



# Bergvesenet

Postboks 3021, 7002 Trondheim

## Rapportarkivet

Bergvesenet rapport nr <b>BV 482</b>	Intern Journal nr	Internt arkiv nr	Rapport lokalisering Trondheim	Gradering <b>Åpen</b>
Kommer fra ..arkiv Falconbridge	Ekstern rapport nr Sul 290-73-9	Oversendt fra Sulfidmalm A/S	Fortrolig pga	Fortrolig fra dato:
Tittel Report on follow-up work in regional stream sediment anomalies. Setesdal, Southern Norway. B Haukeli.				
Forfatter F Nixon		Dato 1973	Bedrift Sulfidmalm A/S	
Kommune Vinje	Fylke Telemark	Bergdistrikt Østlandske	1: 50 000 kartblad 14144	1: 250 000 kartblad Sauda
Fagområde Geologi Geokjemi	Dokument type Rapport	Forekomster		
Råstofftype Malm/metall	Emneord Cu Pb Zn			
Sammendrag Vi har to eksemplarer. Duplikat mangler ett bilag.				

FALCONBRIDGE NIKKELVERK A/S

PROJECT 905-9

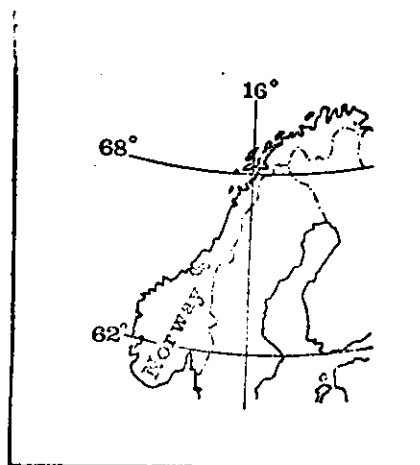
A/S SULFIDMALM

REPORT ON FOLLOW UP WORK ON REGIONAL STREAM

SEDIMENT ANOMALIES. SETESDAL, SOUTERN NORWAY.

B. HAUKELI

F. NIXON



Report Nr. 290/73/9

## INTRODUCTION

A regional stream sediment survey carried out in 1972 revealed the presence of several areas anomalous in Cu, Pb and Zn values in the extreme north of the area surveyed near the border of the Pre-Cambrian with overlying Caledonian rocks. Some of the stream sediments had high Pb values and it was thought that the possibility of Pb deposits similar to those further east along the same contact zone (see report No. 263/73/6) might exist. This report describes the work carried out at one such anomalous area - the Haukeli area.

## LOCATION

The area in question is located at a high altitude at the north of the Setesdal mountain range. The area is just south of the all weather road highway E 76. Altitudes range from 900 - 1500 m above sea level - the entire area being above tree level. Haukeli is located approx. 200 km N of Kristiansand, 200 km west of Oslo and 120 km SE of Bergen.

## ORIGINAL STREAM SEDIMENT SURVEY

In the original stream sediment survey anomalous classes were defined as follows:

Class	ppm range	Significance
1	Cu 17 - 27	high background
	Pb 35 - 46	
	Zn 54 - 100	
2	Cu 27 - 44	significant
	Pb 46 - 76	
	Zn 100 - 180	
3	Cu over 44	highly significant
	Pb " 76	
	Zn " 180	

X The original results from the area are shown on map No. 9.74 A2.1

## WORK CARRIED OUT

The priorities of the follow up work were:

1. Determine the geology of the area.
2. Prospect for sulphides.
3. Try to isolate individual anomalies.

## GEOLOGY

The results of the geological investigations are shown on map No. 9.74 A2. The Pre-Cambrian basement consists dominantly of granitic rocks. In the western part of the area we have a gneissic granite which consists of a coarse grained in part well foliated granitic rock. In the east of the area the Pre-Cambrian basement is composed of a coarsely foliated granitic to granodioritic gneiss.

Also present are limited outcrops of acid volcanic rocks that probably belong to the supracrustals of the Telemark suite. These rocks were mostly porphyritic in nature.

Overlying the Pre-Cambrian rocks are a group of phyllites, mica schists and some black shales. It was difficult to ascertain in the field whether these rocks were allochthonous or autochthonous. In all probability they are allochthonous units and correspond to the so called Holmasjø formation described in a recent paper from the area to the north of the area described here. Some of the black shales may well represent small remnants of autochthonous rocks of Cambro-Ordovician age.

At two places outcrops of banded quartzite have been found, in both places showing multiple minor folding. It is thought that these quartzites might belong to a later nappe.

In the extreme west of the map unit is a definite thrust unit with a strongly tectonized contact, with mylonitic rocks in the base. The dominant rock types in this tectonic unit are quartzo-feldspathic gneisses.

## MINERALIZATION

Pyrite was the only sulphide mineral found in any significant amounts.

This being dominantly in the phyllite, mica schist unit. One speck<sup>k</sup> of galena was found in a small quartz vein in the acid volcanic sequence. Fluorite was also found in several places on joint surfaces in the Pre-Cambrian granitic rocks.

Several rusty zones were found and examined but these very rarely contained sulphides, the rust being due to the release of iron from silicate minerals.

Several rock samples were assayed - the location and assay results are shown on map No. 9.74 A2. As can be seen the results are extremely low.

#### GEOCHEMICAL WORK

Supplementary stream sediment samples were taken in streams in the area and bank soil samples were collected along certain streams with samples being taken on each bank. It was hoped that this would help to isolate and define geochemically anomalous areas. The stream sediments were assayed for Cu, Pb, Zn, Mn and the soils for Cu, Pb, Zn. The results are presented on map No. 9.74.A2.

