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Tittel

Status report, South Pasvik 1979

Forfatter	Dato	Bedrift
Nixon, F. Lieungh, B. Hansen	08.02 1980	Sulfidmalm A/S Sydvaranger A/S

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Malm/metall	Ni	

Sammendrag

Erki

Nyrud claim   Nancoord.

Klemtsa Paktoom Dang C.

Dang C. → siste sommer
IP-anomalie og ...
IP anomali – arbeid i sommer
3 claims – Ek.

Mag-anomali – map. ground.
A/S Prospektering. 1978.

Berggrunnskart.

Copi av / mag-survey 1978-80.
all areas.

OK * Samm... map 1:20 000.
med denne.

Gunnars Bakke
lag notat av samtale

Vedlegg

RAPPORT TIL BERGVERKSKONTORET, INDUSTRIDEPARTEMENTET, ANGÅENDE MALMLETING I SYD PASVIK 1979 UTFØRT AV A/S SULFIDMALM/A/S SYDVARANGER

Innledning

Undersøkelsene i Syd Pasvik er en fortsettelse av det arbeid som ble oppstartet av selskapene i 1977 da rike nikkelblokker ble funnet i et område ved Rømlingås.

Selskapene har de siste årene mottatt støtte til undersøkelsene fra prospekteringsfondet for Nord Norge.

Ved slutten av 1978 sesongen mente vi at vi begynte å få en mye bedre forståelse av de forskjellige geo-aspekter i dette området, men selv om vi allerede hadde lokalisert flere lovende objekter, mente vi at en oppfølgning og intensivering av de metoder vi tidligere hadde benyttet var det riktige for å få løst de forskjellige problemer før vi satte i gang med en mere omfattende diamantboring.

Årets undersøkelser

Følgende arbeidsprogram ble utført i 1979.

1. Petrologiske og kjemiske undersøkelser av de ultramafiske blokker og blottninger.
2. Geologisk kartlegging og blokkleting.
3. Kvartærgeologiske undersøkelser
4. Bakkegeofysikk: - magnetiske og V.L.F. målinger over 65 km^2 med 100 m profil avstand.
5. Oppfølgende I.P. og resistivitetsmålinger.
6. Analysering og tolkning av ca. 2000 morene prøver innsamlet i 1978.
7. Fortsatt innsamling av geokjemiske prøver: - 6000 overflate moreneprøver og 230 dyp moreneprøver.
8. Et mindre diamantboreprogram av 533 m ble utført.

Resultatene

Resultatene av arbeidet i 1979 er vedlagt i rapport og kan oppsummeres slik :

A. Regionalt-geologisk sett er Syd-Pasvik lokalisert i et komplekst, foldet og høyt metamorft område av Archaeiske bergarter. Bergartstyper som er påviste er blant annet granittiske gneisser, glimmerskifer, amfibolitter, grafitt horizonter og magnetkisrik granat førende amfibolitter. Intrusive bergarter inkluderer metaperidotitter og olivin gabbroer.

Området kan sammenlignes med områder av lignende geologi i U.S.S.R.

mot øst og Finland mot vest. I Sovjet ved Allarachensk (ca. 40 km mot øst) forekommer nikkelførende ultramafiske bergarter som er gjenstand for drift.

B. De ultramafiske blokker i Syd Pasvik kan inndeles i følgende grupper basert på petrografi og kjemi.

1) Peridotitter
   1a) Serpentinitter
2) Amfibole-pyroxenitter
3) Olivin gabbroer
4) Amfibolitter
5) Andre

De blokker som har et betydelig nikkelinnhold faller inn i peridotittgruppen og er hovedsakelig harzburgitter.

Basert på en tolkning av petrografien, kjemien og beliggenheten av blokkene er peridotittene og pyroxenittene antatt å være deler av en differensiert ultramafisk kropp eller kropper. For å kunne ha gjennomgått differensiering og akkumulering av en sulfidfase i peridotitten, må en slik kropp ha blitt intrudert som en tykk sill eller ekstrudert som en tykk ultramafisk lava. Hvis vi forestiller oss det geologiske miljø for deformasjon og metamorfose, er det mest sannsynlig at flere siller ble intrudert mer eller mindre ved samme nivå og at disse er blitt brukket opp av senere folding og deformasjon.

C. En tolkning av bakkegeofysikken (V.L.F. og mag.) sammen med kartlegging av de få blottninger i området og resultater av begrenset diamantboring tyder på at en sone av ultramafiske kropper opptrer over en strekning av ca. 10 km i forbindelse med biotitt granittiske gneisser, glimmer skifer og amfibolitter i den såkalte "Gjøkvannsonen". Kartlegging indikerer at denne sonen fortsetter videre nordøst over ca. 10 km før den forsvinner inn i Sovjet.

Mesteparten av peridotittblokkene, inkludert de nikkelrike, er lokalisert i eller i nærheten av denne sonen. Det samme er tilfellet for de peridotitt/serpentinittiske blottninger samt ultramafiske kropper påtruffet i borehull. Andre plasser i området er fordeling av peridotitt og pyroxenitt blokker mer sporadisk.

D. Vi mener nå at magnetiske målinger plukker opp ultramafiske bergarter. Ved første øyekast synes disse å være små og isolerte, men mer detaljert tolkning indikerer at de representerer oppbrukne (forkastede - boudinerte) deler av større kropper og derfor har mer kontinuitet. Diamantboring av en slik kropp ved Blankvann har også indikert ultrabasittene til å være utholdende langs etter fallet.

De forskjellige elektriske metoder anvendt hittil gir bare begrenset korrelasjon med magnetiske anomalier. E.M. anomalier som er diamantboret er forårsaket av grafitt og/eller magnetkis. Man må dog ikke glemme at i dette høymetamorfe området (øvre amfibolitt) kan sulfidmineralisering som er remobilisert fra ultrabasitten finnes i omgiverde bergarter. Slike mineraliseringer kan forårsake E.M. anomalier uten korrelasjon med magnetiske.

Fra et geofysisk synspunkt er første prioritet magnetiske anomalier - som avspeiler ultramafiske bergarter - men anomalier med co-incident eller tilstøtende E.M. anomalier er av ekstra interesse.

E. Hoved isretning i området er SV-NØ 25-35°, påvist ved skuring. Men under den siste fasen av glasiering har det vært isbevegelser i flere retninger. Disse er påviste ved studier av fabric i morenen og av studier av De Geer morenens oppbygning.

I nærheten av Rømlingåsblokkene har isen beveget seg rett øst, mens den nær Blankvannblokkene har hatt en nordvestlig retning.

En slik variasjon av isbevegelse er veldig viktig med hensyn til blokktransport i området og i øyeblikket synes det å være 3 muligheter når det gjelder transportretning av de rike nikkelblokkene.

1. Med hovedisbevegelsen, dvs. 25-35°.
2. Transport med yngre bevegelse - som indikert ved skuring, fabric analyse og oppbygging av DeGeer morener.
3. En kombinasjon av 1 og 2.

Angående transportlengden av blokkene er hovedinntrykket at blokkene ikke er transportert langt. Dette baseres blant annet på at blokkene er relativt store, lite forvittret og ved Rømlingås danner en "blokk-skole" med mange nye blokker over et lite område. Blokkenes fordeling med ingen nikkelblokker i de store blokkrygger lenger syd, peker også på kort transport.

F. Basert på det ovenfornevnte er det konkludert at de magnetiske og elektromagnetiske anomalier i forbindelse med Gjøkvannsonen er de beste mål for å finne både kilden til nikkelblokkene og blindmineralisering av samme typen. Et omfattende boreprogram skal utføres i dette området i 1980

FAGRAPPORT
TECHNICAL REPORT

A/S SULFIDMALM

Dato/Date	Rapport Nr./Report No	Kartblad/Mapsheet	
8.2. 80	502/79/30	2333 II,III	

Forfatter
Author Nixon, Lieungh, Hansen

Tittel/Title

Status report, South Pasvik 1979

Resyme/Summary

Summary of [illegible]

At this stage in the exploration in South Pasvik, many questions remain unanswered. However, it is now possible to summarize the known facts and from these determine the best approach to the next stages of exploration.

1 In terms of regional geology we are located in a complexly folded and high grade metamorphic area of Archaean terrain. Rock types recognized include granitic gneisses, mica schists, amphibolites, graphite zones and pyrrhotite rich garnet amphibolites. The area is contiguous with similar geology to the east in the USSR and to the west in Finland. In the USSR at Allarechensk (some 40 km from our area) ultramafic rocks occur with some associated nickel sulphide mineralization and are at present being mined.

2 The Pasvik boulder suite can be subdivided petrographically and chemically into the following groups.
1. Peridotites, 1A Serpentinites, 2. Amphibole pyroxenites, 3. Olivine gabbros, 4. Amphibolites, 5. others. The boulders that contain significant nickel sulphides belong to the peridotite group (essentially harzburgites)

From the chemistry, petrology and intermixing of boulders, the peridotites and orthopyroxenites are considered to represent parts of a differentiated ultramafic source or number of sources. Such a body was probably intruded as a sill or extruded as a thick ultramafic flow to allow in situ differentiation and the accumulation of a sulphide phase in the peridotite. Envisaging this environment prior to metamorphism and deformation it is more than probable that a number of sills would be intruded at about the same horizon. Subsequent folding and deformation will have disjointed the original source body.

3 An interpretation of ground physics (V.L.F. and mag.) together with mapping of the few outcrops and the results of limited diamond drilling suggest that in the area of interest a zone of ultramafic bodies occur over a distance of some 10 km associated with biotite granitic gneisses, mica schists and amphibolites of the so-called "Gjesvann Zone". Mapping suggests that this zone may extend a further 10 km to the north.

The majority of the peridotite boulders - including the ores bearing significant sulphide mineralization - are located near to or in association with this zone, as are peridotite/serpentinite outcrops and peridotite/pyroxenite intersections in drill holes. Otherwise in the area peridotite and pyroxenite boulders occur more sporadically.

4 It is now felt that magnetic surveys outline the ultramafic bodies. On first impression these seem to be small in size and isolated but detailed magnetic interpretation suggest that the anomalies represent broken up (faulted-boudinaged) fragments of larger bodies and have thus more continuity. Drilling of a profile near [illegible] has also indicated the ultramafics to have down dip extensions.

The various geophysical methods employed have so far given only very limited correlation with magnetic anomalies and pure E.M. anomalies drilled so far have been caused by graphite and/or pyrrhotite. It must be remembered however that the metamorphism of this area (probably upper amphibolite) would be sufficiently great to cause sulphide remobilization into wall rocks or pressure shadow zones in adjacent folds etc. As such massive sulphides may occur in place, but which have not survived boulder transport. E.M. surveys may eventually detect these but geophysically the priority of exploration must remain with magnetic surveys to detect source ultramafic bodies, and magnetic anomalies with coincident or adjacent E.M. are considered prime targets.

5 To date results of geochemical investigations - deep and shallow till sampling - have not proved conclusive. Many samples have still to be assayed and no attempt will be made here to comment in depth on the present results.

6 The main ice movement direction has been proven by striations to be roughly SW— NE 25°-35°. Studies of till fabric and distribution of De Geer moraines have shown that during the later stages of deglaciation in association with calving at the ice front the ice has moved in different directions. Near the Ruslingås boulders movement almost due east has been suggested while near the [illegible] boulders ice movement towards NW is indicated.
Such a variation of ice movement is no doubt of importance when considering boulder transport in this region and three possibilities at the present time suggest themselves.

1) Transport with the main older ice-movement direction i.e. 25-35°.
2) Transport with younger movement i.e. as indicated by fabric and at right angles to the De Geer moraines.
3) A combination of 1 and 2.

As regards length of transport we have few hard facts. However the unanimous expert opinion is that the boulders have not been transported far. Indications for this assumption are: - the relative large size of the boulders - the fact that most are not unduly weathered - their distribution at Ruslingås as a school of boulders, and the lack of boulders to the south of the Ruslingås area where a marked break of slope south of Tumamoen has resulted in a dumping of boulders from the ice moving N.E. The fact that no nickel boulders have been found in this "boulder dump" leads the Quaternary experts to indicate a source to the north of this topographic feature.

7 Based on the above facts it is concluded that the zone of magnetic anomalies and associated E.M. anomalies outlined in association with the Gjesvann zone is the best target both for finding the source of the nickel boulders and also for similar types of blind mineralization.
A combination of geophysical and quarternary indications suggest the Bjørnsjøen area as the 1st priority target. An extensive drill program to test this and other targets has been planned as outlined below.

Andre relevante rapporter
Other relevant reports

472/77/23
480/78/USSR
483/78/23
484/78/23
494/78/23

Kommentarer/Comments

Fordeling
Distribution

- [ ] Canada
- [ ] Nikkelverket
- [ ] Kristiansand
- [ ] Oslo

1. INTRODUCTION

The South Pasvik area of the East Finnmark Pre Cambrian region became of immediate interest for nickel exploration with the discovery in 1977 of several erratic blocks of mineralized ultramafic material containing up to 4% Ni.

Work in 1978 led to the discovery of several hundred ultramafic boulders and a new "area" of 3 nickel boulders (3% Ni) was located. Magnetic surveys outlined anomalies which were thought to represent ultrabasic bodies, E.M. however gave no good correlation with the magnetics but picked up graphite and pyrrhotite zones. These geophysical results were confirmed by three short drill holes.

2. WORK CARRIED OUT IN 1979

A) Petrological and chemical investigations of the Pasvik ultramafic suite (reported by C.J.A. Coats 1.6.79).

B) Geological mapping and boulder tracing.

C) Quaternary geological investigations.

D) Ground magnetics and V.L.F. (65 km^2 covered on 100 m line spacing).

E) Follow up I.P. and resistivity surveys over selected areas.

F) Analysis and interpretation of 1915 shallow till samples from 1978.

G) Continued geochemical shallow till sampling over magnetic anomaly zone completed with some 6000 samples. A deep till sampling program with some 229 samples over a selected area was also completed.

H) A limited drilling program to test magnetic anomalies and to establish structure of the ultramafics was carried out.

3. REGIONAL GEOLOGICAL SETTING

The Pasvik region lies at the north-west extremity of the Kola Peninsula. In the Kola Peninsula five regions of copper-nickel mineralization exist: Petsamo, Allarachensk, Monchegorsk, Imandre-Varzug and Lovnoozero.

The first four areas are located within or near to the so-called Pechenga-Varzug mobile belt, a fold belt of Proterozoic age built up of rocks of the spilite-keratophyre and diabase associations with layers of phylites, sandstones and tuffites. The belt which strikes in a NW direction along the central portion of the entire Kola Peninsula crosses the Norwegian border in the Pasvik area, continues into Finland and comes into Norway in the Polmak area before running under the Eocambrian cover. It comprises a deep-seated tectonic trench which developed during early Proterozoic along a system of graben-like Archaen blocks.

The nickel bearing intrusions which are usually in the form of interlayered bodies are mainly located along the surface of layering and shearing within the deformed tuffogenic sedimentary sequence (Petsamo) or along breaks at their contact with the underlying gneisses (Monchegorsk). Less frequently the deposits are confined near fractures in the adjacent Archaen blocks (Allarachensk).

The two areas of deposits in the U.S.S.R. which are of most interest with regard to nickel potential in Norway are the Petsamo and Allarachensk areas. The Petsamo nickel field lies 5-30 km from the Norwegian border and its continuation passes into Norway at Skogfoss (see earlier reports). The Allarachensk area is located some 40 km from the border and this area is considered analogous to the South Pasvik region discussed in this report.

In the Allarachensk area the sulphide containing ultrabasic intrusives have the form of small conformable bodies emplaced within the lower Archaen rocks of the Kola Series (biotite and amphibole-biotite gneisses, feldspathic amphibolites, granites and granitic gneisses).

The Allarachensk deposit is associated with a synclinal structure in the SW limb of a domal structure and adjacent to a NNE striking regional fault.

The deposit consists of two ore bodies associated with two ultramafic intrusives (peridotite-harzburgite) that are conformable with the enclosing country rocks. The main ultramafic is elongated and saucer-shaped with a length of 1000 m and thickness varying between 3-20 m. Three types of mineralization occur:

A) Disseminated ores.

B) Massive and breccia remobilized ores (up to 17% Ni)

C) Disseminated mineralization in country rocks.

Plate 1 shows a generalized geological map of the region. As will be noted the main concentration of nickel deposits are located in the Proterozoic Petsamo formation where they are associated with serpentinized peridotites.

The two deposits at Allarachensk are also shown. In addition to these deposits Russian sources have shown numerous ultramafics in the southern Archean block of which some 20 are known to carry nickel mineralization.

4. LOCAL GEOLOGY

Lack of outcrop makes interpretation of the local geology difficult but based on the few available outcrops, numerous boulder finds, limited diamond drilling and an interpretation of geophysical data some relationships can be suggested.

The area is composed of a complexly folded and high grade metamorphic area of Archaen rocks and is contiguous with similar geology to the east in the USSR and to the west in Finland. The grade of metamorphism is probably upper amphibolite.

The greater part of the South Pasvik area is composed of a mixture of essentially granitic gneisses and migmatitic rocks derived from there. These rocks often exhibit banding with quartz-feldspar rich bands alternating with more biotite rich bands. The rocks usually have a dominant reddish colour and are often cut by pegmatite dykes. Other types although essentially granitic gneisses contain varying amounts of mica and amphibole.

In the centre of the area geophysical (magnetic and VLF) indications and drill hole data coupled with a few outcrops suggest the occurrence of a zone of mica schists, amphibolites and garnetiferous amphibolites with associated graphite and pyrrhotite zones. This zone has been termed the Gjøkvann zone and seems to be present throughout our area possibly being disrupted by the Tomamoen fault. To the north of the fault the strike of the zone is N/S with a dominant westerly dip whilst to the south of the fault the zone would appear to be more diffuse and broken up.

To the east and perhaps in association with this zone are outcrops of a mica bearing white coloured granitic gneiss. From the distribution of the high magnetic values and the distribution of ultramafic boulders and ultramafic intersections in drill holes it would appear that peridotite intrusions are associated with or near to this Gjøkvann zone.

It is felt that the Gjøkvann zone represents a younger Archaen unit and due to the ultramafic association has a high nickel potential.

Another geological unit which is amplified by the geophysics is the Ellenvann zone; this is a NNW/SSE zone in the western part of the area. Little is known of the geology but amphibolites, mica schists, graphite bands and pyrrhotite bands have been encountered previously in this area. To the north this zone now seems to continue under the Proterozoic Petsamo formation and ultramafics hace been found associated within it. Limestone boulders have also been found in proximity.

In the extreme south of the area two outcrops of olivine gabbro have been found. These and the petrology og the ultramafics will be discussed in more detail in section 5.

Enclosure 2 shows the supposed limits of the Gjøkvann and Ellenvann zones.

5. QUATERNARY INVESTIGATIONS

In this area of few outcrops and complicated and varied glacial deposits it is felt that an understanding of the quaternary geology is an essential part of the exploration activities.

Investigations have shown that the dominant glacial striation direction in the Pasvik area is between 25 and 35^{o}. These striations can be found in several places and correlate well with investigations in neighbouring areas.

This 25-35^{o} direction relates to a period when the ice mass was of such a thickness that the topography caused only minimum deflections to its direction of movement. Based on the coarse nature of the striations and their regional extent, it can be assumed that the related ice movement has been the main movement in the area and has been of prime importance for material transport on a regional scale.

The large esker systems in the main Pasvik Valley are more or less parallel to the main ice movement and their development probably started whilst the ice followed this direction.

As the ice mass became thinner its movements became more and more influenced by the ground topography. These movements however usually show only a limited regional extent and were of a less duration than the main movement. They have left few traces and are difficult to reconstruct. Usually in such reconstructions fluting structures are most commonly used together with striations and fabric analysis. Fluting structures are considered good criteria - but unfortunately they are not well developed in the area of interest and are thus of little use.

Striation observations need outcrop of which there are few in the area and again this is of little use. - Most of our observations have thus been based on fabric analysis of till material which is the most uncertain and time consuming method.

The most interesting result based on striation indications is the recognition of local deviation from the main ice-movement. Observations both at Gjøkvann and several places further north indicate clear divergence (up to 90°). This has been caused by calving at the ice-front and indications point to a large calving bay along the Tomamoen esker. Fabric analysis also support this, as do the distribution of De Geer moraines.

De Geer moraines are very characteristic to the area - and especially of the area of the nickel-rich boulder finds. In the literature there are several theories concerning the association of De Geer moraines with the ice front and ice movement but the results of our trenching through De Geer moraines in Pasvik suggest that they were formed at and parallel to the ice front.

The distribution of these De Geer moraines can provide us with valuable clues in reconstructing the later movement stages of the ice. The ice-mass must have moved at right angles to the ice front and the De Geer moraines that are found west of the Tomamoen esker - near the Rømlingås boulders - indicate a more easterly ice-movement during the last phase of melting in this area. On the eastern side of the esker movement has been more westwards.

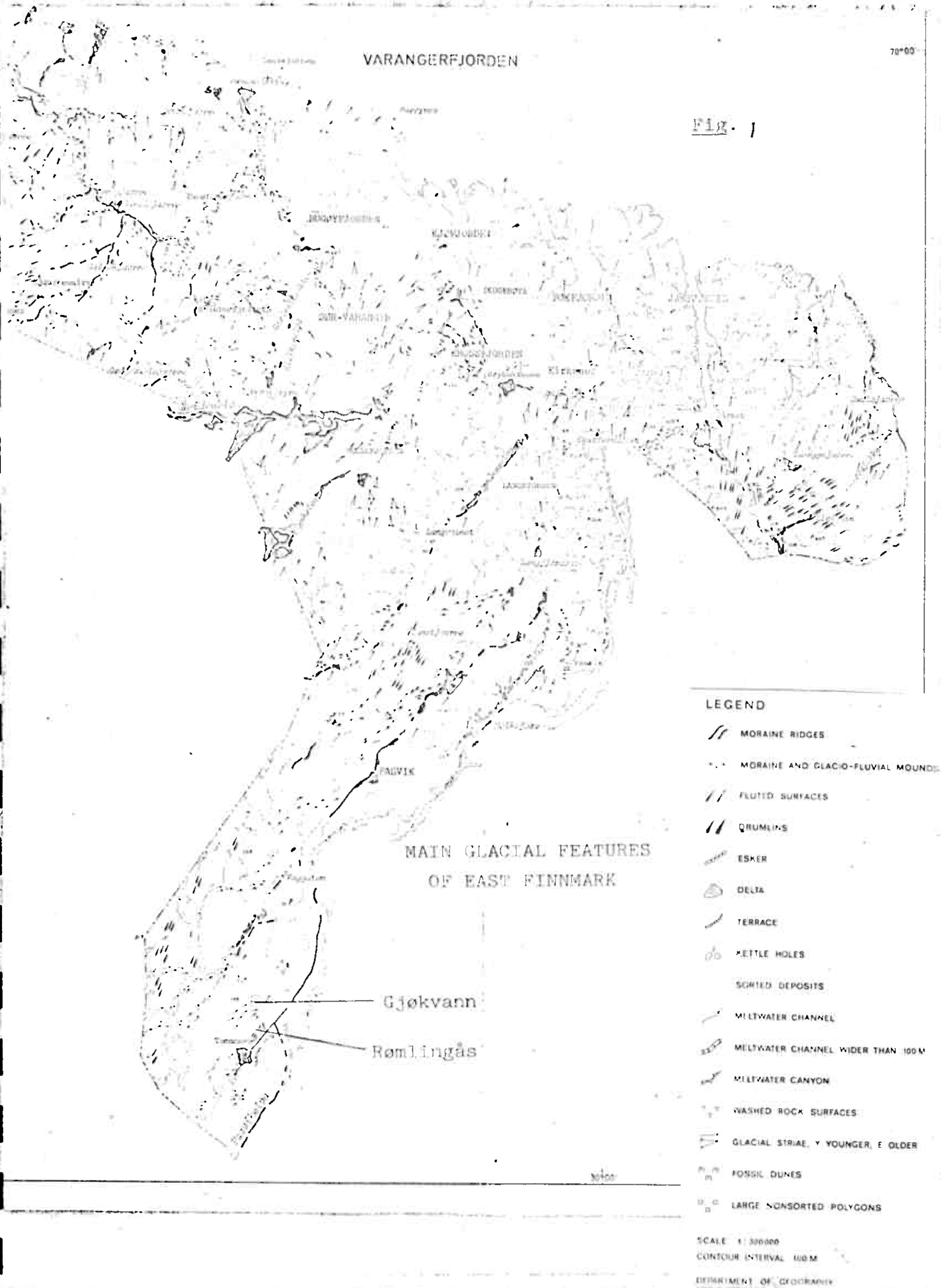
Such a variation of ice movement is no doubt of importance when considering boulder transport in this region and three possibilities at the present time suggest themselves.

