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SAKSBEARBEIDER Øyvind Gvein and Ingolf J. Rui.

RAPPORT VEDPØRENDE:

THE KNABEN AREA.

Report from the field-season 1979 and a compilation of results from previous drilling and exploration work.

RESYMÉ:

Vertical sections through the Knaben II-orebody show that the ore zone is not delimited toward depth in the southern sectors. A drill hole of 500-600 m. is proposed to explore the deeper part of this area.

Previous drillings in other parts of the Knaben region have not disclosed ore grade mineralization.

Streamsediment investigation in the region responds clearly to MoS₂ in the vicinity of known mineralized areas.

The anomalous values are mostly scattered but confirm that the N-S zone through Knaben and a zone near the river Kvina is anomalous in Mo.

Geophysical methods are evaluated. Magnetical measurements seem to be the only usable method do to the fact that the altered gray gneiss ("gangfjell") - the potential orebearing rock - shows low susceptibility.

Further investigations are proposed.

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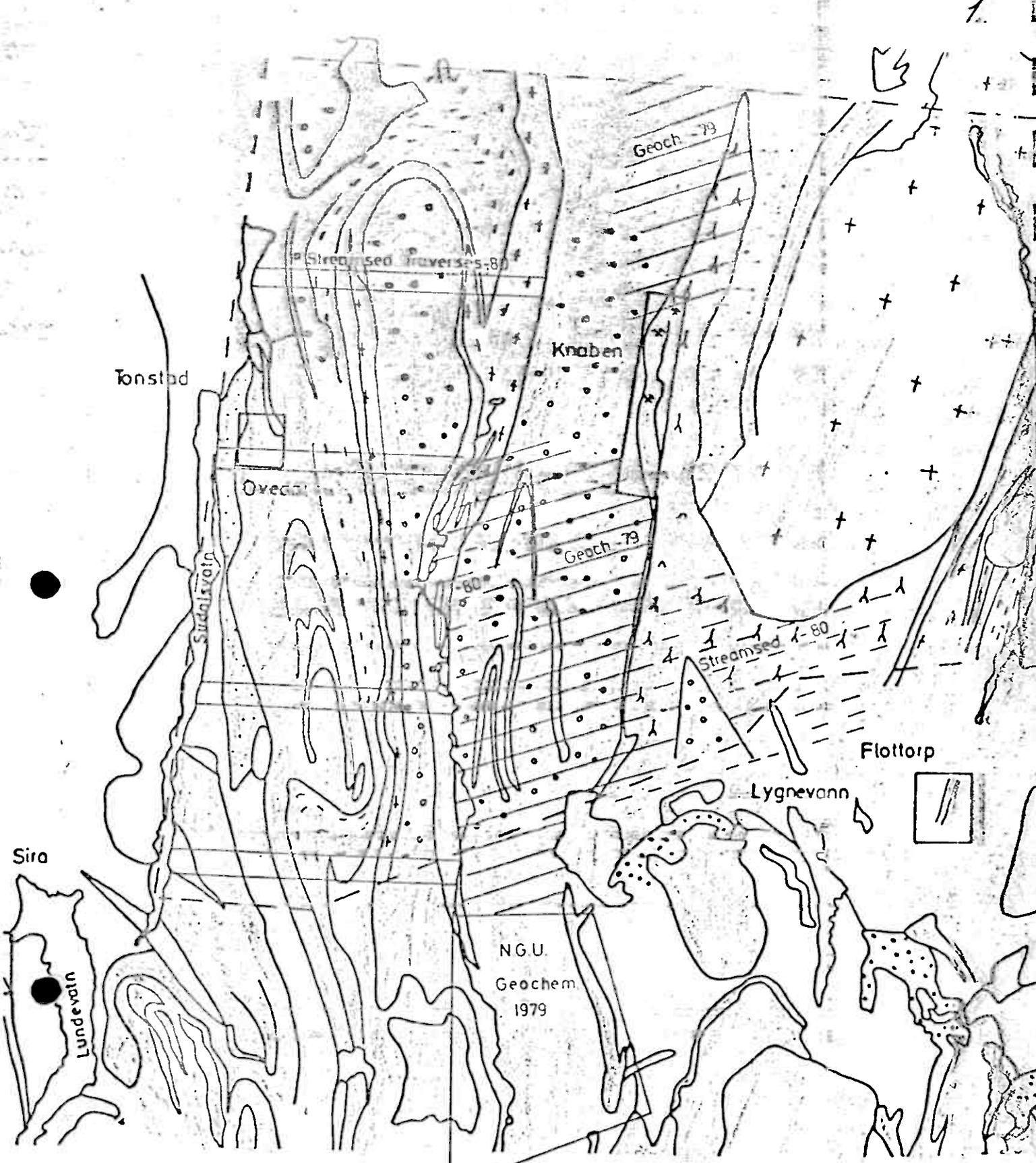
REPORT NO. 1077

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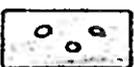
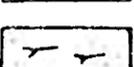
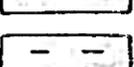
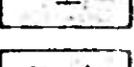
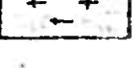
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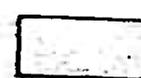
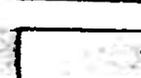
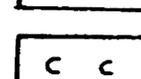
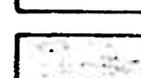
| | |
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| 1077 - 1 | Mo in streamsediments |
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| 4 | F - in streamwater |
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(After T. Falkum) 1:250000

After Leake (1972)
inside area bordered
by stippled line

-  Equigranular poorly foliated granite
-  Massive porphyritic felsic gneiss with some layering
-  Massive porphyritic felsic gneiss
-  Layered felsic gneiss
-  Layered biotite feldspar gneiss
-  Nondifferentiated pink gneiss

-  Grey layered gneiss with basic material
-  Feldspar gneiss
-  Charnokitic gneiss
(Outside map area)
-  Younger granite intrusives
-  Quartz monzonite - intrusives

THE KNABEN AREA

Report from the fieldseason 1979, and a compilation of results from previous drilling and exploration work.

1. INTRODUCTION

The geology in the agreement area was presented in the report "The Molybdenite - Province of South-Western Norway" in March 1979. During the fieldseason 1979 our work started in the area to the north and the south of the Knaben II - Mine as the main working area. In addition we have to a certain extent been doing general reconnaissance work in the region to study rocks and mineralizations.

Geochemical work is carried out in the areas shown on the map at the facing page. (This map also show our proposal for geochemistry in 1980).

The Geological Survey of Norway (N.G.U.) has carried out geochemical investigations in the area shown on the map. We will receive a report on this work in course of April.

