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| | | F.M. Vokes | | |

**Tittel**
Copper and Iron Sulphide Deposits of Porsanger County of Finnmark, Notheren Norway

| Forfatter | Dato | År | Bedrift (Oppdragsgiver og/eller oppdragstaker) |
|---|---|---|---|
| Juve, Gunnar | | 1968 | Sydvaranger A/S/NGU |

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| Porsanger | Finnmark | | 20353 | Honningsvåg |

| Fagområde | Dokument type | Forekomster (forekomst, gruvefelt, undersøkelsesfelt) |
|---|---|---|
| Geologi | | Porsangerfeltet<br>Karihaugen<br>Corgus<br>Rittabergen |

| Råstoffgruppe | Råstofftype |
|---|---|
| Malm/metall | Cu |

**Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse**

Utkast til artikkel, på engelsk med urettet korrektur og med noe manglende innhold av de figurer det refereres til. Geolog og strukturer i det aktuelle området beskrives i detalj. Videre gås gjennom og beskrives de 2 malmparagenesene som er konstatert i feltet. I kobberparagenesen beskrives overgangen fra protore, til cementasjon og til en oksydasjonssone.
noen analyser prsenteres.

Vedlagt geologisk oversiktskart (norsk) og 4 polerslipfotos.

# COPPER AND IRON SULPHIDE DEPOSITS OF PORSANGER, CONTY OF FINNMARK, NORTHERN NORWAY.

## I N T R O D U C T I O N

The here presented work is part of the exploration program of the firm A/S Sydvaranger in the northern most county of Norway, Finnmark, during the field seasons of 1965, 1966 and 1967. The work was started and has been led by professor Jens A.W. Bugge, Oslo.

On regional and local scales it has been tried to correlate old wellknown prospects with new indications found during this campaign. The aim has been to evaluate the economic exploitability of the occurrences, to characterize them locally, and if possible, regionally in order to establish a base for further prospecting in the surrounding areas.

As it is possible to link together genetically several of the wide-spread copper mineralizations of the western part of the county, special considerations have been made to place the Porsanger deposits within the frame of what I will call "The copper province of western Finnmark".

In the present description a survey of the different ore types, their host rocks and surrounding milieu will be given.

The general structure, tectonical and metamorphic development are mainly seen from the point of view of ore localization. Based on a relatively broad analytical material,* the outlines and some characteristics of the geochemistry of ores and host rocks are ~~discussed~~. given.

* The material consists of 59 complete analyses (21 elements), 42 analysis of ore + trace elements, 53 ore analyses carried out in the N.G.U. laboratories, several hundreds of Cu-analyses dating from 1908 to 1968 performed by differant labs, analyses from a special volumetric sampling and ore dressing experiments by A/S Sydvaranger 1967.

The geochemical data will be treated more exhaustively and presented together with the microscopical description in "Copper province of western Finnmark" (manuscript).

# L O C A L I Z A T I O N - T O P O G R A P H Y

The county of Finnmark covers more than 46 000 km$^2$~~; - about the size of Denmark.)~~

The actual occurrences lie in the late precambrian (karelidian age) sediments and volcanites of the Lakselv valley, at the bottom of the largest fjord of Finnmark, Porsangen.

Figure 1.
Geological map. County of Finnmark.

The Lakselv valley is formed like a broad channel, excavated by ice erosion through the over-lying eocambrian (caledonian) nearly flatlying sediments, from the big tundra in the South to the ocean. The long fjord is of course only the submerged continuation of the valley. Theclassical U-form is discerned in the cross-sections of this broad valley.

The general topography of the valley bottom is gently undulating. But on a detailed scale it is seen to be dissected by a system of ridges an depressions. At some places relatively deep canyons accentuate this relief. Some of the broader depressions are filled with conspicuously thick glacio-fluvial deposits.

By levelling in relation to the well exposed limit between the precambrian rocks and overlying caledonian complex, it is seen that the valley-bottom at places has kept its main sub-cambrian relief: - namely that of the sub-cambrian peneplain, so well demonstrated on the tundra further south. During the final stage of the quaternary epoch the rigdes and higher plateaus of the valley have been washed nearly free from overburden. This makes these parts easily mappable, a phenomenon which is in striking contrast to the heavily covered tundra of southern Finnmark and northern Finland, and to the depressions of this actual area as well.

