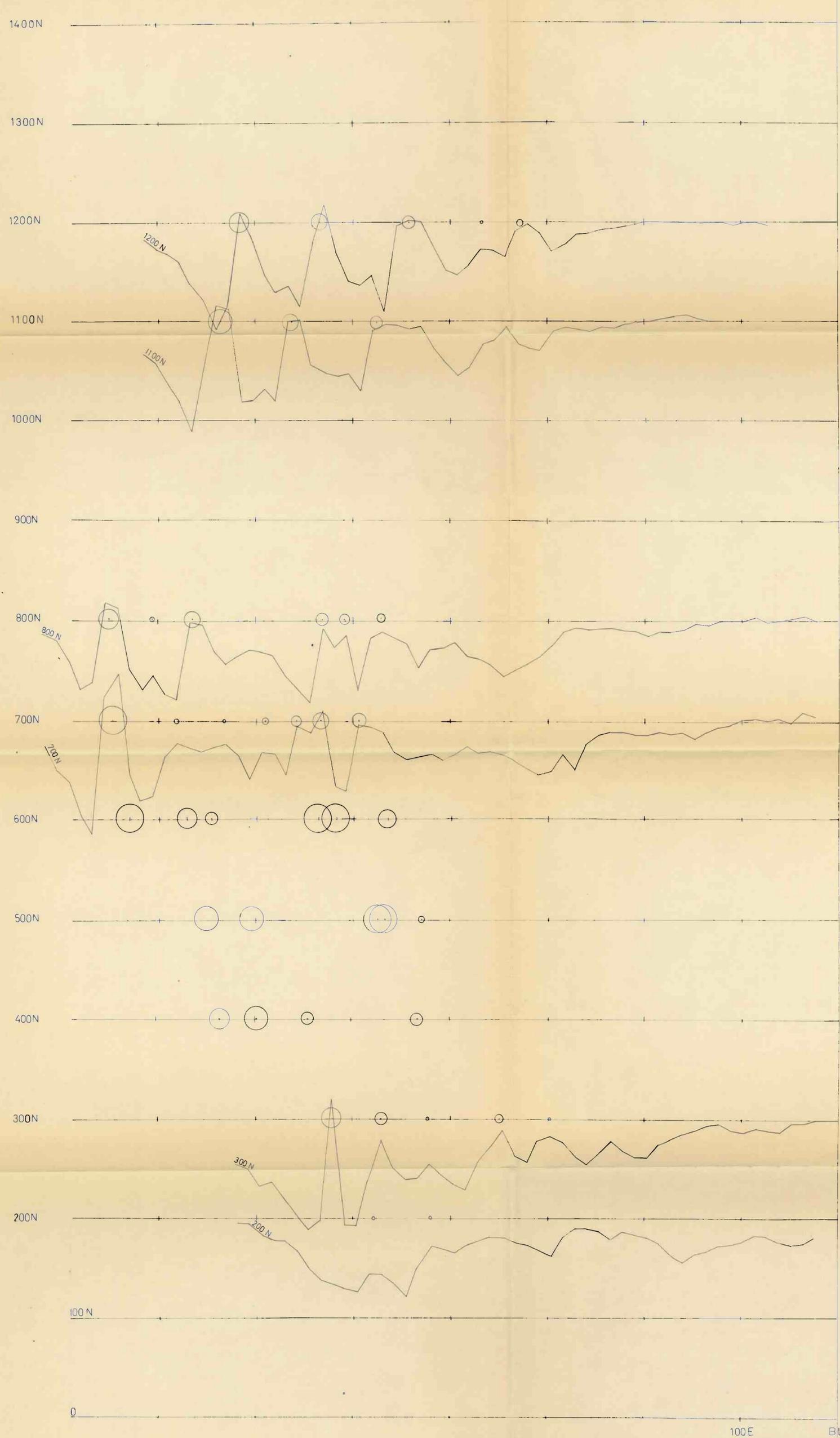
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			CHK <sup>1</sup>	
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1/2 SULFIDMALM				

