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RAPPORT NR: 1483

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SAKSBEARBEIDER

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RAPPORT VEDRØRENDE:

The Guorbajavri cobalt mineralization.

FORDELING

OSLO:

KIRKENES:

ANDRE:

RESYMÉ:

During follow-up work of airborne regional geophysics the Guorbajavri cobalt mineralization was discovered by basal till/bedrock sampling. Guorbajavri is situated 6 km south-southeast of the Bidjovagge Mine. The mineralization consists of cobaltiferous pyrite disseminated in albite felsite. The thickness of the zone is about 5 m with an average grade of 0.09% Co. The nickel/cobalt ratio is 0.31.

A promising EM anomaly in the continuation along strike of the cobalt mineralization was proved by diamond drilling to be caused by graphitic schists. Apart from some supplementary geophysics no further work is recommended on this target.

KOMMENTAR:

INTRODUCTION

In 1980 1500 line km of geophysical helicopter survey was flown in the Bidjovagge area by the Geological Survey of Norway (NGU report no 1783). One of the anomalies that was selected for follow-up work from this survey is a weak EM-anomaly just north of the lake Guorbajavri. The area is situated 6 km south-southeast of the Bidjovagge Mine (Fig. 1) and the rocks belong to the Caskias greenstone group. In 1982 the area was investigated on the ground by VLF, Self potential and magnetics and got the designation "Target area no 14" (Aspro report no 1370). The area to the north of the lake was surveyed and only one weak VLF-anomaly was found (Fig. 1).

Basal till/bedrock geochemistry.

The VLF anomaly did not look too promising, but it was decided to do one profile of geochemical sampling over the anomaly. The sampling was done with ASPRO's percussion drilling unit in the late winter of 1983. Samples of basal till and bedrock were collected in a profile close to shore line. Distance between sampling points was 5 m. Both till and bedrock samples were analysed for Cu, Ni, Co, Zn and Au. The results are presented in Fig. 2. The till thickness was between 2,5 m and 8,0 m. The only strong anomaly is a cobalt and nickel bedrock-anomaly of the two easternmost sampling points. Up to 149 ppm copper was recorded in bedrock samples, but this cannot be considered an anomaly in the greenstone environment. All samples contained less than 20 ppb gold. The high cobalt content of bedrock is not reflected in the basal till geochemistry. This demonstrates that till samples must be used very carefully. A study with a stereo microscope of the drilling chips from the cobalt-rich samples showed an albite felsite with disseminated pyrite mineralization. The high cobalt values in a Bidjovagge type albite felsite were encouraging and it was decided to continue the investigations in this area.

GEOLOGY

Detailed geological mapping was the next step in the exploration of area no 14. The mapping was done by ASPRO geologist Kari Berge. The outcrops are shown in Fig. 1. The eastern and southern parts of the area are dominated by finegrained banded amphibolites. These rocks are interpreted

as meta tuffs. The meta tuff contains thin layers of albite felsite. Small amounts of pyrite and occasionally chalcopyrite are often oxidized and give a limonite coating. A meta tuff at 230 N, 420 W, just south of the lake (Fig. 1) contains carbonate veins with scapolite and amphibole. A magnetite-rich meta tuff is observed to the west. This observation corresponds with a north-south striking zone of magnetic high from the geophysical surveys.

The northern part of the area is dominated by a coarse-grained, massive amphibolite, probably a meta gabbro.

The most interesting outcrop is situated just to the east of the VLF anomaly on line 816, an albite felsite with oxidized pyrite.

GEOPHYSICS

After the initial geophysical ground survey was performed, the geophysical data from the helicopter survey had been reprocessed (ASPRO report no 1381). The resistivity map of this new processing enhanced an EM anomaly just south of the lake (Fig. 3). The EM-anomaly to the north of lake that was first selected for follow up work does not produce a resistivity anomaly. A large area of resistivity low over the lake and eastwards corresponds to a topographic depression with assumed thick deposits of finegrained glacial sediments.

In the summer of 1983 an area to the south of the lake was surveyed by slingram and magnetics to cover the resistivity anomaly (Fig. 1). Also the profiles to the north of the lake were resurveyed with the slingram system. A short, thick conductor was found to the south of the lake (Fig. 1), while no slingram anomaly was produced north of the lake. These results are in very good agreement with the resistivity map from the airborne survey. The complete slingram results are given in ASPRO report no 1468.

DIAMOND DRILLING

The work so far on area 14 had outlined two interesting targets, the cobalt mineralization north of the lake and the good conductor on the southern side. It was decided to test these targets by diamond drilling. The good conductor seemed a special interesting target. It has a limited strike length, a thickness of 25-30 m, and it is situated in the continuation along strike of the cobalt mineralization.

Ddh. 14.1 was drilled to test this anomaly. The drillhole section and geophysics are shown in Fig. 4. The intersection of two thin zones of graphitic schist explains the apparently thick conductor as interpreted from geophysics. The core log report and analyses are given in Table 1. Minor amounts of pyrite was observed in the graphitic schist. The analytical results are negative.

Ddhs. 14.2 and 14.3 were drilled to test the cobalt mineralization. Drill hole sections are shown in Fig. 5. Core log reports and analyses are given in Table 1. The position of the sampling points of the geochemical survey were probably not quite well established in the grid, because the first hole (ddh. 14.2) hit mineralized rock as soon as the till was penetrated. To get a full intersection of mineralization and country rock hole 14.3 had to be drilled. The albite felsite with disseminated pyrite is an extremely finegrained brownish rock. Changes in colour-shades give the rock a fine-banded appearance. The meta tuff/meta tuffite is rather inhomogenous with varying amounts of amphibole, biotite, feldspar, carbonate and chlorite. The rock is usually well foliated some zones are brecciated with carbonate infillings. The carbonate rock contains varying amounts of quartz, feldspar and dark silicates with a continuous transition into the amphibole carbonate rock.

The cause of the weak VLF anomaly is probably a thin zone of graphitic schist (ddh 14.3). The disseminated mineralization does not seem to give any response to either VLF or Slingram.