With patchwise distribution (~~manily~~ mainly in areas which are not so roughly scoured by the ice) areas of deep chemical erosion are found. This is as a whole a quite rare phenomenon in Norway, where we more or less have taken for granted that the glaciation should have scraped and washed all hard rock down to an unaltered level.

This very special combination of physical and chemical weathering has had a decisive influence on the mineralisation of the area. One of the results is that in the mineralized zones there is an irregular pattern of high and low metal contents according to the degree of chemical weathering at the locality.

## G E O L O G Y

### HOST ROCK SERIES

The mineralized complex is of late precambrian age, - 600 - 1800 million years. Most probably the age is karelidian.

Figure 2.

On the top of the figure is seen a schematized profile of the mineralisation types within their host rocks.

The rock series includes:

1. Amphibolites/green schists of volcanic sedimentary and of orthodox sedimentary origin. Pillow lavas are found.

2. Quartzites/gneissic quartzites/leptites/quartz keratophyres.

3. Limestones/dolomites.

4. Mica schists.

5. Black schists (Graphite amorphous hydrocarbons). Locally plugs and sill-like bodies of ultrabasic composition are found. They are mainly quite pure hornblendites, often deepley serpentinized.

Their existence is indeed intriguing, but they definitely do not seem to have any connection with the mineralizations.

Gradual transitions between the different members (unities) are found. But mostly, the apparently unsharp limits are due to very fine-bedded alternations and repetitions of two or three of the series members. The thicknesses of these repeated strata may vary between few millimeters and several meters.

Thus, on a whole, the limits between the abovementioned four groups are in fact quite sharp and consistent.

Figure 3. Lakselv valley, Porsanger.
Geological map of the northern part of the valley, with a generalized E - W section.

MAIN STRUCTURE OF THE COMPLEX

The map shows a simplified picture of the northern part of the Lakselv valley. The main structure is an irregular ring or basin in which it has been possible to follow some of the mineralized horizons (mainly pyrrhotite-pyrite-ore layers) the whole way round, except for short distances made inaccessible by overburden or water. A pronounced vertical fault separates the valley into this northern part and a southern part which is much more covered and thus not so well known structurally. Both the vertical and the lateral displacement of the fault indicate that the same part of the stratigraphical column is represented in the South, and thus the same mineralized horizons.

Neither this fault nor any of the numerous smaller ones found seem to have any direct connection with the mineralization processes.

The axial plane traces of the major folds are seen to be oriented more or less radially towards the centre of the basin.

The folding has influenced the area along two main directions: The first fold phase ($F_1$): NNW-SSE and the second fold phase ($F_2$): E-W.

$F_2$ has generally quite clearly deformed the $F_1$ structures, but it must be stressed that locally $F_2$ folds are undoubtedly deformed by $F_1$ influence indicating a certain contemporaneity of the two phases.

It may be discussed to what extent the folding of the caledonian mountain range, lying discordantly above the here described complex, has influenced its structure.

The complex is overlain by quite flatlying cambrian autochtouous sediments. Above these occur eocambrian sediments separated from their base by a thrust plane or a thrust zone. At some places this thrust plane cuts down into the precambrian basement and has locally torn away large pieces of the older rocks and incorporated them into its own body. Of course these thrust movements have been very powerful, but on a whole, their effect on the precambrian basement is in the scope of our investigation, of negligible character.

Neither is it believed that the pure folding movements of caledonian time have had any effect further than to fold the lose torn pieces into the eocabrian sediments.

The fold axis directions which in the precambrian Lakselv sediments exeptionally are found to be parallel to caledonian directions, are interpreted as interference directions between the above mentioned $F_1$ and $F_2$.

Thus, the whole tectonic history of the complex was completed already in precambrian time. ~~The schistosity, which has~~

The all-over prevailing schistosity is parallel to the sedimentary layering and has been developed prior to the first folding phase. When in roughly tectonized parts it is oblique to it, the compostional banding only seldom fails to show what are the original outlines of the different layers.