Scale 1:2000



HAVGGAJAVRRE MASI 1776		SCALE	OBS. R.B.	3-76
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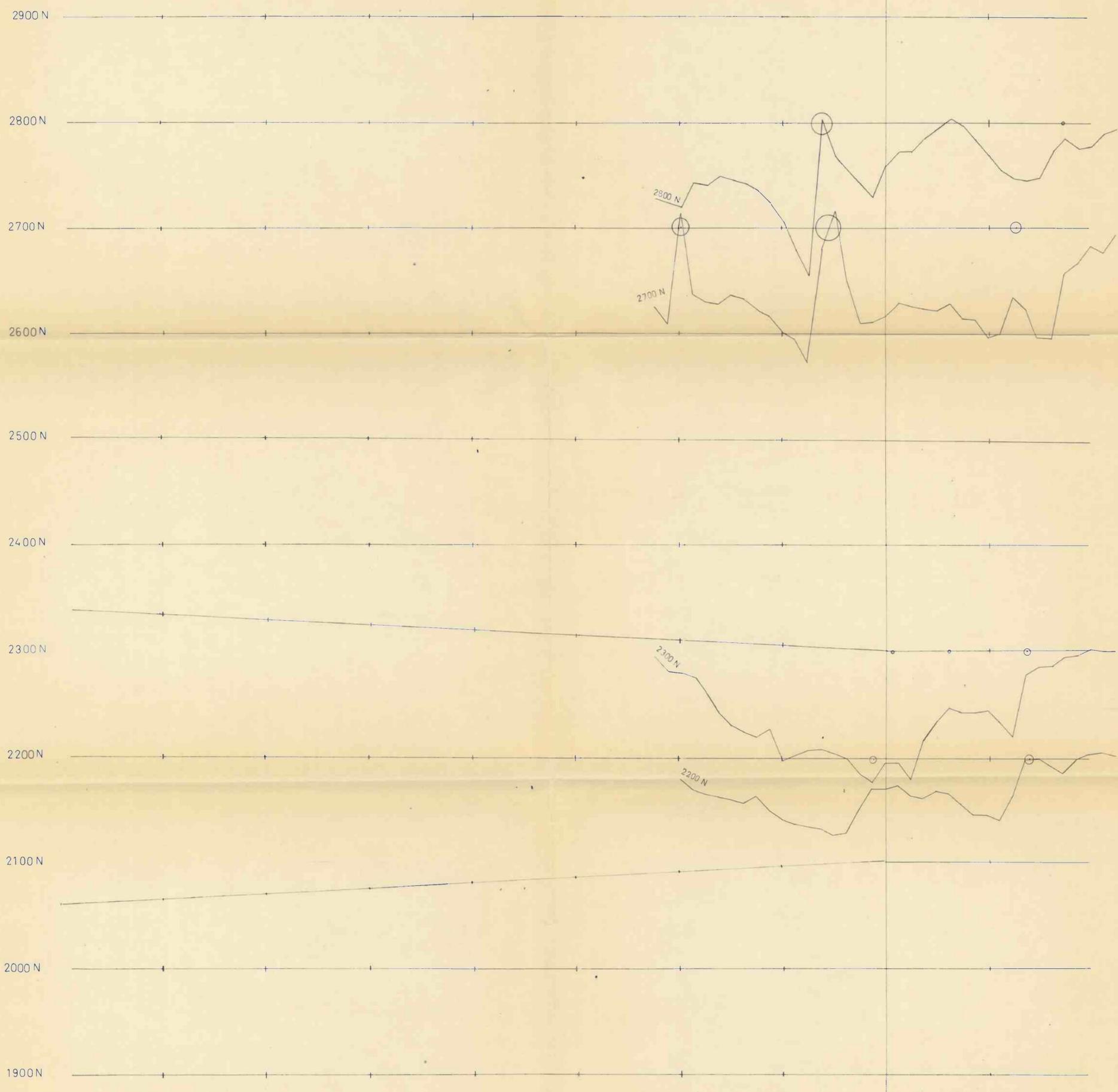
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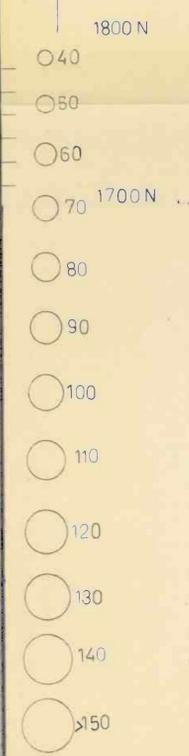
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Shoot-back, 50 m		1:2000	DRAW. M.P.	4-76
Profiles: 0-1400 N			TRAC. K.A.	2-77
			CHK.	
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<b>% SULFIDMALM</b>				

300W    700W    600W    500W    400W    300W    200W

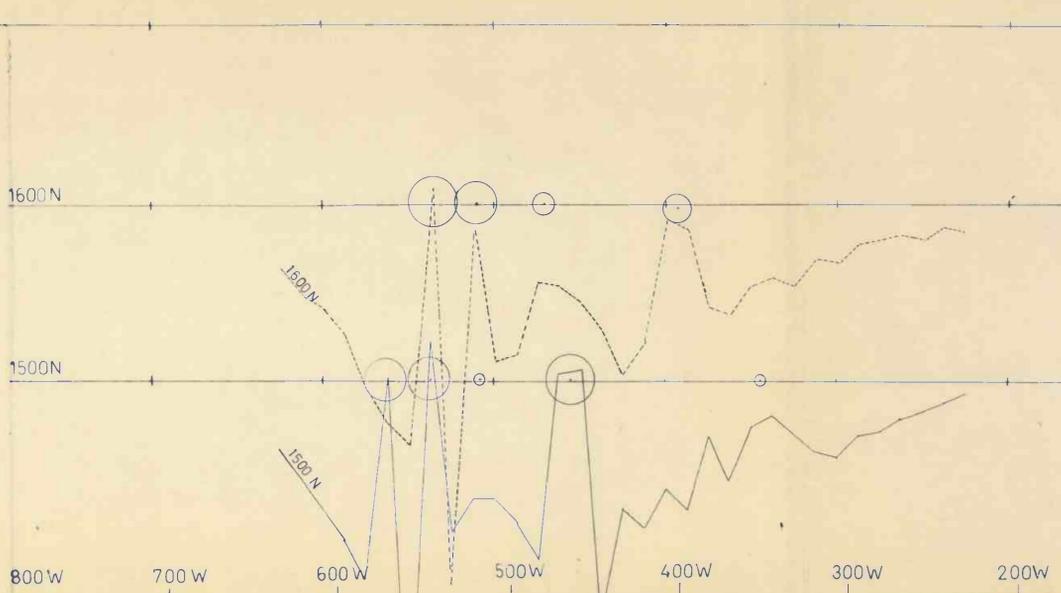
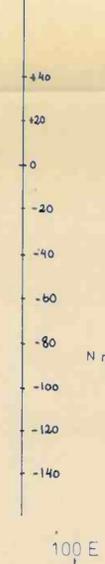
As 1/10/76 000 A.L. (L.F. 100) Bureau Hydrog.