Ddh. 14.2 and 14.3 showed respectively 4,55 m of 830 ppm cobalt and 5,0 m of 1024 ppm cobalt. This gives an average grade of 0,093% cobalt for the mineralization. The average nickel grade is 0,029 which gives a nickel/cobalt ratio of 0,31. The correlation coefficient between nickel and cobalt is 0,82. There is a very weak correlation between cobalt and iron ($r = 0,23$). The content of copper, zinc, gold and silver is very low. A total of 123,30 m was drilled in area no. 14.

ELECTRON MICROPROBE ANALYSES

The only possible cobalt-bearing mineral found in polished sections is pyrite. The pyrite occurs as up to 4 mm large individual grains and aggregates. The grains are subhedral to anhedral. Parts of the grains are specked with tiny inclusions (Fig. 6). This is interpreted as a primary, poikilitic generation with a metamorphic overgrowth of "clean" pyrite.

The poikilitic pyrite was studied carefully by etching in an attempt to find framboidale textures. Such textures could not be detected in the light microscope. The disseminated poikilitic pyrite may however indicate an exhalative origin for the albite felsite and the mineralization.

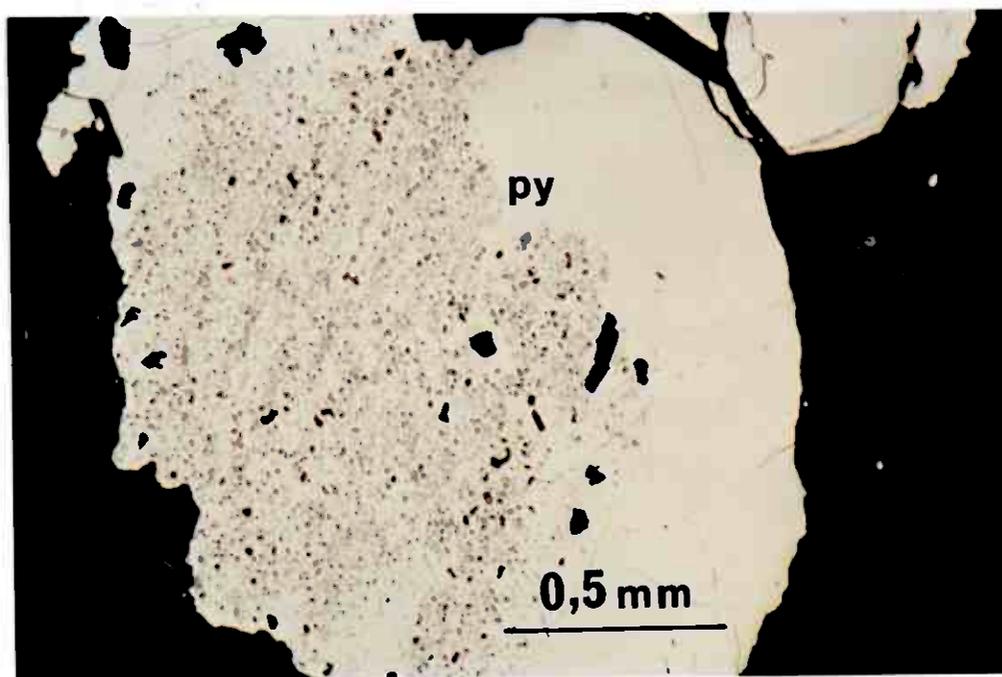


Fig. 6. Microphoto of poikilitic, primary pyrite with a metamorphic overgrowth of secondary pyrite.

One polished section was analysed by electron microprobe at Sentralinstituttet for Industriell Forskning. An average of six point analyses gives:

Fe	47,00	wt %
Cu	0,03	" "
Ni	0,19	" "
Co	0,59	" "
S	55,52	" "
<hr/>		
	103,33	wt %
<hr/>		

The sulphur and iron values are a bit too high due to a poor calibration of standards, and this causes the high sum. The cobalt content of the pyrite varies from 0,15% to 1,10%. The same variation seems to exist within both generations of pyrite. The average nickel to cobalt ratio of the pyrite is

0,32. This is in agreement with the ratio found in whole rock geochemistry (0,31) and supports the observation of pyrite as the only cobalt-bearing mineral.

DISCUSSION, CONCLUSIONS

The Guorbajavri cobalt mineralization is a new type of mineralization in the Bidjovagge area. Some pyrites in the Bidjovagge ore bodies contain cobalt, but the average cobalt grade of the ore is about 0,03%. Cobaltiferous pyrite in carbonate veins has been recorded in the Masi area by Holmsen et.al., 1957 (NGU, 201, p. 72).

Both the average grade of the Guorbajavri mineralization and the cobalt content of the pyrite are too low to be of economic interest at present. According to Dr. H. Wennerwirta of Outokumpu Oy (pers. comm.) an economic pyrite concentrate should contain more than 2% cobalt. The investigations of the Guorbajavri mineralizations indicate that all the cobalt is bound in pyrite. This excludes the possibilities of a high grade cobalt concentrate.

In April 1984 the ice-covered lake Guorbajavri will be surveyed by EM and magnetics. This will complete the geophysical picture of the area and will test if a more massive mineralization is present under the lake. No further follow-up work is recommended.

In the Outokumpu zone in Eastern Finland cobalt has been used as an indicator of the proximity of a copper-cobalt ore body (Hakanen, P., 1983, Journ. Geochemical Expl. 19, pp. 611-614). Although important differences exist between the Outokumpu zone and the Bidjovagge area, this aspect of the Guorbajavri showing must be considered.

Stabekk, Feb. 09.1984


Ragnar Hagen

BORHULL NR. 14-1-83.

Bormeter	ppm Cu	ppm Zn	ppm Ni	ppm Co	% Fe	ppm Ag	ppm Au
15-16	107	14	98	38	3,20	< 0,1	< 0,02
20-21	218	38	265	150	4,50	< 0,1	< 0,02
21-22	326	61	122	57	5,90	< 0,1	< 0,02
22-23	481	14	115	56	5,50	< 0,1	< 0,02

Kjerneobservasjoner.