ORES, LOCALIZATION AND TYPES

The ores (mineralisations)are unequivoqually located to the amphibolite units (mostly to one unity 400 - 600 m thick) in which they may be followed tens of kilometers.

In the whole valley - an area of more than 350 km$^2$ with an apparently enormous "mineralisation density", we are now able to restrict the ore distribution to this small part of the stratigraphical column.

Two main ore parageneses may be pointed out:

I. The iron sulphide paragenesis (the "Kisparagenesis").

II. The copper paragenesis.

I. The iron sulphide paragenesis (Kisparagenesis") consists mainly of pyrrhotite, but pyrite may be an importent constituent. Minor arsenopyrite is locally seen. The chalcopyrite content is very low. Sphalerite and galena are considered as local accessories. At places graphite is an important constituent. The "Kis"-paragenesis displays a simple geometry, - thin strata which are consistently concordant to the sedimentary layering. Thanks to the formation of gossans the pyrrhotite-pyrite layers are easely mappable over long distances.
These sulphide horizons are of no ecconomic value today, but were of great value during the mapping work, and particularly for the localization of the economically more interesting paragenesis; namely:

II. The copper paragenesis.

On a regional scale this one follows parallelly to the iron sulphide paragenesis, but displays on the local scale a totally different geometry.
Is mostly occurs as elongated clouds of impregnation and more seldom as small scale, fissure-depositions. Exceptionally "contact ores" are seen: irregular assemblages of sulphides in amphibolite matrix, but limited to one side by a quartzite wall.

The ore mineral assemblages are of different types in this "Copper ore" type; their general characteristics are:

IIA. Protore.

What is believed to be the protore of the rich superficial mineralisations is an even, lowgrade impregnation of chalcopyrite and pyrite in the unaltered amphibolites. Molybdenite occurs as a trace mineral. Minor magnetite is observed.

IIB. Cementation zone copper ore.

The rich copper ores seen in some superficial zones is considered to be a cementation product of the above mentioned protore.
It consists mainly of chalcocite and bornite. Hematite is a more or less constant minor constituent, either as martite after primary magnetite or as new-formed individuals and beautiful specularite clusters. Molybdenite occurs as trace mineral even here.
Chalcopyrite <u>may</u> be present in relatively considerable amounts, but does not seem to be an integrated member of this paragenesis.*
In a few exceptional localities the textural features reveal that chalcopyrite has been enriched as such, but this is always in transition zones to the real cementation assemblage: chalcocite and bornite.
Native copper occurs as traces in some places, and has been found locally in lumps of up to ½ kg, often together with quartz and carbonate as fissure fillings. The matrix of this ore type is often transformed.
Processes which have given the amphibolites a new appearance are:
Formation of new chlorites, talc, sericite, bleaching of biotite, coloration of feldspars and biotite by finely distributed hematite and new formation of specularite.
Locally there seems to be an enrichment of quartz and calcite, but this impression may be due to the coarser grain size and the more prominent fissure fillings in these areas.

*As chalcopyrite also may be a mineral of secondary enrichment, the limits of the different zones may be irregular and somewhat arbitrary. The zoning geometry has to a large extent been determined in the field by help of the rock transformations, but microscopy underlines the field observations, and especially that chalcopyrite nearly exclusively seems to occur as a primary mineral (Deer, Howie and Zussmann, H. Bjørlykke, F.M. Vokes).

IIC. Oxidation zone ore.

The last step of transformation undergone by this copper ore type is a pure product of the oxidation zone. Malachite, azurite and cuprite are conspicuous representatives of this multicoloured assemblage. Iron hydroxides generally accompany them.
As a transitional product between the cementation zone assemblage and that of the oxidation zone, it is seen that the blue isotropie chalcocite always is best develpped near oxidation zone minerals. It has grown inwards from cracks and surfaces on the ordinary chalcocite.
Under the same conditions the native copper always is surrounded by a layer of cuprite.
The ultimate results of the weathering is that even the oxidation products have been leached away. In some gossans a 5-25 cm zone of total leaching-out of the ore metals is observed. The host rock, then transformed to a loose, dirty clayey aggregate has however retained the original foliation.
The three varieties of the copper ore:
Protore (chalcopyrite), cementation zone ore (chalcocite, bornite, hematite, native copper) and oxidation zone ore (malachite, azurite, cuprite) are in some places intimately mixed.
Their ecconomic evaluation has been complex.
By the help of extraction of larger volumes and channel sampling (B. Røsholt 1968) the prospect as a whole, has for the time being turned out not to be very promising from an economical point of view.