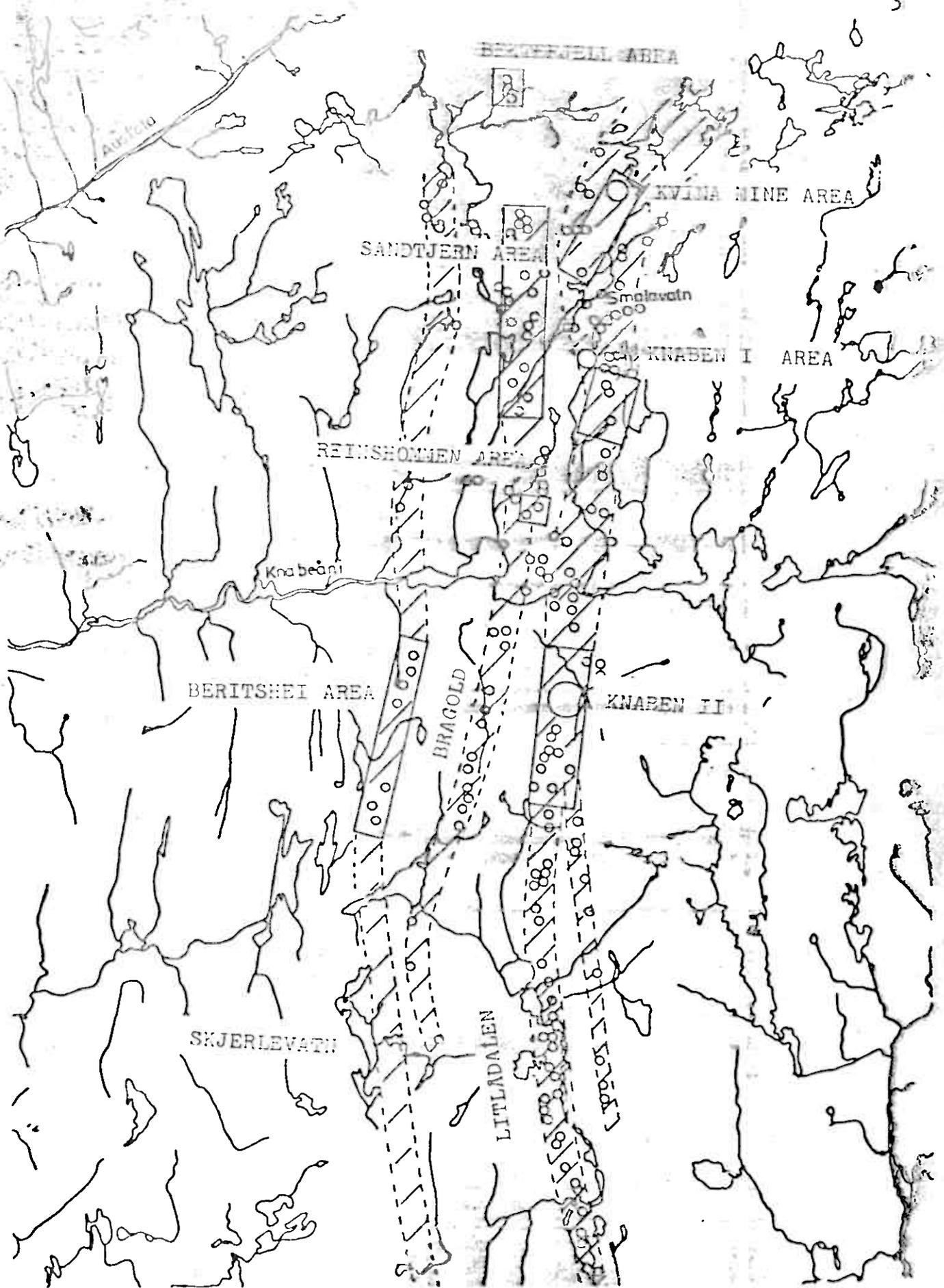
A/S Sydvaranger's geologists Ø. Gvein and I.J. Rui have been responsible for the work. 4 students A. Sigersvold, T.H. Hanssen, R. Jerndalo and A. Sæveland have carried out the geochemical sampling.

In February this year Gvein and Rui visited The Inspector of Mines in Bergen to collect data from previous core drilling and underground exploration work.

A compilation of the most important data is presented in this report.

2.0 GEOLOGY

- 2.1 General Geology: Vaste areas in the surroundings of Knaben
- * consist of homogenous red granite often showing rectangular (1-2 m) blastoporphyes of alkalifeltspar. Mo-mineralization in the peripheral Bragold zones to the west of the Knaben II deposits (Map p.3) occur in association with quartz veins in the red granite (Fig.I).



Mineralized zones in the Kvina-Knaben area,
 scale 1:50 000

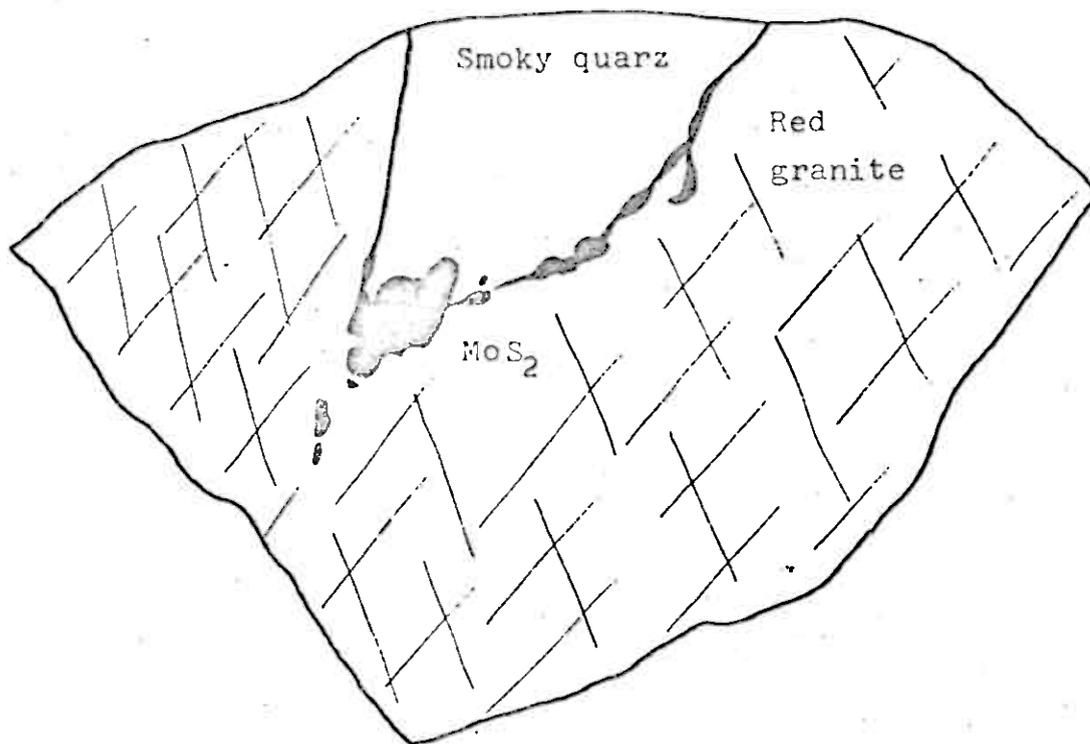


Fig. 1 : Sawed rock slab showing quartz-molybdenite vein of the type commonly found in the Bragold, Skjerlevatn, Sandtjern and Bektefjell areas. This sample could also be looked upon as a miniature of the mode of mineralization at the Kvina mine. Natural size.

The deposits in the Skjerlevatn zone in the south and the Sandtjern and Bektefjell areas to the north show a similar mode of occurrence. The quartz-molybdenite veins are in places clearly connected with thin shear zones up to a few meter thick, the latter in turn being arranged in a N-S trending regional pattern.

The main zone of Mo-mineralization occur from the Kvina mine in the north through the Knaben I and the Knaben II mines, tapering southwards along the valley of Litlådalen. Even though the red granite is the principal rock type, this zone shows a heterogeneous nature by the relatively abundant presence of dark biotite-amphibolite, and rusty gneiss designated "fahlbands".

The amphibolite bodies may be up to 20-30 m thick, rarely extending for more than a couple of hundred meters along strike. They often appear to be severely twisted and torn apart in a mobile granite fase. The amphibolites which essentially consists of plagioclase, amphibole, biotite and quartz may represent remnants of an older supracrustal complex. Two parallell amphibolites mapped near the Knaben II mine are, however, clearly discordant to the regional foliation and the trend of the mineralized zone.

The rusty gneiss zones - the "fahlbands" sometimes carry disseminated molybdenite together with iron sulphides. The extensive and uncomplicated parallellism to the regional foliation indicate that the "fahlbands" represent mineralizations in shear zones.

Reconnaissance work at Flottorp (map. p.1) has confirmed earlier studies. The molybdenite dissemination is here confined to three separate gneissic zones at the most 40-50 m broad and which is enclosed in ordinary pink granite. Whether these gneissic zones may represent remnants of supracrustal rocks or shear zones in the granite is not clarified.

2.2 The Knaben II mine.

Common sulphide minerals recognized in the ore zone are molybdenite, pyrite, pyrrhotite and chalcopyrite - only the first one has been of economic importance.

The molybdenite occurs as dissemination, or more concentrated as patches or streaks along joints in gray granite/gneiss which have been invaded by abundant, subparallell quartz veinlets ("gangfjell"). The rock probably represent a bleached modification of the surrounding red granite, evidenced by a rather strong sericite alteration of the feldspars in the former. This process is also accompanied by the formation of small amounts of secondary carbonate.

The contact between the red granite (country rock) and the altered gray "gangfjell" in the Knaben II mine is in part sharp (blockdiagram in enclosure 1077-7), but transitional rock types are indicated on the geological mine maps.

On the block diagram the Knaben II ore zone shows to be roughly plate-shaped dipping ca. 30° E. In the northern 2 blocks rich mineralization occur near the surface, ultimately cropping out in

the open pit.

Southward the best portion of the ore is found at deeper levels successively in section 5 and section 7. At the same time the ore zone wedge out toward the surface, leaving sparse evidence of the richer mineralization at deep. In fact, the narrow quartz-molybdenite veins found at surface are of the same general type as those occurring in, for instance, the Beritshei and the Bragold zones described above.