Borhull nr.	14-2-83	Profil	-
Koordinator: Y	62893	X	81450
Påst i høyde	456		
i retning	300 ^g		m.
med helning	47°		
Borhullets lengde	29,60 m		

Boret meter	Bergart	Kjerne- mangel	Skifrihet	Bergart prøve
0 - 9,40	Overdekke			
9.40-13.50	<u>Albitt-karbonatbergart.</u> Grå, foliert med mørke og lyse bånd, 1 mm brede. Svært finkornet (tett) med lag av amfibol og py. Også lag med grovkornet kalkspat med opptil ca. 15% py i 2-3 mm store korn eller i lag.		10-11 - 90° 11-12 - 90° 12-13 - 90°	
13.50-14.45	Grågrønn uorientert til foliert med opptil mm-tykke bånd. Finkornet. Amfibol, feltspat og kalkspat. Fra 14,00 m noe innhold av rød feltspat, uregelmessig opptreden av 0,5 cm aggregater eller porfyroblaster av amfibol.		13,9 - 90° 14,25 - 85°	
14.45-15.15	<u>Amfibol-skifer.</u> Grågrønn, plant foliert, finkornet (< 1 mm) skifer. Mineraler: Feltspat, amfibol, biotitt og noe kloritt. Py opptrer i enkelte tynne lag. Kalkspatårer.		14,7 - 85°	
15.15-15.90	<u>Amfibolitt breksje.</u> 0,5-5,0 cm tykke lag av amfibol + kloritt og grovkornet (< 3 mm) kalkspat som går over i breksjert amfibolitt med kalkspat i matriks. Noe kloritt.		15,95 - 85-90°	
15.90-16.80	<u>Klorittskifer.</u> Grå - brun - grønn, plant foliert og skifrig. Finkornet. Synlige mineraler: Kloritt og noe biotitt.			
16.80-19.90	<u>Amfibolskifer.</u> Mørk grå. Til 19,0 svakt orientert og middels kornet. Amfibolbergart med litt kloritt. Deretter foliert og finkornet amfibolskifer med biotitt, med dm-mektige lag av middels kornet kalkspat med amfibol.		17,05 - 90° 18,60 - 70°	

Boret meter	Bergart	Kjerne- mangel	Skifrihet	Bergart prøve
19.90-23.0	<p><u>Karbonatbergart.</u> Lys gråhvit med grønnstriper. Plant til uregelmessig foliert og middels kornet. Mineraler er kalkspat, kvarts og/eller feltspat og noe amfibol som øker i mengde fra 20,0 m. Lag av uorienterte cm-store tremolittaggregater ved 21,10-21,15. Spor av py fram til 20,0 m.</p>		19,40 - 20,50 - 21,60 - 22,15 - 22,95	90° 80° 75° 75° 65°
23,0 -29,6	<p><u>Albitt-karbonatbergart.</u> Gråhvit, noe uregelmessig foliert med mørke mineraler. Finkornet (1 mm) med et tett (mikrokrystallint) parti mellom 25.15-25,80 m. Mineraler: Kvarts/feltspat og kalkspat. Amfibol opptrer i lag sammen med noe biotitt, og i aggregater eller deformerte amfibolittfragmenter. py forekommer disseminert eller i mm-tykke lag. py-innholdet avtar nedover.</p>		23,50 - 24,50 - 25,50 - 26,50 - 27,0 -	90° 90° 80° 90° 80°
	<p>SLUTT</p>			

BORHULL NR. 14-2-83.

Bormeter	ppm Cu	ppm Zn	ppm Ni	ppm Co	% Fe	ppm Ag	ppm Au	% Co *
9,45-10	22	7	250	912	7,60	< 0,1	< 0,02	
10-11	30	6	431	1293	13,00	< 0,1	< 0,02	0,12
11-12	19	4	262	880	10,00	< 0,1	0,08	0,12
12-13	16	7	179	658	7,10	< 0,1	0,02	
13-14	45	8	247	444	7,10	< 0,1	0,02	

* Lab. Kirkenes

Kjerneobservasjoner.

Borhull nr.	14-3-83	Profil	
Koordinator: Y	62 878	X	81 450
På satt i høyde	460		m.
• i retning	3008		
• med helning	45°		
Borhullets lengde	39,70 m		

Boret meter	Bergart	Kjerne- mangel	Skiftrighet	Bergart prøve
0 - 5,5	Overdekke			
5,5 - 9,75	<u>Amfibolitt</u> Grønn, uorientert, finkornet med korn 1 mm. Enkelte større aggregater eller porfyroblaster av amfibol. Amfibol er hard-mineral. Biotittinnhold fra 0-25%. Andre mineraler er feltspat og kvarts. Kwarts opptrer i årer opptil 0,5 cm (ved 7,25 m). Py opptrer i årer av mm-tykkelse. Cp sammen med py i en åre (7,80 m)			
9,75-10,0	<u>Overgangssone</u>			
10,00-11,75	<u>Feltspatbergart</u> Mørk grå med mm-store lyse flekker, foliert, middels kornet med kornstørrelse 1-2 mm. Svak foliasjon i begynnelsen, som blir mer utpreget i løpet av 11 m og tenderer til bånding. Feltspat er hovedmineral. Flere mm-tykke kvartsårer skjærer foliasjonen. Mellom 11,50 og 11,70 opptrer porfyroblaster (0,5 cm) av amfibol.		10 m-50° 10,8-80° 65°	
11,75-14,90	<u>Amfibolskifer</u> Flekket bergart, foliert ved lag med vekslende kornstørrelser fra fin- til grov-kornet. Fra 14,50 m også ved lag med biotitt. Hovedmineralene er amfibol og feltspat, med noe karbonat. Spor av py og cp.		12,65-75° 13,45-75°	
14,90-15,50	Grågrønn, båndet og plant skifrig, finkornet bergart. Synlige mineraler er feltspat, brun glimmer og grønne mineraler.		15,20-70°	
15,50-19,50	<u>Amfibolskifer</u> Rosa, grønn og grå, båndet, tett bl.a. med porfyroblaster eller aggregater av amfibol. Feltspat er hovedmineral. Amfibolaggregatene er 1-10 mm store, langstrakte og orienterte parallelt foliasjonen. Fra 18,50 m er bergarten middels kornet (1-2 mm) og svakt foliert.		16,70-75° 17,75-75°	