1) Transport with the main older ice-movement direction i.e. 25-35°.
2) Transport with younger movement i.e. as indicated by fabric and at right angles to the De Geer moraines.
3) A combination of 1 and 2.

As regards length of transport, we have few hard facts but there are certain indications that the nickel boulders have not been transported far i.e. their size, weathering and distribution.

Fig. 1 shows the general glacial features of East Finnmark and fig. 2 shows in cartoon form the glacial conditions around the Ni boulder areas.

Fig. 1


VARANGERFJORDEN
70°00'
FAGVIK
MAIN GLACIAL FEATURES
OF EAST FINNMARK
Gjøkvann
Rømlingås
LEGEND
MORAINE RIDGES
MORAINE AND GLACIO-FLUVIAL MOUNDS
FLUTED SURFACES
DRUMLINS
ESKER
DELTA
TERRACE
KETTLE HOLES
SORTED DEPOSITS
MELTWATER CHANNEL
MELTWATER CHANNEL WIDER THAN 100 M
MELTWATER CANYON
WASHED ROCK SURFACES
GLACIAL STRIAE, Y YOUNGER, E OLDER
FOSSIL DUNES
LARGE NONSORTED POLYGONS
SCALE 1:300000
CONTOUR INTERVAL 100 M
DEPARTMENT OF GEOGRAPHY

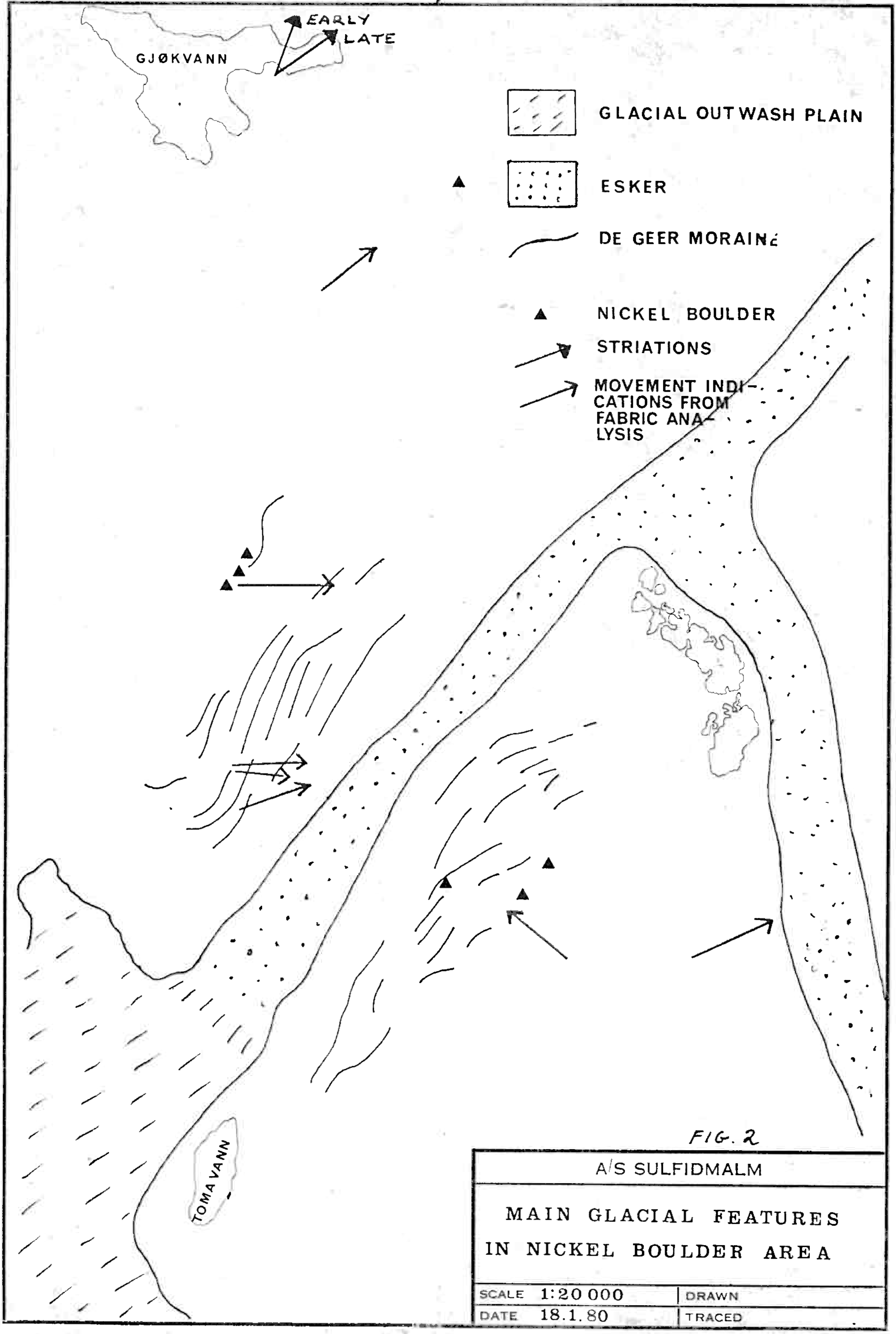


FIG. 2

A/S SULFIDMALM

MAIN GLACIAL FEATURES IN NICKEL BOULDER AREA

SCALE	1:20 000	DRAWN
DATE	18.1.80	TRACED

6. BOULDER TRACING

I Introduction

In this area of extreme overburden cover boulder tracing has proved an invaluable method of exploration, and has indeed led to the discovery of several nickel/copper bearing ultramafic boulders.

The bulk of the boulder tracing was carried out in late 1977 and in 78 using both conventional prospecting techniques for surface material and the use of a trained sulphide sniffing dog and a hand held Proxan E.M. unit for the discovery of boulders covered by vegetation or at shallow depth in the overburden.

In 1979 regional boulder tracing was carried out in association with regional mangetic surveys and detailed Proxan tracing was carried out in specific areas.

The efforts of the boulder-tracing program has resulted in the discovery of several hundred boulders of basic and ultrabasic affinity. Each discovery was classified megascopically in the field and the location colour-coded on a topographic base map at 1:20 000 scale. Selected mineralized boulders were analysed for Cu,Ni and S (table 1)

It soon became evident that more definitive documentation was needed on the large number of discovered ultramafic boulders with the objective of classifying the rock types present and to determine whether within the total group ultramafic boulders of similar composition would determine recognizable trains. From this it was hoped to identify a group which might represent the source body or bodies containing nickel sulphide mineralization. A total of 75 boulders (meant to give a good cross section of the total boulder count) were selected for microscopic examination and of these a total of 45 were selected for detailed chemical analysis.

The results of this work was reported by C.J.A. Coats in June 79 and the following is a resume of the results mentioned in this report.

TABLE 1

COMPOSITION OF PASVIK MINERALIZED BOULDERS

Sample	Rock type	%Ni	%Cu	%Co	%S	S/Ni	$Cu/Cu+Ni^{100}$
4LN78	Peridotite	1.26	0,50				28
38EK78	Peridotite	1.75	0.28		4.32	2.47	14
43EK78	Serpentinite	3.0	0.24		8.8	2.93	7
44EK78	Peridotite	0.62	0.60		2.68	4.32	49
78EK77	Syenite (wall rock)	0.67	1.12		2.2	3.28	63
79EK77a	Peridotite	3.15	1.37	0.07	11.6	3.68	30
" b	"	3.20	0.64		10.6	3.31	17
" c	"	3.10	1.20				28
" d	"	2.76	1.98				42
" e	"	2.1	0.60		12.75	6.07	22
80EK77a	Amphibolite	0.43	0.33	0.02	1.6	3.72	43
" b	"	0.68	0.54				
81EK77a	Amphibolite	3.47	0.53		10.8	3.11	13
" b	"	2.82	0.60				18
88EK77a	Peridotite	0.80	0.52		3.28	4.10	39
" b	"	1.02	1.58		4.2	4.12	61
" c	"	0.39	0.36				48

6. II Petrology of the boulder suite

The Pasvik boulder suite can be subdivided petrographically and chemically into the following groups.

Group 1 Peridotites
" 1A Serpentinites
" 2 Amphibole pyroxenites
" 3 Olivine gabbros
" 4 Amphibolites
" 5 Others

A Peridotites

Peridotites consist of harzburgites, lherzolites, minor wehrlites and possibly some amphibole peridotites. On a division of rock texture they form two distinct groups which are referred to as metamorphic and magmatic. Regardless of textural and compositional variations the peridotites have the common physical property of being very magnetic.

All of the nickel rich boulders fall into this group (with the exception of one in group 1A and one in group 5).

Estimated modal compositions are shown in table 2.

B Serpentines

Only two samples classified as serpentinite, one an outcrop, the other a nickel rich boulder located near by. Both show an absence of primary silicates and have dominant antigorite. The serpentine-amphibole-sulphide association in the mineralized boulder is comparable with the olivine-amphibole-sulphide association of some of the mineralized group 1 peridotites.

C Amphibole pyroxenites

These rocks contain larger proportions of pyroxene and amphibole and lesser olivine than the peridotite group. In general their textures suggest an originally high content of primary orthopyroxene a substantial portion of which is now replaced by amphibole.

TABLE 2

ESTIMATED MODAL COMPOSITIONS OF GROUP 1 PERIDOTITES

Sample	OLIV.	SERP.	OPX.	CPX.	AMPH.	PHLOG.	CHL.	TC-CARB.	OPAQ.
1SP78	25	20	40	1	2	4	–	Tr.	8
4LN78	25	–	10?	–	30	15	–	–	20
6KM78	20	–	20	–	50	–	3	2	5
17KM78	30	15x	5	–	15*	–	10	20	5
27KM78	55	→	15	–	25	–	–	–	5
38KM78	25	Tr	20	15	35	–	–	2	3
41KM78	20	→	15	–	55	–	3	2	5
1EK78	40	→	15	15	25	–	–	–	5
2EK78	35	→	5	–	35	20	2	1	2
3EK78	10	1	15?	–	40	–	1	30	3
6EK78	20	5x	10	–	55*	–	5	2	3
9AEK78	35	25	5	9	25	–	–	–	1
13EK78	25	25	15	–	25	–	–	–	10
19EK78	20	15	10	–	45	–	5	–	5
23EK78	40	10x	10	–	35	2	–	–	3
34EK78	45	3x	20	–	10	–	20	1	1
39EK78	–	60	–	25	–	10	→	–	5
44EK78	4	8	–	–	85	–	–	–	3
47EK78	10	45x	15?	–	20	5	–	1	4
50EK78	10	–	25	→	62	2	–	–	1
77EK77	5	50	–	–	40	–	Tr	–	5
80EK77	30	–	–	–	50	–	6	4	10
88EK78	85	–	–	–	10	–	4	–	1
106EK77	40	→	–	20	40	–	–	–	1
79EK77	40	–	–	–	25	–	–	1	24

x Antigorite others lizardite

* Anthophyllite

Variation in metamorphic textures suggest derivation from more than one source.

Some of the group contain minor sulphide mineralization (1 - 5 %) Highest nickel values are present in 3LN78 (0.22% Ni) and 16KM78 (0.23% Ni).

Magnetic susceptibility varies from weakly magnetic to distinctly magnetic.

Estimated modal compositions are shown in table 3.

D Olivine gabbros - corona type

These are magmatic plutonic basic rocks which do not display textures indicative of much metamorphism, microscopically the textures displayed are uniquely characteristic of this rock type. The principal silicate phases are olivine, clinopyroxene, amphibole and plagioclase. Observed variation in mineral composition may indicate that the source body is a layered and differentiated type.

Most of the samples (including 2 outcrops) contain some 3% sulphides with minor nickel and copper.

Magnetic susceptibility is weak.

Estimated modal compositions are shown in table 4.

E Amphibolites

Amphibole rich rocks in which there is no recognizable pyroxene.

F Others

Only two samples are of interest. Sample 29EK78 a rock of probable volcanic origin assayed 1.57% Cu and sample 78EK77 a small boulder of medium-course grained biotite syenite with 2-5% disseminated sulphides assayed 0.67% Ni and 1.12% Cu. The nickel content probably is derived from sulphide mobilization adjacent to a mineralized peridotite.

6 III In summary chemical evidence suggest that the peridotites and pyroxenites (group 1 and 2) are related and that the corona-type olivine gabbros have been derived from some other unrelated plutonic intrusions. This is not to imply that the peridotites and pyroxenites have been derived from

TABLE 3

ESTIMATED MODAL COMPOSITITONS OF GROUP 2 - AMPH. PYROXENITES

Sample	OLIV.	SERP.	OPX.	CPX.	AMPH.	PHLOG.	CHL.	TC.	OPAQ.
3LN78	–	–	10	–	70	–	10	5	5
10LN78	–	–	10	–	80	–	–	–	10
16KM78	–	–	10	–	70	–	5	–	15
18KM78	–	–	–	–	70	–	–	25	5
23KM78	–	–	35	?	50	10	Tr	–	5
29KM78	–	–	20	–	65	5	–	5	5
35KM78	15	–	40	–	35	5	–	4	1
40KM78	2	–	60	–	35	–	–	–	3
18AEK78	–	–	25	–	65	6	–	–	3
32EK78	5	5	75	–	10	–	–	–	5
33EK78	10	5	70	–	10	–	–	–	5
36EK78	15	–	15	–	65	–	1	–	4
49EK78	20	5	15	–	55	–	–	–	5

TABLE 4

ESTIMATED MODAL COMPOSITIONS, OLIVINE GABBRO CORONA TYPE

Sample	OLIV.	CPX.	OPX.	AMPH.	BIOT.	PLAG.	OPAQUES.
3GK78	20	10	-	40	-	30	-
20KM78	5	35	-	45	-	5	10
22KM78	35	30	-	24	5	5	1
25KM78	30	25	-	34	1	10	-
39KM78	30	- 65 -		-	-	5	-
13EK77	45	35	-	19	-	1	-
26EK78	5	55	-	30	-	10	1
44EK77	50	10	-	15	-	20	5
51EK77	45	13	-	20	-	20	2
55EK77	20	20	-	30	Tr	25	5
61EK77	50	15	-	20	-	15	Tr
64EK77	20	35	10	10	1	20	4
72EK77	20	30	5	25	5	15	1
74EK77	10	10	15	50	-	15	-
76EK77	-	15	10	60	-	10	5
67EK77	25	20	-	45	1	5	4

a single differentiated source, because metamorphic textural differences do exist between members of these two groups. One can infer therefore that there are a number cf ultramafic source bodies each exhibiting a degree of magmatic differentiation. A lower or basal peridotite zone and an overlying pyroxenitic zone is compatible with the chemical evidence.

6 IV General conclusions

The boulders that contain significant nickel sulphide mineralization belong to the peridotite group (essentially harzburgites).

From the chemistry, petrology and intermixing of boulders, the peridotites and orthopyroxenites are considered to represent parts of a differentiated ultramafic source or number of sources. Such a body must have been intruded as a sill or extruded as a thick ultramafic flow to allow insitu differentiation and the accumulation of a sulphide phase in the peridotite. Envisaging this environment prior to metamorphism and deformation it is more than probale that a number of sills could be intruded at about the same horizon. However folding and deformation may have disjointed an original single source body by large scale boudinage effects.

The majority of the peridotite boulders including the ones bearing significant nickel sulphide mineralization are located near to or in association with the Gjøkvann zone mentioned above, -peridotite outcrops and peridotite intersections in drill holes are also associated with this zone. Otherwise in the area peridotite boulders and pyroxenite boulders occur more sporadically. Based on this evidence plus geophysical and quarternary geological indications (see above) the Gjøkvann zone seems at the moment to have the best potential for peridotites and as a source area for the target boulders.

The distribution of olivine gabbro boulder trains and two known outcrop locations and various reasons of of chemistry suggest that they do not constitute part of the ultramafic source bodies which host the economically significant sulphide mineralization.

All evidence now points to the conclusion that the source of these boulders lies in the extreme south of the Pasvik area near the Finnish Russian border in the area of outcrop 34.KM.78 and 74.EK.77. It is not known whether these outcrops represent exposures of smaller plutonic bodies or of a large gabbroic body running along the border area.

The olivine gabbros may be comparable to basic layered intrusions of Proterozoic age farther to the north in Finland.

7. GEOPHYSICAL INVESTIGATIONS

The geophysical methods that have been applied in the area are as follows:

1. Ground magnetics.
2. V.L.F., E.M.
3. Crone shootback E.M.
4. I.P.
5. Gradient array resistivity.

I MAGNETICS

The area of potential interest has been covered by a magnetic survey on 100 m line spacings with stations for every 12.5 m. The instrument used was a McPhar M700 Fluxgate magnetometer with a similar unit being used as a continuous control base station. To date a total of 58 km^2 has been covered (a summary of results is presented in encl. 3 and individual sheets as appendix). Various areas of special interest were covered in more detail.

In general the magnetic background is quite flat with values in the 500-700 range. The main feature of the area is a NW - SE trending anomaly zone in the western portion of the area (the Ellenvann zone). The zone - although cut by a corner of the Upper Pasvik National Park (where no measurements have been taken) is thought to be continuous throughout the entire survey area and open to both NW and SE. The zone is much broader in the north than in the south - this may be due to the changes in dip or a general thickening of the magnetic units. The unit appears to dip to the west and helicopter mag. and E.M. surveys to the north indicate that this zone swings to a more N-S direction and runs up under the Proterozoic Petsamo formation

As mentioned above this zone consists at least in part of amphibolitic and schistose rocks with graphite and some pyrrhotite, and ultramafics are known from its continuation to the north. Although no ultramafics are known from the zone in our area, it should be remembered that ultramafics in this environment could well be "geophysically masked" by the generally high magnetic values of the zone itself.

The second main feature is a broad zone of moderate anomalous values running in a N-S direction in the centre of the surveyed area. This zone is thought to be displaced by a NE/SW fault zone (Tommamoen Fault) and continues to the south as a more diffuse feature and with a more NNW-SSE strike. This feature is thought to be associated with a zone of more micaceous and amphibolitic rocks "the Gjøkvann zone".

Associated with the eastern flank of this zone are various high magnetic anomalies thought to represent ultramafic bodies (drilling and outcrop have substantiated 3 such anomalies as meta peridotites).

The anomalies are generally small circular to elongated areas usually with some dipole effect. They are often seen in clusters and have a somewhat zonal distribution. The cause of the distribution pattern is not yet fully understood but may represent ultramafic sills or flows that have been disjointed by folding and deformation, (a simplified map of the distribution pattern is shown on encl.2).

It is thought that these magnetic anomalies represent the prime targets for nickel mineralization in the area. They are favourably situated with regard to the nickel boulders and several have already been proved to represent meta peridotites.

A somewhat discerning feature is that the anomalies are usually small - these however may only be representing shallow bodies and deeper plunge and dip extensions may not be outlined so well by magnetics. Most of the anomalies represent a dip to the west and drilling on two of the bodies has indicated ultramafic immediately under the overburden cover.

Three areas of magnetic data - in total 6 km^2s - have been studied and interpreted by Allan Spector and Associates Ltd. The reports on this work are enclosed as appendix.

An interesting feature of Spectors work is the interpretation of fault zones that apparently disrupt and dissect the ultramafic zones.

TABLE 5

MAGNETIC SUSCEPTIBILITY OF PASVIK BOULDER SAMPLES

Sample	Type	Suscep.
17KM78	Peridotite	20
44EK78	"	1
79EK77	"	45
106EK77	"	40
1SP78	"	50
3LN78	Amph. pyroxenite	50
18KM78	"	30
32EK78	"	50
3GK78	Olivine gabbro	6
26EK78	"	9

7 II V.L.F.

In general it is thought that the V.L.F. anomalies represent real geological phenomena and are not overburden effects. It is felt that the V.L.F. preferably picks out shallow conductors when present. In the absence of shallow conductors it picks out deeper structures. On Tommamoen glacial outwash plain the V.L.F. does not seem to penetrate to bedrock to any great extent.

Anomalies usually show good repetition from profile to profile and they usually have good amplitude. Generally they exhibit a dip to the west.

A marked feature are anomalies associated with the Ellenvann zone. Here there is good correlation with magnetics - the zone having a general NW/SE strike and westerly dip. There is some indications of fault breaks, and in the northern portion there is a parallel V.L.F. anomaly zone that does not have any co-incident magnetics.

This Ellenvann zone is a pronounced anomaly zone and from previous investigations in 1971 is known to contain both graphite zones and barren sulphide zones - ultramafics are also known from its continuation to the north.

To the north east and east of the Ellenvann zone the area is marked by dominantly N/S trending anomalies but also by several having a more NE/SW trend - which are especially dominant in the eastern portions of the investigated area.

The N/S trending anomalies probably are related to a "younger" Gjøkvann zone whereas the NE/SW trends probably represent deeper "structures" in the older granitic basement.

South of the Ellenvann zone there appears an anomalous area with rapid changes in amplitude along profiles and little continuity from profile to profile. There is no magnetic correlation and the area obviously represents a different geological environment.

Generally speaking apart from the Ellenvann zone there seems to be little correlation between magnetics and V.L.F. There is some correlation on the eastern flanks of the Gjøkvann zone but otherwise there is little direct correlation between V.L.F. and probable ultramafic bodies.

III CRONE SHOOTBACK E.M.

No new Shootback-EM measurements were carried out in 1979. The majority of Shootback-EM work was reported in 1978, report no. 494.78.23, appendix 1 - which concluded that Shootback-EM was not considered a suitable tool for follow up work in the area.

Penetration seems to be a problem here, - where overburden is neither conductive nor very deep. Shootback-EM 50 m coil sep. does not pick up conductors over plotted anomalies from 100 m. coil sep.

Minor Shootback-EM work carried out in -78, not reported on, will be commented upon in this report under follow up IP and Resistivity Surveys in selected areas.

IV I.P.

Method: Conventional frequency I.P. f=0.3-5Hz., 25 m. dipole-dipole configuration, - vertical conductive sounding. Instrument McPhar model P660. The results are plotted as pseudosections showing apparent resistivity in ohm/m., Metall-factor MF and frequency-effect FE in %.