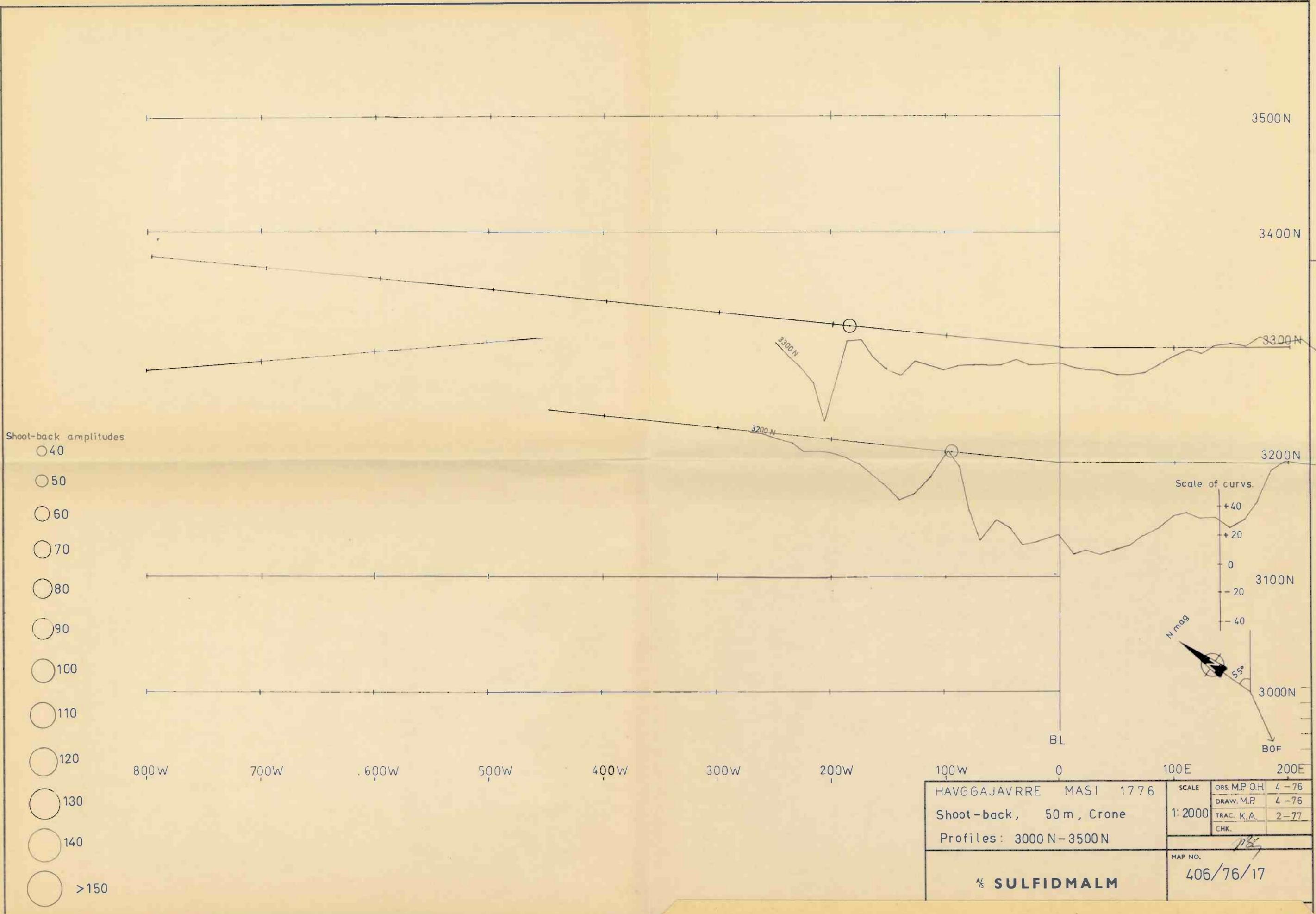
Shoot-back amplitudes



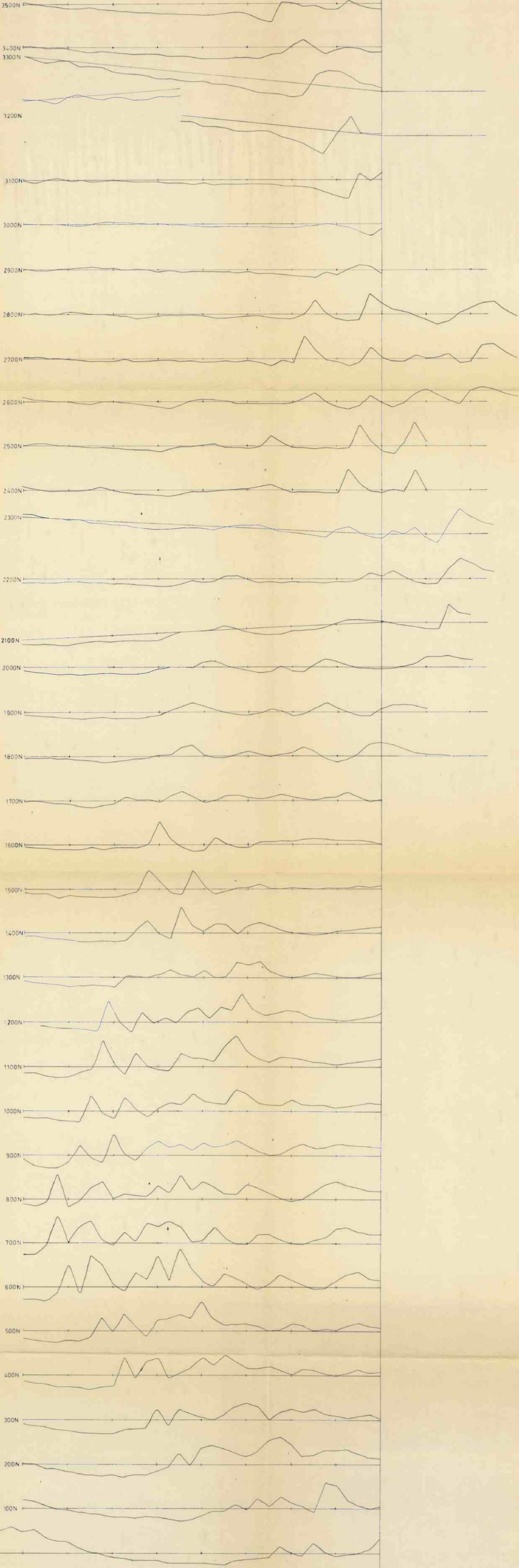
Scale of curves



HAVGGAJAVRRE MASI 1776		SCALE	OBS. O.H. MP	4-76
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% SULFIDMALM		MAP NO. 406/76/17		

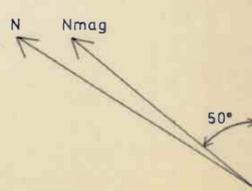