Unfortunately no clear pattern emerged, certain areas have high values but <sup>e</sup> no definite anomalous zones occur. The following table shows the soil results for each of the 3 major rock groups which were sampled:

Acid volcanic			Granite-/Gneiss			Phyllite - mica schists		
Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn
1	25	34	1	32	41	30	54	47
17	34	44	7	61	66	15	12	23
14	61	27	4	68	51	6	32	36
11	44	19	15	16	31	4	114	175
15	38	32	10	28	34	1	12	25
23	52	39	6	30	19	7	81	27
13	42	41	6	94	176	19	34	11
13	30	66	1	13	28	2	8	39
6	50	160	16	96	96	5	9	103
10	49	90	2	24	62	3	26	35
86	290	393	5	28	44	1	22	23
8	64	81	4	38	88	2	14	45
18	55	43	4	21	26	1	7	39
13	59	40	19	77	87	21	19	30
			15	51	100	8	24	17
			3	22	72	4	20	43
			4	20	35			
			10	30	40			

The mean values for these groups are as follows:

Acid volcanic	Cu = 17
	Pb = 63
	Zn = 79
Granite/Gneiss	Cu = 11
	Pb = 41
	Zn = 60
Black schists	Cu = 8
	Pb = 30
	Zn = 44

As can be seen the acid volcanic has the highest mean value for all metals - next follows the granite/gneiss group and then the black schist group.

The two most anomalous areas that present themselves is an area in acid volcanics at the north west of Kjelevatn and a small area to the south west of Kjelevatn in granite.

Most of the new stream sediments collected are in the anomalous classes as defined by the regional survey.

A short soil grid was put in, in order to check out a part of the contact zone, where we had in prospecting found much flourspar along joints and the odd speck of galena in quartz veins in the acid volcanic. The location is shown on map 9.74.A2. Having no fixed find to work on this small grid was intended to give an idea of the order of ppm values here. No really high values were obtained. It is interesting to note, however, that the highest Pb values lie adjacent to the soil anomaly located down slope near the stream. The results of this soil grid are shown on maps 9.74.C4, C5 and C6.

#### DISCUSSION

With the discovery of this geochemically anomalous area during the regional stream sediment investigations in 1972 it was thought that we might have a possibility of lead mineralization similar to that found at various places along the Eastern border of the Caledonides in Scandinavia. A review of these deposits was given by the writer in report 263/73/6.



Our subsequent geological investigations tend to disprove this possibility. We have no evidence in our area of autochthonous sediments such as sandstones and arkoses to which the most known large lead deposits are associated. In the allochthonous rocks quartzites are present but these proved to be barren and were also metamorphosed and highly folded. Thus from a geological point of view it would seem that we do not have the conditions for a large lead deposit. The sediments overlying the Pre-Cambrian are mostly shaly schists and phyllitic rocks with pyrite being the only mineralization noted.

Specks of galena were noted in quartz veins in the Pre-Cambrian and a certain amount of fluorspar along joint surfaces were also observed, but ~~this~~ <sup>observed</sup> was the only mineralization of note observed. Representative rock samples of the various rock units were assayed with very low results (see map 9.74.A2).

The prospecting and geological work has not then been able to determine the source of the geochemical anomalies. To explain the geochemical anomalies the following explanations are forwarded:

1. Anomalies derived partly from strong iron-manganese precipitation

It was noted that in several places heavy iron-manganese precipitation was evident in some streams and the subsequent stream sediments were assayed for Mn with values ranging from 200 to over 2000 ppm. However, very few of the streams originate in bogs.

2. Frost action

Most of the area is at a high altitue (over 1000 m) and the area has a fairly thin overburden cover. It is believed that with a thin moraine cover and mean temperature close to zero innumerable joints are formed in the bedrock. Because of the larger surface exposed to weathering any metals present may be more easily leached out from the bedrock than is normal. Norwegian investigations for example have shown that lead is strongly bound by humus. Under conditions in which frost action is strong, humus production is low and, consequently, there might be only small amounts of humus present to tie up the lead. The lead will thus accumulate in the stream sediment even though the actual lead content in the bedrock is relatively low.

### 3. Partial derivation of lead from granites

It is felt that some of the lead may be derived from the weathering of the granite present in the area.

### 4. Blind mineralization

This explanation is of course a strong possibility but it is felt that if any blind mineralization is present it is of uneconomic interest, as the major criteria for at least a major Pb, Zn deposit are missing. It is of interest to note that a small Pb, Zn, Cp occurrence is known to occur in a similar geological environment some 100 km to the north east. Here galena, zincblende with minor chalcopyrite and pyrrhotite occur as very irregular and economically insignificant coarse grained disseminations in this<sup>n</sup> quartz/Calcite lenses. These lenses have been emplaced between the almost flat-lying bedding planes of the Cambrian phyllites which overlie steeply dipping Pre-Cambrian gneisses. Geological and lead-isotope evidence give a Permian age for the deposit.

It is thought that one or a combination of these causes are the probable sources of the anomalies.

### CONCLUSIONS

No further work is recommended on this property.