Survey area:	Profile	10300N / 3050W-3425W,	area 15	encl. 8
	- " -	11300N / 4900W-5125W	" 13-14	encl. 11
	- " -	12200N / 4750W-5075W	" 5-6	encl. 10

V GRADIENT ARRAY RESISTIVITY

Method: Horizontal conductive sounding. Two current electrodes C_1-C_2 are placed a large distance apart, 2 x S = 700 m and are fixed. The potential electrodes are held at a constant sep. a = 25m., and moved along lines paralell to the line joining C_1-C_2. Instrument McPhar model P660 f=0.3-5Hz. The results are plotted as contoured plan maps of apparent resistivity in ohm/m. with areas of higher FE's dotted in.

For technical layout see enclosure 6. and text on enclosure 9

FOLLOW UP I.P. AND RESISTIVITY SURVEYS OVER SELECTED AREAS.

AREA 15 : One magnetic feature in particular was chosen for follow up work, the so called Blankvann anomaly situated in the northern half of area 15. Six survey areas of Gradient Array Resistivity 2, frequency measurements were put in to cover the entire magnetic feature, enclosure 6.

Four N-S striking conductive zones are seen on the map, enclosure 7. The anomalous zones are not continous right through, but seem to be broken up. The best looking anomaly is located in areas encircled 3 and 4 limited by the 500 ohm/m contour with a strike length of about 400 m. Two individual zones within this area - reading 100 ohm/m and with coincident FE>10% stand out (11500N/4000W, 11800N/4037W). The former has good magnetic expression, the latter no magnetics.

The other conductive zones are elongated and scattered throughout the area without any FE's to be mentioned.

In general the correlation between GAR/IP data and magnetics is poor. There are no VLF-EM or Shootback-EM anomalies within this area.

In general the anomalies found appear to shallow and small and of little interest.

Another but smaller magnetic anomaly striking NW - SE in the SE corner of area 15 was also investigated by GAR/IP. Enclosure 6, survey area encircled 7 and 8 .

This area seems to contain two conducting zones, again striking N-S, (see enclosure 7). It seems divided by a resistivity gradient striking NNE-SSW. The area to the south of this division is fairly large and uniform both from a resistivity and FE point of view (less than 500 ohm/m FE's 5%.) At the southern flank of survey area 8 a limited reisistivity low, less than 150 ohm/m with coincident FE 10% is seen. No magnetic, VLF-EM or Shootback-EM correlation.

The area to the north of the division is much more limited in size and contains two paralell zones. The eastern one placed on the magnetic dipole has no strike length, but has a coincident FE 10%. The western anomaly is also small - strikelength about 200 m and has no FE correlation.

IP dipole-dipole measurements were taken along line 10300N, enclosure 8, and the anomalous zones from the horizontal soundings are confirmed by these vertical soundings. Comparing data, best fit exists at the n=1 e.g. ½ dipole separation, (12,5m).

VLF-EM and Shootback-EM coincide with a resistivity gradient striking N-S at the western flank of survey-area 7 .

A recontouring of this magnetic anomaly would make the magnetic strike fit with the electric strike and place the magnetic anomaly in the hanging wall of the VLF-EM, Shootback-EM and resistivity anomalies.

AREA 5-6 Rømlingås North/Rømlingås.

Due to certain indications that the nickel boulders had not been transported far, and the nearby small magnetic anomalies here, another GAR/IP survey was put in here. This survey area is to a certain degree overlapping the original Rømlingås Grid, enclosure 9.

A 1 frequency GAR survey with additional IP dipole-dipole was carried out in -78. This years measurements turned out one single anomaly, striking out of the NW corner of the area. The magnetic picture in general does not confirm this strike. Never the less this anomaly was close to and up ice from the main boulder find with single and scattered magnetic anomalies along the conductive horizon. This horizon is also seen in VLF-EM and Shootback-EM measurements.

One IP dipole-dipole traverse was selected along line 12200N, enclosure 10. This section also clearly indicates the anomaly, best dipole 4900W - 4925W. A trench was dug here in order to explain the IP anomaly. Deep till sampling indicated overburden to be about 2-3 m thick. The first trench had to be abandoned because of water coming in from the swamp, (even permafrost was encountered). On a second attempt the trench was moved 25 m further east, 4875W. This trench was dug 2.5 m deep and 4 m long. Bedrock was found and sampled. The sampling here also became very limited because of incoming water and technical problems with both pump and pack-sack drill. The sample taken was a po-rich amphibolite, which explain the IP anomaly. By moving the trench to a place possible to dig and sample, one also moved to the very limits of the geophysical anomaly.

Another anomaly was refound this year where the two areas are overlapping each other. This was probably drilled through at depth in SP 2/78 - amphibolite with thin grafitic layers.

AREA 13 Boulder 23/EK/78.

This earlier blockfind now believed to be bedrock has a good magnetic correlation. Therefore IP dipole-dipole measurements were carried out on this line 11300N centered on 5000W. This rock however classified as peridotite gave no IP anomaly, enclosure 11. Resistivity values are decreasing towards wast, ca. 4900W. This fact also shows up on the VLF-EM as a x-over and a weak Shootback-EM.

Conclusions

The regional magnetic work is of great value, and indicate the prime targets for our nickel exploration in the area. Most magnetic anomalies are small and reflect shallow sources directly under the overburden. Drilling and outcrops have indicated 3 such anomalies as meta peridotites. Magnetic interpretation work done by Allan Spector Ass. Ltd. confirms the thought of fault zones that apparently disrupt and dissect the ultramafic zones.

It should be noted that Spector indicated that zones of remanent or reversed magnetization might be of particular interest - and be due to sulphide mineralization. Drilling of two such zones have shown them to be the footwall side of outcropping gentle dipping anomalies with a 70-75^{o} magnetic inclination.

The regional VLF-EM along with the magnetics help in understanding of the general geology in the area. In the absence of shallow good conductors it picks out the deeper structures.

The Shoot-back-EM method has a problem with penetration using normal coil separation to find the conductors at shallow depth. Previous drilling indicates graphitic layers in amphibolite suboutcropping under the overburden. To overcome this problem we have increased the coil separation to 100 m, even 200 m, which made anomaly complexity much greater, suggesting source to consist of several narrow bands - making both depth and dip determination ineffective.

Gradient Array Resistivity and IP measurements still hold some promise although individual profiling would now seem to be preferential to larger areas of horizontal soundings.

8. GEOCHEMICAL INVESTIGATIONS

I Surface till sampling 1978

The result of the assays has been plotted in a log x Gaus normal distribution = probability paper.

Based on the diagram, enclosure 12, we are able to divide the Ni-values into two separate statistical populations.

1) "Background population"

   Seen in the figure as a "straight" line and probably caused by the dominant rock group in the area, that is the granitic gneisses.

2) "Anomalous population"

   Clearly anomalous when referred to the background population - but not by itself. Probably caused by rock types with a different geochemistry to gneiss. F. ex. amphibolites, pyroxenites, perodotites and ore-mineralizations.

The "background population" shows a surprising regular Gaus-distribution, in this diagram represented by a straight line.

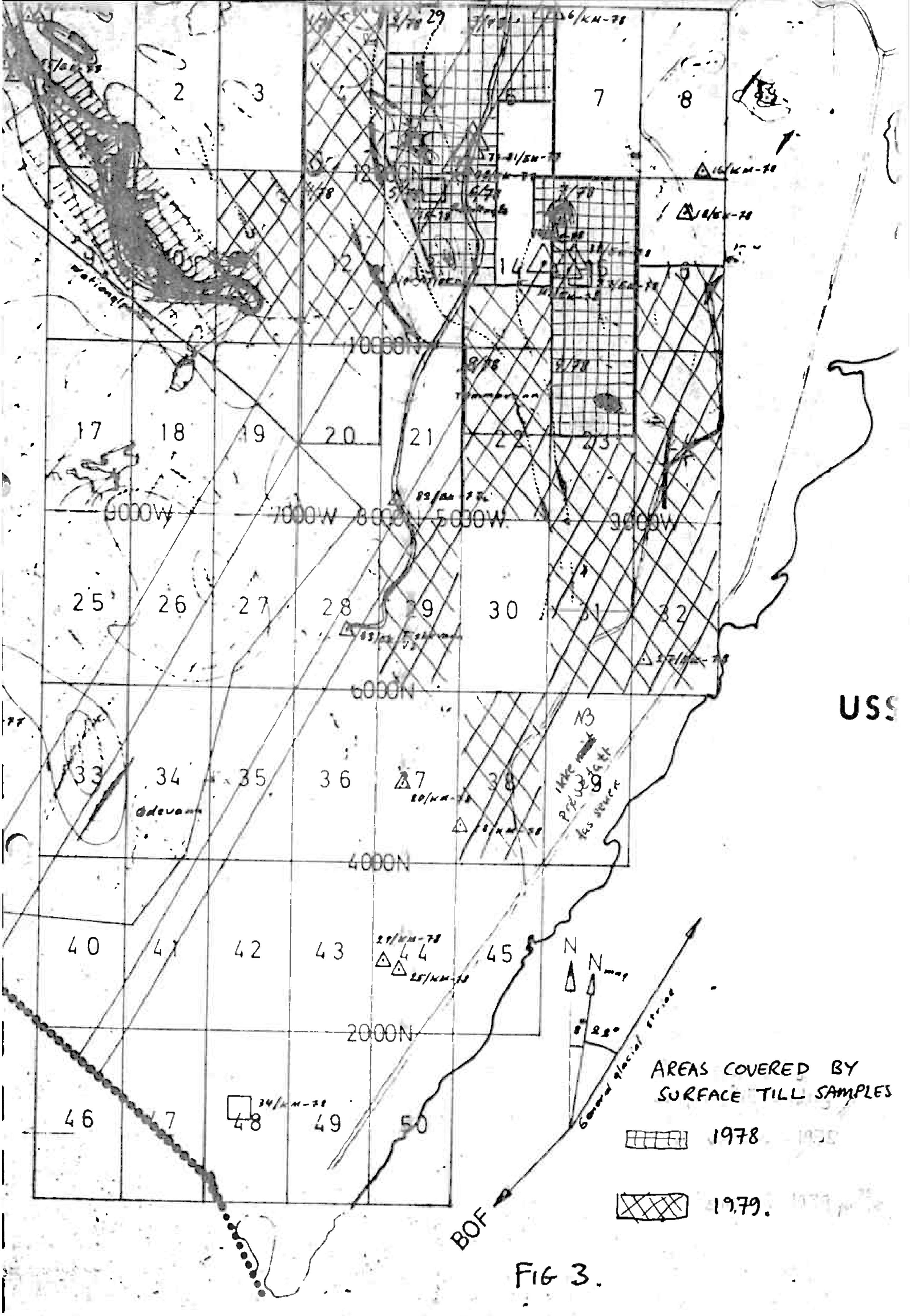
Directly from the diagram one can see a 98% probability for the background values to be less than 100 ppm Ni, and that there is less than 0.02% probability to find a background value higher than 225 ppm Ni.

The "anomalous population" also shows a Gaus normal distribution shape in the diagram - but only 1% of all data can clearly be included in this population.

In the area between 100-225 ppm Ni we have a certain intermixing between the two populations, but values above 225 ppm Ni belong to the anomalous population.

The Ni-values can thus be classified as:

0 - 100 ppm	Background
100 - 225 ppm	Low anomaly (or high background)
225 - 750 ppm	Anomalous
750 -	High anomaly



2
3
6
7
8
12000N
10000N
17
18
19
20
21
22
23
9000W
7000W
8000N
5000W
3000W
25
26
27
28
29
30
31
32
6000N
USS
33
34
35
36
37
38
39
Ødevann
4000N
40
41
42
43
44
45
N
N map
2000N
46
47
48
49
50
BOF
AREAS COVERED BY SURFACE TILL SAMPLES
1978
1979.

FIG 3.

The Cr diagram, enclosure 13, does not give a clear picture - but shows a tendency to a two-population grouping.

In the background population 98% of the values are lower than 140 ppm Cr.

There is less than 0.02% probability to get a background value higher than 290 ppm.

The Cr-values can be classified:

0 - 140 ppm	Background
140 - 290 ppm	Low anomaly
290 -	Anomalous

The Co picture, enclosure 14, is more simple and shows a mainly normal distribution of the values in a single population.

0 - 65 ppm	Background
65 -	High background

Cu-values, enclosure 15, show a single normal distributed population - with the exception of one sample with 3600 ppm Cu.

This single value can og course be defined as highly anomalous.

0 - 100 ppm Cu	Background
100 - 250 ppm Cu	Low anomaly (high background)
250 -	Anomalous

The anomalous Ni-values and Cu-values are plotted on map 16 (enclosure) and show a close correlation to the area with magnetic peridotite - and they are probably caused by normal peridotites.

Special interest is connected to the two samples situated among Ni-rich boulders and especially the single high anomalous Ni-value approx. 700 m south of the Ni-block area.

8 II Deep till sampling 1979

Two samll grids in area 15 (Blankvann) was covered by deep till sampling and approx. 250 samples were collected.

The sampling was carried out by a Partner drill with a two man crew and the max. sampling depth was 4 m.

It was possible to sample at deeper levels but this normally caused technical problems.

The samples were assayed for Ni and Cu.

The results are shown on figs. 4, 4A, 5 and 5A.

3 different Ni-anomalies with values less than 750 ppm Ni were picked up. Two of them in the northern grid were situated on a magnetic anomaly and drilled during summer 1979.

Non-mineralized peridotite was recognised in the drill core from the surface, and explain the anomaly.

No real interesting Cu-values has been registered.

This way of till sampling is not recommended in the future - mainly because of the lack of succes in reaching the bottom till layer in this heavy overburden region.

8 III Surface till sampling

During the summer season a program of surface till-sampling was carried out in the areas 4, 11, 12, 14, 16, 22, 23, 24, 29, 31, 32, 38. A total of 7650 samples were collected (see fig. 3)

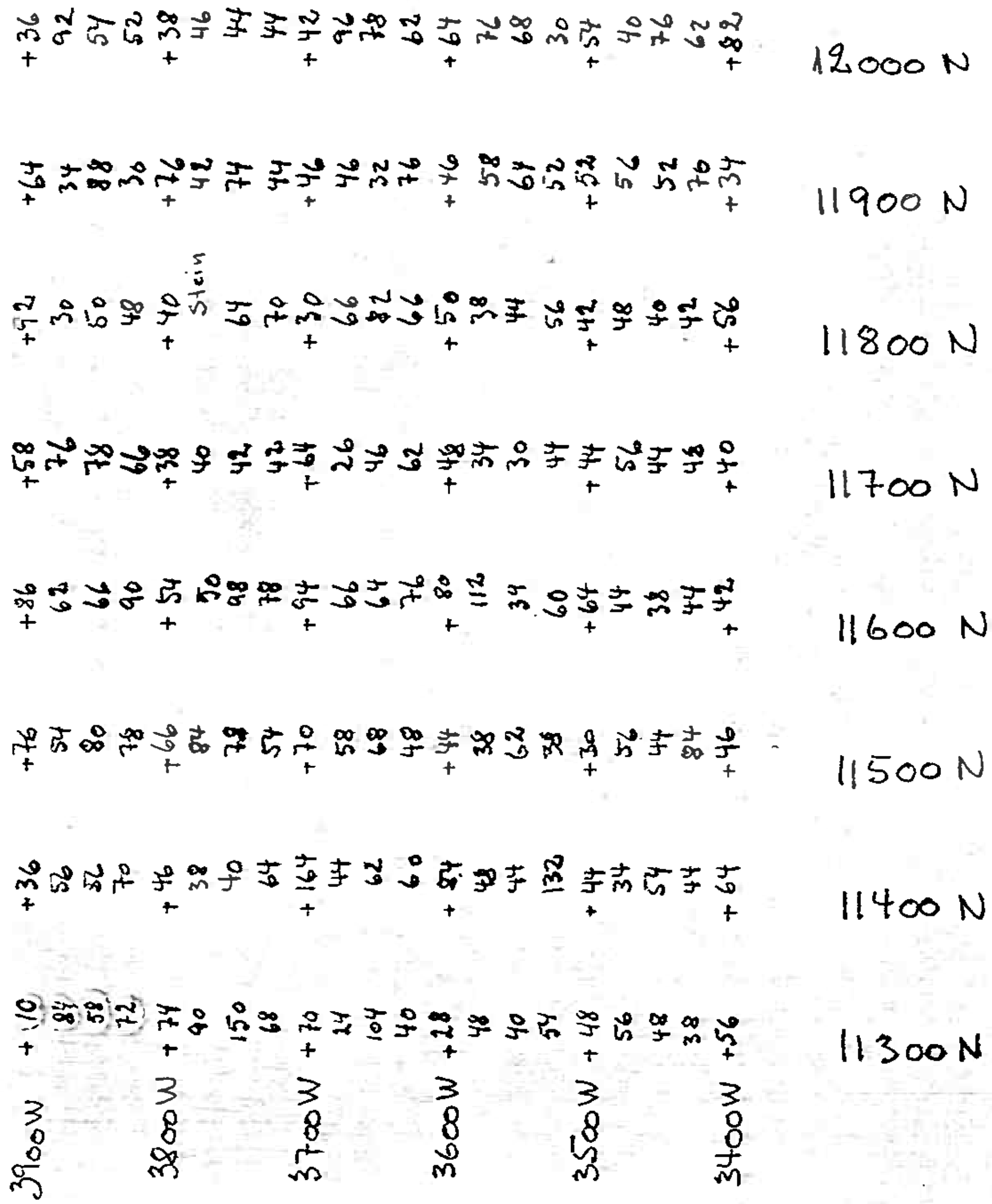
Of these a number of 5175 were picked out and delivered to the Sydvaranger lab. in Kirkenes for assays on Ni, Cr and Cu.

The 5175 samples were picked out from the areas 4, 11, 12, 24, 29, 32, 38.

To date we hace received approx. 1100 assays - but as yet no results of special interest.

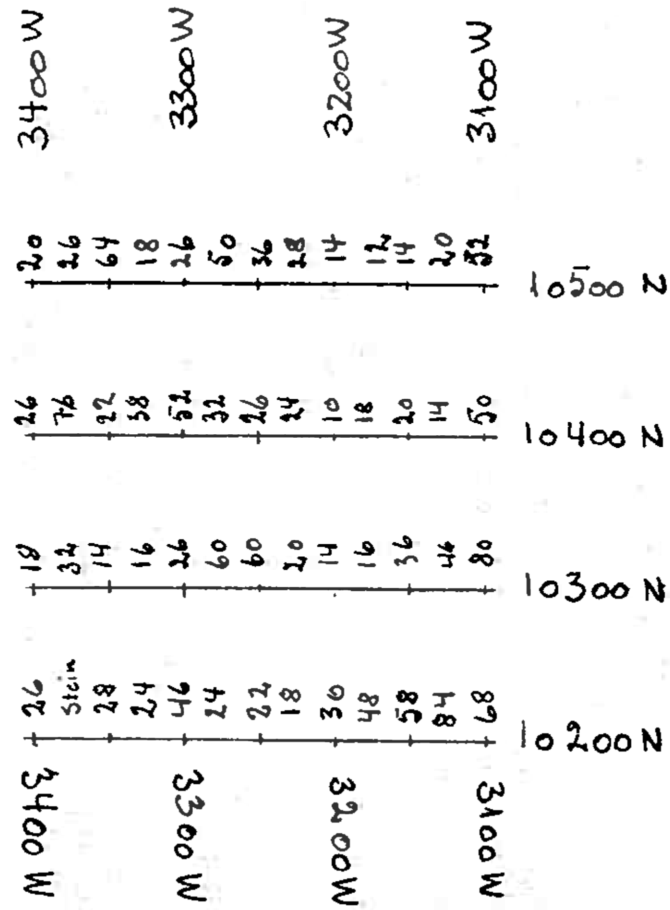
4.A

A/S SULFIDMALM	
GEOCHEMICAL ANALYSES OF DEEP TILL IN BLOCK 15I BASED ON Ni in p.p.m.	
SCALE 1:5000	DRAWN Ø.E.
DATE 12.07.79	TRACED E.N./A.K.



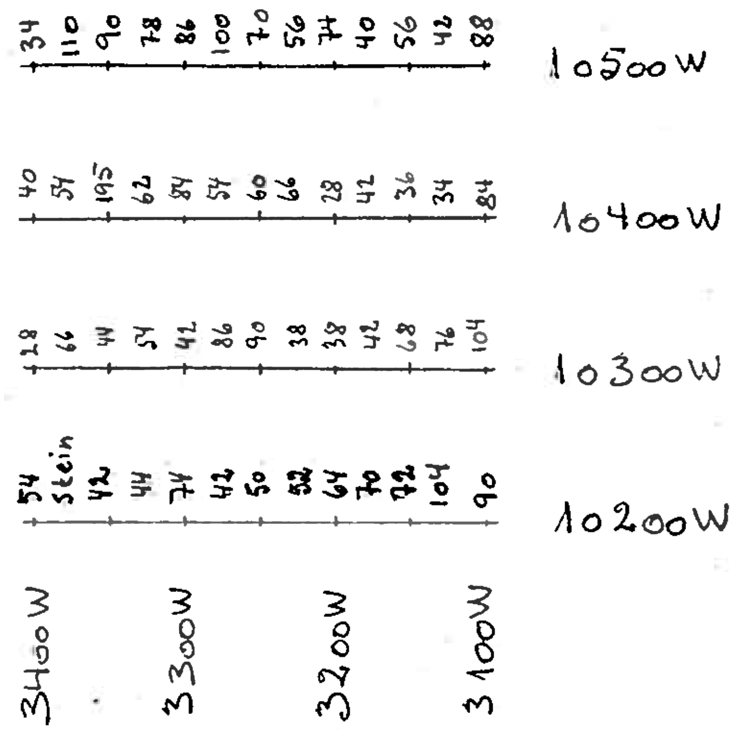
4B

A/S SULFIDMALM	
GEOCHEMICAL ANALYSES OF DEEP TILL I BLOCK 15I BASED ON P.P.M. Cu	
SCALE 1:5000	DRAWN Ø.E.
DATE 18.07.79	TRACED E.N./A.K.



5A

A/S SULFIDMALM	
GEOCHEMICAL ANALYSES OF DEEP TILL IN BLOCK 15II BASED ON ppm Ni	Ni
SCALE 1:5000	DRAWN O.E.
DATE 25.07.79	TRACED A.K./E.M



5 B

A/S SULFIDMALM	
GEOCHEMICAL ANALYSES OF DEEP TILL IN BLOCK 15 II BASED ON ppm Cu	Cu
SCALE 1:5000	DRAWN Ø.E.
DATE 25.07.79	TRACED A.K./E.N

9. DIAMOND DRILLING

To date 15 short drill holes have been drilled during the present investigations in South Pasvik. Table 6 gives a summary of these holes showing locations and depths. 1979 drill logs and sections are enclosed.

Holes SP 01 and SP 02 drilled in 1977 were drilled on a H.E.M. conductor ca. 1.5 km up ice from the Rømlingås boulders. The anomaly was covered by shootback E.M. and mag. A strong shootback anomaly was obtained and drilled. Only weak magnetic response was obtained. The two subsequent drill holes verified pyrrhotite in garnet bearing amphibolite as the source of the E.M. anomalies. No ultrabasic intersections were obtained.

Although no drilling was planned for the 1978 season, the opportunity arose to drill a limited meterage in Pasvik using a machine taken down from Sydvarangers iron-ore operations in Kirkenes.

It was decided to test 3 geophysical anomaly targets in the detailed grid area.

Hole SP 1 was drilled on a magnetic anomaly south of the main boulder finds. It was suspected that the anomaly was caused by an ultramafic. Drilling confirmed this, but no sulphides were found.

Hole SP 2 was put down on a strong shoot-back E.M. and resistivity anomaly just north of the magnetic anomaly drilled by SP 1. The cause of the anomaly was graphite.