800W 700W 600W 500W 400W 300W 200W 100W BL 100E 200E



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950N

800W 700W 600W 500W 400W 300W 200W 100W BL 100E 200E



Havgejavre, Masi 1776  
**Detailed VLF**  
**ON-3500N**

1/8 SULFIDMALM

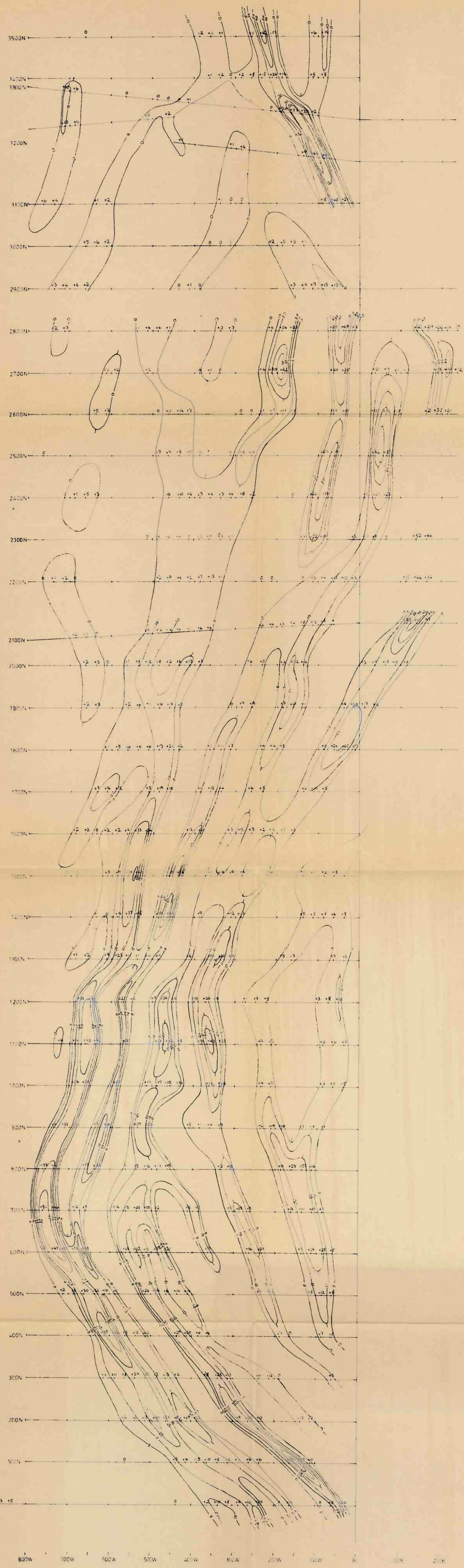
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MAP NO.  
 406/76/17