March 12, 1974

FN/hm



# LIST OF ENCLOSURES

- 9.74.A2      Geology and Geochemistry  
              Haukeli, 1:12'500.
- 9.74.A2.1    Anomalous Geochemical Values  
              Haukeli, 1:12'500
- 9.74.C4      Soil Grid Cu, Haukeli, 1:2'500
- 9.74.C5      Soil Grid Zn, Haukeli, 1:2'500
- 9.74.C6      Soil Grid Pb, Haukeli, 1:2'500

A/S SULFIDMALM  
INTER-OFFICE MEMORANDUM

Date: 25. March 1974

To: Falconbridge Nikkelverk A/S ✓

cc: A.M. Clarke, H.T. Berry,  
F. Nixon, R.B. Band

From: J.B. Gammon

Subject:

905-9. Haukeli, Setesdal. Report Nr. 290/73/9

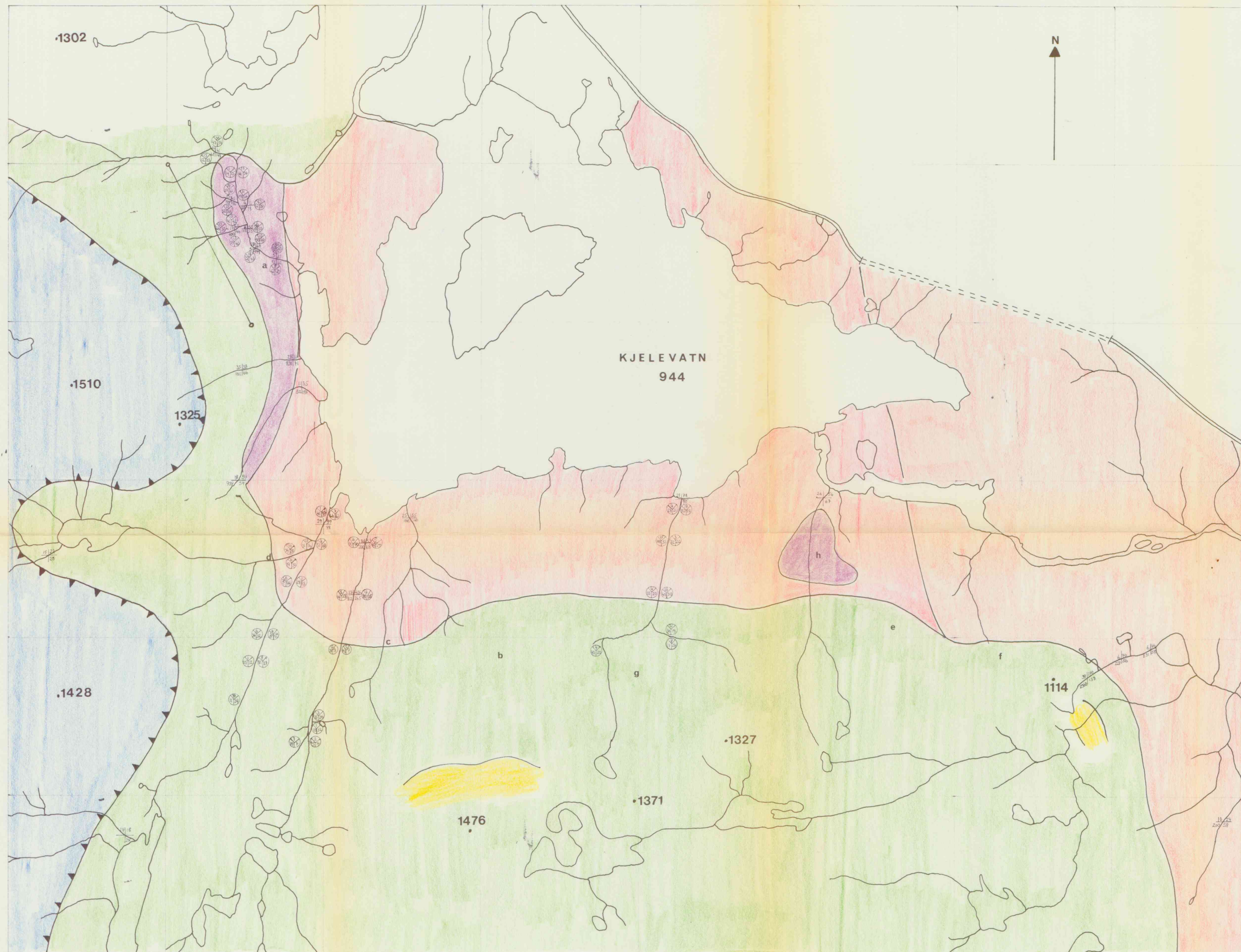
Please find attached Nixon's account of follow up work in the Haukeli stream sediment anomalous area of Setesdal. The geological work, prospecting and additional geochemical sampling of soil and stream sediments did not lead to any attractive targets.

No further work is recommended.