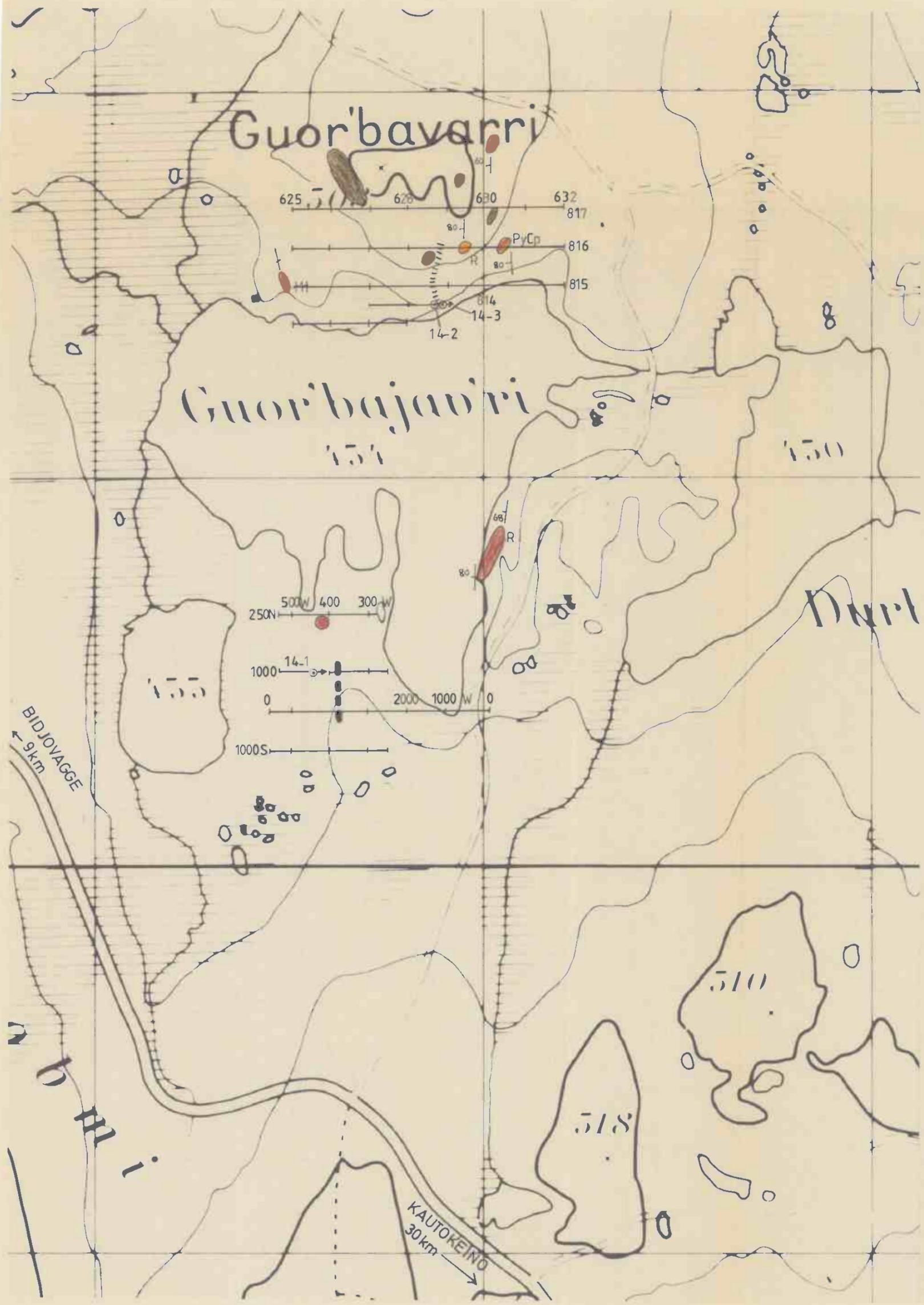
Boret meter	Bergart	Kjerne- mangel	Skifrihet	Bergart prøve
	Fra 15,90 m opptrer disseminert py i mengder på opptil ca. 5%. Ved 17,55 m : cp. 17,45-17,50 m : Grafittlag.			19 - 20 m
19,50-26,60	<u>Albitt-Karbonatb.a. (fels)</u> Hvit til lys gråblå foliert, tett bergart med lyse og mørke bånd. Frem til 20,75 m opptrer lag, årer og aggregater av amfibol. Fra ca. 25 m er det enkelte rødlige lag. Foilasjonen er jevn og plan i enkelte partier, uregelmessig og svak i andre. Bergarten er foldet flere steder. Synlige mineraler er kalkspat og kvarts/feltspat. Grovkornet kvarts og kalkspat opptrer i opptil 15 cm mektige lag og årer. Bergarten er mineralisert med py i lag, årer eller disseminert i mengder fra 5 - 25%. Mineraliseringen er særlig utpreget i lag med grovkornet kvarts og kalkspat.		19,60-70 ^o 20,50-70 ^o 20,95-85 ^o 20,75- 20,90-70 ^o 22,30-75 ^o 23,20-75 ^o 23,90-70 ^o 24,20-60 ^o 25,10-80 ^o 26,60-65 ^o	21 - 22 m 22 - 23 m 23 - 24 m 24 - 25 m 25 - 26 m 26 - 27 m
26,60-27,10	<u>Overgangssone</u> Kalkstein/albitt-karbonatb.a. med amfibollag. Ca 5% py.			
27,10-30,5	<u>Veksling mellom grønnskifer og karbonatbergart</u> <u>Grønn skifer:</u> Grønn med enkelte rødlige partier, foliert og enkelte steder med 1 mm brede bånd, kornstørrelse 1 mm. Mineralene er amfibol (+ evt. kloritt), feltspat og biotitt. 27,85-27,90 m : Amfibolporfyroblaster. <u>Karbonatbergart:</u> (urein) med rødlige partier, uorientert og grovkornet. Inneholder noe amfibol fra 30 m. Lagene er opptil 20 cm mektige. Fram til 27,50 m inneholder b.a. ca. 5% py. Fra 27,50 m spor av py.		28,10-75 ^o 29,25-80 ^o 30,40-80 ^o	
30,50-33,0	<u>Karbonatbergart</u> Svakt båndet fin-middels kornet (1-2 mm) amfibol- karbonatbergart. Spor av py, opptil 1% mellom 32,0-32,25 m. 30,85-30,95: Lag av uorientert tett feltspatbergart med tremolittaggregater med 1-1,5 cm lange nåler.		31,4-85 ^o 32-33 - 90 ^o	
33,0 -33,6	<u>Veksling mellom grågrønn, flekket, finkornet (1 mm) skifer og fin- middelskornet amfibol- karbonatbergart. Lag med grovere amfibol- (tremolitt-) porfyroblaster.</u>		33,60-85 ^o	