Hole SP 3 was drilled on a shootback E.M. anomaly with weak magnetic association up ice from boulder finds. This anomaly was found to be caused by a magnetic bearing graphite horizon.

Although no mineralization was intersected by the three short drillholes, the program did throw some light on the cause of various anomaly types and also gave some interesting intersections of the bedrock of the area, proving the existence of the ultramafic material.

In 1979 the drilling in S. Pasvik was carried out by Bjørkåsen Gruver - a drilling company in the A/S Sydvaranger group.

Mobilization took place in the middle of August with a large Longyear drill machine from Bjørnevann mine and a 4 men crew from Ballangen.

For transport in the field a Timber jack from the State-forest Company was hired with "pilot" on time paying basis.

The drilling operation stopped 1/10 -79 after a season with normal good drilling condition - even if the last ½ month was a bit dry.

A total of 10 holes were drilled (Sp 4 - Sp 13) giving 533.8 m of which 83.6 m were casing drilling.

The overburden had a thickness between 6 m and 13.6 m with a mean depth of 8.4 m.

The entire drill program was situated within area 15 on two separate magnetic bodies.

The drill program was planned concentrated along 3 main profiles to test the magnetic anomaly in size shape and dip.

Vertical holes down to approx. 50 m depth were chosen as most practical in this heavy overburden area.

Drillhole Sp 4-6 was put down on a small but distinct magnetic anomaly in the southern part of the area on profile 10300N. (see section I, enclosure 17).

The drilled SP 4 cut trough s small peridotite in the upper part of the hole - mainly in the casing drilling. Assays from this ran only up to 0.17 Ni and 0.01 Cu.

Drill hole SP 5 and 6 had no intersection with peridotite or similar rocks, but the holes confirmed the general dip of the granitic gneiss and the amphibolites in the area.

The drillholes Sp 6,7,8,9,10,11 were put down on profile 11400N to test shape and internal variation of an expected peridotite (see section II, enclosure 18).

The magnetic anomaly was caused by a differentiated pyroxenite-peridotite with the peridotite- mainly in the lower part. Banding due to different grainsize and dark minerals was visible in the core. Nc sulphides were seen except some few scattered cpy grains in Sp 9 and the assays showed only up to 0.19% Ni and 0.01% Cu.

From the section we can see that the dip of the ultrabasic complex flattens out westwards but follows the observed core angle - and shows no sign of cross cutting.

An extra drillhole Sp 12 was put out approx. 100 m south of the profile to test the variation along "strike" (see section III, enclosure 19).

As seen from the profile - we have the same strong variation in the peridotite-pyroxenite relation.

Sp 12 is more similar to Sp 7.

The last drill hole Sp 13 was expected as the first hole in a drilled profile along 11800N but for several reasons - the drill program ended after this hole, (section IV, enclosure 20).

This section shows as irregular distribution of peridotite/pyroxenite, possibly due to (magmatic) layering and folding.

CONCLUSIONS DRAWN FROM DRILLING 1979

1. The strong magnetic anomalies are caused by a series of peridotite/pyroxenite rocks. Weaker magnetic seem due to amphibolites. (Sp 4-5).

2. The ultrabasic rocks are conformable to the general strike and dip.

3. The ultrabasic rocks are differentiated in pyroxenite and peridotite varieties and show traces of layering in some of the sections.

4. Sulphides are only observed as few small cpy grains in peridotite and do not influence the assays (0.01 - 0.03% Cu).

5. Graphitic rocks are only reported in Sp 4 in the footwall of the small peridotites as a very thin paper.

6. Both the hanging and footwall rocks to the ultrabasics are mica bearing granitic gneiss not so different to the rock in the cpy block 78EK77.

   Granitic rocks are rare and only intersected in Sp 11. A slight tendence to augengneiss towards west may indicate thrust movement.

TABLE 6

OVERSIKT OVER BORINGER I S. PASVIK

Year	No	Coordinates		Casing	Tot. depth
1977	SP 01	10740 N	5930 W	12,0 m	50,0 m
	SP 02	10550 N	5850 W	no data	37,0 m
1978	SP 1	12000 N	5250 W	7,3 m	38,0 m
	SP 2	12060 N	5080 W	10,0 m	47,65 m
	SP 3	10500 N	5960 W	17,5 m	50,2 m
	SP 4	10300 N	3190 W	6,0 m	55,3 m
	SP 5	"	3250 W	11,9 m	51,3 m
	SP 6	"	3150 W	7,5 m	50,0 m
	SP 7	11400 N	3550 W	7,5 m	50,0 m
1979	SP 8	"	3500 W	7,5 m	50,0 m
	SP 9	"	3600 W	7,9 m	53,2 m
	SP 10	"	3650 W	8,2 m	57,0 m
	SP 11	"	3700 W	5,8 m	60,0 m
	SP 12	11300 N	3615 W	7,7 m	46,0 m
	SP 13	11800 N	3590 W	13,6 m	61,0 m
	1979 Drilled total		4 - 12	83,6 m	533,8 m

FIG. 6

FIG 6.


12000
11800
11600
11500
11100
11000
10800
10400
10200
10000
SULFIDMALM
DRILL HOLE
Ni RICH BOULDER

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 10300N-3190W BEARING: DIP: 90° HOLE NO: SP-4 SHEET NO: 1
LOGGED BY: C. Coates STARTED: 8-79 PROPERTY Blankvann S. Pasvik, Finnmark
CASING: FINISHED:
CORE SIZE: 35 mm TESTS (CORRECTED):

From	To		Description
0	6.0		OVERBURDEN
6.0	22.6		AMPHIBOLITE Dark green, fine to medium grained, well foliated amphibole rich rock with approx. 20% feldspar plus garnets. Essentially non-magnetic except for some narrow interbeds of Po + magnetite bearing biotite-feldspar gneiss. Amphibolite is banded with fine lamellae of more feldspatic feldspar-amphibole rock. 6.0 - 6.3 Chlorite-amphibole rock. May be chlorite-tremolite ultramafic contact zone? Magnetic. 6.4 - 9.5 Sulfide mineralization. Dark grey biotite feldspar gneiss with 10-15 % Po + some py. Augens of white feldspar in some sections.
22.2	40.7		AMPHIBOLE GNEISS Dark grey to greenish, medium grained biotite-amphibole feldapar gneiss. Magnetite content variable - so magnetic in patches. Pink to white cg. pegmatite at intervals. 24.2 - 24.7 Pegmatite, white cg. with ~~vulcanic~~ inclusion amph. gneis 25.5 - 29.7 Pegmatite, white ot pinkish-white, coarse grained with diffuse patches of green amphibole crystals. 36.5 - 37.2 Shear zone - chloritic and broken up 0.3 m of core lost.
40.7	55.3		GRANITE GNEISS Grey coloured biotite-quartz-feldspar gneiss, well foliated and occasionally distinctly banded. Non-magnetic. Minor narrow pegmatites.
55.3			END OF HOLE (Casing left in hole)

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 10300N - 3190W BEARING: DIP: 90° HOLE NO: SP-4 SHEET NO: 2

LOGGED BY: C. Coats STARTED: PROPERTY Blankvann

CASING: FINISHED: S. Pasvik Finnmark

CORE SIZE: 35 mm TESTS (CORRECTED):

From	To		Description
			Foliation angles
			7 m - 50°
			10 m - 70°
			12 60°
			14 - 75°
			16 - 77°
			18 - 73°
			20 - 75°
			22 - 60°
			24 - 60°
			25 - 65°
			30 - 60°
			32 - 70°
			34 - 75°
			36 - 75°
			38 - 60°
			40 - 85°
			42 - 77°
			44 - 76°
			46 - 60°
			46
			50 - 64°
			53 - 76°
			55 - 75°

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 10300N - 3250W BEARING: DIP: 90° HOLE NO: SP-5 SHEET NO: 1
LOGGED BY: C. Coats STARTED: PROPERTY Blankvann
CASING: FINISHED: 8-79 S. Pasvik Finnmark
CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	11.9		OVERBURDEN
11.9	41.9		AMPHIBOLITE
			Dark green, fine to medium grained, foliated amphibole-rich rock with approx. 30% feldspar and some biotite. Small garnets ubiquitous, each with white depletion halo Foliation distinct but banding poorly developed. Occasional ~~their~~ thin lamellae of more feldspathic material. Only faintly magnetic in part few fractures.
			Pale green clinopyroxene plus garnet in some lamellae? ~~THis may indicate grade of metamorphism near pyroxene~~ granulite facies.
			26.0 - 29.4 Sulfide mineralization approx. 5% Po+Py Graphite in some sections. Highly magnetic Rock more schistose and biotite rich with some streaky feldspar augens. Unit would appear to an interbedded sediment to the amphibolite. Probably conductive.
			31.2 - 31.4 Amphibole pegmatite. Coarse gr. veinlike. Adjacent narrow magnetic zone.
			35.0 - 41.9 Amphibolite with scattered narrow zones (up to few cms.) of highly magnetic, finely laminated biotite-amphibole rock. These are a generally more siliceous than amphibolite.
41.9	51.3		AMPHIBOLE GNEISS
			Dark green to grey, irregularly banded and well foliated biotite-hordblende feldspar gneiss. Magnetic in their sections but generally non-magnetic. Medium grained and generally coarser than the amphibolite above. Abundant narrow cg. white to pink pegmatite veins.
			51 - 51.3 Amphibole biotite schist. Sheared material.
51.3			END OF HOLE
			(casing left in hole)

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 10300N - 3250W BEARING: DIP: 90° HOLE NO: SP-5 SHEET NO: 2
LOGGED BY: C. Coats STARTED: PROPERTY Blankvann
CASING: FINISHED: 8-79 S. Pasvik Finnmark
CORE SIZE: TESTS (CORRECTED):

From	To		Description
			Foliation angles
			12 m - 80° 32 - 80°
			14 - 60° 34 - 85°
			16 - 80° 36 - 85°
			18 - 85° 38 - 85°
			20 - 85° 41 - 85°
			22 - 80° 45 - 90°
			24 - 85° 48 - 75°
			26 - 60° 50 - 60°
			28 - 80° 51 - 55°
			30 - 80°
			(det er mulig at noen av 80-tallene egentlig skal være 6-taller, AB)

A/S SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 10300N - 3150W BEARING: DIP: 90° HOLE NO: SP-6 SHEET NO: 1

LOGGED BY: C. Coats STARTED: PROPERTY Blankvann

CASING: FINISHED: 8 - 79 S. Pasvik Finnmark

CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	7.5		OVERBURDEN
7.5	27.1		PLAGIOCLASE AMPHIBOLITE Dark greenish grey, well foliated feldspar-amphibole rock. Minor compositional banding, with some bands of leucocratic gneiss and amphibole-biotite rock. Magnetite content variable - distinctly magnetic in part (7.5-7.9) Narrow white pegmatite dykes. 8.95 - 9.5 Pegmatite 11.4 -14.6 Pegmatite, white to greenish grey and pink. Foliation evident in part, so may include bands of white quartz-feldspar gneiss. IN-cluded seams amphibolite. 17.5 - 20.0 Core highly fractured and broken up. 19.0 - 19.5 Pegmatite. 20.2 - 20.9 Pegmatite stringers in amphibolite.
27.1	50.0		GRANITE GNEISS Light grey to grey-pink leucocratic gneiss, with distinct foliation and only poorly developed banding, composed of quartz, feldspar and biotite (∓ amphibole?). Non-magnetic. Medium grained granular texture with preferred orientation of biotite. Narrow stringers of white or pink cg.pegmatite.
50.0			END OF HOLE (casing left in hole)

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 10300N - 3150W BEARING: DIP: 90° HOLE NO: SP-6 SHEET NO: 2

LOGGED BY: STARTED: PROPERTY Blankvann

CASING: FINISHED: 8 -79 S. Pasvik Finnamrk

CORE SIZE: TESTS (CORRECTED):

From	To		Description
			Foliation angles
			8 - 70° 32 - 80°
			10 - 65° 35 - 80°
			12 - 65° 37 - 76°
			15 - 70° 40 - 75°
			17 - 74° 42 - 70°
			19 - 70° 44 - 70°
			20 - 70° 46 - 70°
			22 - 70° 47 - 70°
			24 - 70° 50 - 70°
			26 - 72°
			28 - 76°
			30 - 75°

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N-3550W BEARING: .... DIP: 90° HOLE NO: SP-7 SHEET NO: 1

LOGGED BY: .... STARTED: .... PROPERTY Blankvann

CASING: .... FINISHED: 9-79 S. Pasvik Finnmark

CORE SIZE: .... TESTS (CORRECTED): ....

From	To		Description
0	7.5		OVERBURDEN
7.5	24.9		PERIDOTITE
			Dark green, massive ultramafic rock with various textural and compositional features. Highly magnetic throughout.
			7.5 - 8.9 Peridotite with high amphibole content (amph. perid.
			8.9 - 10.2 Tremolite-chlorite (phlopogite?) zone. Dark grey. Some shearing and broken core.
			10.2 - 14 Serpentinized peridotite with considerable amphibole development (often pyroxene). Probably tremolite + chlorite. Dark green, granular texture (primary magmatic)
			14 - 15.4 Sheared and altered section of tremolite + chlorite. Vein of extremely coarse pyroxene (amphibole?) which is fractured with stringers of saporite & minor grains cpy. Small (2-3 cms) vein of quartz with Po grains.
			15.4 -22.3 Serpentinized peridotite, granular texture. Pyroxene cleavages visible with replacement by some amphibole magnetite-rich areas indicative of olivine locations.
			22.3 -23.4 Amphibole-chlorite zone, fine grained. Core broken.
			23.4 -24.9 Serpentinized peridotite. Some alignment of magnetite streaks. Contact sharp and relative unaltered. Increase in tremolite content for 0.2 m.
			No sulphide mineralization in peridotite unit!
24.9	50.0		GRANITE GNEISS
			White to light grey leucocratic biotite quartz feldspar gneiss. Well foliated and gneissic texture. Non magnetic.
			37.2 - 38.0 Amphibolite. Dark green band of beat-amphl. feldrock.
			45.0 -45.7 Pegmatite. Highly fractured with development of a 0.1 m biotite seam. Lost core.
			48.0 -48.3 Lost core (?)
			48.5 -48.6 Amphibolite band
50	End of hol		

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3550W BEARING: .... DIP: 90° HOLE NO: SP-7 SHEET NO: 7

LOGGED BY: C. Coats STARTED: .... PROPERTY Blankvann

CASING: .... FINISHED: 9-79 S.Pasvik Finnmark

CORE SIZE: .... TESTS (CORRECTED): ....

From	To		Description
			Foliation angles
			26m - 80°
			28 - 80°
			30 - 75°
			32 - 80°
			34 - 70°
			36 - 60°
			36 - 60°
			40 - 65°
			42 - 55°
			44 - 60°
			46 - 50°
			48 - 65°
			50 - 70°

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3500W BEARING: DIP: 90° HOLE NO: SP-8 SHEET NO: 1
LOGGED BY: C. Coats STARTED: PROPERTY Blankvann
CASING: FINISHED: 9-79 S. Pasvik
CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	7.5		OVERBURDEN
7.5	50		GRANITE GNEISS
			Light grey, foliated and diffusely banded biotite granite gneiss. Principal minerals quartz & feldspar. Nonmagn. Included narrow zones of amphibolite.
			7.4 - 8.3 Amphibolite. Dark green, foliated
			16.0 -16.6 Amphibolite. Shear zone of biotite-chlorite at 16.6. m
			23.2 -23.6 Lost core. Rock locally fractured.
			24.0 -25.0 Lost core.
			27.2 -27.3 Amphibolite band.
			31.6 - 31.8
			32.6 - 34 Lost core (Probably soft amphibolite band)
			34.9 - 35.7 Amphibolite with narrow white pegmatite veins
			46.8 - 47.2 Amphibolite
50.0			END OF HOLE

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3500W BEARING: DIP: 90° HOLE NO: SP-8 SHEET NO: 2
LOGGED BY: C. Coats STARTED: PROPERTY Blankvann
CASING: FINISHED: S. Pasvik
CORE SIZE: TESTS (CORRECTED):

From	To		Description
			Foliation angles
			7 - 67° 32 - 70°
			9 - 70° 35 - 47°
			11 - 74° 39 - 70°
			15 - 60° 41 - 65°
			17 - 60° 43 - 70°
			19 - 65° 46 - 60°
			21 - 67° 48 - 60°
			23 - 70° 50 - 65°
			26 - 75°
			28 - 65°
			30 - 75°

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3600W BEARING: DIP: 90° HOLE NO: SP-9 SHEET NO: 1

LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann

CASING: FINISHED: 9 - 79 S. Pasvik

CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	7,90		OVERBURDEN
7,90	13,50		White homogene quartz feldspar gneiss with some scattered biotite flakes.
13.50	43.70		Metapyroxenite weak - strong magnetic more chlorite at 13.50 - 14.50 no visible sulfides
43.70	47.40		Metaperidotite, strong magnetic few cpy grains between 46.50 - 46.85
47.40	53.20		White quartz feldspar gneiss as on top
53.20			END OF HOLE
			Core angles
			9 m - 90°
			13.50 - 85°
			49.00 - 75°
			50.00 - 75°

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3650W BEARING: DIP: 90° HOLE NO: SP-10 SHEET NO: 1
LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann
CASING: FINISHED: 9 - 79 S. Pasvik
CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	8.20		OVERBURDEN
8.20	11.10		White quartz-feldspar gneiss with some biotite
11.10	13.25		Dark hornblende gneiss with few red augens.
13.25	19.65		White-grey biotite gneiss with few red augens.
19.65	20.30		Green hordblende gneiss with some white gneiss bands unmagnetic.
20,30	20.95		Grey-white banded biotite gneiss
20.95	22.20		White homogen gneiss
22.20	26.45		Grey-white banded biotite gneiss
26.45	26.95	·	Dark hordblende gneiss un-magnetic (some pyroxene?)
26.95	27.50		Light grey banded biotite gneiss
27.50	28.65		Dark hornblende gneiss (some pyroxene) unmagnetic
28.65	30.00		White homogen gneiss with few biotite grains
30.0	34.30		Light grey banded biotite gneiss
34.30	34.50		Crosscutting quartz vein
34.50	39.30		Metapyroxenite with some talc-serp. bands. Low-unmagnetic Quartzpegmatite at 35.10 - 35.60
39.30	46.20		Bluish dark massive metaperidotite, increasing magnetic to 40.00, then strong magnetic.

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3650W BEARING: ______ DIP: 90° HOLE NO: SP-10 SHEET NO: 2

LOGGED BY: B. Lieungh STARTED: ______ PROPERTY Blankvann

CASING: ______ FINISHED: 9 - 79 S. Pasvik

CORE SIZE: ______ TESTS (CORRECTED): ______

From	To		Description
46.20	48.50		Grey-grenn metapyroxenite, distinct lighter coloured than metaperidotite. Low magnetic.
48.50	50.20		White-grey weak banded gneiss with few biotite grains.
50.20	50.40		Dark hordblende gneiss with some biotite (?)
50.40	52.20		White-grey banded biotite gneiss
52.20	52.65		Very dark hornblende gneiss (some pyroxene?)
52.65	57.00		White-grey massive gneiss with some biotite
57.00			End of hole
			Core angles
			11.00 - 75°
			13.10 - 78°
			14.00 - 78°
			18.00 - 65°
			20.30 - 65°
			26.20 - 62°
			33.70 - 70°
			(34.30 - 50° Crosscutting quartz vein)
			49.00 - 60°
			49.70 - 78°
			51.00 - 85°
			57.00 - 85°
			mean foliation approx. 73° (read core angle)

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3700W BEARING: DIP: 90° HOLE NO: SP 11 SHEET NO: 1

LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann

CASING: FINISHED: 9 - 79 S. Pasvik

CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	5.80		Overburden
5.80	18.60		Grey-white banded biotite gneiss
18.60	20.15		Grey-red granite - partly foliated, with red feldspar
			some pockets with small clear quartz crystals
20.15	23.60		Foliated granitic gneiss
23.60	28.60		Amphibole gneiss, partly amphibolite with distinct bandin[g]
			unmagnetic pure gneiss at 13.90 - 14.05
			14.60 - 15.00
			15.55 - 15.65
28.60	32.60		Light grey biotite bearing gneiss, the upper part (30 cms)
			with red feldspar.
32.60	32.80		Dark amphibole gneiss (some pyroxene?)
32.80	37.55		Grey weakly foliated gneiss
37.55	38.15		Dark amphibole gneiss (some pyroxene?)
38.15	46.90		White granitic gneiss with weak banding
			small aggregates of amphibole-garnet between 45-46 m.
46.90	47.30		Talc-serpentine, light grey with long fibres, unmagnetic
			very soft rock
47.30	47.70		Peridotite (?) dark massive weak-distinct magnetic rock
			relict layering paralell to core at 47.40
47.70	48.10		Ultrabasic breccia
48.10	50.30		Talc-serpentine rock

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11400N - 3700W BEARING: DIP: 90° HOLE NO: SP 11 SHEET NO: 2

LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann

CASING: FINISHED: 9 - 79 S. Pasvik

CORE SIZE: TESTS (CORRECTED):

From	To		Description
50.30	51.90		Grey Gneiss
51.90	52.05		Amphibole gneiss - amphibolite
52.05	60.00		Grey-white gneiss, mainly quartz feldspar gneiss with biot biotitebands.
60.0			End of hole
			Core angle
			6.75 - 60°
			10.00 - 70°
			12.00 - 68°
			16.00 - 75°
			20.40 - 85°
			23.60 - 72°
			28.00 - 80o
			28.60 - 72°
			30.00 - 80o
			36.50 - 90°
			45.00 - 90°
			50.30 - 80° rock contact
			55.00 - 70o
			59.30 - 65o
			60.00 - 80°
			mean foliation value 76°

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11300N - 3615W BEARING: DIP: 90° HOLE NO: SP 12 SHEET NO: 1

LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann S. Pasvik

CASING: FINISHED:

CORE SIZE: TESTS (CORRECTED):

From	To		Description
0	7.70		OVerburden
7.70	14.95		White-grey gneiss with weak banding of biotite
14.95	19.00		Pyroxenite
			Strong - medium magnetic
19.00	22.80		Green-grey metapyroxenite with transition to meta-
			peridotite from 22.00 - 22.80. Magnetic.
22.80	25.20		Feldspar - pegmatite crosscutting the ultrabasic rocks
			core angle upper contact 45°
			- " - lower - " - 20°
			cpy-~~fish~~ blet approx. 2x2x3 cm in the pegm. at 23.10
25.20	27.60		Talc-serpentine-amphibole rock
27.60	29.35		Coarse grained bluish metaperidotite. High magnetic
			contact to talcserp. rock above 30°.
29.35	30.05		Talc serpentine rock weak magnetic
30.05	31.50		Dark peridotite medium magnetic
31.50	32.70		Weak magnetic meta pyroxenite
			core loss at 32.30 - 32,40
32.70	32.90		Hornblende gneiss unmagnetic
			contact against lower gneiss = 80°
32.90	46.00		White-light grey granitic gneiss with weak biotite bands
			Amphibole gneiss at 37.75 - 37.90
			Core loss at 39.35 - 39.50
	46.00		End of hole

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11300N - 3615W BEARING: DIP: 90° HOLE NO: SP-12 SHEET NO: 2

LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann

CASING: FINISHED: 9-79 S. Pasvik

CORE SIZE: TESTS (CORRECTED):

From	To		Description
			Core angles
			10.00 - 90°
			14.00 - 85
			22.80 - 45 Crosscutting pegmatite
			25.20 - 20 - " -
			27.60 - 30 Pyroxenite-peridotite contact
			32.90 - 80 Hornblende gneiss - gneiss contact
			34.00 - 80
			40.00 - 85
			44.00 - 65
			46.00 - 85

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11800N - 3590W BEARING: DIP: 90° HOLE NO: SP 13 SHEET NO: 1

LOGGED BY: B. Lieungh STARTED: PROPERTY Blankvann

CASING: FINISHED: 9 - 79 S. Pasvik

CORE SIZE: TESTS (CORRECTED):

From	To	Description
0	13.60	Overburden
13.60	16.60	Metaperidotite, dark bluish, coarse grained, strong magnetic
16.60	16.80	Core loss
16.80	17.50	Metapyroxenite, greenish-grey fine grained
17.50	17.70	Fine-medium grained peridotite
17.70	25.00	Coarse grained metaperidotite. Increasing grainsize and bluish colour downwards.
25.00	26.10	Medium coarse grained metaperidotite
26.10	27.15	Medium grained meta peridotite
27.15	30.90	Fine grained peridotite, more fine grained towards bottom
30.90	32.75	Feldspar-pegmatite and breccia upper contact approx.10°
32.75	35.50	Fine grained metapyroxenite with gradual coarser grain towards 35.50
35.50	42.80	Medium grained metapyroxenite
42.80	44.60	Metaperidotite Between 42.80 - 42.90 a transition from pyrox.-peridotite
44.60		A sharp contact to the lower fine grained pyroxenite contact angle approx. 25°.