Along the dip the ore zone widens and eventually split up in two subparallel zones with lowgrade or barren "gangfjell" inbetween as indicated in section 2 and 5. Following this line it appears that the richest portions of the ore represent an elongate ore shoot which crop out in the open pit, plunging about 15-20° south. The ore shoot could be controlled by a set of crossing shear zones diverging to the east. This means that the most promising target area with respect to the continuation of the Knaben II orebody is in the area south of section 7, at about 300-400 meters a.s.l., or 500-600 m. below surface.

2.3. The Knaben I-area.

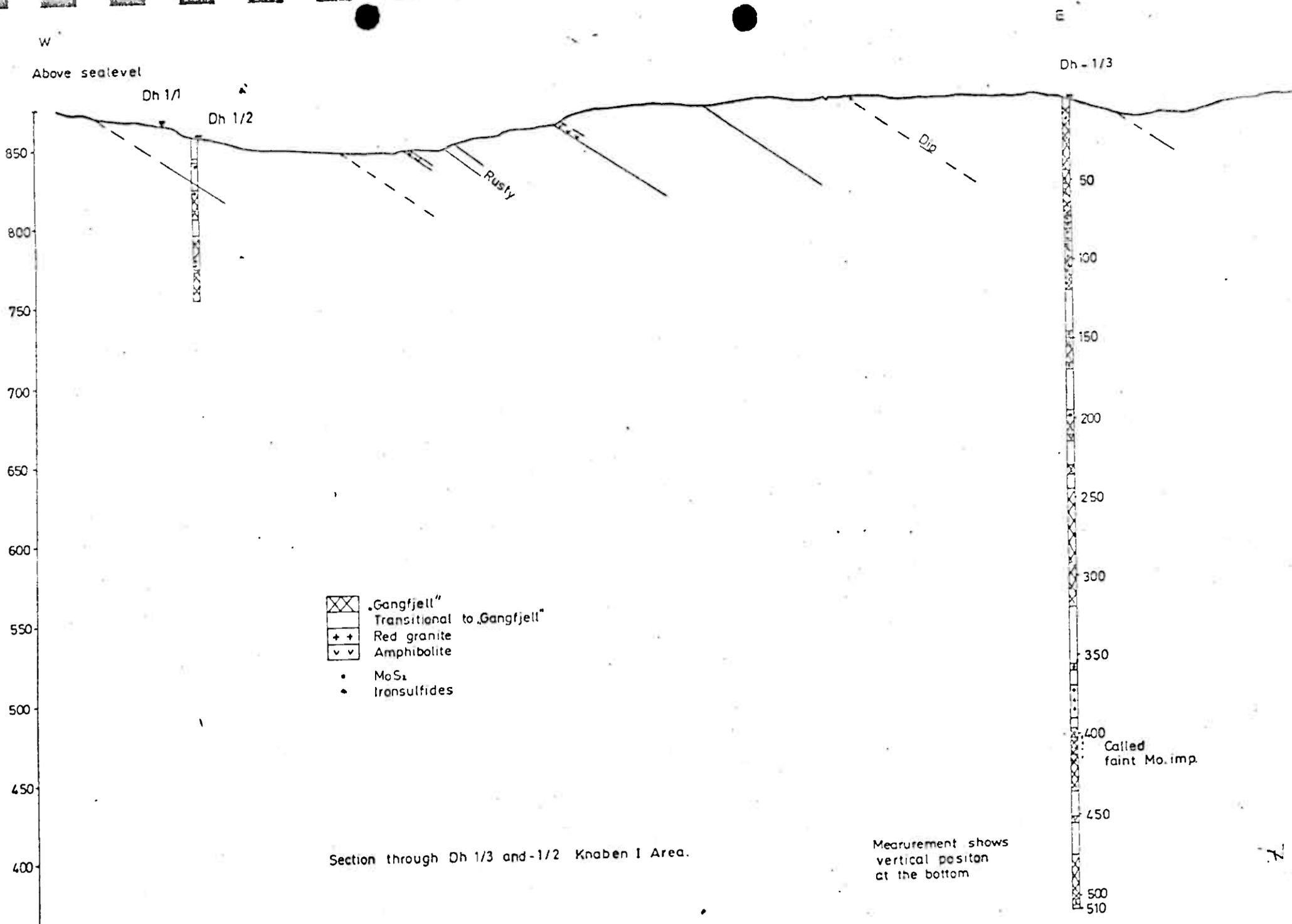
In the Knaben I-area (map. p. 3) long hole-drilling took place in 1961 and 1962. Vertical sections through three drillholes i.e. 1/3 1961, 2/1962 and 3/1962 are shown on the next pages, the latter is situated some 1,5 km to the south of the former.

The drillsites for these three holes are close to the border between red granite in the east and more heterogeneous, often rusty gneiss in the west. (Maps in scale 1:5000 in the enclosures 5 and 6 - shows some details of the area).

It is of course a disadvantage that the cores from these holes have not been saved. We therefore have to rely on terms used in the corelogs such as "gangfjell" and "rock transitional to gangfjell" which are frequently in use. The transitional rock is mostly situated in between red granite and "gangfjell" and it is likely to conclude that a gradual change from red granite to "gangfjell" take place.

The molybdenite-mineralization is weak and usually connected to quartz veins, and there is no apparent correlation with Mo-mineralization in outcrops.

Fe-sulfides is in places reported to occur together with molybdenite



W

E

Above sealevel

Dh - 1/3

Dh 1/1

Dh 1/2

Rusty

Dip

850
800
750
700
650
600
550
500
450
400

50
100
150
200
250
300
350
400
450
500
510

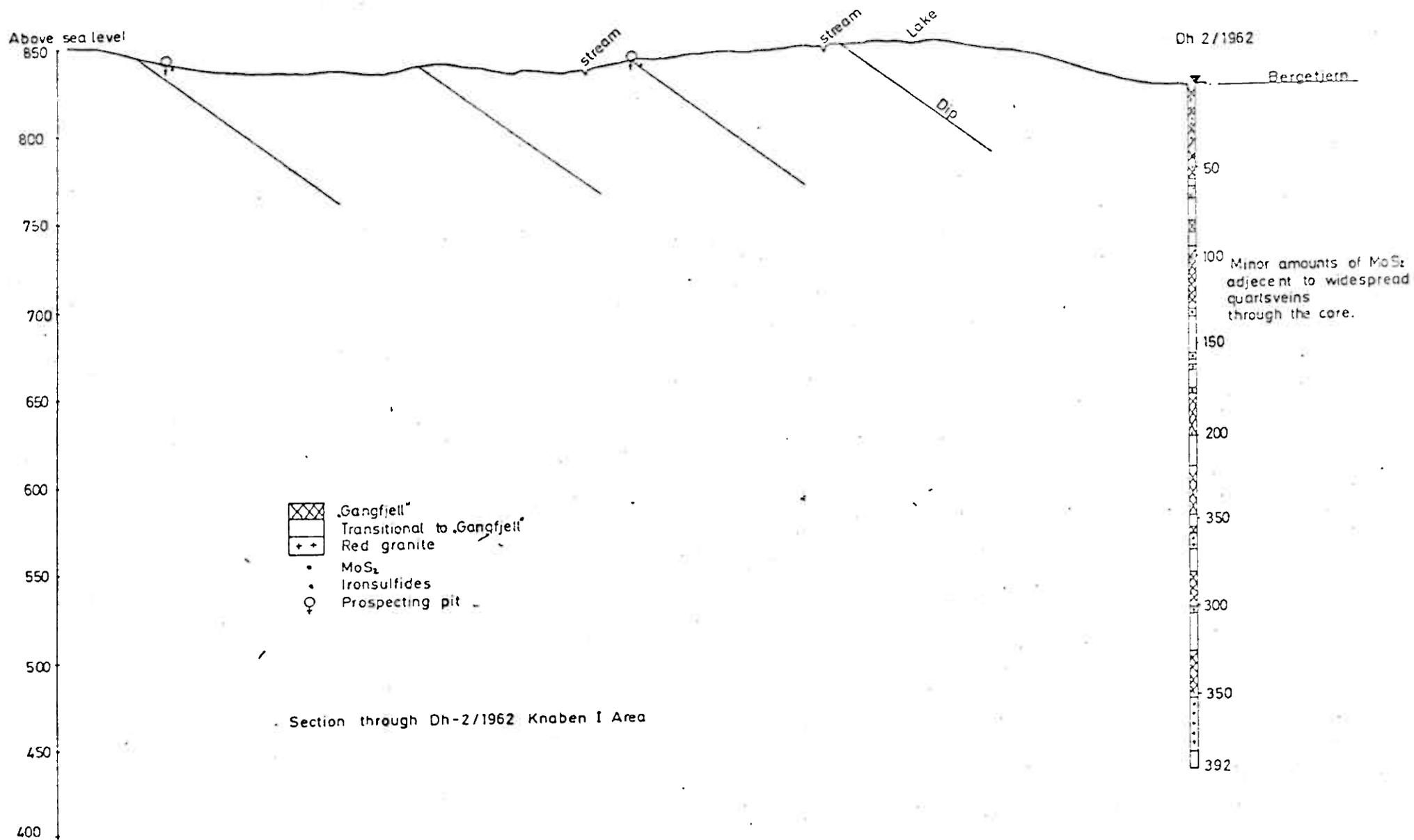
- ⊗ "Gangfjell"
- ▬ Transitional to "Gangfjell"
- ++ Red granite
- ∇∇ Amphibolite
- MoS₂
- Ironsulfides

Section through Dh 1/3 and -1/2 Knaben I Area.