Boret meter	Bergart	Kjerne- mangel	Skiftrighet	Bergart prøve
33,60-39,70	<p><u>Amfibol-karbonatbergart</u> Hvite til båndete, grågrønne - lys grå - mørke lag. Plan til uregelmessig foliasjon og folding. Fin til middelskornet. Mineraler er kalkspat (+ feltspat) med vekslende innhold av amfibol. Biotitt opptrer i enkelte lag, særlig sammen med amfibol.</p> <p>Spor av py, enkelte mm-tykke lag mellom 36,0-36,60 m. Gjennomsettende, opptil cm tykke karbonatårer. 37,0-37,15 m : Foldekne.</p>		34,80-85 ^o 35,0-36,0 ^o 80 ^o 36,0-80 ^o 36,70-80 ^o 37,25-70 ^o 37,75-60 ^o 38,40-75 ^o 39,50-70 ^o	
39,70	SLUTT			

BORHULL NR. 14-3-83

Bormeter	ppm Cu	ppm Co	ppm Ni	% Fe
19-20	175	52	103	2,2
20-21	143	190	166	3,7
21-22	8	203	207	6,9
22-23	9	915	317	8,3
23-24	19	950	334	8,9
24-25	8	1885	408	6,8
25-26	14	745	258	7,9
26-27	24	625	202	6,7

FIG.
1.

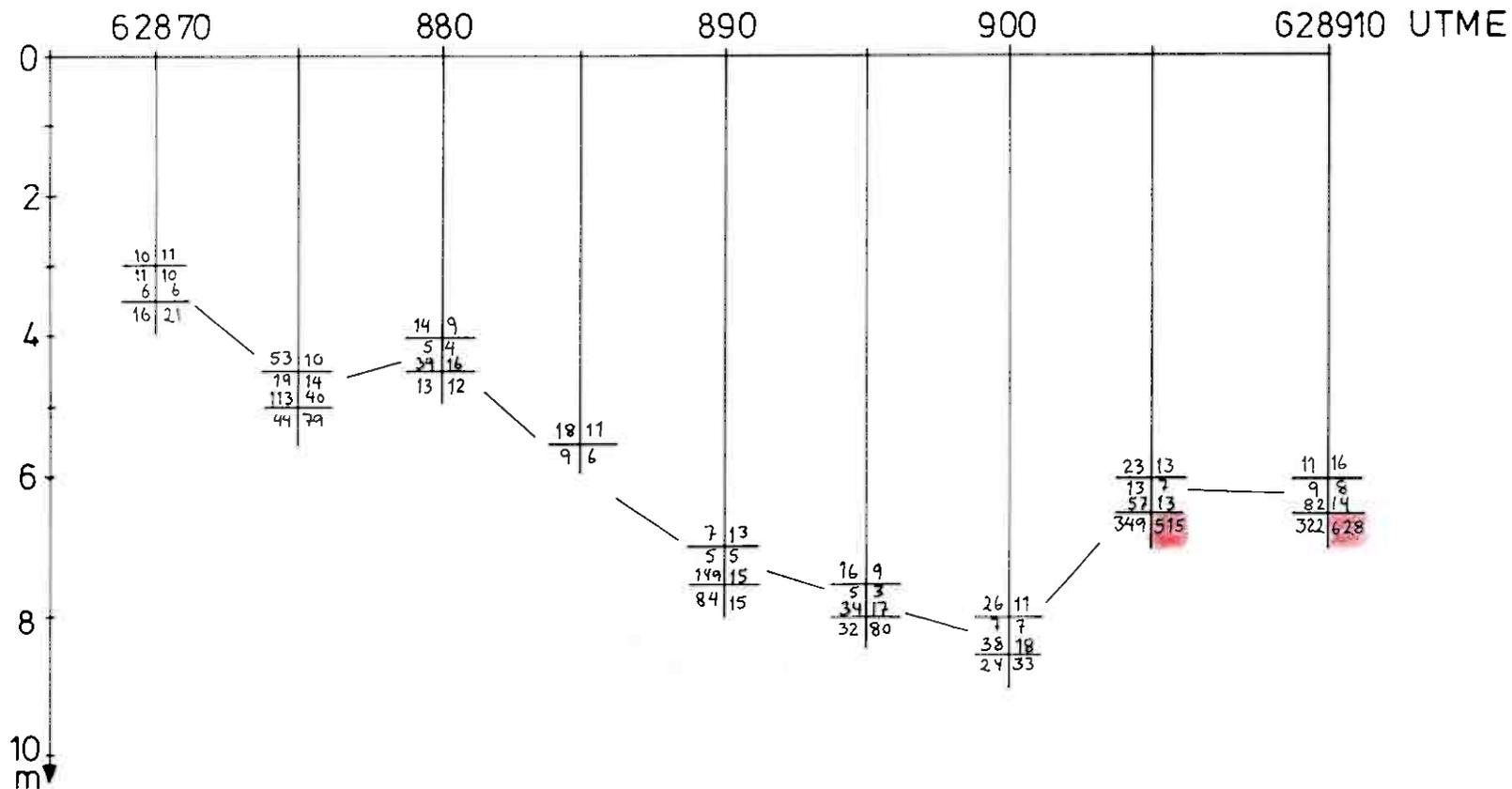


LEGEND

- Meta gabbro
- Albite felsite
- Meta tuff
- Py Pyrite
- Cp Chalcopyrite
- Mt Magnetite
- R Limonite
- Diamond drill hole
- Geophysical profile
- Good conductor
- Poor conductor (VLF only)