*J.B. Gammon*

NOTTATT		01. 04. 74		BESV.	ARK.
OM. DIR.				FORSKN./UTV.	
TEKNISK DIR.				EL. LYSEAVD.	
INSTRALDIR.				M.L. AVD.	
INT. SEF.				R. & SM. AVD.	
ANL. AVD.				EL. TEK. AVD.	
INSTR. AVD.				INSTR. AVD.	
MEK. AVD.				MEK. AVD.	
PROSJ. AVD.				PROSJ. AVD.	
WIDEARB.				SVARDATO	





- LEGEND**
- AUTOCHTHONOUS PRE CAMBRIAN**
- Quartz-feldspar gneisses
  - Quartzite
  - Phyllite, mica schist and black shale

**PRE CAMBRIAN**

- Acid volcanic
- Gneissic granite
- Granitic gneiss

$\frac{Cu}{Pb}$   $\frac{Mn}{Zn}$  stream sediment results

soil results

thrust

.1371 spot height

assay results

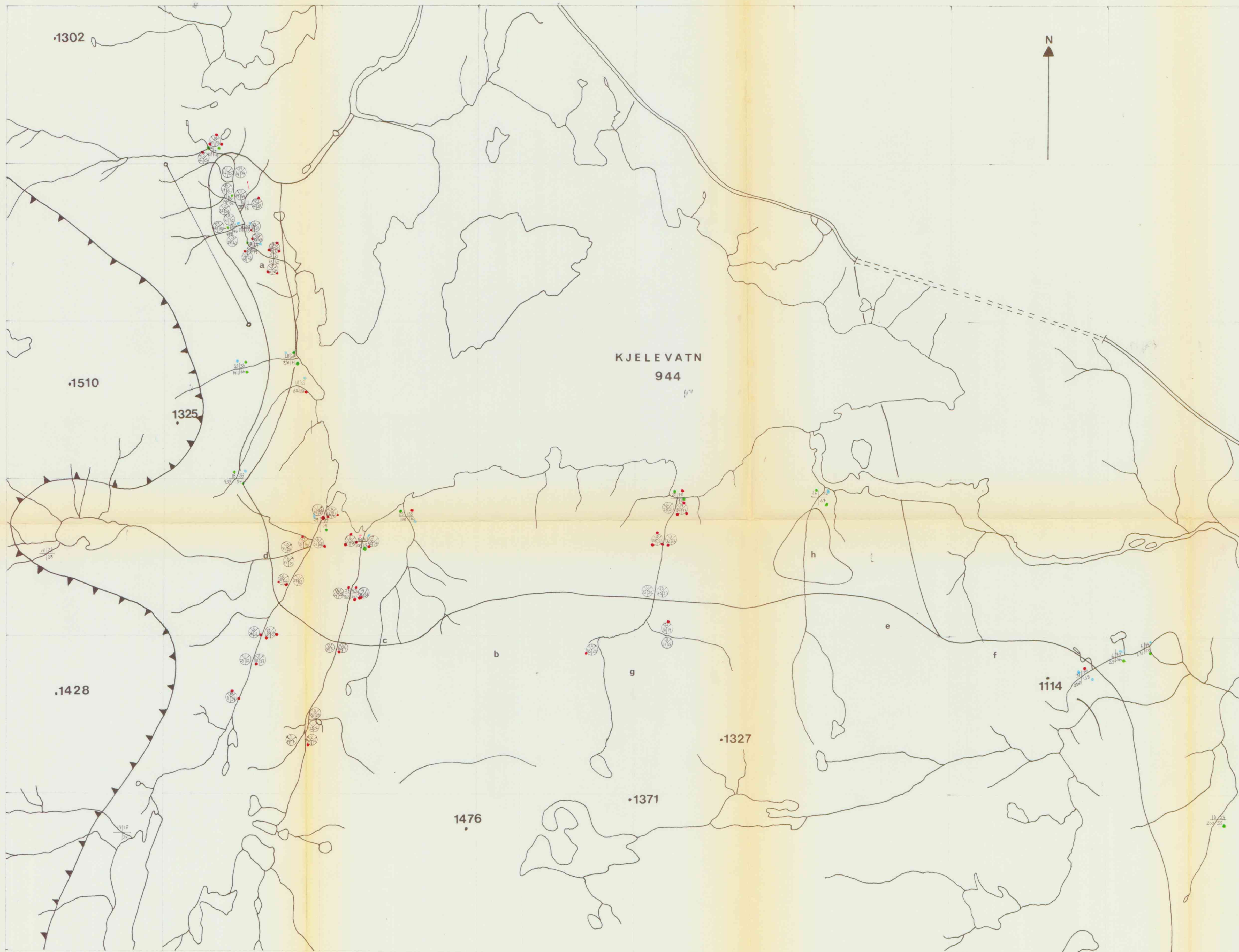
	Cu	Pb	Zn	Fe	S
a	0.09	0.08	< 0.1	2.7	0.4
b		< 0.02	< 0.1		0.12
c		< 0.02	< 0.1		0.11
d		0.03	< 0.1	2.4	0.74
e	0.08	0.02	< 0.1	3.9	1.0
f		< 0.02	< 0.1	4.6	0.24
g	0.06	< 0.02	< 0.1	5.8	1.2
h	0.09	< 0.02	< 0.1	5.8	3.8

soil grid base line



GEOLOGY AND GEOCHEMISTRY HAUKELI NORWAY	SCALE 1:12500	OBS.	8 73
		DRAW.	2 74
		TRAC.	2 74
		CHK.	
SULFIDMALM	MAP NO. 9.74.A2.		
	MAP SHEET 1414 IV		