Measurement shows vertical position at the bottom

Called faint Mo. imp.

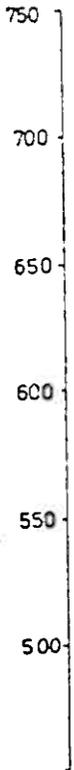
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E

W

Above sealevel

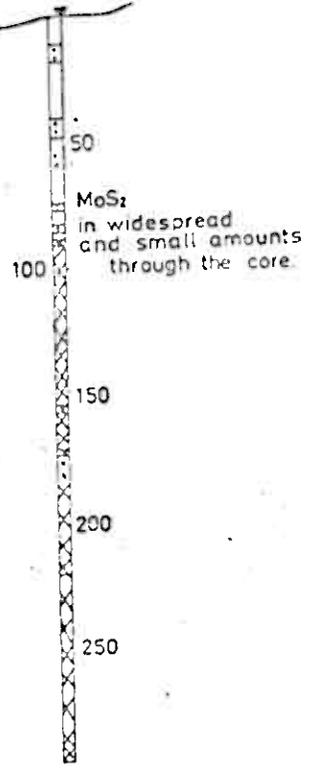


-  Gangfjell
-  Transitional to Gangfjell
-  Red granite
-  Amphibolite
-  MoS₂
-  Fesulfides
-  Prospecting pit

Section through Dh- 2 /1962
Waterreservoir in the river Knabeåi.

Rusty
Dip

DH- 3, 1962



but most frequently the latter is not present. This will of course reduce the advantage of I.P.-measurements.

2.4. The Reinshommen field.

In the Reinshommen field (map.p.3) there is a small old mine with two adits (called "stoll" on the map page 11). In the outcrop MoS_2 occurs in association with quartz veins, partly also as a weak dissemination in aplite (similar to "gangfjell".).

The area is drilled with 4 holes as shown on the map and the sections p.11 and 12. So far we have not been able to find the corelogs and therefore we don't know the type of mineralization in the drill holes.

The rock has a faint foliation dipping some 30° east and the holes are drilled perpendicular to the plane of mineralization.

Drill hole no.5 shows high MoS_2 - content, 0,72% over an interval of 1m. This zone could correspond to a rusty gneiss zone in the surface, but this particular level has not been mentioned in the other holes.

Drill hole no.4 is mineralized at a level corresponding to the "aplite" in the surface and the same level is also reported in drill hole no.3 - 23,45m of 0,10% MoS_2 .

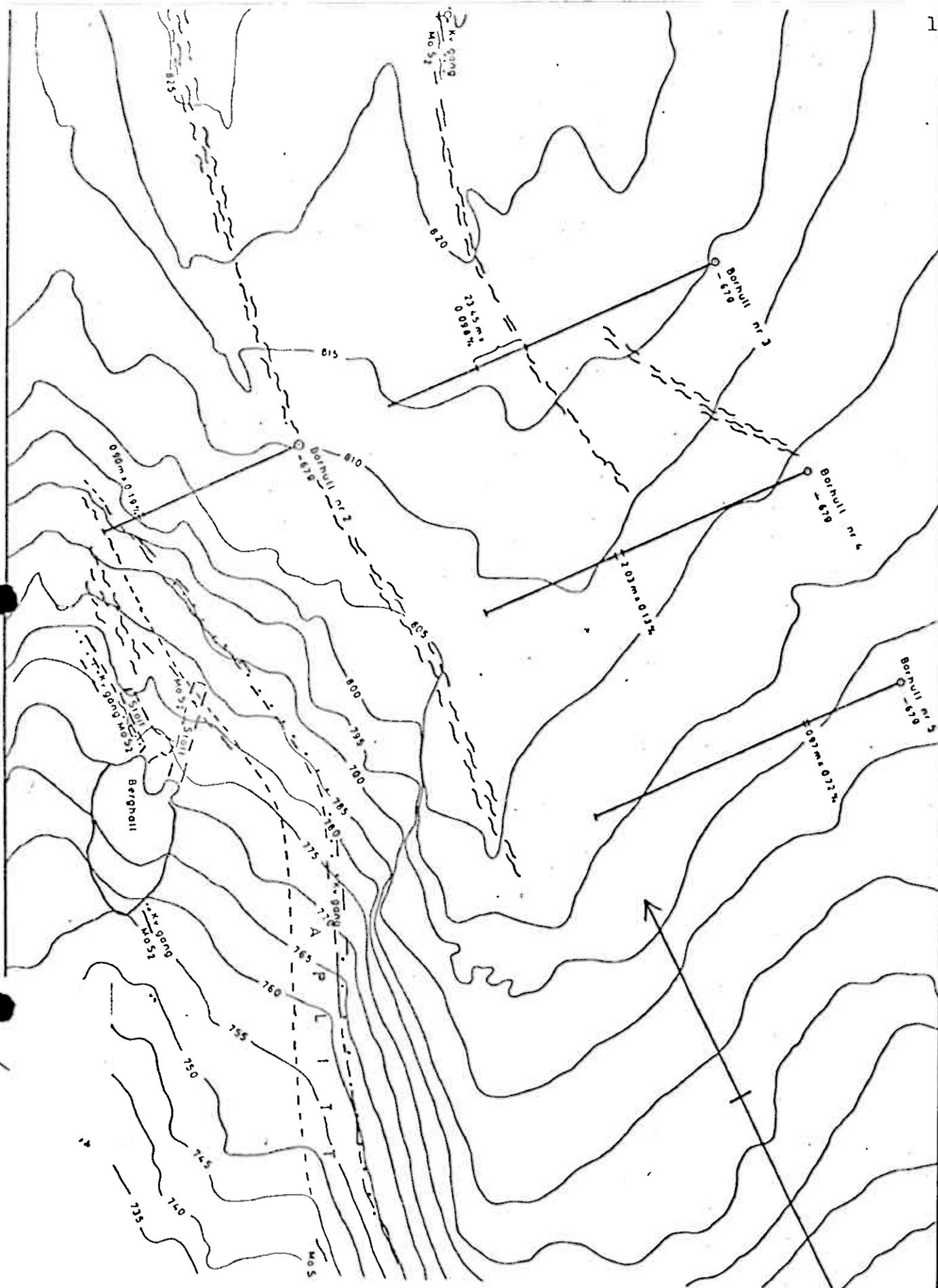
Drill hole no.2 however, shows nothing at the "aplite" level, but is mineralized in a somewhat lower zone. It is possible that this field is mineralized on the aplite level along an unknown axial direction in line with the situation at Kvina, Knaben I and Knaben II. We should therefore keep the Reinshommen field in mind.

2.5. The Kvina area.

The Kvina Area (map. p. 3) forms the northernmost extension of the so-called Knaben Mineralized Zone. Apparently the amount of "gangfjell" in the red porphyry granite has decreased markedly in this area, as compared to the areas further south, indicating a fundamental change in the geological conditions.

MoS_2 -mineralization is connected to a pegmatite body and is concentrated in a nearly pure quartz border zone toward the surrounding gneiss.