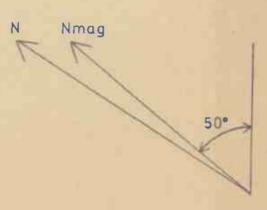
MAP SHEET

HAVGEJAVRE, Masi 1776 Detailed VLF ON-3500N Fig. 3 Sheet 12

800W 700W 600W 500W 400W 300W 200W 100W BL 00E 200E



800W 700W 600W 500W 400W 300W 200W 100W BL 00E 200E



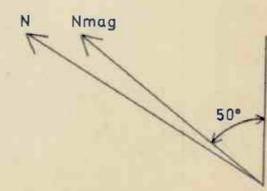
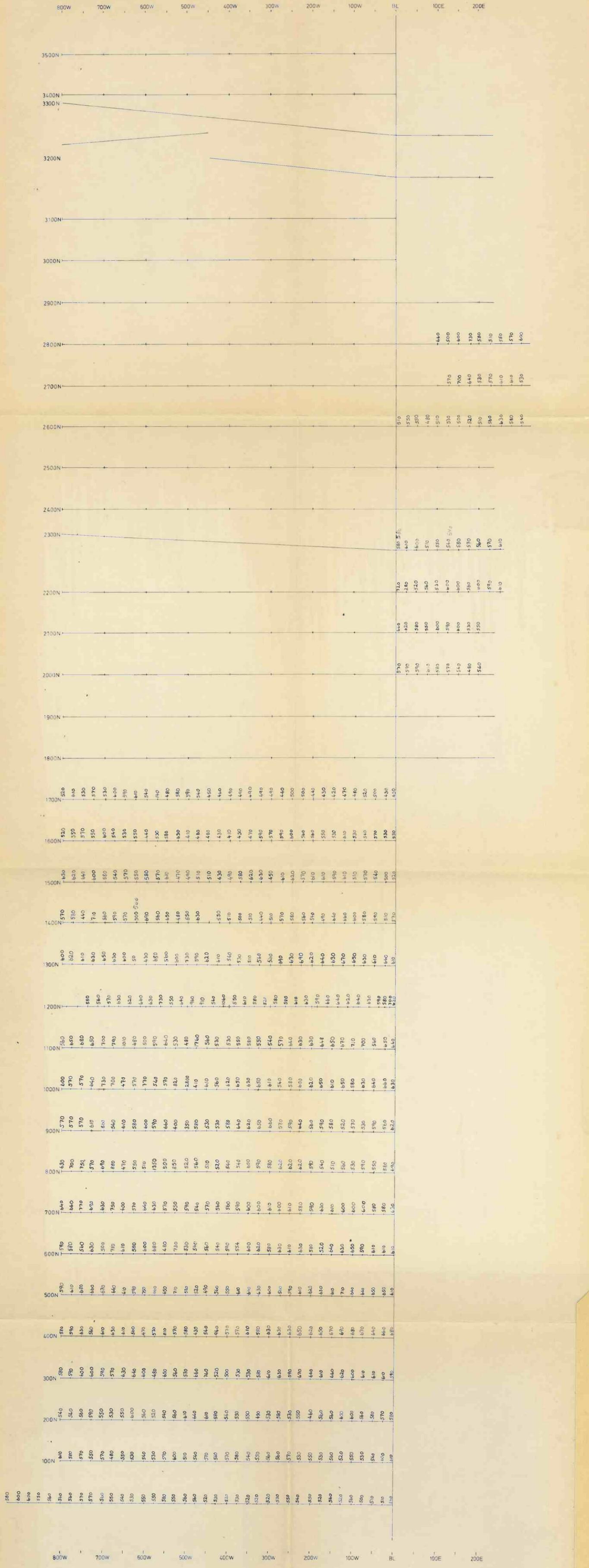
Havvgjavrrre, Masi 1776  
**Detailed VLF  
 Fraser contours**

SCALE	OBS. OHMF EK	3-76
1:4000	DRAW. OH	4-76
	TRAC. KG	6-76
	CHK.	

% SULFIDMALM

MAP NO	406/76/17
MAP SHEET	

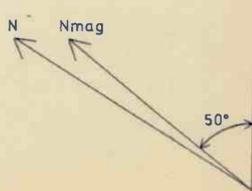
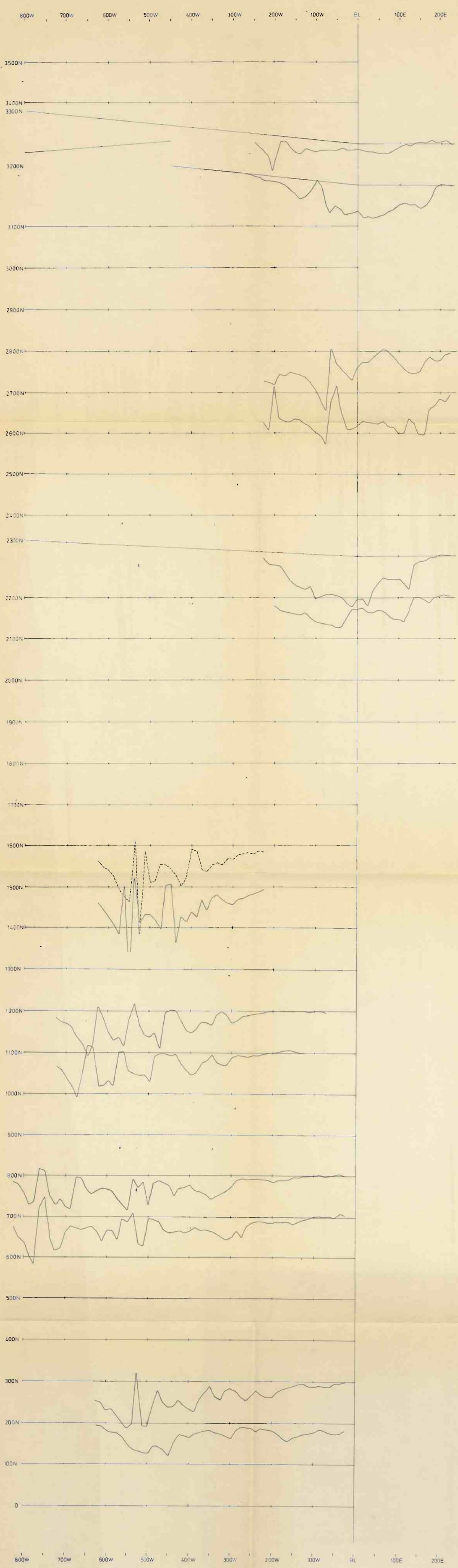
Havvgjavrrre, Masi 1776 Detailed VLF Fraser contours Fig 3 Sheet 13