**LEGEND**

**AUTOCHTHONOUS PRE CAMBRIAN**

Quartz-feldspar gneisses

Quartzite

Phyllite, mica schist and black shale

**PRE CAMBRIAN**

Acid volcanic

Gneissic granite

Granitic gneiss

Cu Pb stream sediment results  
Mn Zn

soil results

thrust

spot height

assay results

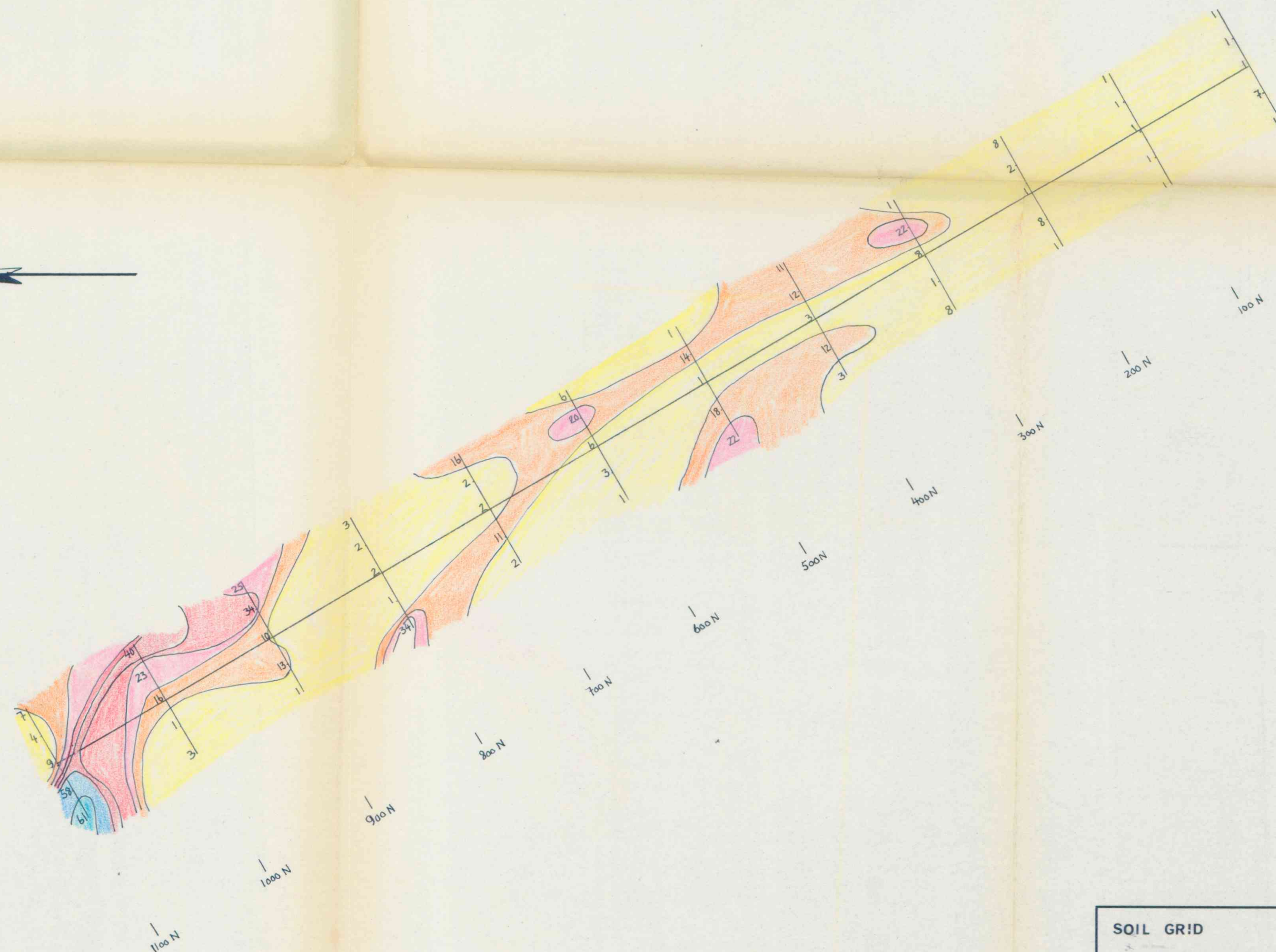
	Cu	Pb	Zn	Fe	S
a	0.09	0.08	< 0.1	2.7	0.4
b		< 0.02	< 0.1		0.12
c		< 0.02	< 0.1		0.11
d		0.03	< 0.1	2.4	0.74
e	0.08	0.02	< 0.1	3.9	1.0
f		< 0.02	< 0.1	4.6	0.24
g	0.06	< 0.02	< 0.1	5.8	1.2
h	0.09	< 0.02	< 0.1	5.8	3.8

soil grid base line

0 250 500 750 1000 m

GEOLOGY AND GEOCHEMISTRY HAUKELI NORWAY	SCALE	OBS.	8 73
	1:12500	DRAW.	2 74
		TRAC.	2 74
		CHK.	
SULFIDMALM		MAP NO.	9.74.A2.1
		MAP SHEET	1414 IV