The pegmatite-quartz body has a lense shape, and lies concordant to the foliation of the porphyry granite. Average strike: $N22^\circ E$, dip: $30^\circ SSE$. The lense has a slight plunge (10°) to the south. Maximum width is 16 m. It has been followed by mining for 240 m along the axis. Maximum horizontal extension is approx. 80 m. It

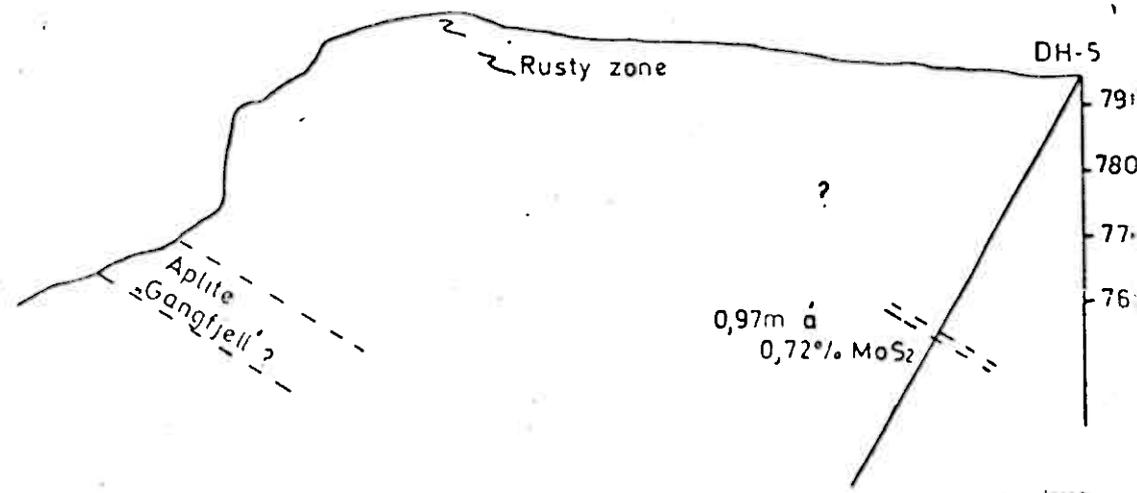
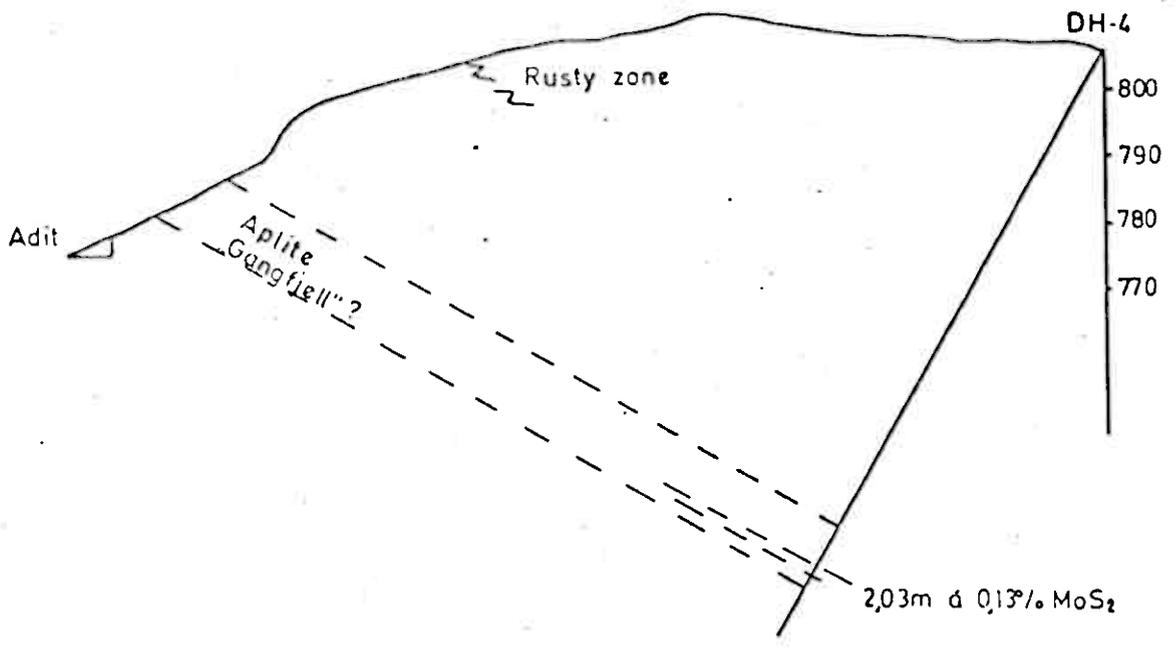
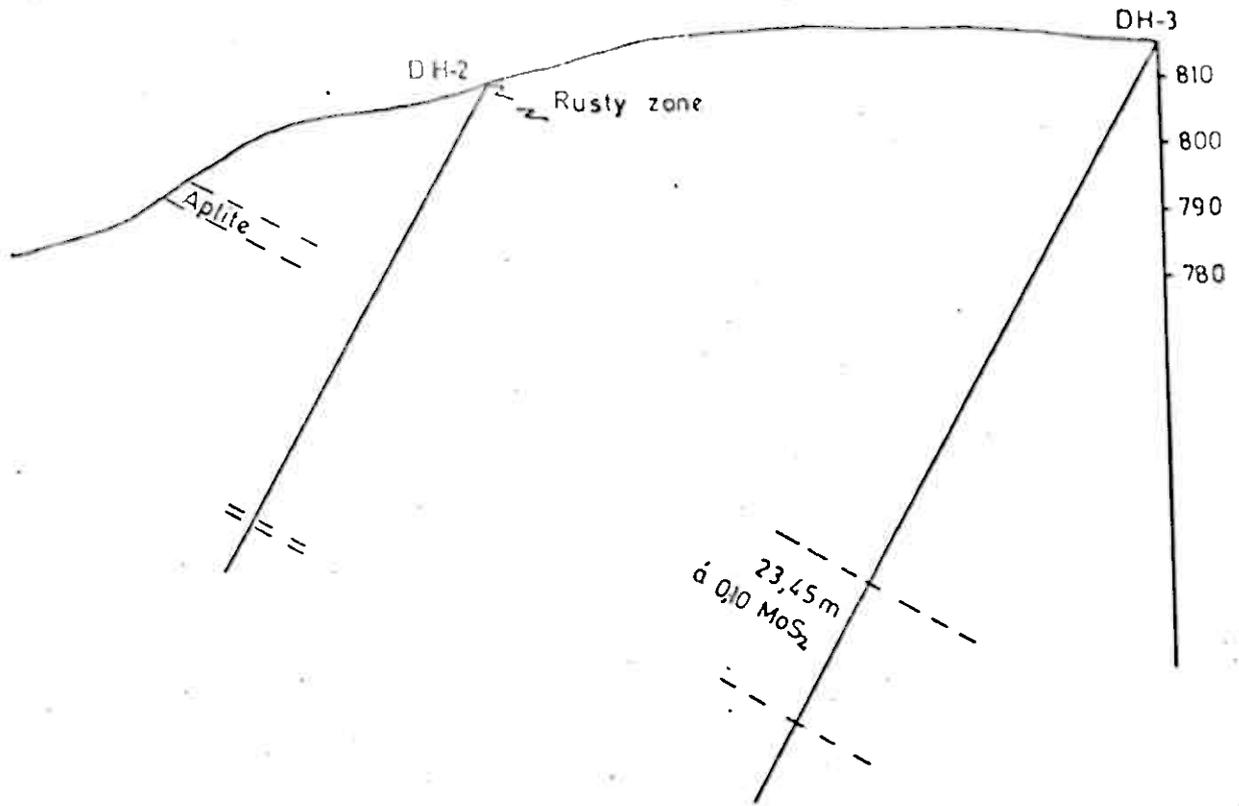


The Reinshommen Area :
 Sulfidbearing (rusty) gneiss
 Aplitt (similar to "gangfjell")

Kv = Quartz, Stoll = Adit

50m





50m

Profiles Reinshommen

outcrops to the north, and in the southern workings the width of the quartz vein is only 2 m.

Most of the workings have been done on the quartz zone, both to the hanging wall and to the footwall of the pegmatite. In the immediate vicinity of the quartz, the surrounding gneiss is a grey, quartz-rich, MoS_2 -impregnated "gangfjell" variety, which has been mined to a minor extent. This rock grade over a short distance into almost barren red porphyry granite (except for some thin MoS_2 -mineralized joints).

3 diamond drill holes have been drilled in this area. Hole no.1 was drilled under the main part of the ore zone, and the object was to examine the deeper extension of the ore-containing lense. A section through this hole (p.14) shows that the quartz lense have no termination downwards.

No drilling has been carried out directly to the south of the Kvina orebody, with the purpose to explore the deeper extension along the assumed axis of the pegmatite-quartz-lense.

Although the conditions in the southern workings of the mine indicate that the lense wedges out here, there is a chance that a pinch-and-swell model for the pegmatite-quartz-body may be actual. So if one more hole was to be drilled, we would suggest that this should be the target.

The other 2 drill holes were done to examine some smaller mineralized zones 500 and 1200 m SW of the Kvina orebody. Only traces of molybdenite were found (page 14).

