



# Bergvesenet

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Report on a Geophysical Suvey, Orreknappen Grid, Iveland, S. Norway

Forfatter  
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Bedrift (Oppdragsgiver og/eller oppdragstaker)  
Sulfidmalm A/S

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Iveland

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Dokument type

Forekomster (forekomst, gruvefelt, undersøkelsesfelt)  
Orreknappen  
Bekken  
Paasche skjerp

Råstoffgruppe  
Malm/metall

Råstofftype  
Ni, Cu, Co

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Engelsk tekst. mangler kartbilagene

Ref til undersøkelser i 1967-68 hvor Ni-førende magnetkis i ultrabasitter var påvist i to områder med gamle gruehull. Geologien i området beskrives med ultabasitter og interessant grov hornblende dioritt. Områdets mineraliseringer presenteres med analyser.

Rapporten beskriver videre geofysiske undersøkelser med ABEM Slingram og Crone CEM Shootback.

De geofysisiske målingene kan ikke påvise sammenheng mellom de to mineraliserte områdene som ligger ca 500 meter fra hverandre.

Geologi og målinger tyder på tektonisk kontrollerte soner av begrenset utsrekning.

Pack sac drilling foreslås.

FOR FALCONBRIDGE NIKKELVERK A/S

A/S SULFIDMALM

PROJECT 905-7

REPORT ON A GEOPHYSICAL SURVEY,  
ORREKNAPPEN GRID, IVELAND, S.  
NORWAY.

FEBRUARY 1972

F. NIXON



## INTRODUCTION

The present survey was carried out in order to cover the ground between two small areas of known mineralization. Limited geological and geophysical investigations had previously been carried out in the known areas in 1967 and 1968.

The grid area is located in Iveland community, approx. 2 km NNE of Klepptjern.

Results of the 1967-68 investigations will also be presented here.

## WORK CARRIED OUT

- 1) In 1967 regional mapping/<sup>in</sup> the Evje-Iveland area relocated two areas of known mineralization. Area A) Orreknappen area, where a small shaft had been driven in nickeliferous pyrrhotite and area B) Bekken area, where four small prospect pits had been sunk in nickel bearing ultrabasics.
- 2) A small scale electromagnetic survey was carried out in 1967 covering the two areas mentioned above. The ABEM slingram equipment was used.
- 3) In 1968 a more detailed geological investigation was carried out around the mineralized showings.
- 4) The present survey has consisted of 8,8 line km of EM measurements with 100 m profile separation, using the ABEM slingram with 60 m coil separation and a frequency of 1760 Hz.

More detailed profiling with closer interval survey and 40 m coil separation has been carried out in the vicinity of the two areas of known showings. Some detailing of the "Bekken" area has also been carried out with the Crone CEM unit-horizontal shootback method.

A magnetic survey was also run simultaneously with the EM in the same grid, but with 50 m line separation and 12,5 m stations.

## RESULTS

### A) Geology

The Orreknappen area lies near the eastern margin of the more massive basic rocks of the Iveland-Evje complex.

The main rock type in the area is a medium grained amphibolite which gradually changes in a northerly direction into hornblende and dioritic gneiss; rocks north of the Birkeland stream being mainly gneissic.

Pegmatites are abundant and quite large, some being over 100 m in length.

An interesting rock type is the so-called "coarse hornblende diorite" which in the area is confined to the vicinity of the Orreknappen mine. The rock is essentially a dioritic rock with hornblende aggregates (sometimes up to 10 cm in length) in a felspar groundmass. The rock has a clear metamorphic paragenesis and at times looks like a product of migmatization.

Ultrabasic rocks are found in situ at only three localities - Orreknappen and two of the Bekken prospects. All the rocks are meta- pyroxenitic/hornblenditic and occur in connection with tectonic features, either occupying shear zones or as layers or bands along fracture planes. Most carry sulphides.

The foliation in the area varies, but the main trend here is roughly NE/SW with dips towards the west. All the linear structures in the area plunge towards the south-west. The area falls into the regional fracture pattern; - dominant regional fractures E/W, NW/SE, NE/SW.

The Birkeland stream follows a strong E/W tectonic zone.

Short descriptions of the Orreknappen prospect and the two small prospects in the Bekken area follow:

The Orreknappen prospect lies about 30 m to the west of the road to Aukland farm, approx. half way between the farm and where the road joins the main Frikstad-Vatne road.

The showing is a government holding leased to Sulfidmalm.

The prospect is first mentioned in 1869 and between this date and 1872 trial exploration was carried out and a 1½ m deep pit was sunk. In 1907 sampling was carried out. In 1917 trial work was carried out by Evje Nikkelverk A/S. The shaft was sunk to a depth of 15 m and a cross cut 80 m long? was driven. Two diamond drill holes proved to be barren. 285 t of ore with a Ni content of 2% were produced. Work was continued until 1918, but then abandoned.

The rocks that outcrop in the immediate vicinity of the prospect are amphibolites and coarse lib. diorite. The amphibolites contain ore minerals associated with felspar and quartz, but most of the visible ore is connected with shears.