Havggajavrre, Masi 1776  
**Magnetic Survey**  
 ON-3500N

% SULFIDMALM

SCALE	OBS.	RB	3-7
1:4000	DRAW.	RB	3-7
	TRAC.	KG	3-7
	CHK.		
MAP NO.			189
MAP SHEET			406/76/17



Havggjavrrre, Masi 1776  
**Shoot-Back 50m**  
**ON-3500N**

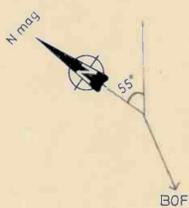
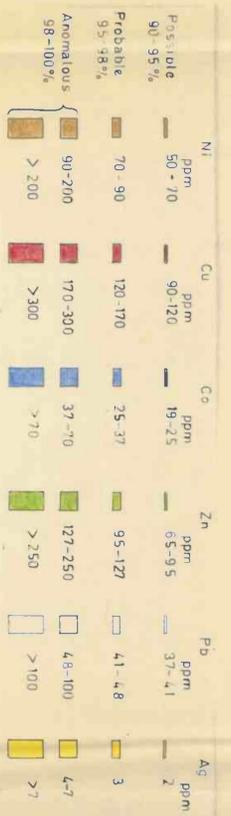
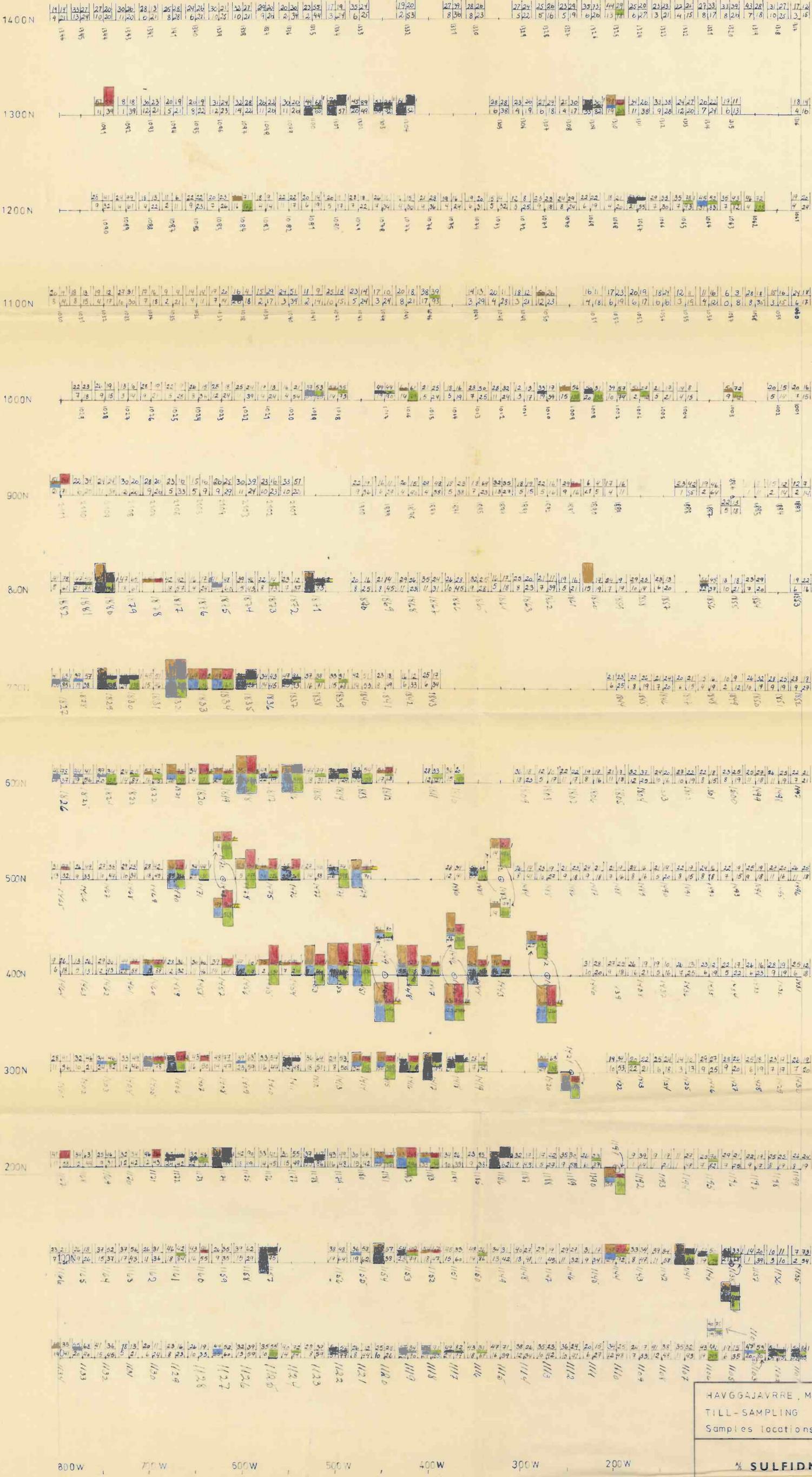
1/6 SULFIDMALM