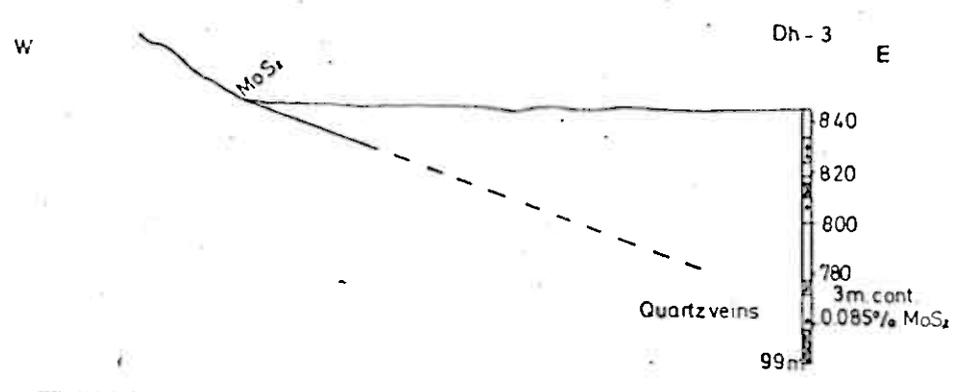
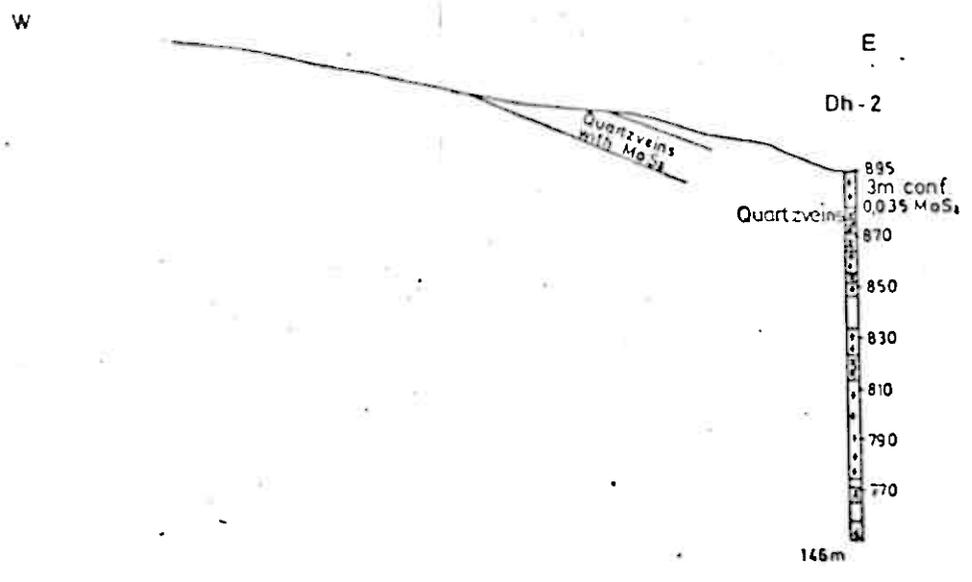
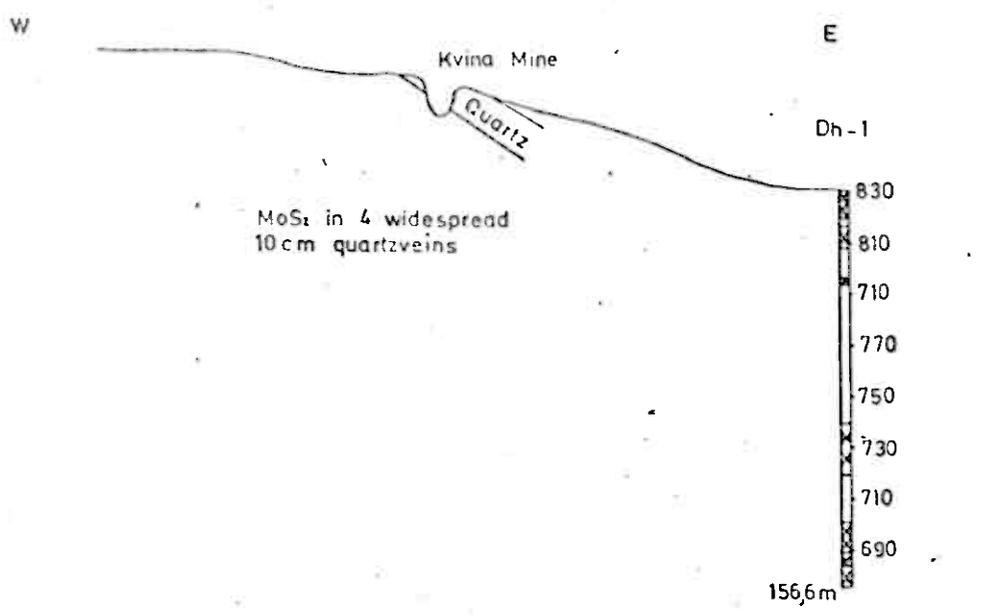
2.6. The Beritsheii (Svoen) area.

This area is situated west of the Knaben II-Mine (map. p. 3). "Gangfjell" characterized by weak dissemination of MoS_2 and other sulfides adjacent to veinlets of smoky quartz occur along narrow zones in red granite.

This area is drilled in 1972 with 9 vertical holes totalling 540 m. Core logs show "gangfjell" in zones up to 10 m, usually 3-4 m., enclosed in red granite which is the dominating rock in the area. The MoS_2 content in the "gangfjell" is below 0,08% and the quantities appear to be limited.

2.7. Concluding remarks.

Evaluation of the previous core-drilling in the area shows that



-  Gangfjell
-  Transitional to Gangfjell
-  Red granite
-  Amphibolite
-  MoS₂

Kvina Mine Area

the Knaben II-ore still must be looked upon as the most interesting target in the field.

Proven and probable reserves is estimated to some 5 mill.t. grading 0,15% MoS₂, but the ore is not delimited toward depth in the southern part. Therefore we think that it is correct - in the coming fieldseason- to drill a 500-600 m long hole as a beginning of the exploration of the deeper parts of the ore-body. Such a drill hole should be sited in or near section 7 (see block diagram).

In addition, we wish to drill shorter holes in the Bragold and Sandtjernfields (map p. 3) to study the mineralizations in red granite.

The zone between Knaben II and Kvina Mine is still the most promising area in the Knaben field. The relatively extensive drilling carried out previously have not, so far, disclosed ore grad mineralization, perhaps apart from the Reinshommen field. On the other side the Knaben I-field for instance could still hide ore-bodies of Knaben II-size. With regard to the outcropping of the Knaben II orezone south of the quarry where it is only a rusty zone; every rustzone is a potential.

3.0. GEOCHEMISTRY.

Stream sediments, soil and streamwater have been sampled in the area north and south of The Knaben Mine as outlined on map page 1.

4 students have collected 816 stream-sediment samples, 64 soil- and 538 watersamples.

The stream-sediments are analyzed for Mo, Cu, W and Ba, the latter because of barite which is known in this geological region, south of the agreement area.

The stream-sediments consist of inorganic material sampled at each 250 m along the stream and sieved on the spot for the fraction less than 180 μ m. The sievescreens should be made of nylon but by accident one of the samplerteams was equipped with brass-sieves. As a consequence the Cu-content of these samples is enlarged to a different and uncertain degree and must be regarded as useless.

South of Knaben, soil-samples have been taken from a bog area with few and small streams, as a test of the method. The samples are taken near the rockface and sieved in the laboratory for inorganic material in the fraction - 180 μ m. These samples are analyzed for Mo and Cu.

Water is sampled on plastic bottles of 10 cl size. Samples are taken at each 1 km along the streams, or one sample pr. stream. Stream-sediments and soil samples are analyzed by Mercury Analytical Ltd. in Limeric, Ireland, water samples by Institute for Atomic Energi near Oslo.

3.1. Stream-sediments. Results.

3.1.1. Molybden.

Map 1077-1 in enclosure shows the anomalous Mo-values in the sampled area. The values of 816 samples can be grouped as follows:

| | | |
|--------|-----------|------------------------|
| 66,05% | less than | 5 p.p.m. Mo |
| 18,9% | | 5 - 6 p.p.m. |
| 10,9% | | 7 -10 p.p.m. |
| 3,5% | | greater than 10 p.p.m. |

The greatest value, 376 p.p.m. is from a stream near an old crushing-mill. Apart from this, and two other figures of 70 and 50 p.p.m., all the values are below 25 p.p.m. (Figures above 7 p.p. are plotted on the map). This means that anomalous and nonanomalous values are closely spaced, and that especially the quality of the analysis is critical. Results from sediments sampled in mineralized areas show, however, that known mineralization is well indicated and we feel that the results therefore can be regarded with confidence.