A/s SULFIDMALM

DIAMOND DRILL RECORD

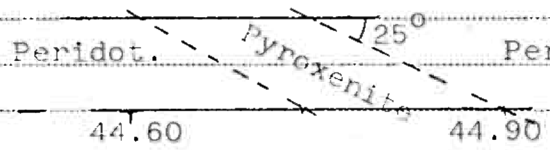
LOCATION: 11800N-3590W BEARING: DIP: 90° HOLE NO: SP 13 SHEET NO: 2

LOGGED BY: ~~B. Lieungh~~ STARTED: PROPERTY Blankvann

CASING: FINISHED: 9 - 79 S. Pasvik

CORE SIZE: TESTS (CORRECTED):

From	To		Description
44.60	44.90		Fine grained pyroxenite. approx. 10 cms thick



From	To		Description
44.90	46.50		Coarse grained dark metaperidotite
46.50	46.90		Metaperidotite with decreasing grainsize, colour change from bluish-greenish green at 46.90.
46.90	47.00		Same transition rock but reversed
47.00	48.00		Metaperidotite, bluish.
48.00	48.90		Transistion from bluish metaperidotite - greenish pyrox.
48.90	49.95		Grey-white massive gneiss.
49.95	50.40		Amphibolite
50.40	50.70		Grey-white massive gneiss
50.70	51.30		Medium-coarse grained amphibole with fine grained borders of both sides. Diabase dyke?
51.30	56.60		Partly brecciated grey-redish granitic gneiss.
56.60	58.40		Brecciated amphibolite
58.40	60.0		Grey gneiss
60.0	60.25		Amphibolite

A/s SULFIDMALM

DIAMOND DRILL RECORD

LOCATION: 11800N - 3590W BEARING: .... DIP: 90° HOLE NO: SP 13 SHEET NO: 3
LOGGED BY: B. Lieungh STARTED: .... PROPERTY Blankvann
CASING: .... FINISHED: .... S. Pasvik
CORE SIZE: .... TESTS (CORRECTED): ....

From	To		Description
60.25	60.55		White granitic gneiss
60.55	61.00		Brecciated amphibolite
61.00			End of hole
			Core angles
			30.90 - 10° Pegmatite crosscutting (?) peridotite
			44.60 - 25° Contact between upper peridotite and lower finegrained pyroxenite, sharp contact

AKTIESELSKABET SYDVARANGER
LABORATORIET

Kirkenes, 14.01. 80

Analysebevis

Analyse av borkjerneprøver fra Pasvik 1979.

Prøvene er totaloppsluttet i HCl, HNO_3 og HF, og analysert på AAS.

Borhull nr.	boremeter	% Ni	% Cu
Sp 7	7,5- 8	0,15	
	8 - 9	0,15	
	9 - 10	0,13	0,01
	10 - 11	0,15	0,01
	11 - 12	0,15	0,01
	12 - 13	0,15	0,01
	13 - 14	0,15	
	14 - 15	0,08	0,02
	15 - 16	0,13	0,01
	16 - 17	0,12	0,01
	17 - 18	0,12	0,01
	18 - 19	0,11	0,01
	19 - 20	0,12	0,02
	20 - 21	0,11	0,02
	21 - 22	0,11	
	22 - 23	0,11	0,01
	23 - 24	0,11	0,01
	24 - 25	0,11	
Sp 9	13,5- 14	0,09	0,02
	14 - 15	0,08	0,01
	15 - 16	0,14	0,02
	16 - 17	0,14	0,02
	17 - 18	0,14	
	18 - 19	0,14	

Borhull nr.	boremeter	% Ni	% Cu
Sp 9	19 - 20	0,17	0,01
	20 - 21	0,18	0,01
	21 - 22	0,16	
	22 - 23	0,17	
	23 -24	0,17	
	24 - 25	0,17	
	25 - 26	0,19	0,01
	26 - 27	0,18	
	27 - 28	0,18	0,01
	28 - 29	0,17	0,01
	29 - 30	0,17	0,01
	30 - 31	0,17	
	31 - 32	0,15	
	32 - 33	0,17	
	33 - 34	0,17	
	34 - 35	0,17	
	35 - 36	0,15	
	36 - 37	0,14	0,01
	37 - 38	0,14	0,01
	38 - 39	0,14	0,02
	39 - 40	0,14	0,02
	40 - 41	0,11	0,01
	41 - 42	0,09	0,02
	42 - 43	0,11	
	43- - 44	0,10	0,02
	44 - 45	0,10	
	45 - 46	0,10	0,01
	46 - 47	0,13	
	47 - 47,5	0,06	
Sp 12	15 - 16	0,14	
	16 - 17	0,13	
	17 -- 18	0,14	0,01
	18 - 19	0,13	0,01
	19 - 20	0,13	0,01
	20 - 21	0,08	
	21 -22	0,14	0,01
	22 - 23	0,11	0,01
	23 - 23,5	0,03	
	25 - 26	0,12	0,01

Borhull nr.	boremeter	% Ni	% Cu
Sp 12	26 - 27	0,15	0,01
	27 - 28	0,14	
	28 - 29	0,15	
	29 - 30	0,12	
	30 - 31	0,13	
	31 - 32	0,10	0,01

Verdier < 0,01 % er ikke tatt med på analysebeviset.

Grete Hofseth

Grete Hofseth

Torbjørn Nilsen

Torbjørn Nilsen

AKTIESELSKABET SYDVARANGER

LABORATORIET

Kirkenes, 25.09. 1979

Analysebevis

(Gjenpart)

Analyse av 2 borkjerneprøver fra Pasvik

Prøvene er sendt av Geolog Lieung, A/S Sulfidmalm og ankom lab. 21.09. 1979.

De er analysert på Cu og Ni med AAS.

Prøvemrk.	% Cu	% Ni
SP 1 SP.9.	< 0,01	0,11
SP 2 SP9.	0,03	0,14

Grete Hofseth

Torbjørn Nilsen

4000 11-78 221 PS A4

AKTIESELSKABET SYDVARANGER
LABORATORIET

Kirkenes, 22. august 1979.

Analysebevis
(Gjenpart)

Borkjerne fra Pasvik.

Mottatt fra Bjarne Lieungh 20/8 1979.

Prøve mrk.		% Ni	% Cu	
DB 4-79	A	0,15	0,02	enkelt stykke
DB 4-79	B	0,17	0,01	casing boring ca 5,5m

gh
Grete Hofseth

GRAB SAMPLES OF ULTRAMAFIC FROM CASING.

4000 11-78 221 I S A4

10. SUMMARY OF GENERAL CONCLUSIONS

At this stage in the exploration in South Pasvik, many questions remain unanswered. However, it is now possible to summarize the known facts and from these determine the best approach to the next stages of exploration.

1 In terms of regional geology we are located in a complexly folded and high grade metamorphic area of Archaen terrain. Rock types recognized include granitic gneisses, mica schists, amphibolites, graphite zones and pyrrhotite rich garnet amphibolites. The area is contiguous with similar geology to the east in the USSR and to the west in Finland. In the USSR at Allarochensk (some 40 km from our area) ultramafic rocks occur with some associated nickel sulphide mineralization and are at present being mined.

2 The Pasvik boulder suite can be subdivided petrographically and chemically into the following groups.
1. Peridotites, 1A Serpentinites, 2. Amphibole pyroxenites, 3. Olivine gabbros, 4. Amphibolites, 5. others. The boulders that contain significant nickel sulphides belong to the peridotite group (essentially harzburgites)

From the chemistry, petrology and intermixing of boulders, the peridotites and orthopyroxenites are considered to represent parts of a differentiated ultramafic source or number of sources. Such a body was probably intruded as a sill or extruded as a thick ultramafic flow to allow in situ differentiation and the accumulation of a sulphide phase in the peridotite. Envisaging this environment prior to metamorphism and deformation it is more than probable that a number of sills could be intruded at about the same horizon. Subsequent folding and deformation will have disjointed the original source body.

3 An interpretation of ground physics (V.L.F. and mag.) together with mapping of the few outcrops and the results of limited diamond drilling suggest that in the area of interest a zone of ultramafic bodies occur over a distance of some 10 km associated with biotite granitic gneisses, mica schists and amphibolites of the so-called "Gjøkvann Zone" Mapping suggests that this zone may extend a further 10 km to the north.

The majority of the peridotite boulders - including the ores bearing significant sulphide mineralization - are located near to or in association with this zone, as are peridotite/serpentinite outcrops and peridotite/pyroxenite intersections in drill holes. Otherwise in the area peridotite and pyroxenite boulders occur more sporadically.

4 It is now felt that magnetic surveys outline the ultramafic bodies. On first impression these seem to be small in size and isolated but detailed magnetic interpretation suggest that the anomalies represent broken up (faulted-boudinaged) fragments of larger bodies and have thus more continuity. Drilling of a profile near Blankvann has also indicated the ultramafics to have down dip extensions.

The various conductive methods employed have so far given only very limited correlation with magnetic anomalies and pure E.M. anomalies drilled so far have been caused by graphite and/or pyrrhotite. It must be remembered however that the metamorphism of this area (probably upper amphibolite) would be sufficiently great to cause sulphide mineralization into wall rocks or pressure shadow zones in adjacent folds etc. As such massive sulphides may occur in place, but which have not survived boulder transport. E.M. surveys may eventually detect these but geophysically the priority of exploration must remain with magnetic surveys to detect source ultramafic bodies, and magnetic anomalies with co-incident or adjacent E.M. are considered prime targets.

5 To date results of geochemical investigations - deep and shallow till sampling - have not proved conclusive. Many samples have still to be assayed and no attempt will be made here to comment in depth on the present results.

6 The main ice movement direction has been proven by striations to be roughly SW— NE 25°-35°. Studies of till fabric and distribution of De Geer moraines have shown that during the later stages of deglaciation in association with calving at the ice front the ice has moved in different directions. Near the Rømlingås boulders movement almost due east has been suggested whilst near the Blankvann boulders ice movement towards NW is indicated.

Such a variation of ice movement is no doubt of importance when considering boulder transport in this region and three possibilities at the present time suggest themselves.

1) Transport with the main older ice-movement direction i.e. 25-35°.

2) Transport with younger movement i.e. as indicated by fabric and at right angles to the De Geer moraines.

3) A combination of 1 and 2.

As regards length of transport we have few hard facts. However the unanimous expert opinion is that the boulders have not been transported far. Indications for this assumption are: - the relative large size of the boulders - the fact that most are not unduly weathered - their distribution at Rømlingås as a school of boulders, and the lack of boulders to the south of the Rømlingås area where a marked break of slope south of Tomamoen has resulted in a dumping of boulders from the ice moving N.E. The fact that no nickel boulders have been found in this "boulder dump" leads the Quaternary experts to indicate a source to the north of this topographic feature.

7 Based on the above facts it is concluded that the zone of magnetic anomalies and associated E.M. anomalies outlined in association with the Gjøkvann zone is the best target both for finding the source of the nickel boulders and also for similar types of blind mineralization.
A combination of geophysical and quarternary indications suggest the Bjørntjern area as the 1st priority target. An extensive drill program to test this and other targets has been planned as outlined below.

RECOMMENDATIONS

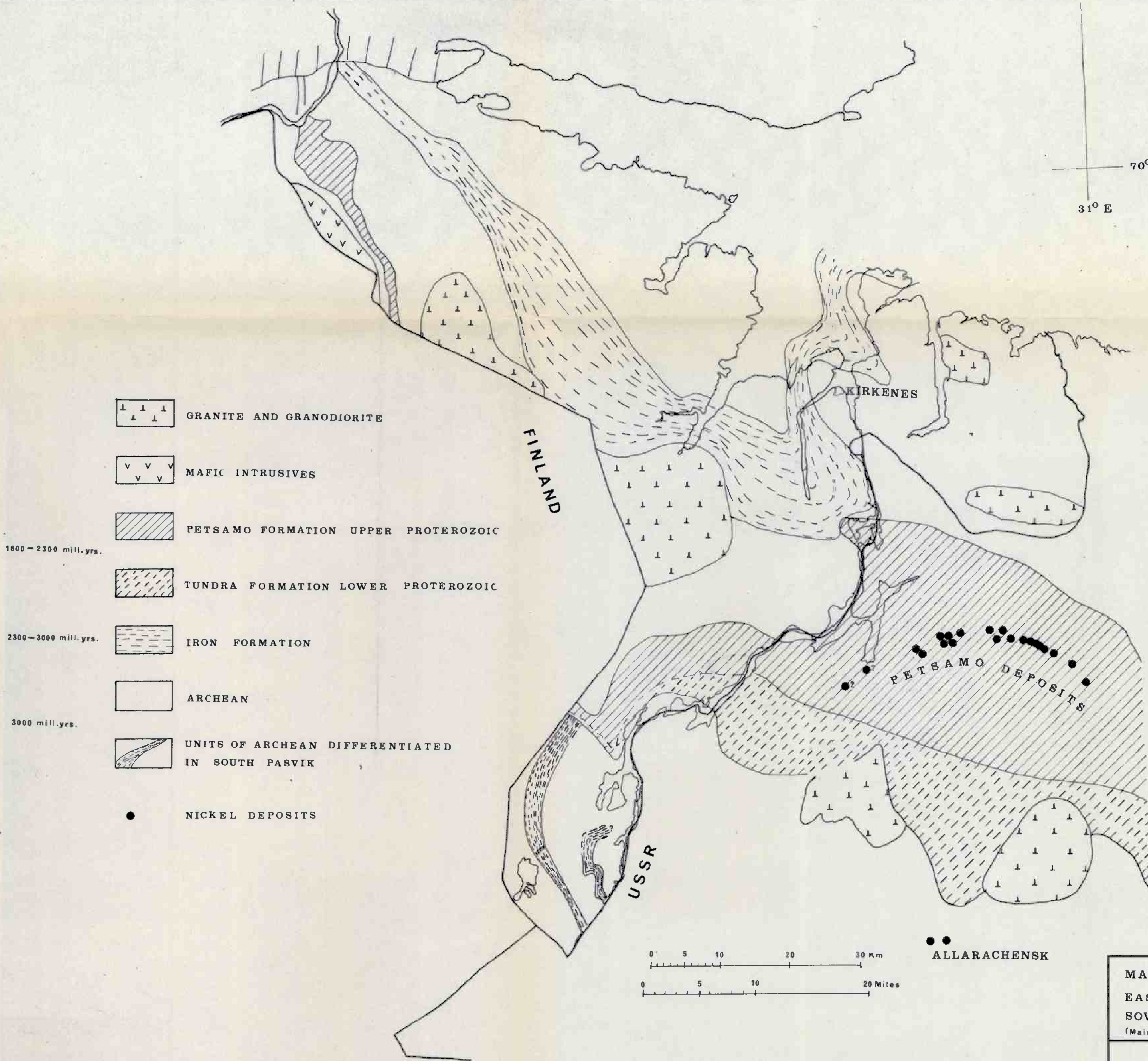
1. All magnetic anomalies in the Gjøkvann zone are of interest and based on a proprity basis should be tested, preferably by drilling.

2. The area to the south west of the Rømlingås boulder finds i.e. the Bjørntjern area is considered our prime target area for finding the source of these boulders. Magnetic and E.M. anomalies in this area should be thoroughly tested by drilling.

3. The supposed continuation of the Gjøkvann zone to the north east should be confined and followed by ground mag/V.L.F. mapping and boulder tracing.

LIST OF ENCLOSURES

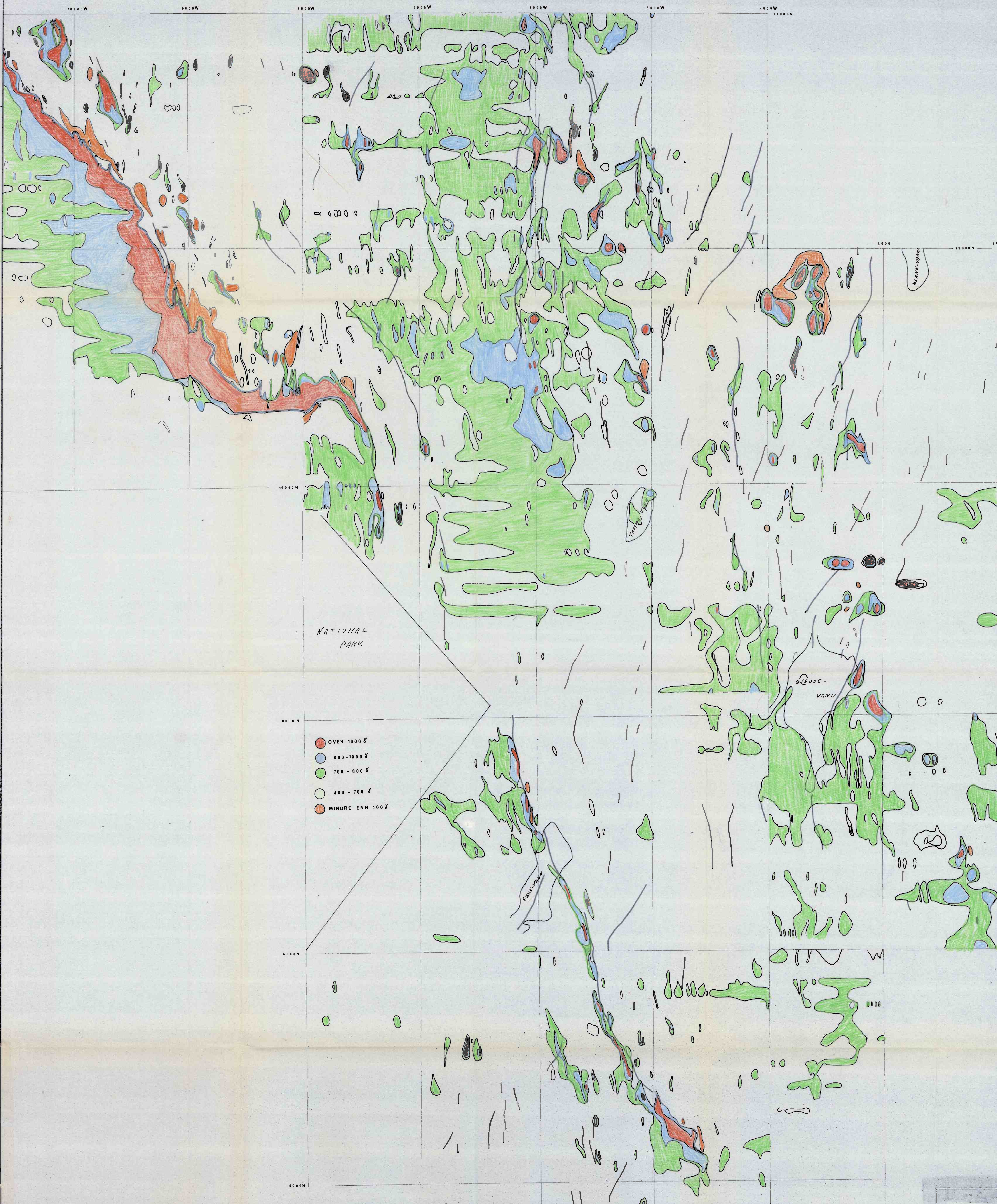
1. Main Geological Features of East Finnmark and adjoining Soviet territories. 1:400 000
2. South Pasvik - boulder distribution, geology and main magnetic features. 1:20 000
3. Summary map og ground magnetics 1978 - 1979
4. Summary map of V.L.F. dip angle data 1978 - 1979
5. Summary map of V.L.F. Fraser contoured data 1978 - 1979
6. Gradient array resistivity surveys, Location map 1:7 500
7. Gradient array resistivity measurements, Areas 1-8, 1:5 000
8. I.P. Survey Line 10300N 1:1 250
9. Gradient array resistivity measurements, Rømlingås North 1:2 500
10. I.P. Survey Line 12200N 1:1 250
11. I.P. Survey Line 11300N 1:1 250
12. Frequency Distribution Till Samples Ni
13. - " - - " - Cr
14. - " - - " - Co
15. - " - - " - Cu
16. Geochemistry related to magnetics and nickel boulders 1:2 000
17. D.D.H. 4 - 5 - 6
18. D.D.H. 7 - 8 - 9 - 10 - 11
19. D.D.H. 9 - 12
20. D.D.H. 13



MAIN GEOLOGICAL FEATURES OF EAST FINNMARK AND ADJOINING SOVIET TERRITORIES (Mainly after Bugge and Gorbonov)	SCALE 1:400 000	OBS.
		DRAW.
		TRAC.
		CHK.
A/S SULFIDMALM	MAP NO.	
	MAP SHEET	

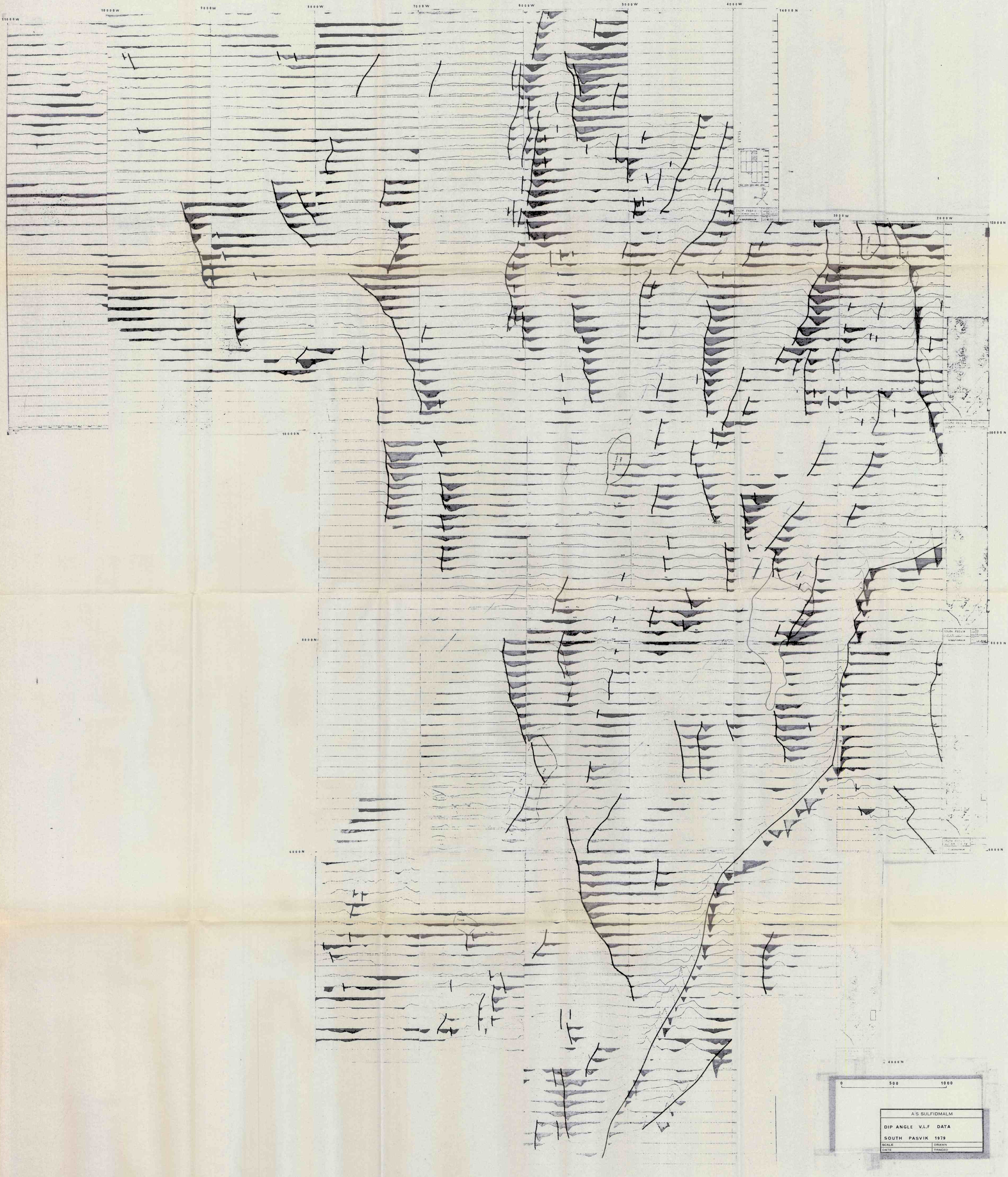
A.s Tørrkopi. 2000. A 2. E 9 gl. 10-71. Sentrum Trykkeri.