Thin veins of meta pyroxenite occur, usually as coatings, on joint planes.

The main mineralizations present were:

- A) Connected with shears: - usually massive.
- B) As veins.
- C) As concentrations along joint surfaces.
- D) As disseminations.

The smaller veins are rich in pyrite and chalcopyrite whereas larger veins are rich in pyrrhotite - usually having more chalcopyrite towards the border. In places the massive ore has inclusions of amphibolite which is slightly sheared and contains disseminated ore minerals. A polished section of a sample of massive pyrrhotite gave the following minerals:

	<u>Est. % by Vol.</u>
Pyrrhotite	74
Marcasite	7
Chalcopyrite	1
Pentlandite + Violarite	2
Goethite	4
Gangue silicates	12.

The following assay results are available. As can be seen, the ore has an unfavourable Ni/S ratio:

<u>Spec.</u>	<u>Ni %</u>	<u>Co %</u>	<u>Cu %</u>	<u>Fe %</u>	<u>S %</u>	<u>Type</u>
2.68 E9a	1,43	0,066	0,07	51,5	36	Massive ore
3.68 E9	0,86	0,053	1,38	44,2	22	Heavy dissemination

In the ~~n~~orthernmost mineralized area are the following four small prospect pits:

- A) Bekken
- B) Paascheskjerp syd (two small prospect pits)
- C) Paascheskjerp nord.

The Bekken prospect pit lies on the south side of the Birkeland stream about 200 m ENE of Aukland Farm.

A small waterfilled prospect pit 2m x 3m x 1.5 m that is located on a shear zone in amphibolites. This shear zone is parallel to the stream (EW).

Mineralization is seen in situ at one place only - in connection with meta-ultrabasics that partly occupy the shear zone. The entire shear zone is highly weathered. The ultrabasic material was entirely hornblenditic, but so much altered and sheared that it was impossible to decide whether the rock was intrusive or merely a shear product of the amphibolite.

The mineralization in the shear zone consisted of fairly massive pyrrhotite and minor pyrite. The dumps yielded some massive sulphides, a lot of which were in vein form. Minor disseminations of pyrite were found in amphibolite.

Two analyses of dump material gave the following values:

<u>Sample</u>	<u>Ni</u>	<u>Co</u>	<u>Cu</u>	<u>Fe</u>	<u>S</u>	<u>Type</u>
V 2 b	0,35	0,04	0,26	26,1	12,6	Mineralized ultrabasic
V 2	1,3	0,11	0,12	53,5	40,0	Massive pyrrhotite

Paascheskjerp south lies about 20 m east of Bekken prospect pit on the northern side of Birkeland stream. Two small prospect pits in which the main rock type is amphibolite which in places is well sheared. Ultrabasic rocks were noted as:

- A) thin bands parallel to the foliation
- B) black sheared bands.

Type A are green hornblenditic/ meta-pyroxenitic rocks and of an intrusive origin. Type B are considered to be shear products, they consist of a lustrous black hornblende oriented parallel to the plane of shearing.

The foliation in the rocks around the prospect is 125 / 50 SW, two dominant shears also trend in more or less the same direction, 120 being measured at 120/ 28 SW and 125/ 48 SW.

No mineralization was found in situ, two mineralized specimens found on the dumps returned the following assays:

<u>Spec.</u>	<u>Ni</u>	<u>Co</u>	<u>Cu</u>	<u>Fe</u>	<u>S</u>	<u>Type</u>
0/ BIRK 7	0,6	0,06	0,11	39,9	19,0	M. pyroxenite with
0/ BIRK 6	0,1	0,01	0,06	20,6	2,7	po. " "

The small prospect pit named Paascheskjerp north consists of a small water filled pit with mineralized ultrabasic blocks on the pits.

## GEOPHYSICS

An initial reconnaissance survey was carried out using the ABEM EM gun unit with 60 m cable and 1760 Hz frequency. Profile spacing was 100 m. The results of this survey are presented on map nr. 07/72/1. As can be seen from the map, only one area gives any definite response, this being on line 400 N between 60 W and 120 W. Here the imaginary values range from +4% to -6%. Otherwise the entire grid is almost entirely flat (0% imaginary component) except for odd areas where -1% is recorded; (- a series of -1% values are recorded near the Orreknappen prospect).

This initial survey has shown that there is no large scale conductor present between the Orreknappen and Bekken prospects and that there is no connection between these two prospects. This conclusion is also strengthened by the geological observations in the Bekken area. The mineralization seems to be possibly controlled by E/W tectonic features, whereas in the case of Orreknappen there may be some tectonic control running NE / SW.

Failing to find any connection between the two prospects, it was decided to carry out some detailing work in order to try and define more accurately the geometry and extent of the mineralizations at Orreknappen and in the Bekken area.

Maps 07/72/4 and 07/72/5 show the results of detailing in the Bekken area. The area was detailed with the ABEM gun, high frequency 40 m cable and the Crone CEM unit using the horizontal shoot-back system.