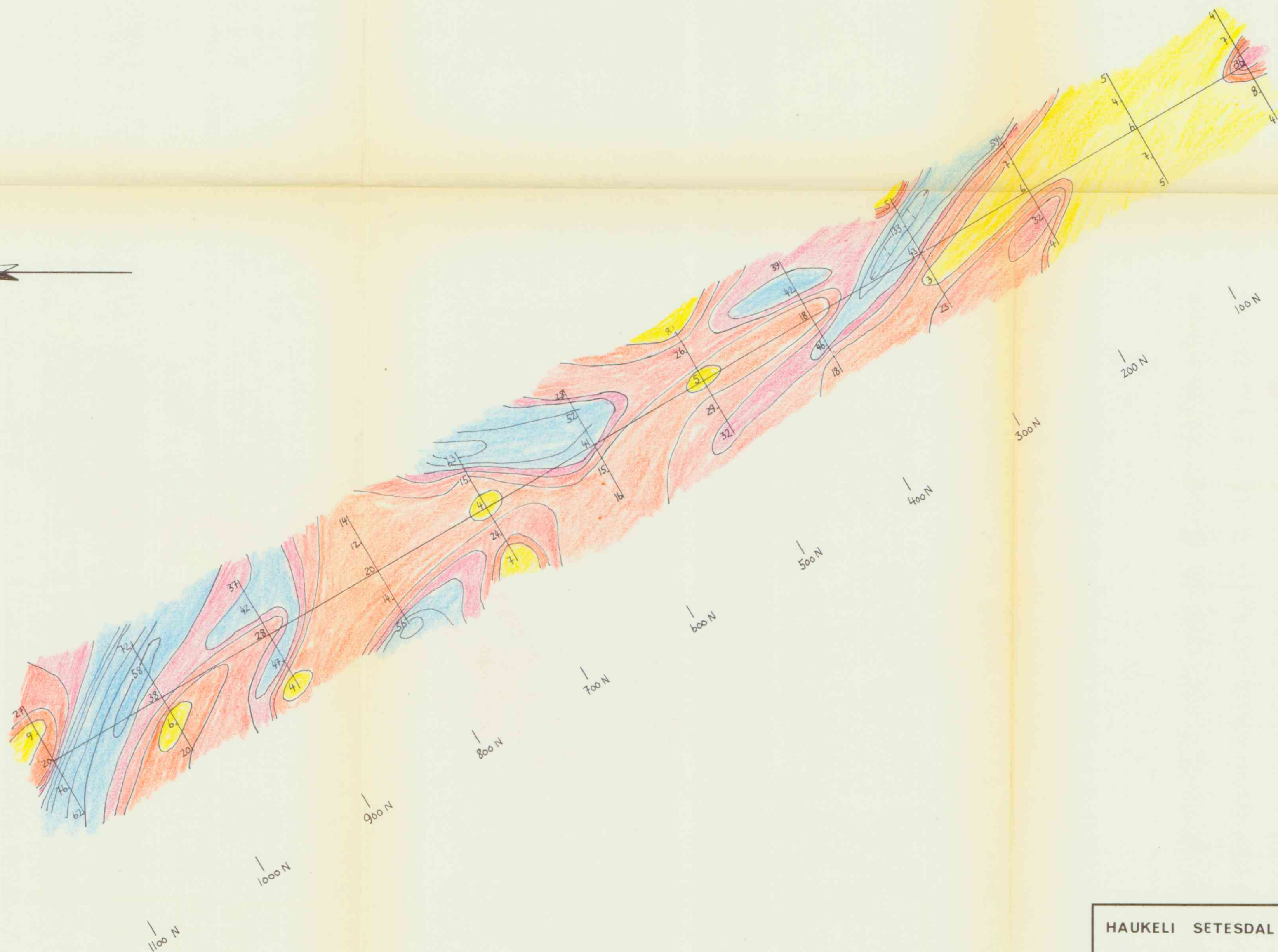




50  
25  
0  
25  
50

SOIL GRID  HAUKELI, SETESDAL  CU	SCALE	OBS. DE	8 - 73
	1:2500	DRAW. LN	2 - 74
		TRAC. LN	..
		CHK.	
1/2 SULFIDMALM	MAP NO.		
	9-74-C4		
	MAP SHEET HAUKELISÆTER 1414 IV		