Geometrical and petrological relationships between ores and host rocks.

The only primary geometrical connection between the two main ore types (iron sulphide type and copper sulphide type) is that both of them, on a regional scale, have a stratiform distribution and are adjacent to each other within the foot wallhanging wall limits of the greenstone/greenshist units. That they locally may be difficult to tell apart geometrically is mainly due to intense tectonization, but exceptionally also to original rapid changes in the depositional milien and to metamosphic processes.

The amphibolite units form a series of original marl sediments and extrusive volcanic greenstones. Within the amphibolite unities the two "pure" rick types, marl and greenstone, prevail volumetrically, but all blends between the two exist.

The complex is metamorphosed in the (greenschist) epidote-amphibolite (garnet-biotite) mineral facies. A metamorphic homogenization (convergence) as to mineral content has taken place. As the metamorphic lavas and metamorphic marls generally have the same mineral constituents, a non genetical terminology was used for mapping purposes. However, it was tried, on textural grounds to discern between volcanic greenstones and greenschists of other origin. Microscopy has amply demonstrated these possible field distinctions to be useful. Greenschists may be of three origins: purely volcanic, detrital volcanic and marl.

Pillow lavas were found at several localities, but are difficult to follow along the strike.

Pure limestones of several meters' thickness are together with carbon-bearing schists and the sedimentary iron sulphides excellent stratigraphic levels.

Generally it can be concluded that the copper paragenesis is bound to the green lavas and the iron sulphide paragenesis (Kisparagenesis) is bound to the basic marl sediments.

It is however, sometimes difficult, in detail to retrace every individual locality of the one or the other ore assemblage back to its original depositional milieu. The reasons for this may be one or several of the following:

1. The two paragenesis have originally been deposited very near to each other.
2. The tectonization has brought them even nearer to each other.
3. General metamorphic and particular cementation processes have mobilized products from the one and/or the other paragenesis and redeposited them within the same volume.

The primary deposition of the iron sulphide paragenesis must have been one of sedimentary character.

C.W. Carstens, who made a thorough investigation of these iron sulphide deposits in the early thirties ( ) considered them ot represent a metamorphic variety of the sedimentary Kieslagertätten-type "vasskis". This is a view I share in every detail.

They are strictly stratabound deposits of an enormous original horizontal distribution. Their host rocks are marl and quartz feldspathic sediments. There is always an important hydrocarbon component in the matrix or adjacent rocks.

The "vasskis" horizons have no absolute preference for any of these host rocks, but there is a clear tendency that quartz is more abundant as matrix constituent than are for instance the limerich marls.
Especially it is seen that the limestone or dolomite layers which are

found near the ironsulphide horizons are absolutely unaffected by the primary mineralization.

This, even if these iron sulphides are intercalated in a mainly volcanic series, their matrix is purely sedimentary, the deposition seems to have taken place periodically between phases of extrusive activity. The relatively high hydrocarbon content which always accompany the iron sulphide layers is seen as a sign of biochemical activity having favoured their precipitation.

The primary copper paragenesis,protore, is strictly bound to the extrusive greenstones. On a regional scale the mineralization has a stratiform lenticular form, strictly the same geometry as the lava bodies. On a local scale the protore bodies appear as less regular impregnation lenses or "clouds", always with their largest dimensions parallel to the hanging and foot wall limitations of the lava benches.

The dominating protore mineral is chalcopyrite. Pyrite is considered to be an accessory mineral, accompanying chalcopyrite relatively unsystematically. Other accessories are magnetite, hematite and ilmenite. As a trace mineral molybdenite seems to be consistent in all directions.

It must be stressed that molybdenite is a very scarce trace mineral, but the multiple finds of it in the protore paragenesis is somewhat in contrast with the very low content of Mo in the green lavas: 3 - 10 ppm.

Molybdenite is relatively more conspicuous in the cementation zone copper ores. A bigger grainsize is one of the reasons for this, locally very restricted enrichments have taken place. But by no means they seem important enough to form an economic ore.