Area 14 Outcrops Geophysical profiles Diamond drill holes	11000
	Målt:
	Draw R. H. 1/84
	Trace: H.B. 2/84
PROSPEKTERING A/S	Fig. 1

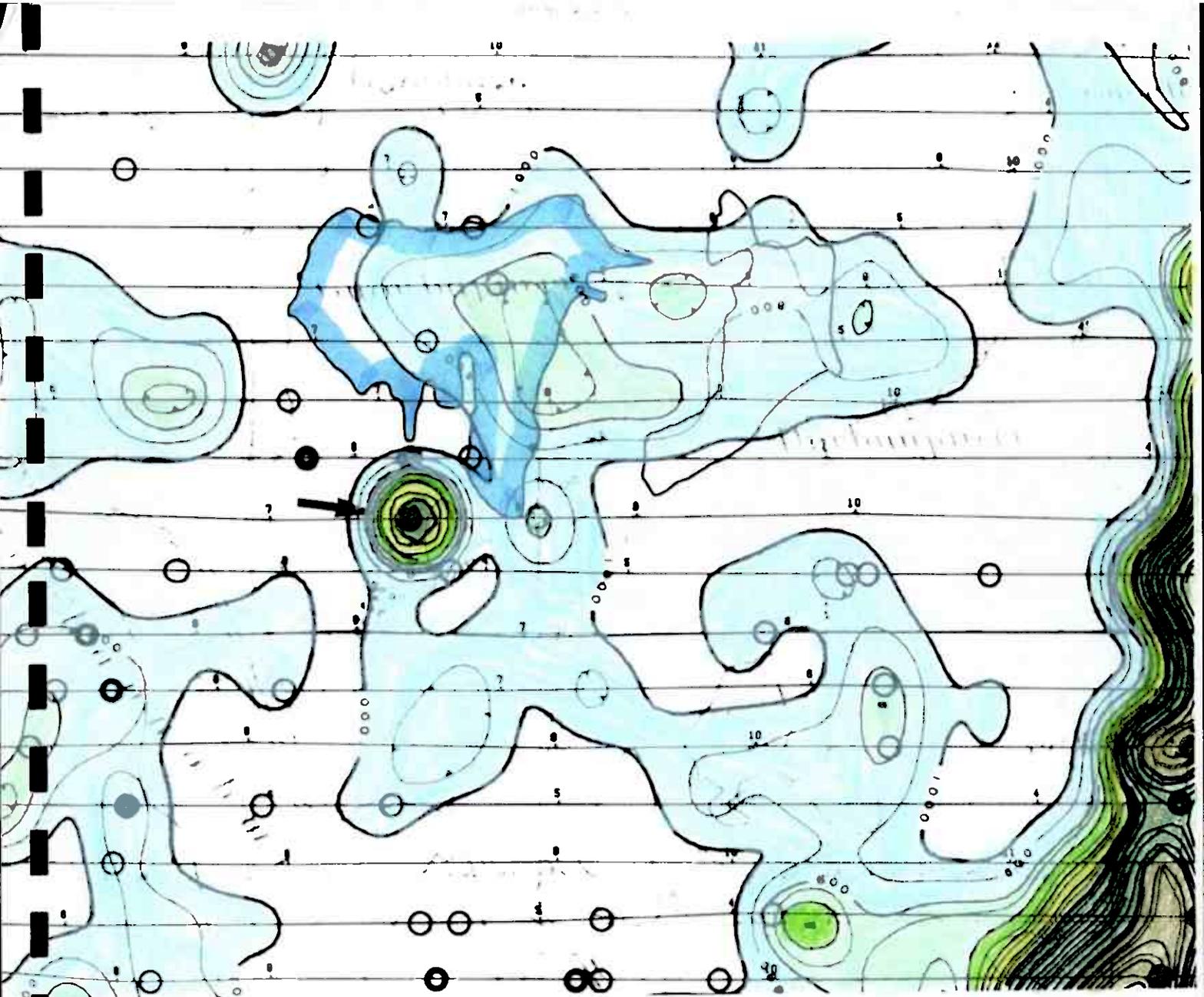


Basal till / bedrock geochemistry

CuZn
NiCo ppm

All samples < 0,02ppm Au

Area 14 Geochemistry N81400	1:2500 1:10 ↓
	Draw RH 2/84 Trac. HB. 2/84
	Fig. 2
PROSPEKTERING A/S	