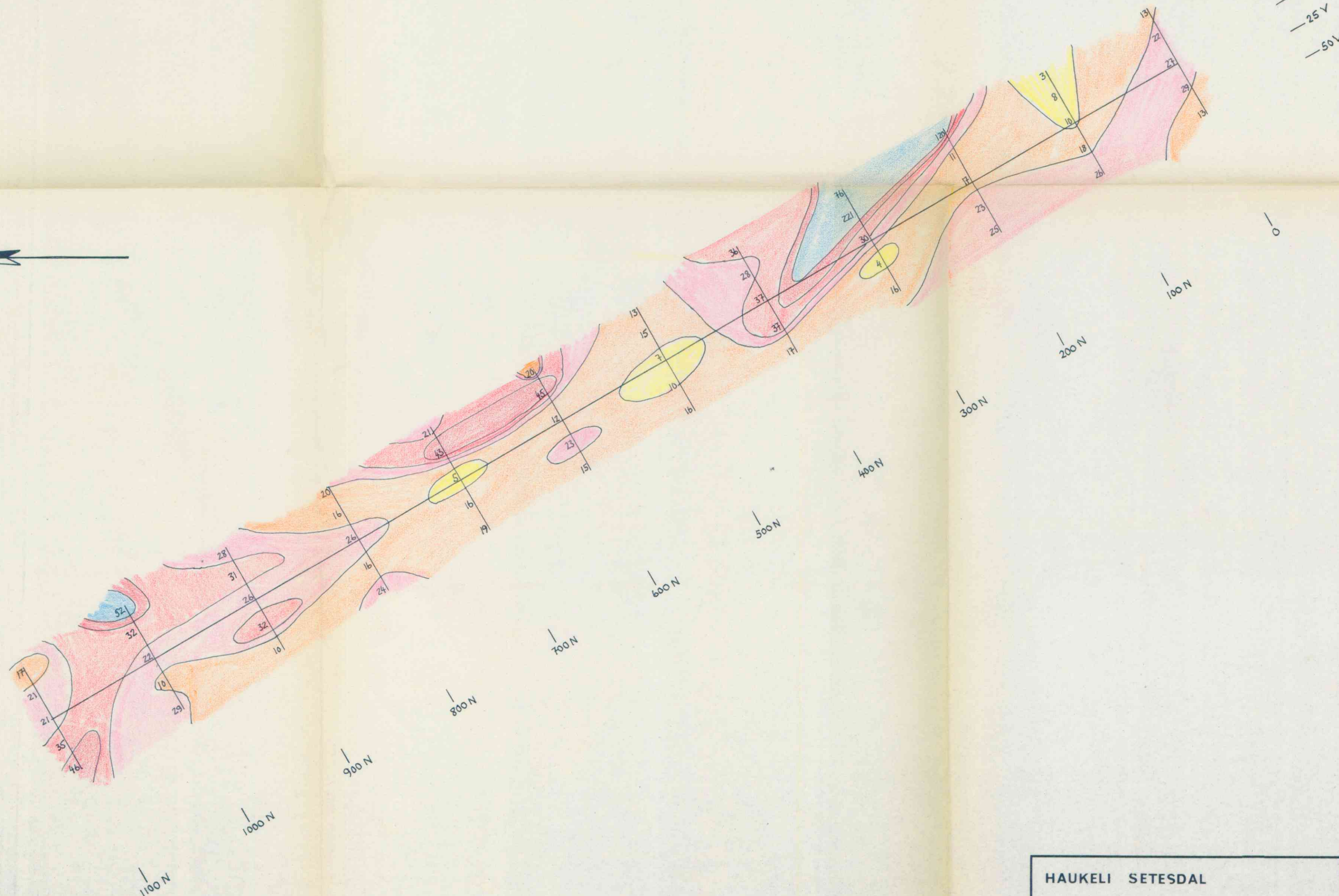




— 50 Ø  
— 25 Ø  
— 0  
— 25 V  
— 50 V

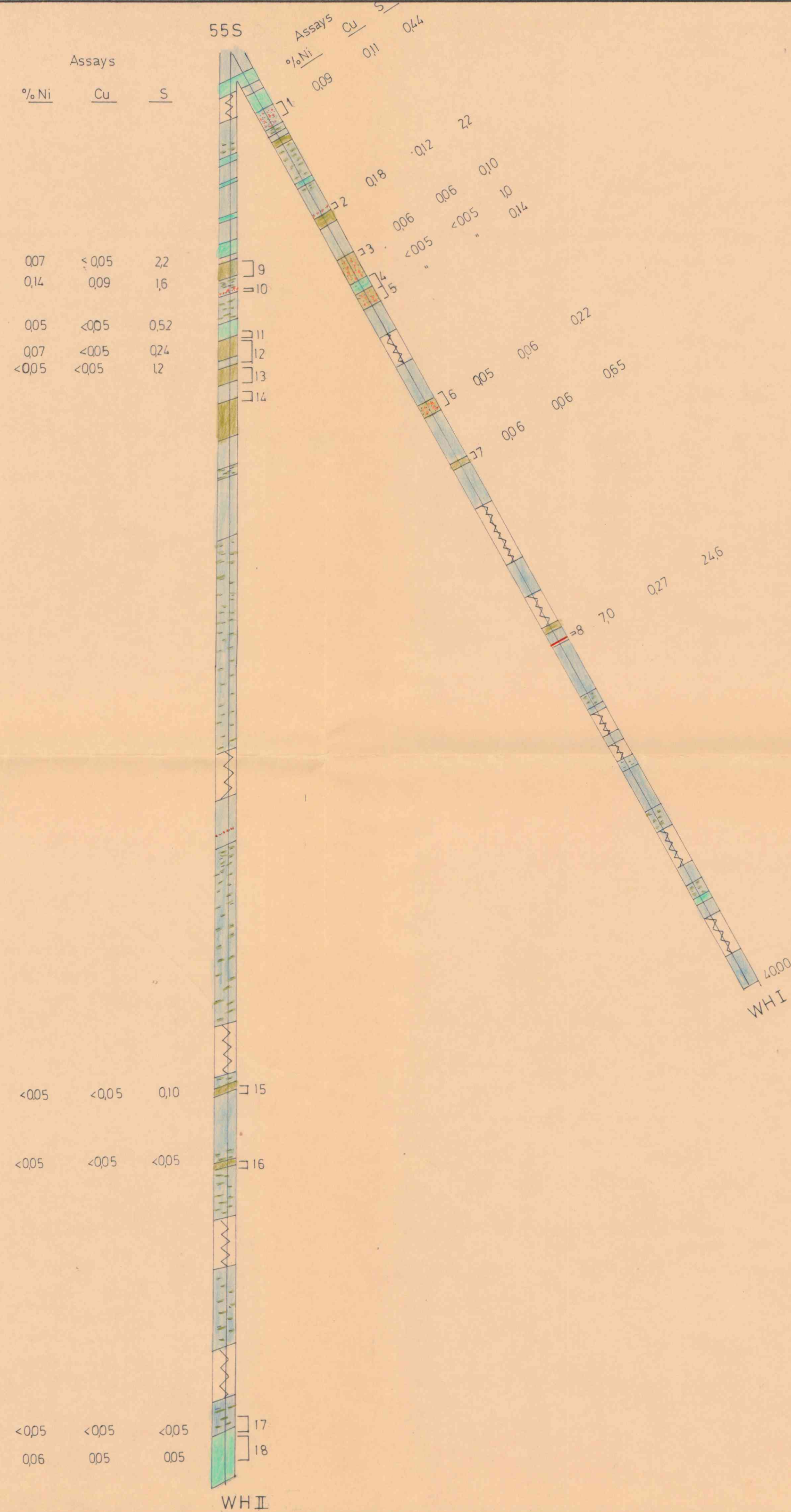
HAUKELI SETESDAL  SOIL GRID  Zn	SCALE	OBS.	DE	8-73
	1:2500	DRAW.	LN	2-74
		TRAC.	LN	..
		CHK.		
1/2 SULFIDMALM	MAP NO.			
	9-74-C5			
	MAP SHEET HAURELISÆTER 1414 IV			