The bearers of the primary copper mineralization (protore) are as earlier mentioned exclusively greenstones, extruded in water or possibly in exceptional cases on dry land. The thickness of the individual benches varies from few centimeters to several decimeters. Typical is that the hanging and foot wall rock of every single lava horizon is completely devoid of this primary mineralization. This holds consequently for every type of adjacent rock, that be the principal hanging and foot wallrock of the whole unit: gneissic quartzites, or the many intercalations of the same and of marl, limestones, and black schists.

The copper content of the protore in these extrusive greenstones is low, and the unaltered rock can never be considered as an ore in the economic sense og the word. A probable background value for the copper content of the greenstones lies under 0,05% and around 0,1% in the better zones. Exceptionally there are zones with 0,2 - 0,3% Cu as chalcopyrite in unaltered greenstones. Thus one has to move to the altered part of the ore zones, where the cementation proccesses have enriched the volume particularly in copper.

One of the best occurrences in the valley, the Karinhaugen prospect, was calculated to have the following ore assay areas on the surface (Nordenskiöld 1908, Geneslay 1938, Poulsen 1938): 2,5% Cu - 700 $m^2$, 1,5% Cu - 1500 $m^2$. However analyses from drillings performed 1939 (Poulsen 1939) show that the ore volume is very restricted and the prospect was discarded as uneconomic. See figure nr. 4.

Figure 4.
The theory of protore-cementation ore - leached/oxidized ore illustrated by old drill hole series in the occurrense Karinhaugen.

DISCUSSION

The iron sulphide ores are considered as metamorphic sedimentary formations generated in a carbon bearing milieu of marl/quarts sedimentation intercalated in a series of basic ~~and acid~~ lavas and ~~tuffs~~. basic and acid tuffs.

How the presumed protore of the copper mineralizations has been primarly introduced into its host rock is far more unclear. Nothing conclusive can at the moment be said about the form in which the copper minerals first were deposited (native, oxide or sulphide).

~~The background value of the copper~~

The background value of the copper content of the green lavas is not higher than normally can be awaited from extrusive greenstones formed under similar conditions.
The distribution geometry of the protore favours the theory that the copper should have been introduced to the site together with its host rock: thus the copper being of direct synvolcanic origin.

The timing of the later development of the copper paragenesis is complex. It must have taken place during an epoch when aquous solutions have been able to circulate through pores and cracks, and must have been a process of long duration.
The copper assemblages (except the protore) as they occur on numerous veins, cracks, and pores, exhibit a typical cementation zone geometry, over important parts of the field, and their mineralogy is not less typical for such formations. Especially the native copper on quartz and calcite veins is of interest.

The metal has been dissolved from its original protore and redeposited at short distances from its original location. Within certain volumes the whole process has taken place in situ. The mobilisation and depositional agenses must have been relatively cool or low-tempered solutions.

The somewhat irregular zoning observed between the protore and the cementation zone generally seems to have horizontal limitations.This suggests that the ground-water can have been at the origin of the dissolving and redepositing medium.This again requires that the cemented areas must have been nearly uncovered or under a quite shallow overburden.

Such conditions have only taken place during the eocambrian epoch and from the quternqry epoch on and up to our days. The relatively short time elapsed since the beginning of the quaternary epoch, makes it little probable that the formation should have taken place in such a recent time.

That the cementation processes ~~sheu~~ may be of eocambrian age is a hypothesis which, with our present XXXXXXXX knowledge, does not meet any severe contradictions, but the material from a larger regional survey has to be treated more in detail before the arguments for and against can be presented with the objectivity they deserve.

As mentioned above, one may locally find mixtures of high and low teperature mineral assemblages in the copper mineralisations. ~~Tectonical disturbances have been emphasized as the most probable reasons for this.~~ Locally it is not possible to establish the consequent age relationships between the different depositions. Tectonical disturbances have been emphasized as the most probable reason for this. However, it is believed that several pulsations under different thermal conditions may have regenerated at least smaller parts of these ores. Through the long history of the deposits it is fully possible that different power-releases have influenced them. For instance there are mineralised crack and fissure systems of both precambrian and caledonian directions.