RESISTIVITY

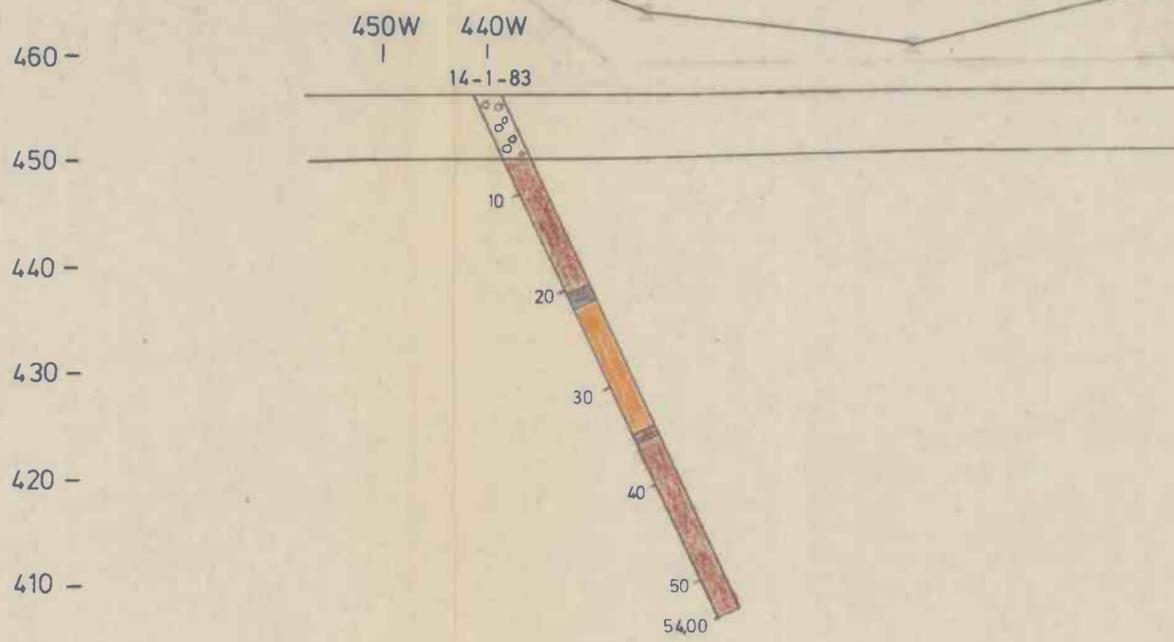
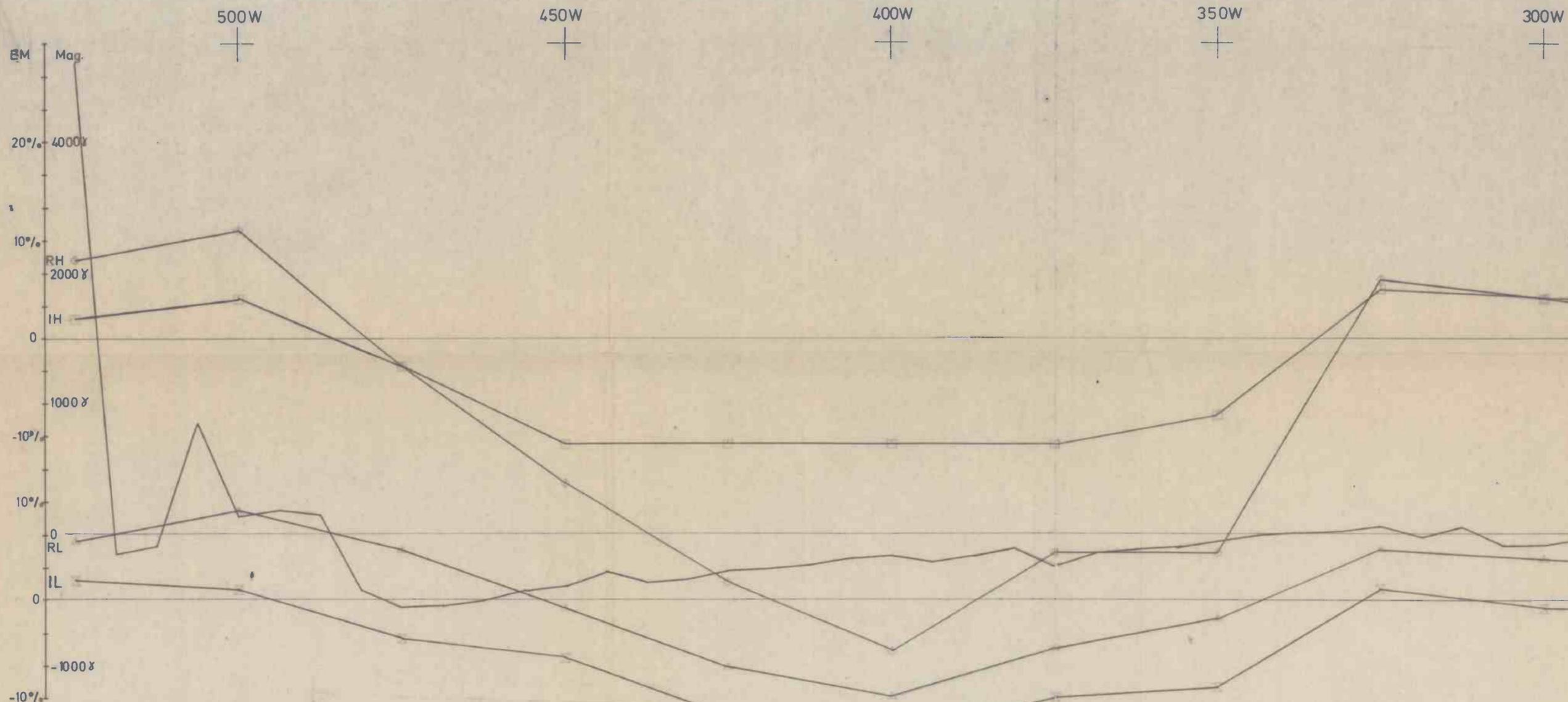
NGU - HEM data 1980

Processed by Dighem Ltd. 1983

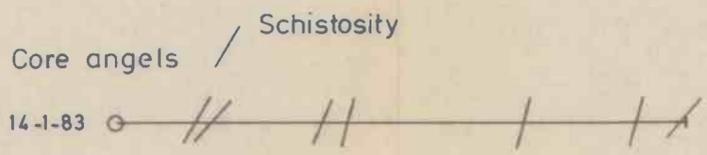


Resistivity Area 14	M
	1:20000
	Målt:
	Tegn:
	Trace: H.B. 2/84
PROSPEKTERING A/S	Fig. 3

FIG. 4.