Map nr. 07/72/4 shows the results of a small electromagnetic survey with the ABEM gun. The imaginary component values have been contoured. The contoured values show two negative highs that form parts of a negative zone trending subparallel to the stream. The known showings lie immediately to the north of this negative trend. The zone is approx. 150 m long. Map 07/72/5 which shows the Crone horizontal shoot-back negative values contoured, gives a similar trend as the ABEM, but slightly displaced in comparison.

The contoured ABEM real component values also give the same general trend.

It is obvious from the two surveys in this area that there is conductive ground here in this area.

From a study of the individual profiles a more exact interpretation of the anomaly zone can be obtained. Enclosures 1A and 1B show ABEM data and Crone data for line 375N, both sets of data indicate non-conductive ground. Enclosures 2A and 2B both suggest conductive ground probably centered around 60 N. The data, however, are difficult to interpret. The Crone data especially may indicate a fairly steep dipping source with some depth to its surface. However, it is also suggested that the anomalies may result from the fact that the profiles are not perpendicular to the strike of the conductor, and that the hanging wall of the conductor may form a dipping plane that is exposed to the instrument over a large part of the profile.

Enclosures 3A and 3B also show evidence of conductive ground. The Crone profile is incomplete to the east to give good interpretation, but seems to indicate a steeply dipping conductor dipping west, centered around zero and of shallow depth to the surface. Enclosure 3B, however, which is the ABEM data, suggests that two parallel conductors are present. This is also suggested on enclosure 4B whereas the Crone profile shows a definite conductor that theoretically has been calculated as shown on the diagram. It would seem that the Crone unit is not as sensitive to closely spaced separate conductors as in the ABEM unit. Enclosures 5A and 5B show no conductive ground.

It is interesting to note that on all contoured diagrams (Crone, ABEM real and imaginary components) there is definite evidence of a break in the anomaly trend. This is thought to be caused by a fault that follows the line of the stream.

On the basis of the evidence of known geology and the geophysics it is suggested that the anomalies are caused by fairly narrow conductors of massive-rich disseminations of sulphides: - py, py that are in association with structural zones, probably shears which in turn may be associated with a main tectonic feature that follows the line of the Birkeland stream. From the location of the prospect pits in this area it would seem that they are not the most promising locations for ore in this area.

In the Orreknappen mine area detailing with the ABEM gun using 40 m cable, was carried out. The results are shown on map nr. 07/6/72. Here it can be seen that a definite, although not strong, anomaly trends NE /SW over a distance of 50 to 60 m. The Orreknappen prospect lies on this anomaly. It is interesting to note that the dominant lineations in this area plunge towards the SW. It is thought that it could be possible that the mineralization may be controlled by a linear feature caused by the intersection of two planar structures.



The contoured magnetic map seems to express the regional fracture pattern E/W NW/SE well.

A marked negative feature is related to the Orreknappen prospect. Similar negative areas in other parts of the grid do not give any electromagnetic anomalies and are not known to be related to mineralization.

The Bekken prospects do not give any well defined magnetic anomalies.

#### CONCLUSIONS AND RECOMMENDATIONS

- 1) Several small nickel showings are located in the area. These carry sulphides of a massive variety and seem to be tectonically controlled. Some of the mineralization is connected with ultrabasic rocks.  
The two main areas of mineralization: - Orreknappen and Bekken, lie approximately 500 m from each other.
- 2) Geophysics has not proved any association between these two areas.
- 3) Combined interpretation of geology and geophysics indicate a restricted conductor in the Orreknappen prospect area that strikes in a NE/SW direction, and it is suggested that this may be tectonically controlled.
- 4) In the Bekken area it is suggested that tectonically controlled mineralization occurs as one or several parallel conductors of limited strike length. The "anomaly zone" is dissected by a fault.
- 5) The geophysical survey has not found any new areas of mineralization. However, it is defined the existence of definite conductive zones in the two previously known areas. Although of limited length, the Bekken anomaly zone is considered interesting because of the fairly high nickel values from the known prospects. (It should also be mentioned here that this Bekken area has been chosen as a test area for the various geophysical systems that Sulfidmalm have to its disposition. ABEM various frequencies, Crone, horizontal shoot-back, Coaxial shootback, and broadside methods, Geonics VLF and magnetics have been carried out). It is recommended that a limited Winkie drill program be carried out.

*JBG*

## ENCLOSURES:

### Maps

- 1) Location map showing geology of Evje-Iveland area.
- 2) EM survey Orreknappen grid.
- 3) Detail EM Orreknappen grid - Orreknappen prospect area.
- 4) Detail EM Bekken area. Imag. component contoured.
- 5) Detail EM Bekken area. Real component contoured.
- 6) Detail CEM horizontal shootback. Bekken area.
- 7) Magnetic anomalies Orreknappen grid.

### Diagrams

Enclosures 1A/1B - 5A/5B, individual ABEM and CEM horizontal shootback profiles.

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