One of the more spectacular consequences of the hypothesis of formation of cementation ores in late precambrian or early palaeozoic time is that important areas now lying under the cover of the caledonian mountain chain would be virtual prospecting fields. Areas in Finnmark of comparable and partly similar geological and topographical positions which probably have been subject to the same processes as the Porsanger deposits are for example Suovrarappa copper prospect North of Kautokeino and Ulveryggen in the Repparfjord window. Other areas of deep chemical erosion are described by Tore Gjelsvik (                ).

The Porsanger copper and iron sulphide deposits offer a unique chance to study stage by stage the complex development of a widespread mineralisation system. If the economic possibilities of the Porsanger area turned out XXXXX not to be very promising for the time being, the studies of these and other prospects in adjacent areas will be continued in order to try to throw more light upon a province which more and more seems to deserve the attention of the prospector.

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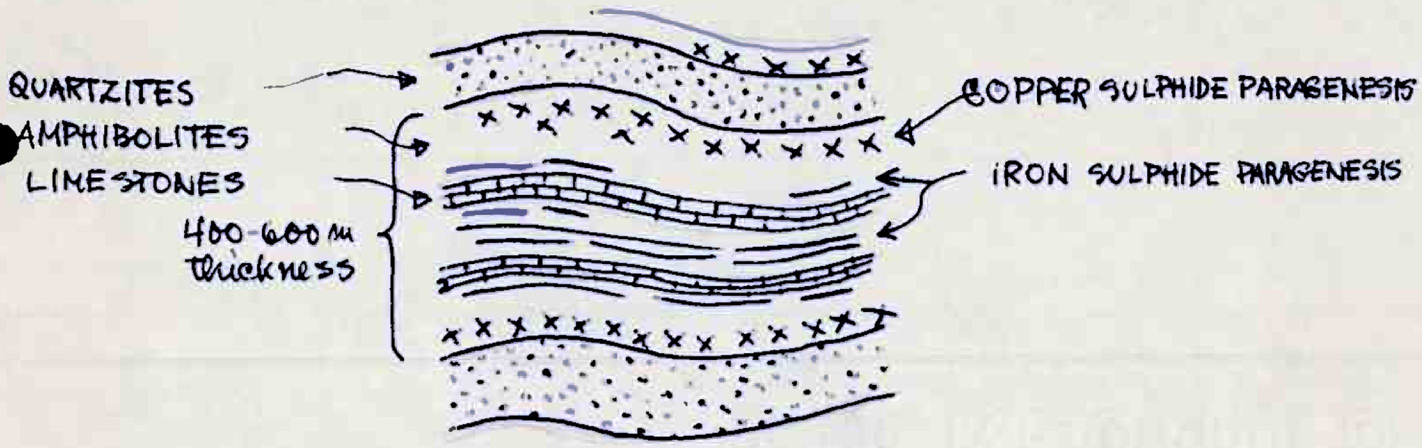
Figure nr 2

PRECAMBRIAN REGIONAL METAMORPHIC SERIES OF THE LAKSELV VALLEY, PORSANGER

Mineral facies: greenschist ↔ epidote (garnet) amphibolite facies




| | IRON SULPHIDE PARAGENESIS (Kis paragenese) | | COPPER SULPHIDE PARAGENESIS | | |
|---|---|---|---|---|---|
| | PROTORE | OXIDATION ZONE | PROTORE | CEMENTATION ZONE | OXIDATION ZONE |
| Major minerals | pyrrhotite<br>pyrite | goethite<br>limonite | chalcopyrite<br>pyrite | chalcocite<br>bornite | malachite<br>azurite<br>cuprite |
| Minor min. | arsenopyrite<br>graphite | metal sulphates<br>native sulphur | pyrite<br>molybdenite<br>magnetite | molybdenite<br>hematite<br>molybdenite<br>native copper | goethite<br>limonite |

| GEOMETRY | IRON SULPHIDE PARAGENESIS | COPPER SULPHIDE PARAGENESIS |
|---|---|---|
| Regional | Stratiform | Stratiform |
| Local | Stratiform | Impregnation lenses and clouds<br>Veins, crack and pore fillings |