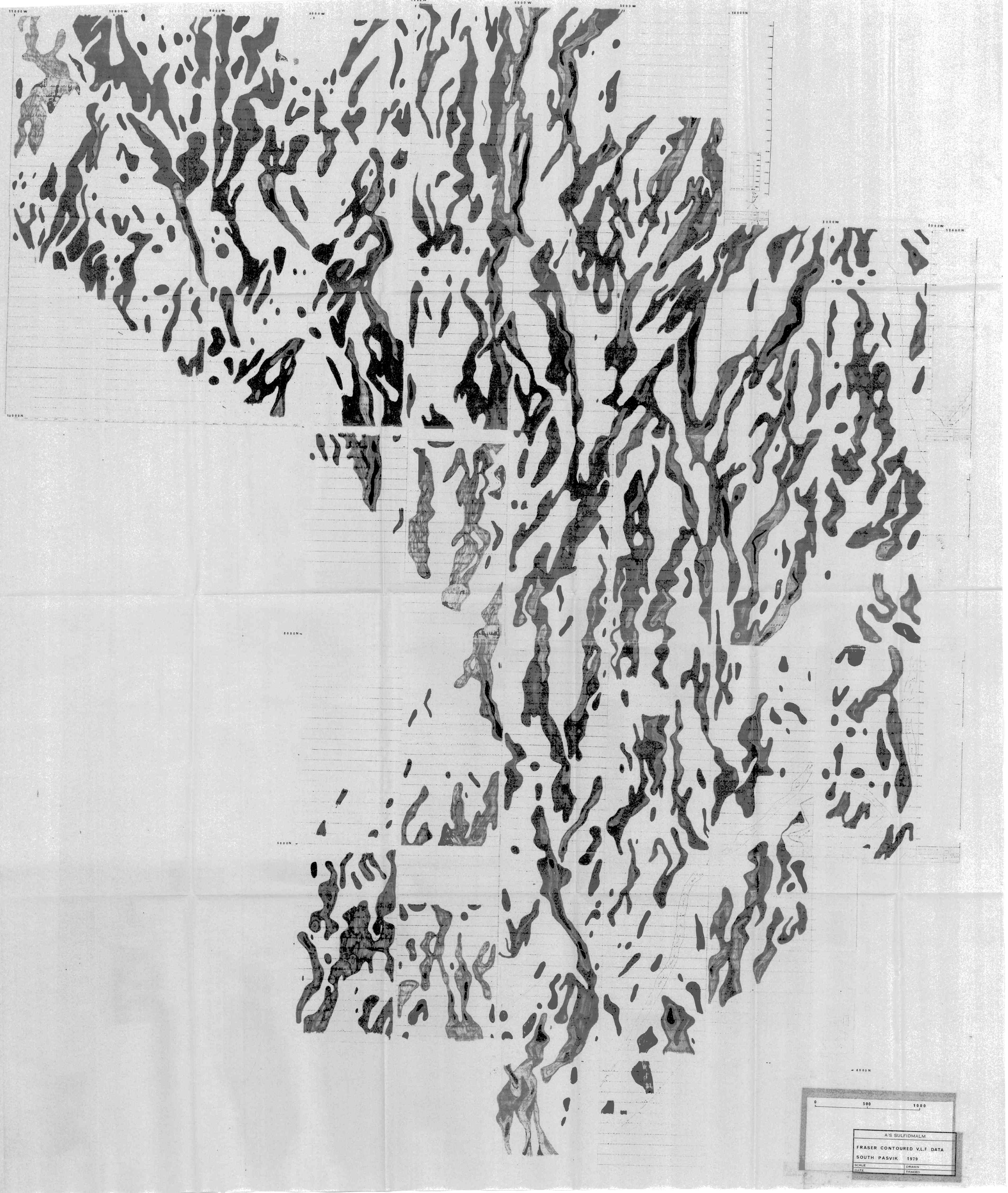
SORTBRYST-TJERN
GJØKVANN
ELLENVANN
SKINNPOSE-VANN
ELLENVANN ZONE
GJÖKVANN ZONE
BJØRNTJERN
BLANKVANN
TOMAMOEN FAULT
GJEDDE-VANN
FISKE-VANN
ØDEVANN
USSR
14000 N
12 000 N
10 000 N
8000 N
6000 N
4000 N
2000 W
3000 W
10000 W
9000 W
8000 W
7000 W
6000 W
5000 W
4000 W
PERIDOTITE
- mineralized
- metamorphic
- anthophyllite bearing
- antigorite bearing
AMPHIBOLE PYROXENITE
OLIVINE GABBRO
AMPHIBOLITE
MAGNETIC ANOMALY
OUTCROP
OUTWASH PLAIN
ESKER
DRILL HOLE
ULTRAMAFIC
PEGMATITE
AMPHIBOLITE / AMPH-GNEISS
MICA SCHIST GNEISS
mica, amph. bearing GRANITIC GNEISS
mica bearing WHITE GRANITIC GNEISS
GRANITIC GNEISS, banded, xenolitic, migmatitic
SOUTH PASVIK
A/S SULFIDMALM
SCALE
1:20000
OBS.
DRAW.
TRAC.
CHK.
MAP NO.
23 79 E1
MAP SHEET

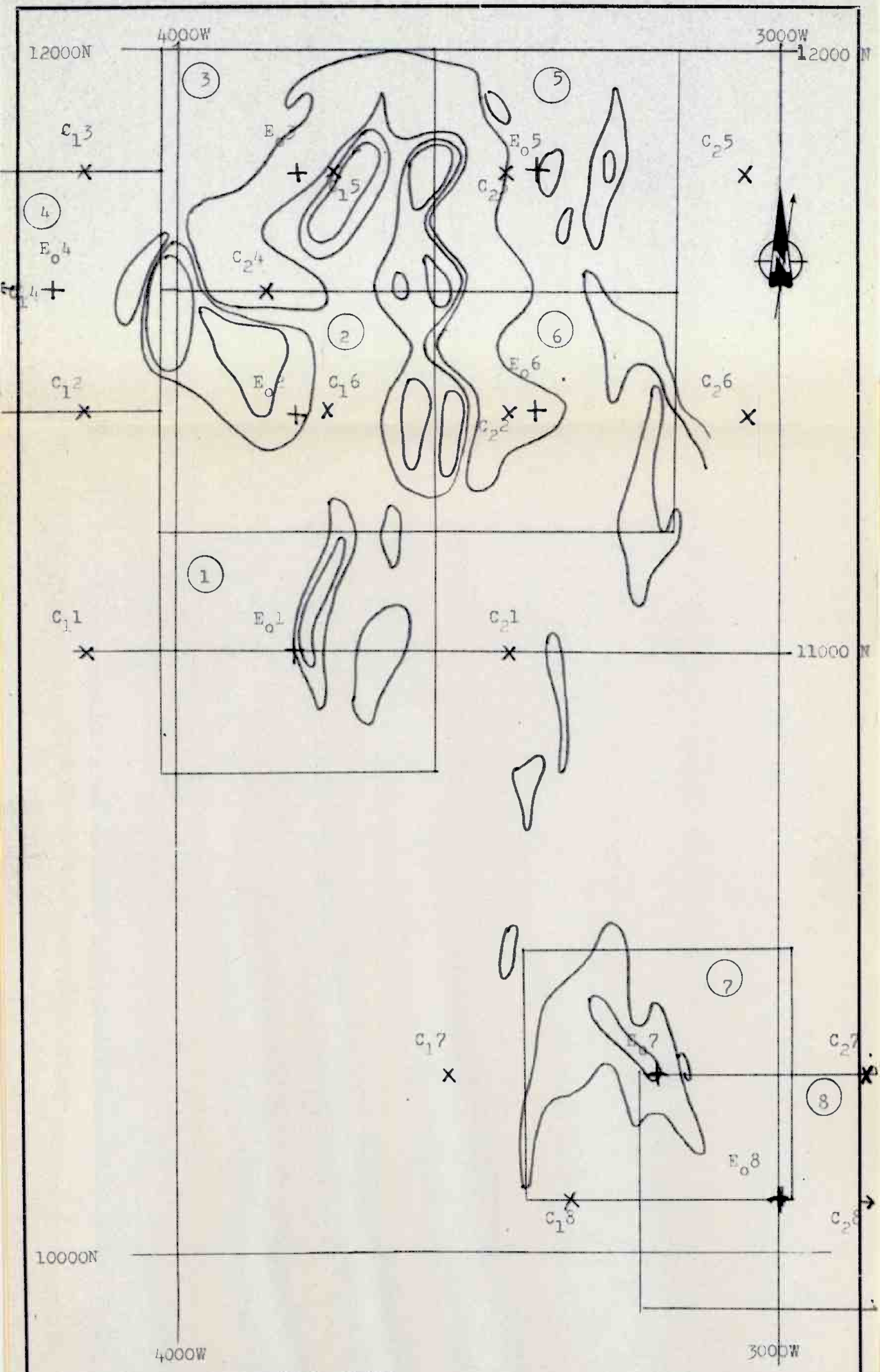


0 500 1000

MAGNETIC DATA SOUTH PASVIK 1979	Scale	Obs. Draw. Trac. Chk.
	Map. no.	
A/s Sulfidmalm		
	Map. sheet	


11000W
10000W
9000W
8000W
7000W
6000W
5000W
4000W
14000N
3000W
2000W
12000N
10000N
8000N
6000N
4000N
0
500
1000
A/S SULFIDMALM
DIP ANGLE V.L.F DATA
SOUTH PASVIK 1979
SCALE
DRAWN
DATE
TRACED


4000N
0
500
1000
A/S SULFIDMALM
FRASER CONTOURED V.L.F DATA
SOUTH PASVIK 1979
SCALE
DRAWN
DATE
TRACED



KEY:

Area number
Limits of area surveyed with GAR
Main mag. feature within the area

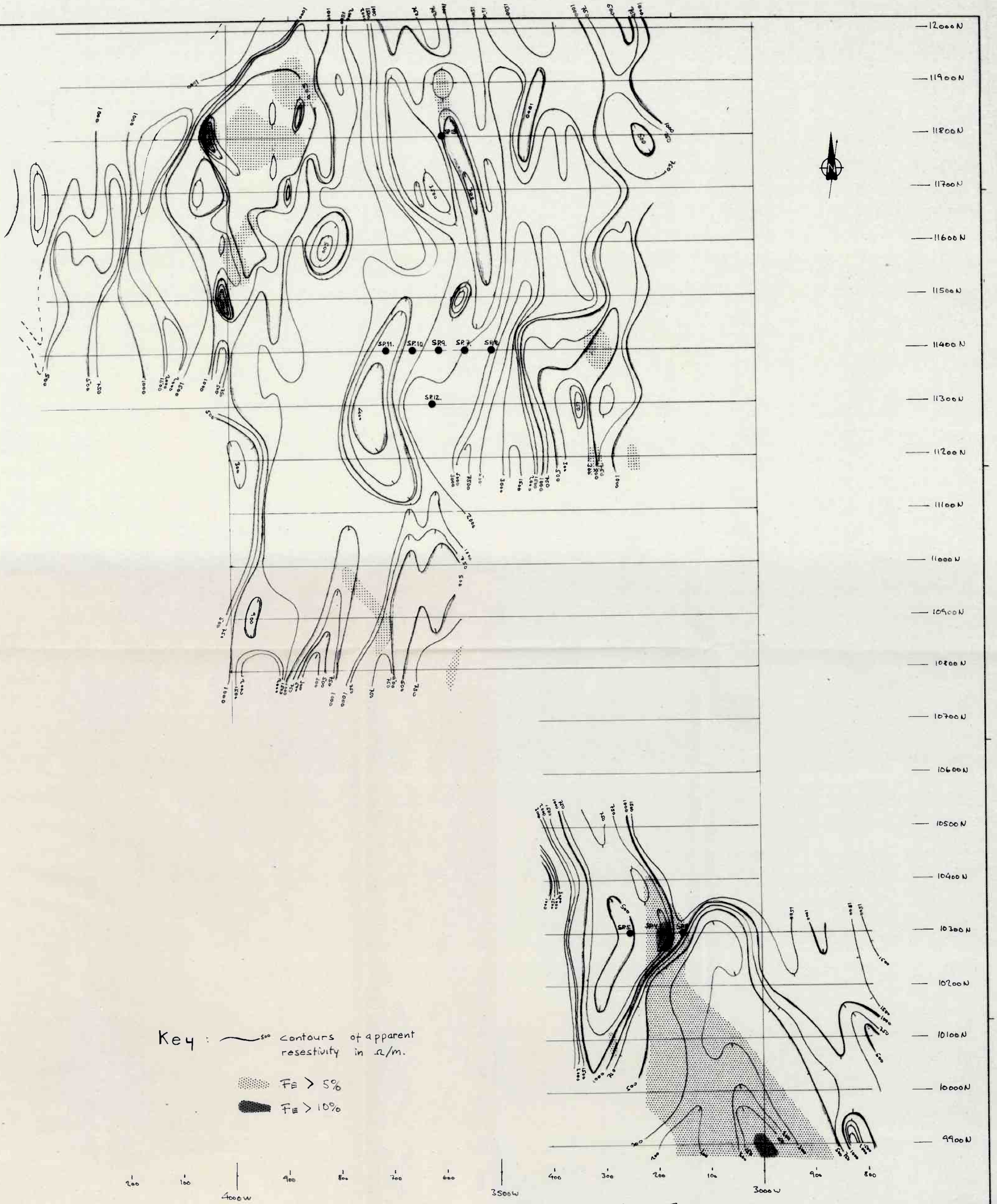
$E_o 1$ + Electric center of area

$C_1 1$ × Current electrode location

A/S SULFIDMALM

SOUTH PASVIK
Gradient Array Resistivity
Location map.

SCALE	1 : 7500	DRAWN	FIH
DATE	1/80	TRACED	FIH



$C_1 - C_2$ = 700 m.
$P_1 - P_2$ = 25 m.
(S = 350 m, a = 25 m.)
Innst.: McPhar IP equ. Rx P660 (f = 5 and 0.3 cps.)

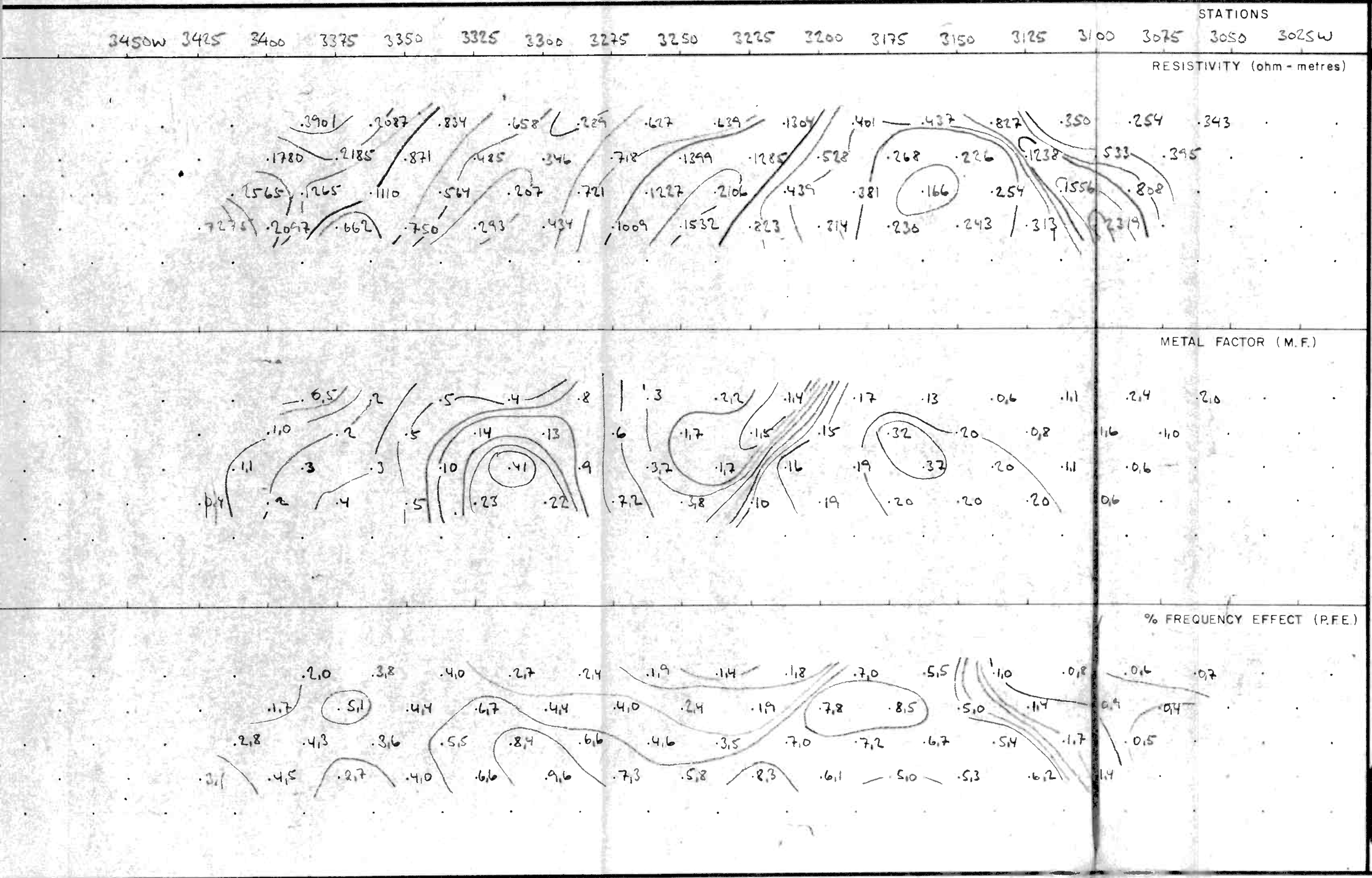
South Pasvik
Gradient array resistivity measurements
Area ① - ⑧

% SULFIDMALM

SCALE		
	OBS. F.H	7-8/79
	DRAW. F.H	12/79
	TRAC. F.H	12/79
	CHK. F.H	1/80

MAP NO. 14-15-23/79 GAR

MAP SHEET



A/s Sulfidmalm

INDUCED POLARIZATION SURVEY

PASVIKS BLANKVANN (7) PROJECT

LINE 10300N

LEGEND

ARRAY: DIPOLE - DIPOLE

UNIT: P660

FREQUENCIES: 0.3 - 5 Hz

SCALE: 1:1250

DATE: 26/7 -79

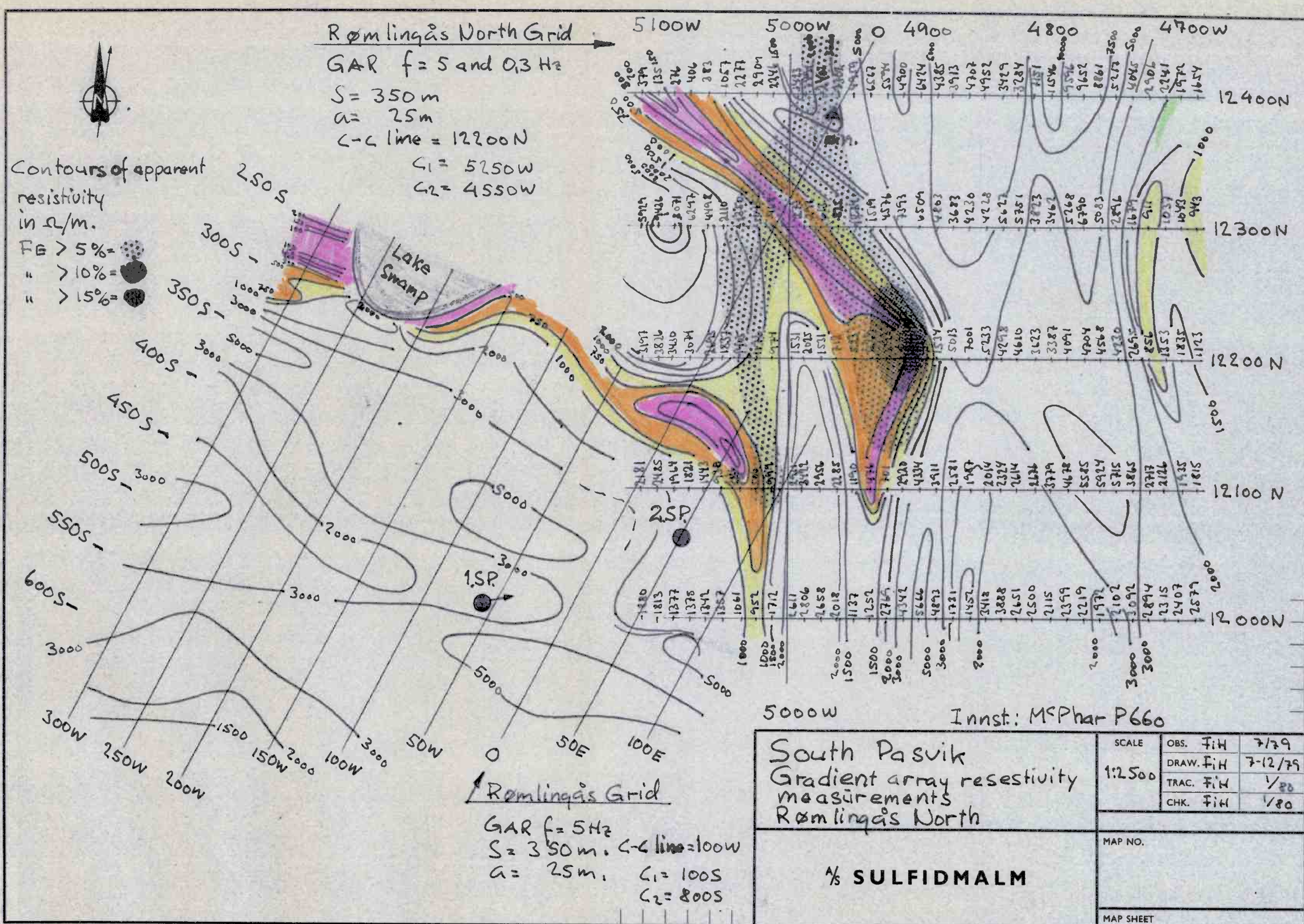
DATA BY: GH

REMARKS:

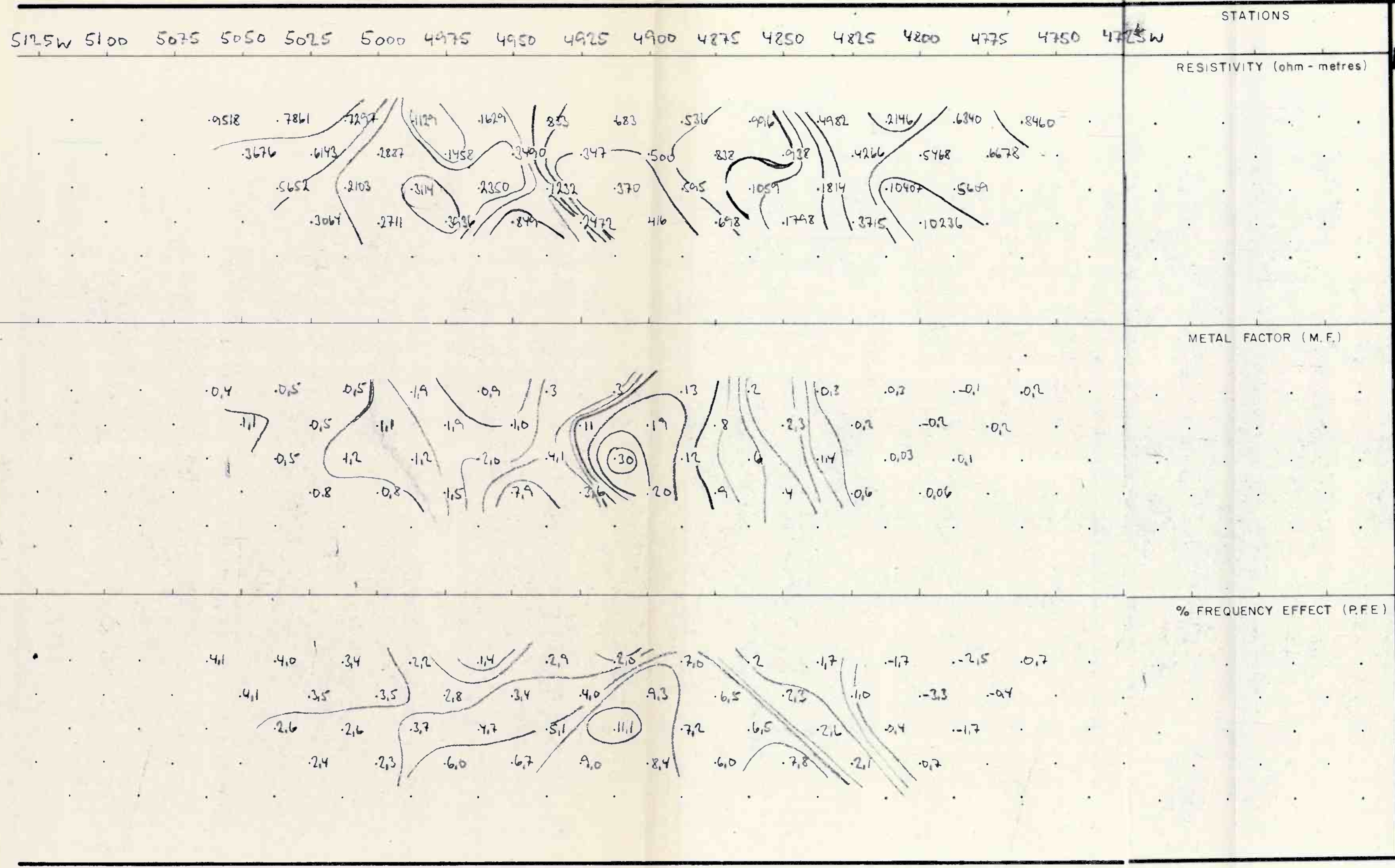
LOGARITHMIC CONTOURS - 1.0, 1.5, 2, 3, 5, 7.5

[redacted]

DWG. No.



A.s Tørrkopi. 1000. A 3. E 9 gl. 11-77. Sentrum Trykkeri.



A/s Sulfidmalm

INDUCED POLARIZATION SURVEY

PASVIK S
RØMLINGÅS NORTH PROJECT

LINE 12200N

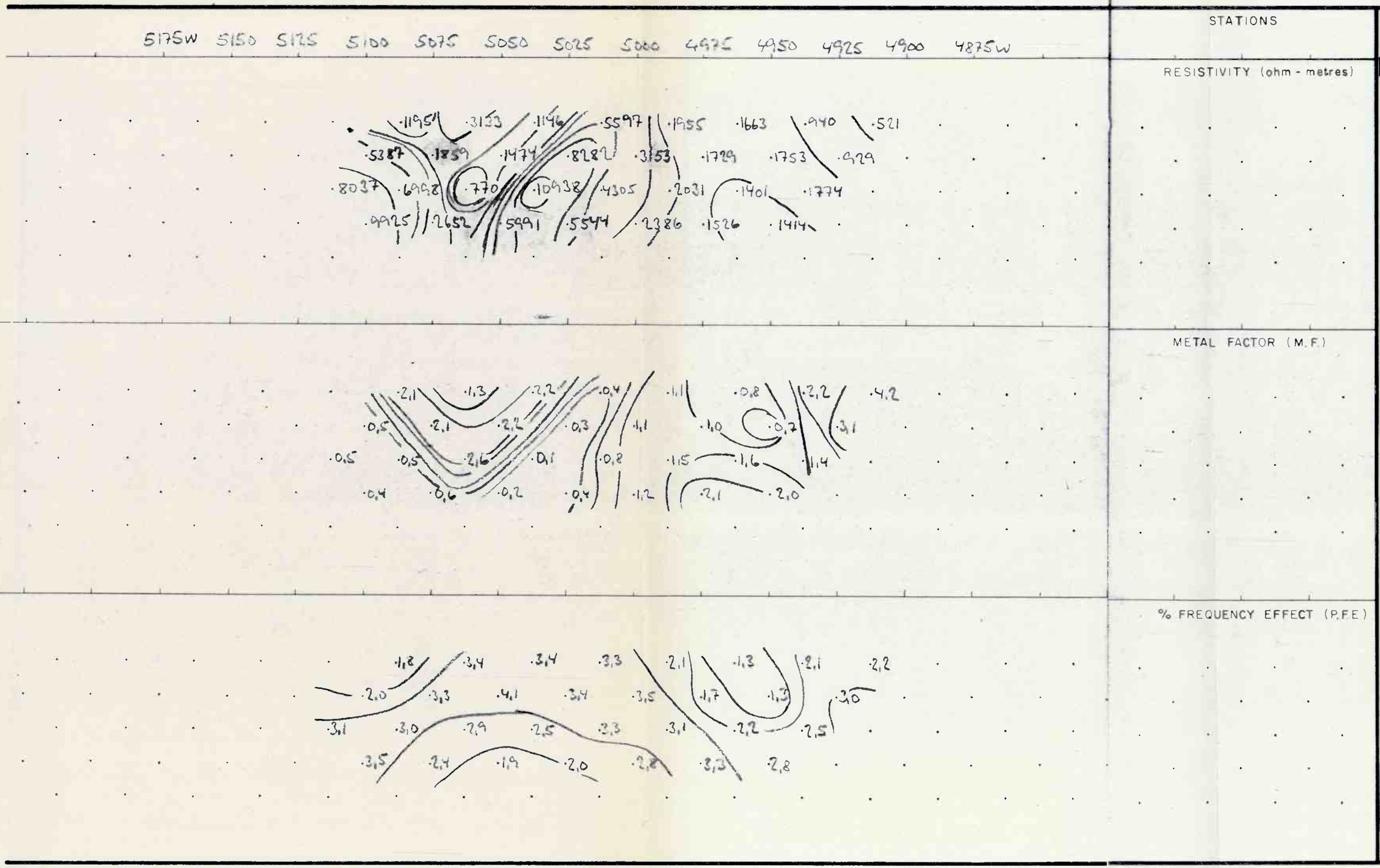
LEGEND

ARRAY: DIPOLE - DIPOLE
UNIT: P660
FREQUENCIES: 0,3-5Hz
SCALE: 1:1250
DATE: 4/7-79
DATA BY: FH
REMARKS:

LOGARITHMIC CONTOURS - 1.0, 1.5, 2, 3, 5, 7.5

[redacted]

DWG No.



A/s Sulfidmalm

INDUCED POLARIZATION SURVEY

Pasvik S PROJECT

LINE 11300N

LEGEND

ARRAY: DIPOLE - DIPOLE
UNIT: P660
FREQUENCIES: 0,3-5 Hz
SCALE: 1:1250
DATE: 5/7-79
DATA BY: FH
REMARKS:

LOGARITHMIC CONTOURS - 1.0, 1.5, 2, 3, 5, 7.5

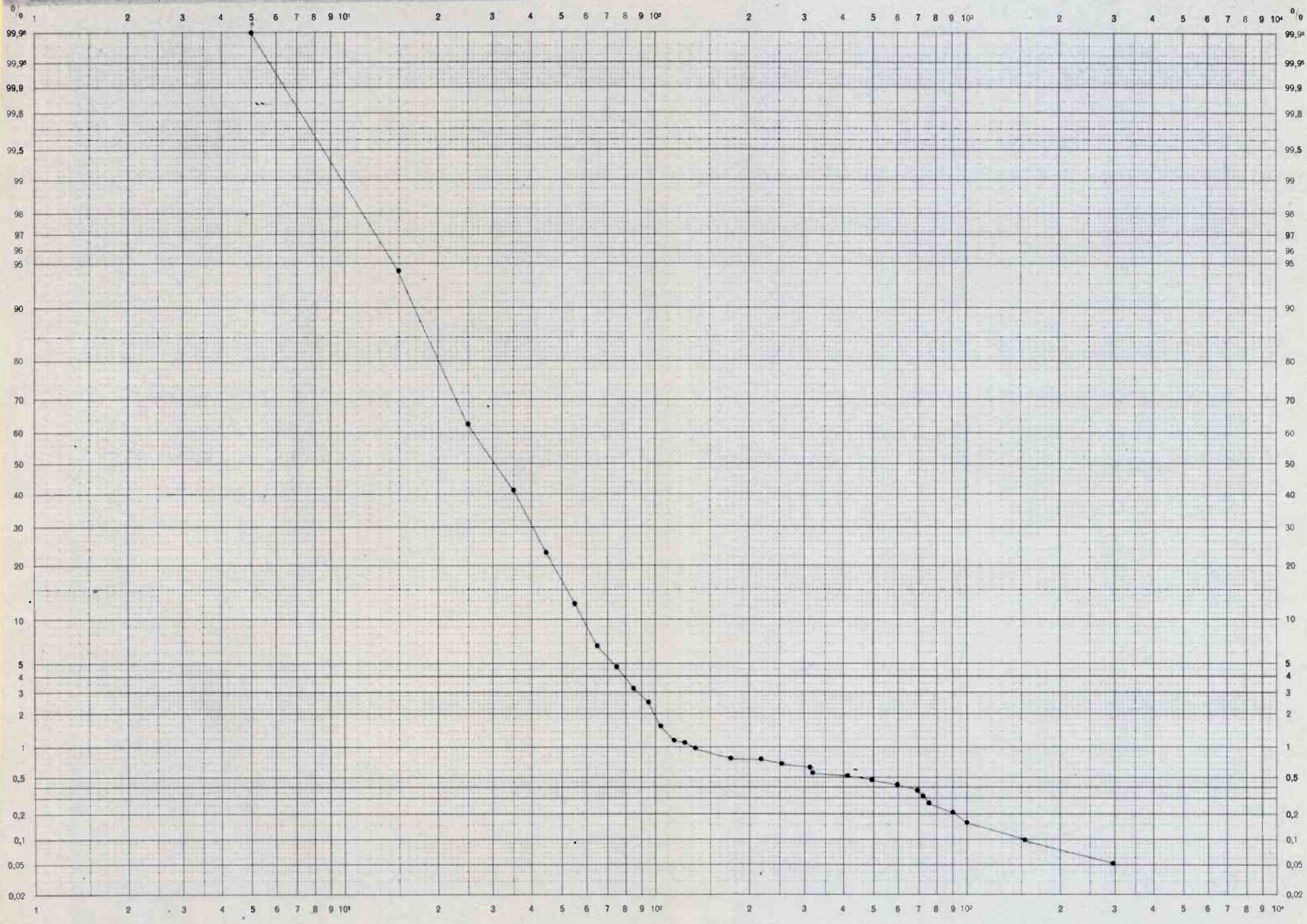
[redacted]

DWG. No.