Looking at the map 1077-1, the Mo-distribution define an eastern area north and south of the Knaben mines and a western area near the river Kvina.

In the eastern area there is a distinct anomaly west and north-west of the Knaben I - Kvina-mines (A on the map). A number of small pits on molybdenite-quartz veinlets are known in this area, which are, however, not geologically mapped in detail.

In the north-eastern subarea (B) more widespread anomalous values delineate a north-south zone that could be a continuation of the Knaben zone. Prospecting pits are not known in this area, neither is it well known geologically.

South-west of Knaben II the Øyvann - Skjerlevann - Bjørnevann-zone (C) is marked on old geological maps as a swarm of small aplite lenses, weakly mineralized. The stream-sediments pick up this zone in three heavy spots.

Subarea(D) which partly is woodland and bogs, shows a relatively large number of randomly spaced values in the interval 7-9 p.p.m. Mo. The reason for this pattern, and why the values to the south suddenly are declined, in spite of the fact that the geological formation is said to continue southwards, is uncertain. This area is also not well mapped geologically.

The western area near the river Kvina is sparsely sampled so far. Some prospecting pits are known and some 15 samples show weakly anomalous values - in a widespread pattern.

3.1.2. Copper.

As earlier mentioned, brass-sieves were by a "shortcircuit" used in the southern part of the area. This has given enlarged values, an increase varying dependent on sediment-type. Sediments with small amounts of fine grained material need more sieving, which means a higher degree of contamination. These samples are therefore useless with respect to Cu.

The laboratory has given the Cu-content in 5 p.p.m. intervals (E.g. 5-10-15 ...) which is a bad way to present it, especially when the content is low.

583 samples sieved on nylon sives gives the following groups of values:

| Content Cu | Number of samples | % of total number | Number of samples anomalous in Mo |
|---------------|----------------------|----------------------|--------------------------------------|
| .50 p.p.m. | 4 | 0,7 | 3 (75 %) |
| 20-50 p.p.m. | 22 | 3,8 | 6 (27 %) |
| 15 p.p.m. | 45 | 7,7 | 14 (31 %) |
| 5-10 p.p.m. | 512 | 87,8 | 40 (7 %) |

The Cu-content is extremely low with a background level in the range of 5-10 p.p.m. Values of 15 p.p.m. and above are regarded as anomalous and are plotted on the map 1077-2.

What is interesting for the purpose Mo-prospecting, is, however, the correlation of Cu to Mo. The above tabel shows that there is a certain positive correlation between these elements, but we believe that the mineralization types can explain correlation/lack of correlation.

Type 1: Molybdenite with minor amounts of chalcopyrite, pyrite and

pyrrhotite together with secondary quartz in altered granite
- Knaben II-type.

Type 2: Molybdenite adjacent to quartzveins in unaltered granite.
Other sulfides occur sparsely.

Samples anomalous both in Mo and Cu should therefore reflect mineralization of Knaben II-type which ought to be the more interesting target.

On map fig. 1077-2 high Mo-figures corresponding to high Cu are indicated.

3.1.3. Tungsten.

Only two samples have given values above the detection limit, which is 1.p.p.m. These two samples (16 and 12 p.p.m.) correspond to the highest Mo-values, west of Knaben I (map 1077-1).

3.1.4. Barium.

The background level for Ba is about 20 p.p.m. Values above 40 p.p.m. are plotted on map 1077-3. Weak anomalous samples are widespread and give no distinct anomalous areas.

3.2. Soilsediments.

The sampling points for soil are drawn at map 1077-1.

64 samples are analyzed for Mo and Cu, where the Mo-values group as follows:

83% less than 5 p.p.m. Mo

6,2% 5-6 p.p.m.

4,7% 7-9 p.p.m.

6,2% above 10 p.p.m. (highest figure 21 p.p.m.)

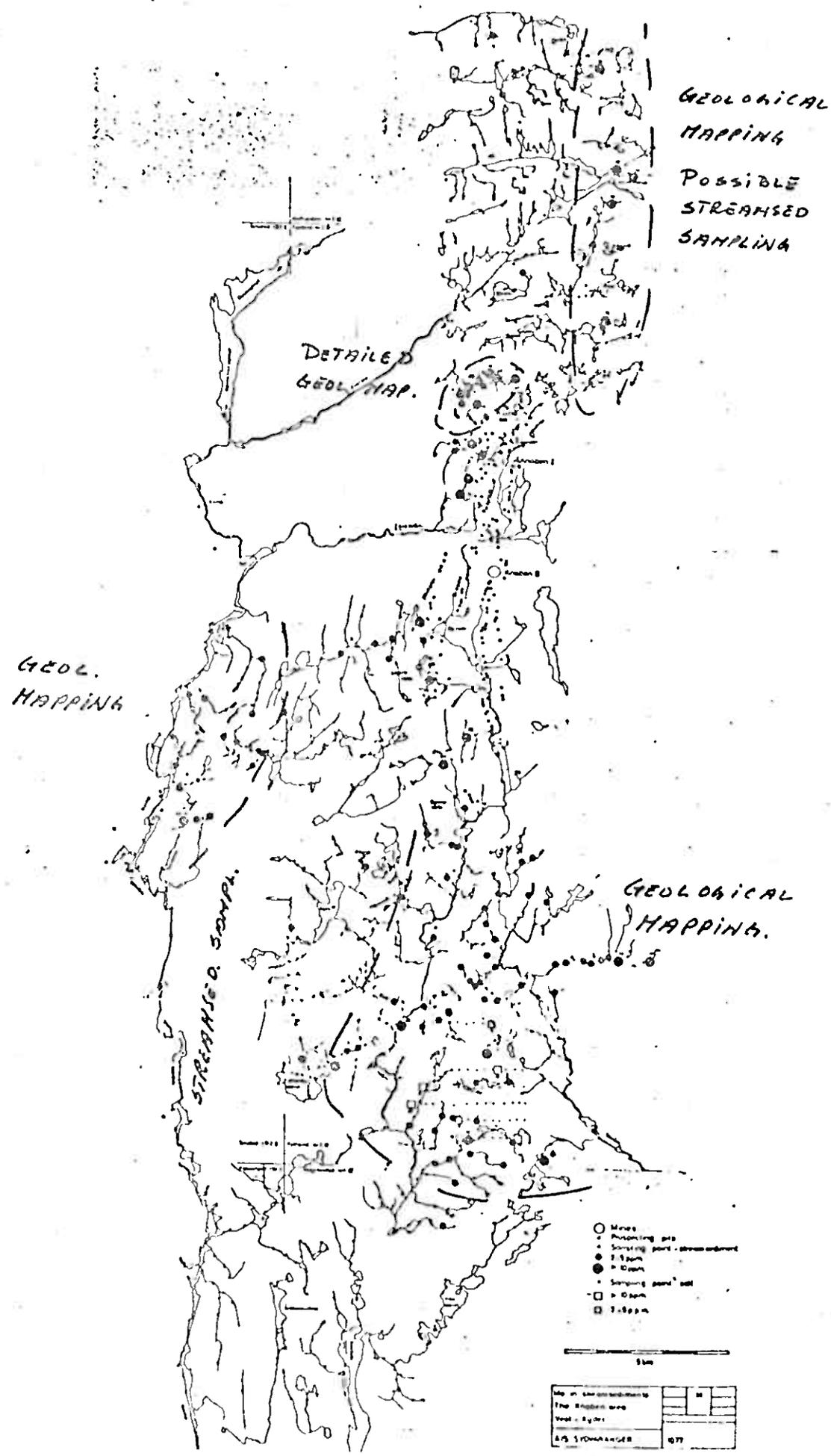
The content varies in the same range as Mo in stream-sediments.

The Cu-content varies from 5-15 p.p.m., with six samples at the highest level. Only one of these shows an anomalous Mo-value.

3.3. F - in streamwater.

The results of F in watersamples are shown in map 1077-4.

In the northern and central part of the investigated area where the rock is exposed, the F-values are below the detection-limit of 0,04 mg. F pr. l. The vegetated area south of Knaben shows higher, but still low values, only a few are above 0,10. The correlation of



those higher values to the high Mo-figures are negative.