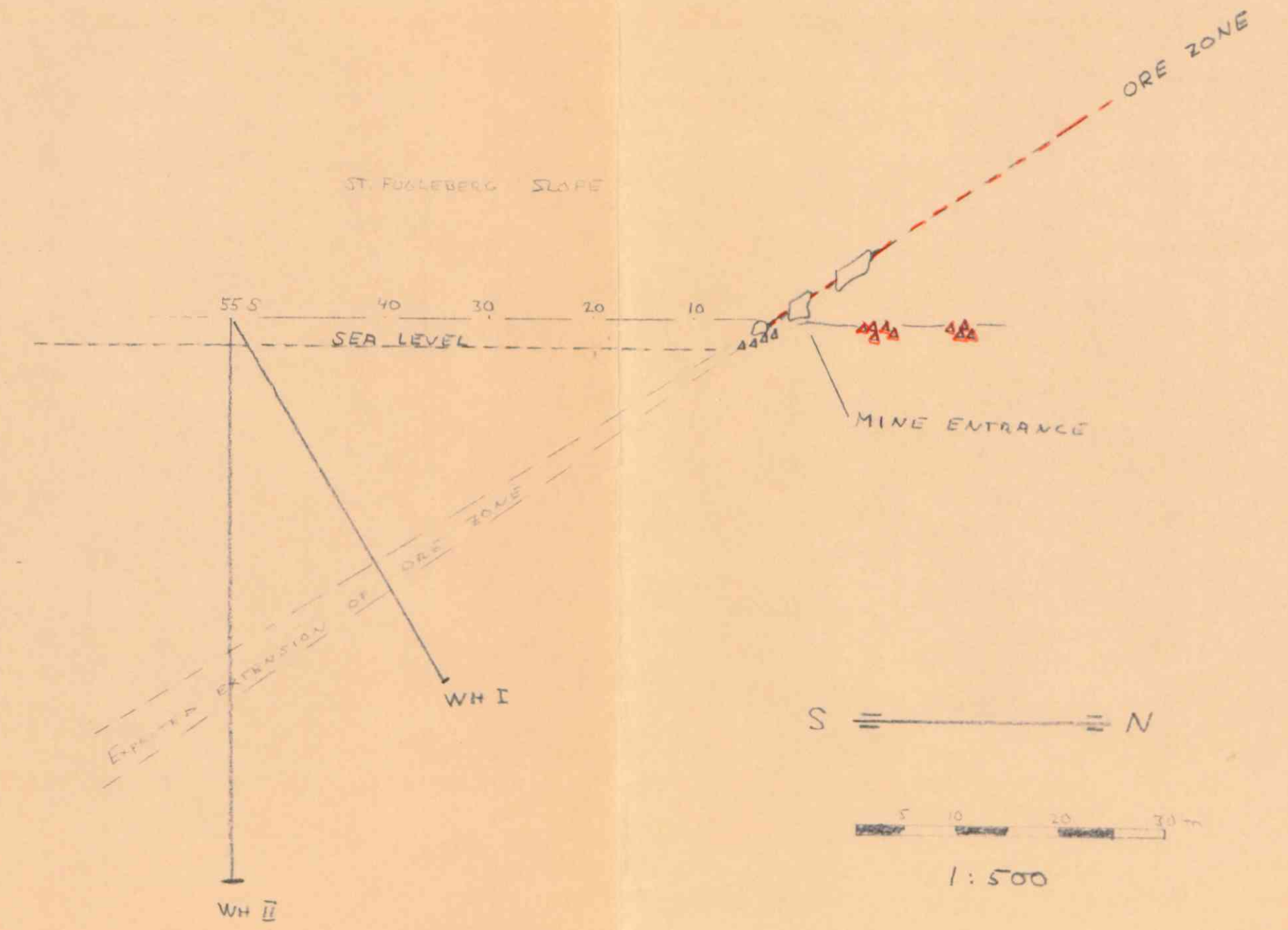


HAUKELI SETESDAL  SOIL GRID  Pb	SCALE  1:2500	OBS.	DE	8 - 73
		DRAW.	LN	2 - 74
		TRAC.	LN	..
		CHK.		
1/8 SULFIDMALM	MAP NO.			
	9-74-C6			
	MAP SHEET HAUKELISÆTER 14/4 IV			





# SECTION SHOWING LOCATION OF DRILL HOLES.



## KEY

- MARBLE
- IMPURE MARBLE (PATCHES OF MICA SCHIST / AMPHIBOLITE IN MARBLE MATRIX)
- MICA SCHIST
- AMPHIBOLITE
- MINOR SULPHIDES
- SULPHIDE MINERALIZATION
- LOST CORE

Drill holes WHI and WH II	SCALE	OBS. J.B.	
MÅLØY, NORDLAND	1:100	DRAW. H.R.	
		TRAC. M.J.	
		CHK. H.R.	
% SULFIDMALM		MAP NO. 1-291-73-18	
		MAP SHEET	