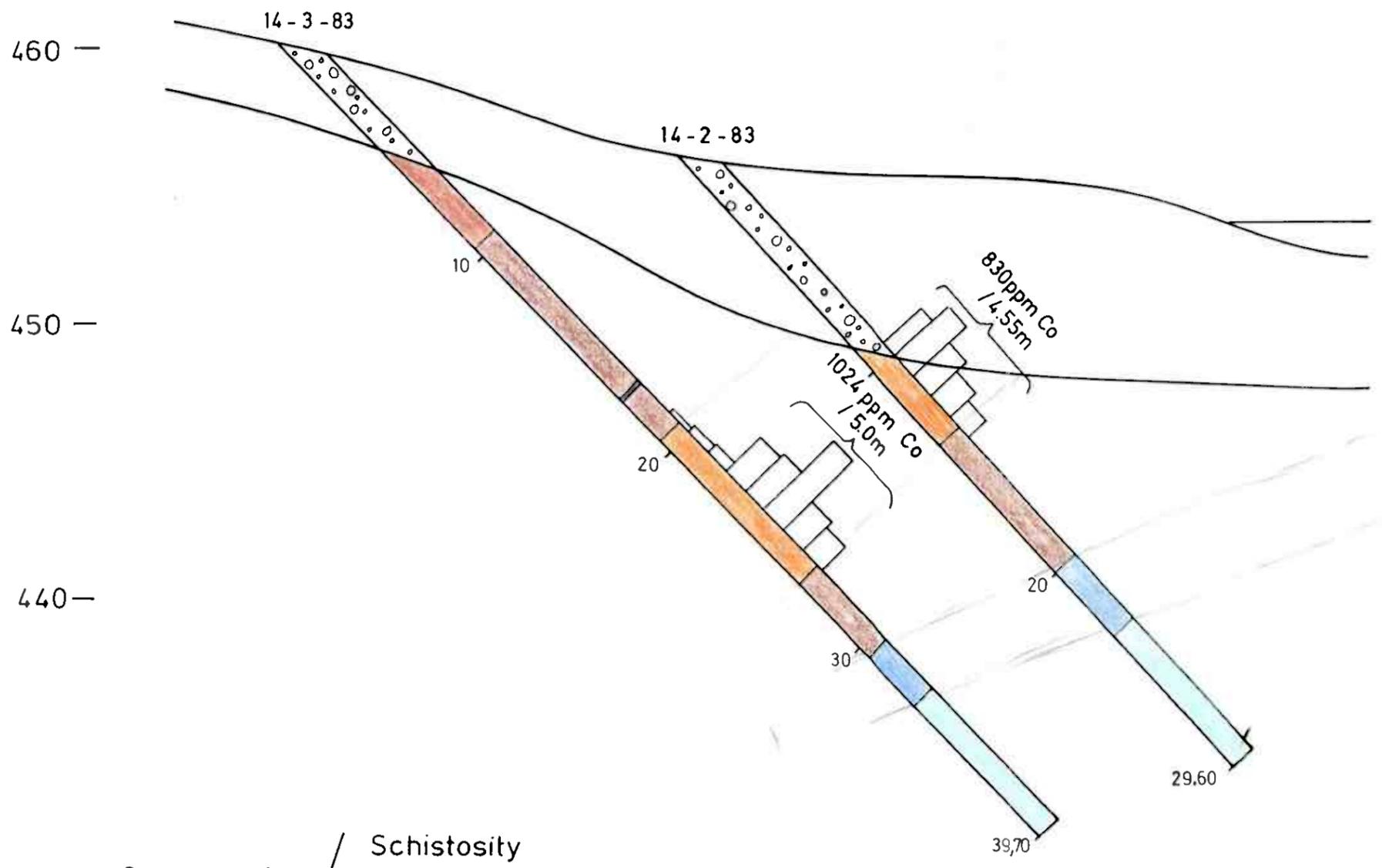


- LEGEND**
- Till
 - Graphitic schist
 - Meta diabase
 - Meta tuff / meta tuffite



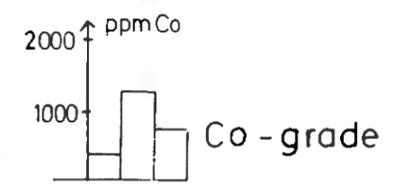
Area 14 Section Ddh 14-1-83 Geophysics 100 N	Scale 1:500
	Obs: KJ 7/83 RH 8/83
	Draw: RH 1/84
	Trace: HB 1/84
PROSPEKTERING A/S	Fig. 4

62870 62880 62890 62900 62910 UTM E

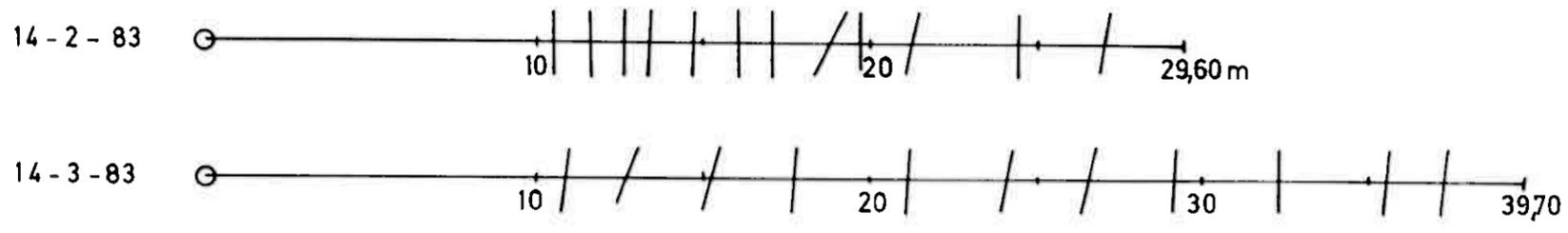


LEGEND

-  Till
-  Meta basalt
-  Graphitic schist
-  Albite felsite w/pyrite
-  Meta tuff/meta tuffite
-  Carbonate rock
-  Amphibole-carbonate rock



Core angles / Schistosity



Area 14 Drill hole section UTM N 81450	Scale: 1:200
	Obs: K B 8/83
	Draw: R H 1/84
PROSPEKTERING A/S	Trace: HB 1/84
	Fig. 5