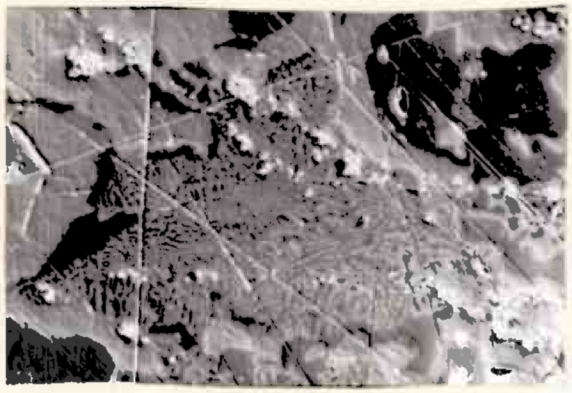
Figure nr. 2

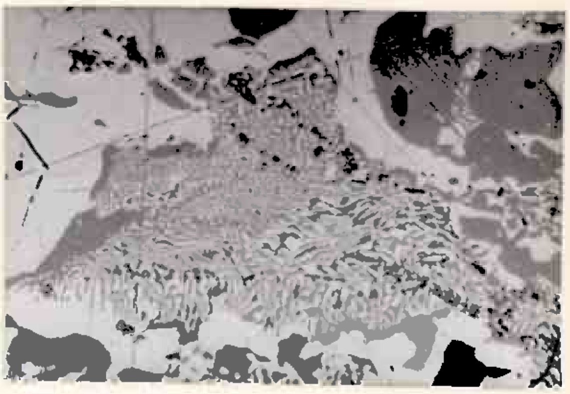
# PORSANGER Copper and iron sulphide deposits

| Element | Number of analysis | | | COPPER SULPHIDE PARAG | IRON SULPHIDE PARAG |
|---|---|---|---|---|---|
| Cu* | 151 | Average | all | 1686 ppm | 80 ppm |
| | | —"— | 5 highest | 20900 " | 8180 " |
| | | —"— | 5 lowest | 36 " | 18 " |
| Pb | 156 | " | all | 15 " | 11 " |
| | | " | 5 highest | 55 " | 60 " |
| | | " | 5 lowest | 4 " | 5 " |
| Zn | 156 | " | all | 18 " | 30 " |
| | | " | 5 highest | 66 " | 92 " |
| | | " | 5 lowest | 6 " | 8 " |
| Ni | 103 | " | all | 462 " | 26 " |
| | | " | 5 highest | 2000 " | 350 " |
| | | " | 5 lowest | 7 " | 7 " |
| Co | 103 | " | all | 46 " | 16 " |
| | | " | 5 highest | 160 " | 74 " |
| | | " | 5 lowest | 5 " | 1,2 " |
| Mn | 103 | " | all | 882 " | 327 " |
| | | " | 5 highest | 2600 " | 640 " |
| | | " | 5 lowest | 104 " | 78 " |
| V | 103 | " | all | 104 " | 139 " |
| | | " | 5 highest | 200 " | 200 " |
| | | " | 5 lowest | 17 " | 16 " |
| Cr | 103 | " | all | 1561 " | 180 " |
| | | " | 5 highest | 12000 " | 640 " |
| | | " | 5 lowest | 50 " | 50 " |
| $Na_2O$ | 61 | " | all | 0,86 % | 2,19 % |
| | | " | 5 highest | 2,15 % | 6,60 " |
| | | " | 5 lowest | 0,10 " | 0,19 " |
| $K_2O$ | 61 | " | all | 0,37 " | 0,87 " |
| | | " | 5 highest | 1,99 " | 3,33 " |
| | | " | 5 lowest | 0,05 " | 0,09 " |

* 5 extremely high Cu values have been substracted from the calculus.

Corgus, Porsanger





myrmekit
cc + bn

4

interferens kontrast objektiv

vanlig lys

Små korn med ekstra høyt relieff
er hematit.

Rittabergene, Pors...

Gediegent Cu med cuprit

Tvers-gående skygger i ...

Rittabergene, Porsanger

Gediegent Cu med
cuprit

# PORSANGER KIS-OG KOBBERFOREKOMSTER

## GEOLOGISK OVERSIKT, LAKSELVDALENS NORDLIGE DEL

GUNNAR JUVE 1965-67