S PASVIK -78

[illegible] samples BjL 6-79 a/s Sulfidmalm

Ni



ED. AERNI-LEUCH, BERN - Nr. 563

ppm Ni →

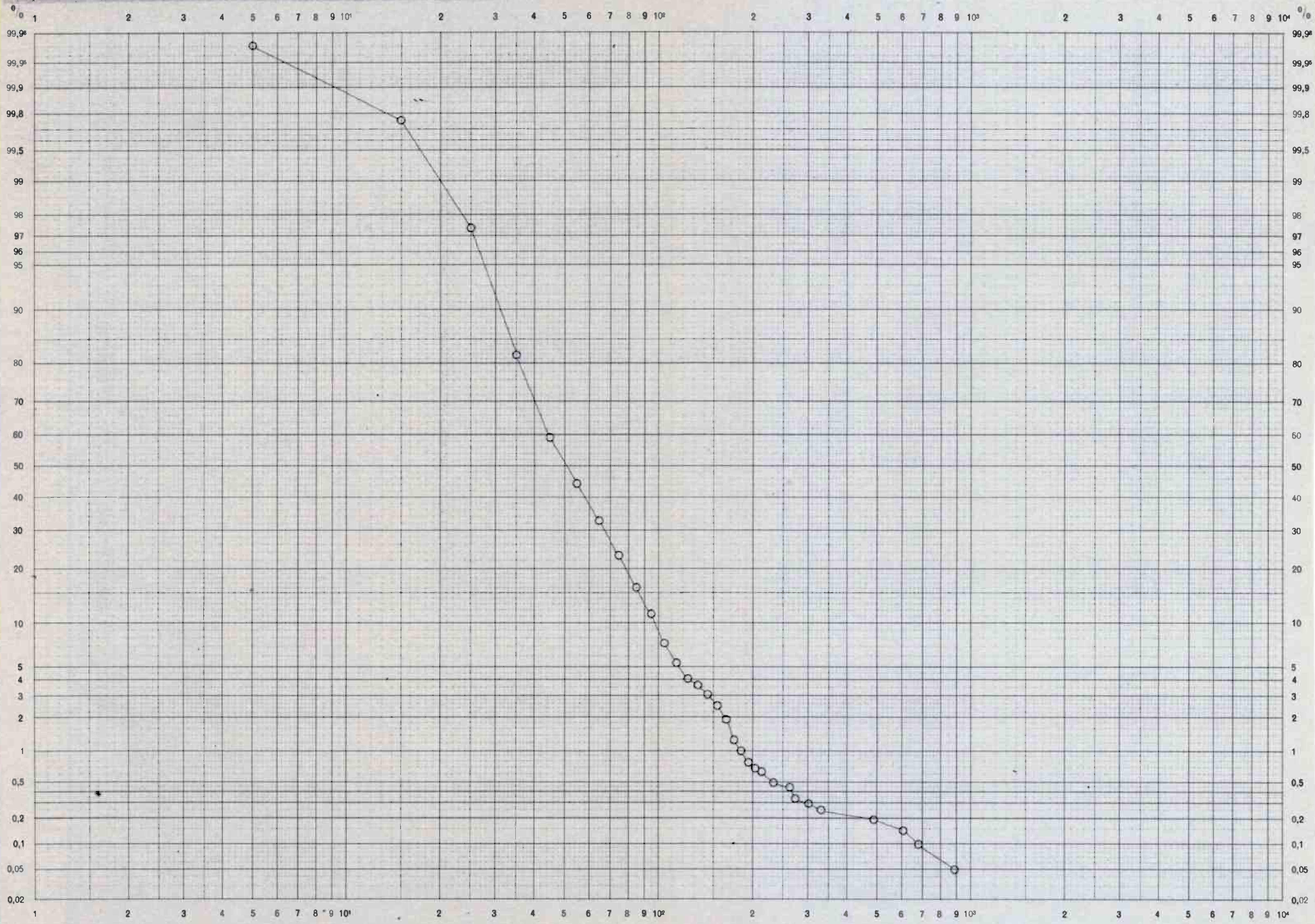
Wahrscheinlichkeitsnetz

Abszissenachse logarithmisch, Ordinatenachse nach dem Gaußschen Integral geteilt

S. PASVIK - 78

1913 Tillsamples Bjl. 6-79 $^{0}/_{0}$ Sulfidmalm

Cr



ED. AERNI-LEUCH, BERN - Nr. 563

ppm Cr ⟶

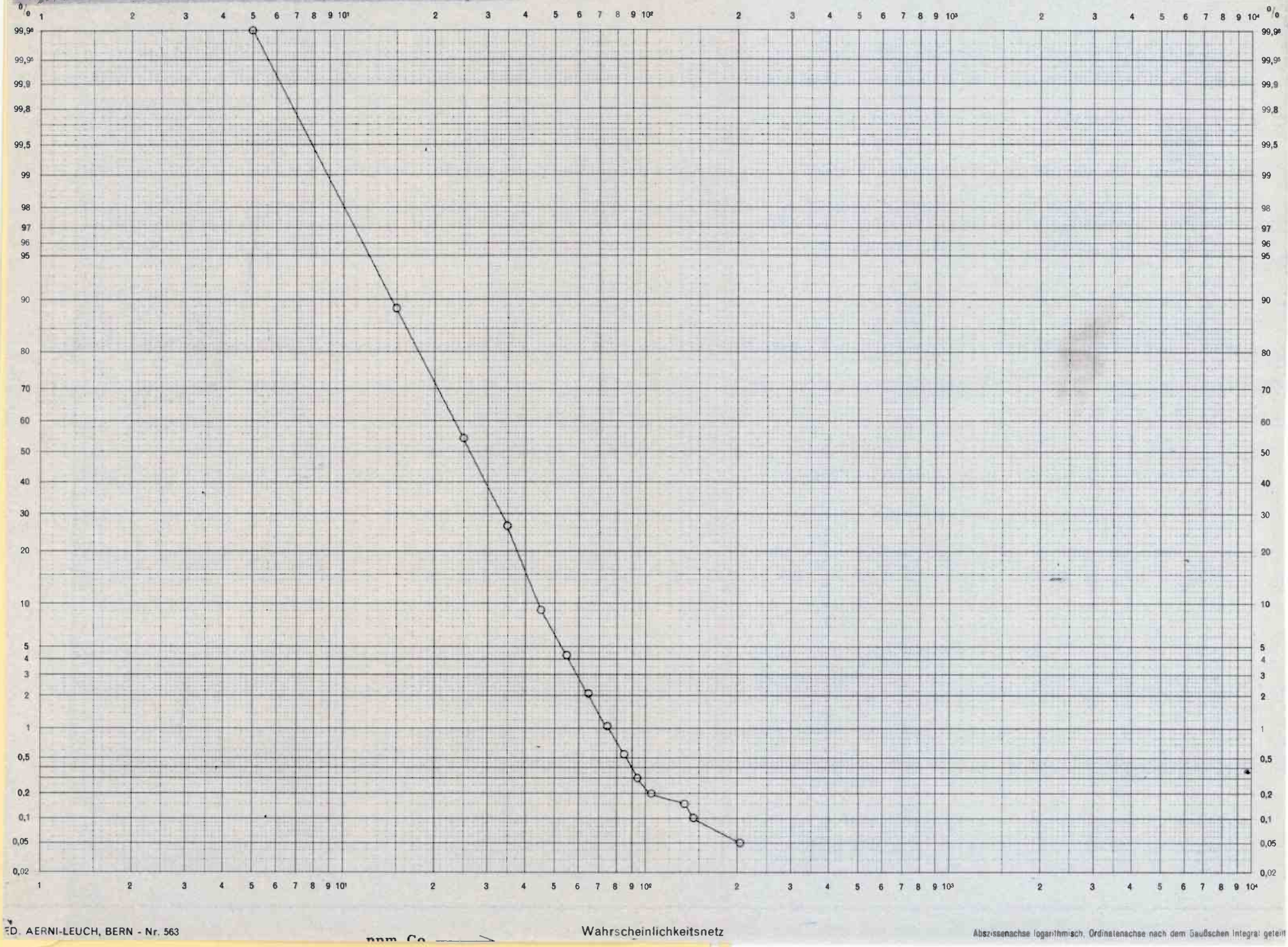
Wahrscheinlichkeitsnetz

Abszissenachse logarithmisch, Ordinatenachse nach dem Gaußschen Integral geteilt

S.PASVIK - 78

1913 Tillsamples BJL 8-79 a/s Sulfidmalm

Co



ED. AERNI-LEUCH, BERN - Nr. 563

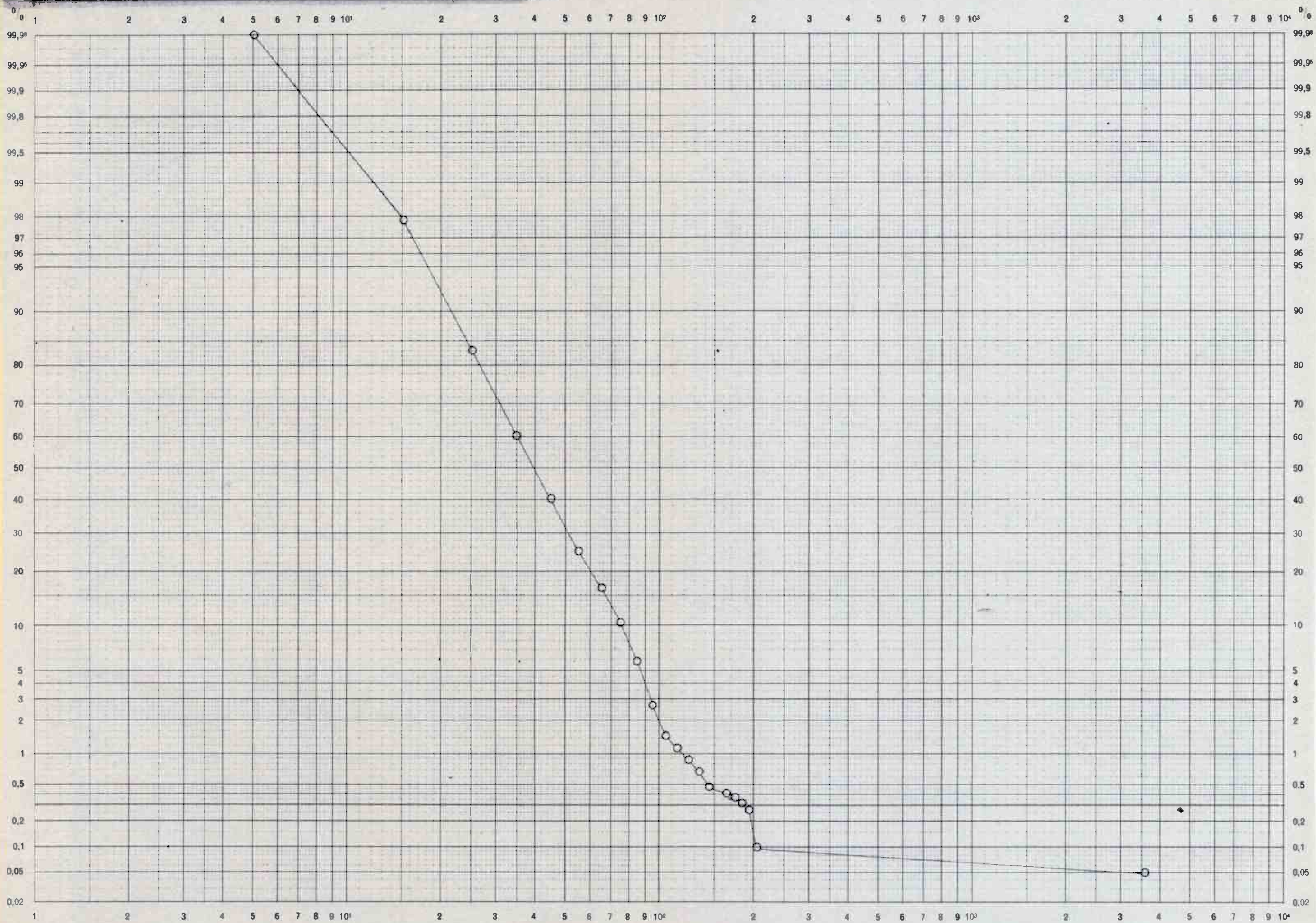
Wahrscheinlichkeitsnetz

Abszissenachse logarithmisch, Ordinatenachse nach dem Gaußschen Integral geteilt

S.PASVIK -78

1913 Tillsamples BjL 6-79 a/s Sulfidmalm

Cu

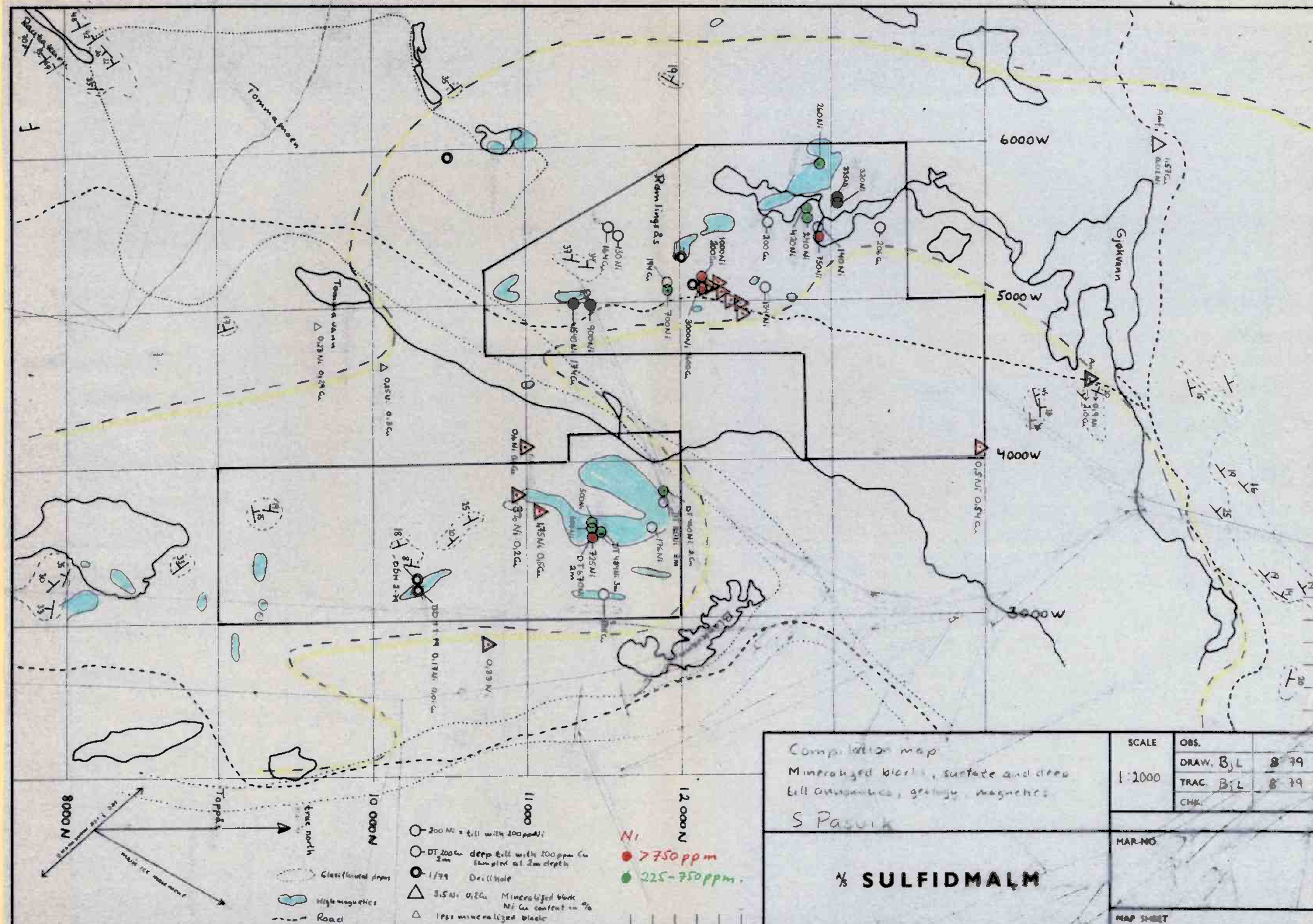


ED. AERNI-LEUCH, BERN - Nr. 563

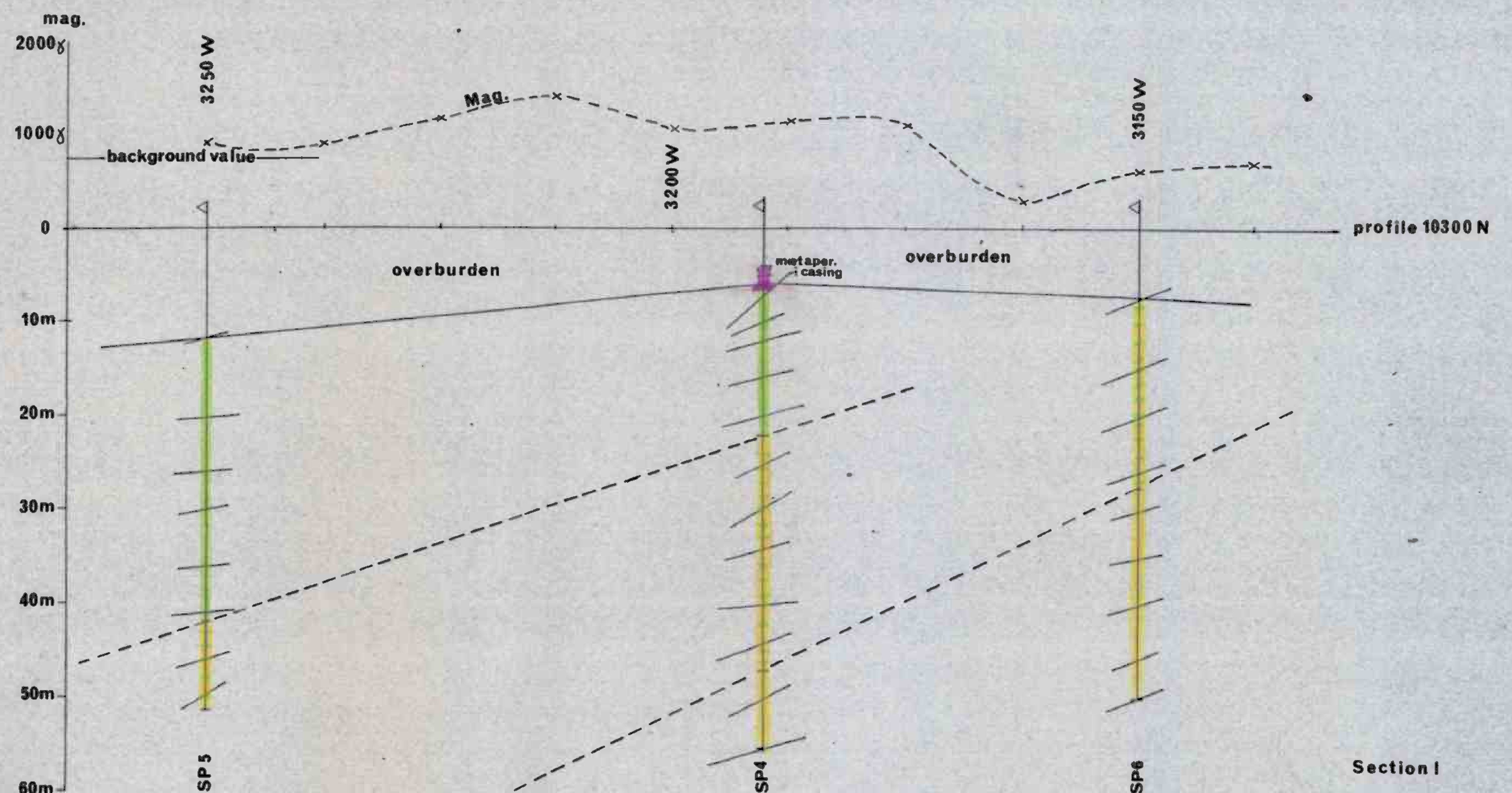
ppm Cu ⟶

Wahrscheinlichkeitsnetz

Abszissenachse logarithmisch. Ordinatenachse nach dem Gaußschen Integral geteil



A.s Terrkopi. 1000. A 3. E 9 gl. 10-71. Sentrum Trykkeri.

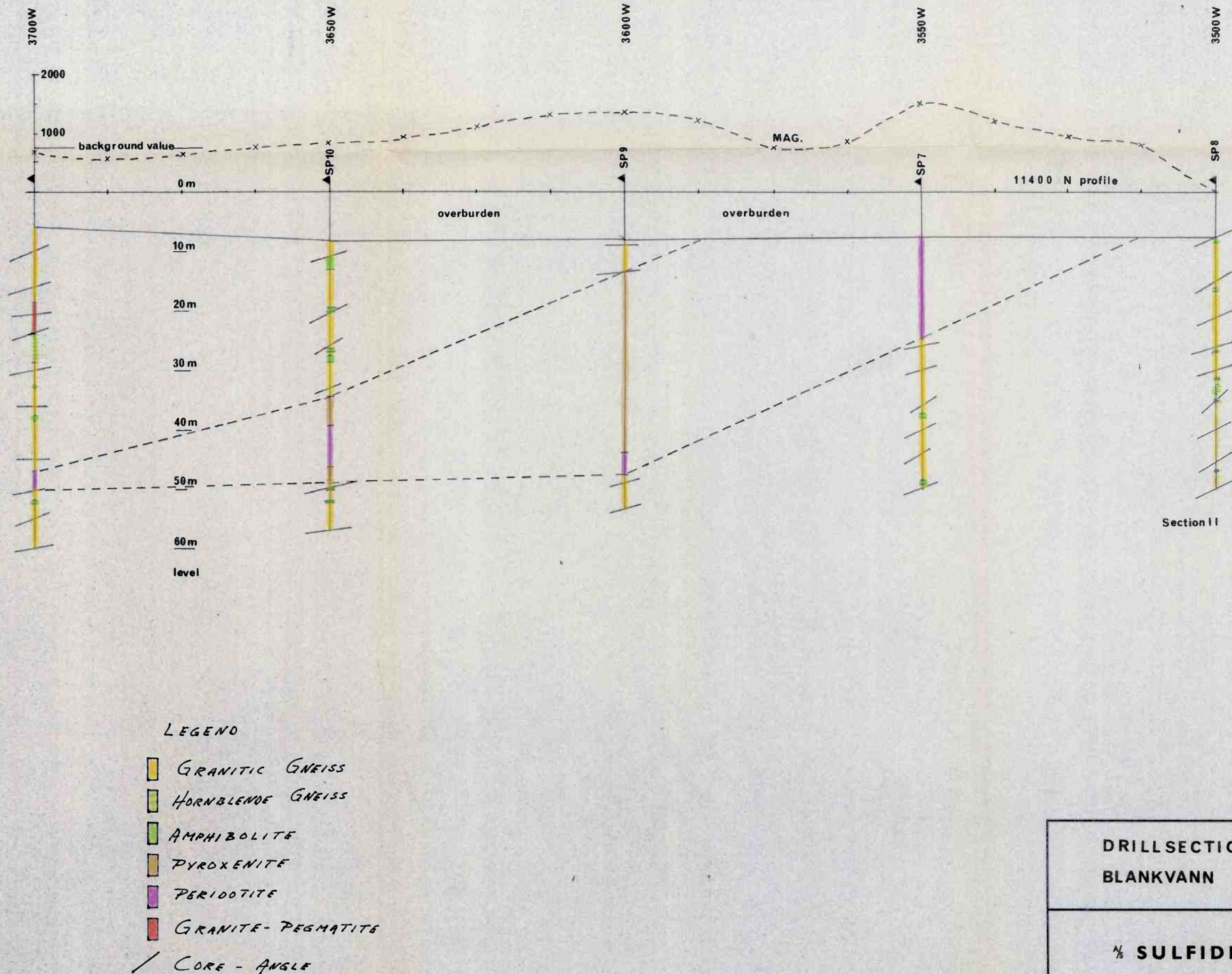


LEGEND

- GRANITIC GNEISS
- HORNBLENDE GNEISS
- AMPHIBOLITE
- PYROXENITE
- PERIDOTITE
- GRANITE - PEGMATITE
- / CORE - ANGLE

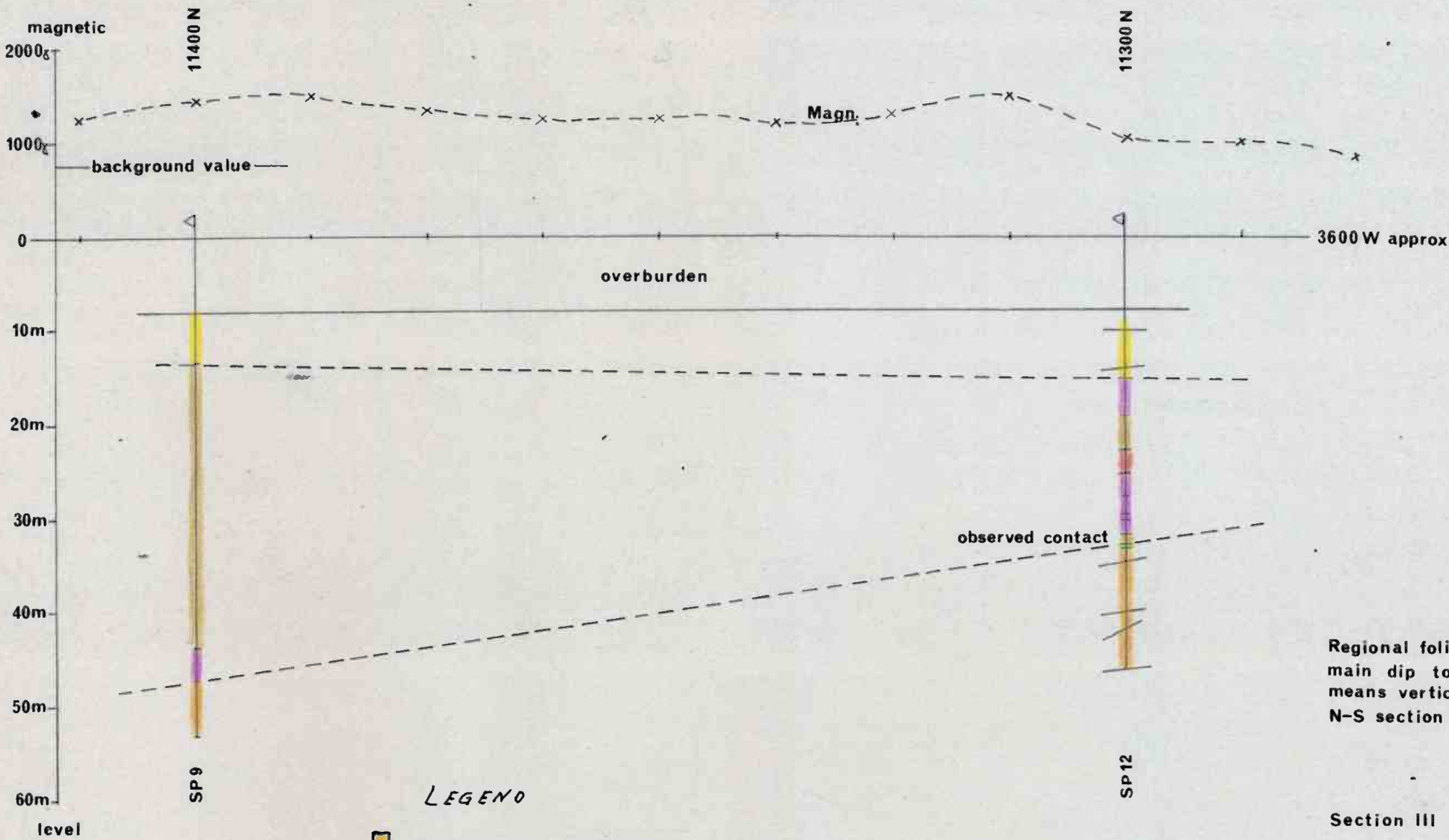
DRILLSECTIONS AT BLANKVANN S. PASVIK	SCALE 1:500	OBS. 9-79	Lieungh
		DRAW.	
		TRAC.	
		CHK.	
A/S SULFIDMALM	MAP NO.		
	MAP SHEET		

A.s Terrkopi. 1000. A 3. E 9 gl. 10-71. Sentrum Trykkeri.



DRILLSECTIONS AT BLANKVANN S. PASVIK	SCALE 1:5000	OBS. 12-79	Lieurrgh
		DRAW.	
		TRAC.	
		CHK.	
A/S SULFIDMALM	MAP NO.		
	MAP SHEET		

A.s Terrkopi. 2000. A 2. ll 9 el. 10-71. Sentrum Trykkeri.



Regional foliation with main dip to W. That means vertical to this N-S section shown here.

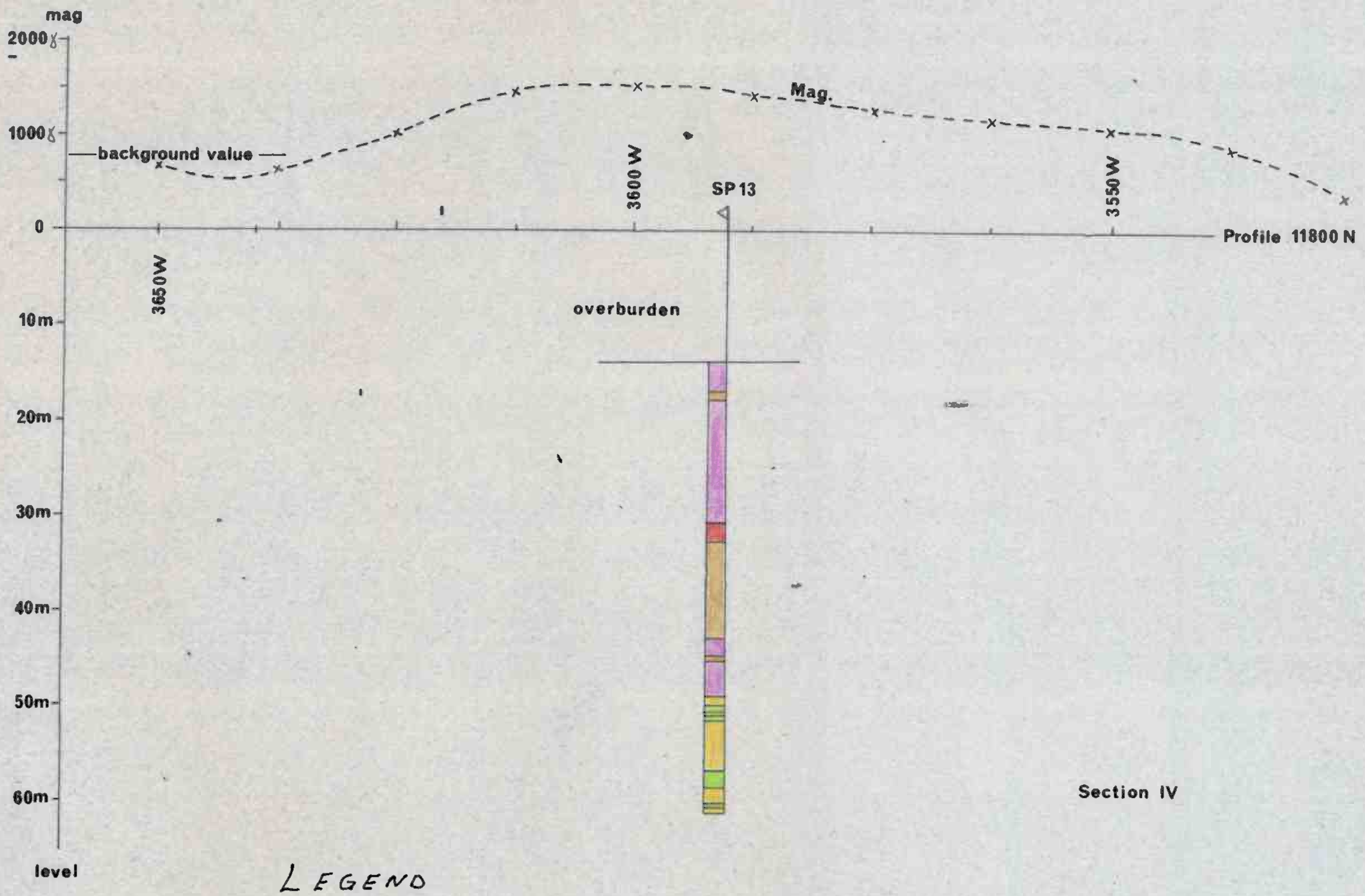
Section III

LEGEND

- GRANITIC GNEISS
- HORNBLENDE GNEISS
- AMPHIBOLITE
- PYROXENITE
- PERIDOTITE
- GRANITE - PEGMATITE
- / CORE - ANGLE

DRILLSECTION AT BLANKVANN S. PASVIK	SCALE 1:500	OBS. 12-79	Lieungh
		DRAW.	
		TRAC.	
		CHK.	
A/S SULFIDMALM	MAP NO.		
	MAP SHEET		

A.s Tørrkopi. 1000. A 3. E 9 gl. 10-71. Sentrum Trykkeri.



LEGEND

- GRANITIC GNEISS
- AMPHIBOLITE
- PYROXENITE
- PERIDOTITE
- GRANITE - PEGMATITE
- / CORE - ANGLE

DRILLSECTIONS AT BLANKVANN S. PASVIK	SCALE 1:500	OBS. 12-79	Lieungh
		DRAW.	
		TRAC.	
		CHK.	
A/S SULFIDMALM	MAP NO.		
	MAP SHEET		

A.s Terrkopi. 1000. A 3. E 9 gl. 10-71. Sentrum Trykkeri.