SCALE	OBS. MP/OH	4-
1:4000	DRAW. MP	4-
	TRAC. MP/KG	4-76/
	CHK.	/
MAP NO.		
406/76/17		
MAP SHEET		

HAVGGJAVRRE, MASI 1776 shoot-back 50m ON-3500N Fig 3 sheet 15

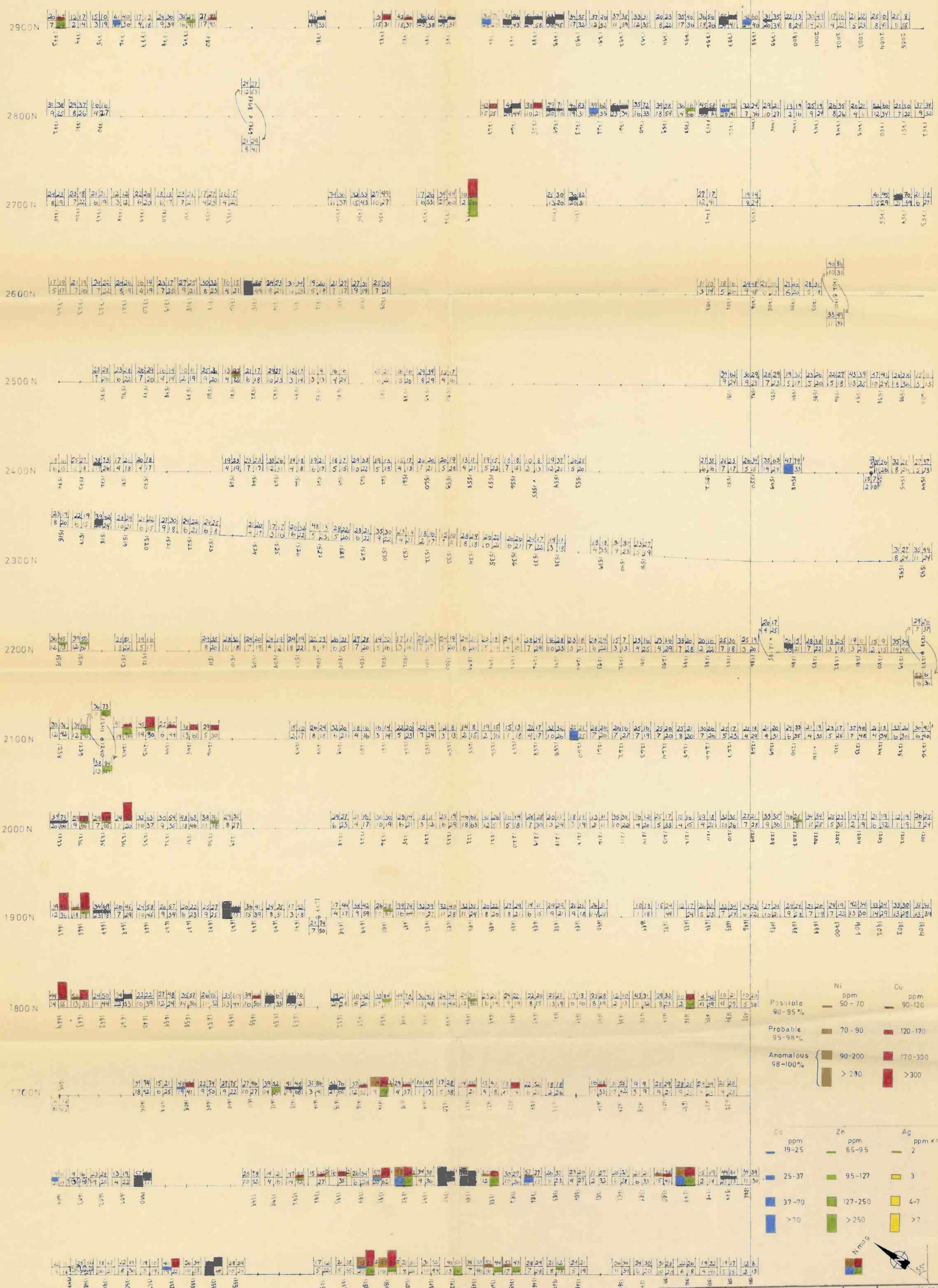


BL



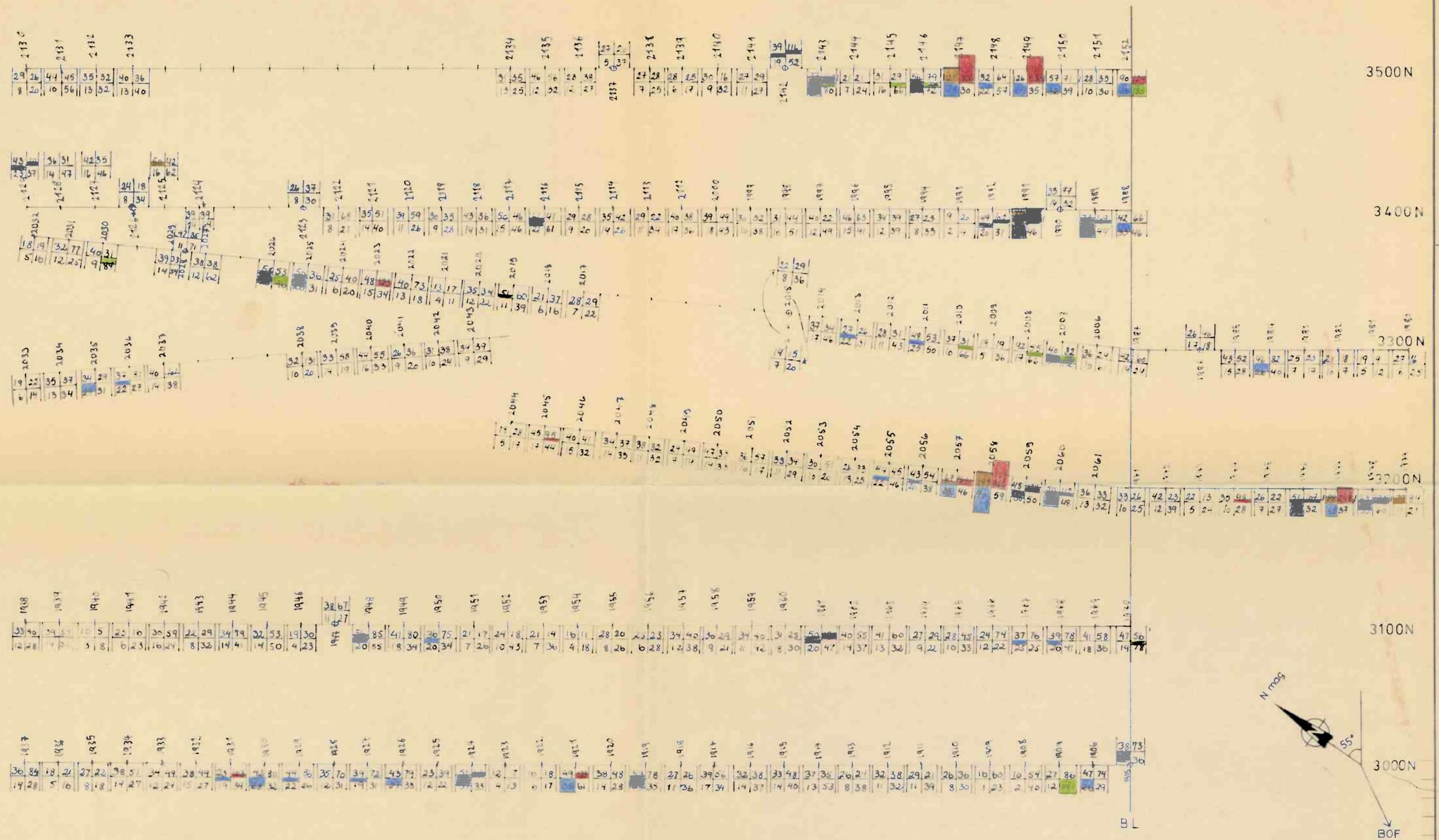
HAVGGAJAVRRE, MASI 1776	SCALE	1:2000	OPSA 0, HH 6-76
TILL-SAMPLING Assays			DRAWA 0, BB 6-76
Samples locations			TRACA 0, BB 6-76
			CHK.
	MAP NO.	406 / 76 / 17	

HAVGGAJAVRRE Masi 1776 Till-sampling Assays Samples locations Fig. 4, sheet 1



HAVGGAJAVRRE MASI 1776		SCALE	OBS.HH.MP6-76+
TILL - SAMPLING Assays		1:2000	DRAW.MP 6-76
Samples locations			TRAC.MP 6-76
			CHK.
		MAP NO.	406/76/17
<b>% SULFIDMALM</b>			

HAVGGAJAVRRE MASI 1776 Till sampling Assays Samples locations Fig.4 sheet 2



	800 W	700 W	600 W	500 W	400 W	300 W	200 W	100 W	0
Ni									
Cu									
Co									
Zn									
Pb									
Ag									

Category	Ni (ppm)	Cu (ppm)	Co (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm × 10 <sup>3</sup> )
Possible 90-95%	50-70	90-120	19-25	65-95	37-41	2
Probable 95-98%	70-90	120-170	25-37	95-127	41-48	3
Anomalous 98-100%	90-200	170-300	37-70	127-250	48-100	4-7
	> 200	> 300	> 70	> 250	> 100	> 7

HAVGGAJAVRRE, MASI 1776		SCALE	OBS.MP HH.	6-76
TILL - SAMLING		1:2000	DRAW.MP	6-76
Samples locations			TRAC.MP	6-76
Assays			CHK.	
% SULFIDMALM		MAP NO. 408/76/17		

A/S SULFIDMALM  
INTER-OFFICE MEMORANDUM

Date: 25th April, 1977  
To: Falconbridge Nikkelverk A/S  
cc: W. D. Harrison, H. T. Berry, R. Jahnsen,  
R. B. Band, E. Kreivi  
From: J. B. Gammon ✓  
Subject:

Report No. 406/76/17. Havggajavrre, Masi.

Please find attached our summary of work carried out on the Havggajavrre Grid in the Masi area. Our attention was drawn to the area by helicopter-EM anomalies in association with till-geochemistry. The limited drilling carried out indicates mineralization assaying 0.75% Zn to be present which would explain the anomalous till values of up to 6700 ppm which were obtained. No further work is recommended.

  
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