3.4. The area investigated by The Geological Survey.

This area is outlined on the small scale map page 1. Report from N.G.U.'s work is under preparation and we will receive it in the course of April, we believe. This report must be born in mind for possible follow up work during the coming field season.

3.5. Summary and conclusive remarks.

The stream-sediment-investigation reflects Mo-mineralization in known mineralized areas. Mo-content in the range above 7 p.p.m. are considered to be anomalous. The anomalous values are mostly scattered, but confirm that the N-S zone through Knaben is anomalous in Mo. West of Knaben near the river Kvina, higher Mo-values also delineate a N-S zone. Dense and indisputable anomalies however, are only detected in known mineralized subareas west of the mines Kvina and Knaben I.

Only a certain amount of the anomalous Mo-samples are simultaneously anomalous in Cu. These localities are believed to be more valuable since it reflects mineralization of Knaben II-type. The area is negative with regard to W and this element can be left out in later work.

The Ba-content gives no distinct anomalies and it should be discussed if this element also should be left out.

Soilsamples seem to be comparable to stream-sediments in respect to Mo and Cu.

The F-content in streamwater is very low and is no guide to ore in the investigated area.

3.6. Recommendation, local and regional.

In the sampled area geological mapping in some detail should be carried out in the following subareas. (Map on facing page).

1. In the north-eastern part, to study the area where anomalous Mo-values delineate a N-S strike.
2. North-west of Kvina mine for detailed study of the anomalous area.
3. Near the river Kvina.
4. South of Knaben.

5. Possible work in the N.G.U.-investigated area.

Further geochemical investigations.

1. In the north-eastern subarea, if the geological investigations make it reasonable.
2. Filling in the area towards the river Kvina.

Concerning the regional work we have proposed streamsediment-sampling in an eastern direction towards the Flottorp area and in 3-4 traverses toward the lake Sirdalsvannet to the west. (Map p. 1). It is proposed to sample in a more open spacing - 500 m between sampling points, and analyze for Mo, Cu, and Zn.

We have just succeeded in finding comprehensive list concerning prospecting pits in the region. These will be plotted on maps, and plans can possibly be changed in light of this new knowledge.

4.0. GEOPHYSICS.

4.1. Radioactivity.

Based on the possible connection between molybdenite and K-feldspar rich rocks, radiometric measurements are carried out in- and outside molybdenbearing rocks, both by N.G.U. and by us.

Only small- and unsystematic variations are registered and the method seems not to be suitable in this area.

4.2. Induced Potential (I.P.)

17 specimens from the Knaben area were measured for I.P. values and suceptibility at N.G.U.'s geophysical laboratory, by geophysicist P. Eidsvik. The values are given in table 1 at the following page.

As the table shows there are very small differences between barren and Mo-bearing rocks from the Knaben II-mine.

- One amphibolite specimen shows high I.P. value due to its content of magnetite and ilmenite.

In addition, also as a drawback for utilization of the method, logs from earlier drillholes show that sulphides (pyrite, pyrrotite) can occur in significant amounts without being accompanied by molybdenite.

4.3. Magnetism.

Table 1 shows a difference in suceptibility from 10^{-3} in red

TABLE 1.

Rock-specimens from Knaben, measured for I.P. and suceptibility.

| Specimen no. | Rock | I.P. % | Suceptibility |
|--------------|--|--------|----------------------|
| 1 | Red granite Knaben II, barren | 2,5 | $1,5 \times 10^{-3}$ |
| 2 | "Gangfjell" " weakly impregnated | 3,9 | |
| 3 | Red granite " not impregnated | 3,0 | 2,0 " |
| 4 | " " " | 2,9 | 2,0 " |
| 5 | Amfibolite " magnetite, ilmenite | 14,0 | 9 " |
| 6 | Aplite " barren | 2,1 | |
| 7 | Red granite Bragold, weakly impregnated | 3,8 | 1,0 " |
| 7 B | " " well impregnated | 8,4 | 0,2 " |
| 10 | "Gangfjell" Knaben II, weakly impregnated | 2,3 | |
| 11 | " " " | 2,5 | |
| 12 | " " " | 2,2 | |
| 13 | " " " | 2,3 | |
| 14 | " " " | 2,0 | |
| 15 | " " " | 0,8 | |
| 16 | " West Kvina, quartz-MoS ₂ | 1,6 | |
| 17 | "Fahlband"zone Knaben weakly impregnated (po,py) | 2,5 | 0,8 " |
| 18 | Aplite Løgehei (West Knaben) weakly impregnated | 1,5 | |

When suceptibility is not mentioned it is below 10^{-5} .

granite to 10^{-5} in "gangfjell". It is concluded that the original magnetic oxides in the "gangfjell" rock is sulfidized.

In 1971 helicopterborn measurements in the area between the Kvina Mine and Knaben II was carried out. Map on facing page shows the results. The zone from Kvina to Knaben II is a magnetic low-area, where Knaben II most conspicuously shows a negative anomaly.

4.4. Conclusion.

Further geophysical work should be based on magnetic ground-measurements. We propose to make a test with a protonmagnetometer and a simpler magnetometer produced by N.G.U., over known mineralizations, and do systematic measurements between Kvina and Knaben II along E-W, 100 m spaced profiles.

Our earlier proposal for an I.P.-test is withdrawn.

5. SUMMARY-AND PROPOSALS FOR FURTHER INVESTIGATIONS.

This report are dealing with the results from the field season 1979 and data from previous drilling and exploration work in the Knaben area.

Vaste areas in the surroundings of the Knaben and Kvina mines are occupied by a porphyric red granite. Abundant Mo-mineralizations occur in an elongate belt (ca. 2×10 km) which in addition to granite contains discontinuous amphibolite lenses and various gneisses. The amphibolite may at least in part, represent remnants of older supracrustals. The gneisses are believed to represent sheared and recrystallized red granite, in part altered by mineralizing hydrothermal fluids.

Molybdenum mostly occur as quartz-molybdenite veins most often in narrow belts presumably controlled by shear zones. Pervasive veining of larger rock volumes, like in the Knaben II mine, have caused sericitization and bleaching of the original red granite.

Vertical section through the Knaben II orebody (block diagram in enclosure 1077-7), show that the ore zone is not delimited toward depth in the southern sectors. A drill hole 500-600 m long is proposed to explore the deeper part of the orebody in this area. Drilling in other parts of the Knaben region have not disclosed ore grade mineralizations, perhaps with the exception of the Reinshommen area (map p.11-12) where one drill hole cut a 23 m thick

zone of 0,10% MoS₂.

The westerly Bragold- Sandtjern zone with abundant quartz-molybdenite veins in red granite (map p. 3) is proposed explored by 2-4 short drill holes to unravel the near surface extension of the vein system.

Geochemistry.

816 streamsediment-, 64 soil- and 538 watersamples have been collected in the area shown on the map p. 1.

Anomalous Mo-values are concentrated in an eastern zone to the north and to the south of Knaben, and in a zone near the river Kvina (attached map 1077-1). Real anomalies is proven only in known mineralized areas, while single high values occur more widespread.

To a certain extent the Mo-anomalous samples are simultaneously anomalous in Cu. These samples may indicate mineralization of the more interesting Knaben II-type.

W and Ba give no additional information and should be left out in the future.

Watersamples have been analyzed for F which is very low everywhere. F- is obviously no guide to ore in this area.

Geophysics.

Radiometric measurements show low and unsystematical differences between mineralized and barren rocks and is therefore not regarded as a usable exploration method.

The I.P.-method has also been demonstrated to be doubtful.

- a) Laboratory measurements show no difference in I.P. effect between weakly disseminated rock specimens of Knaben II-type and barren granite.
- b) Amphibolite shows high I.P.-values.
- c) Core logs demonstrate Fe-sulfides in zones with negligible or no molybdenite.

Suceptibility measurements on specimens demonstrate low values in the altered - in part orebearing- rock. This is confirmed by previous airborne measurements, delineating the Knaben II - Kvina Mine zone as a low magnetic zone.

Magnetic surface measurements will therefore be tested.

Proposals for further investigation.

Drilling:

One hole of some 600 m in the southern sectors of the Knaben II-orebody, near section 7 in the blockdiagram.

2-4 holes of some 50 m in the Bragold-Sandtjern zone.

Geology:

- a) Map areas in the streamsedimentsampled area as shown on map p.19.
- b) Structural mapping in the area Knaben II - Kvina Mine.
- c) Mapping in connection with the magnetic ground profiles.
- d) Map the Flottorpzones to the SE of Knaben.

Geophysics:

Magnetic groundmeasurements with basis in the Knaben II-mine area, continuing along selected traverses northward to Kvina.

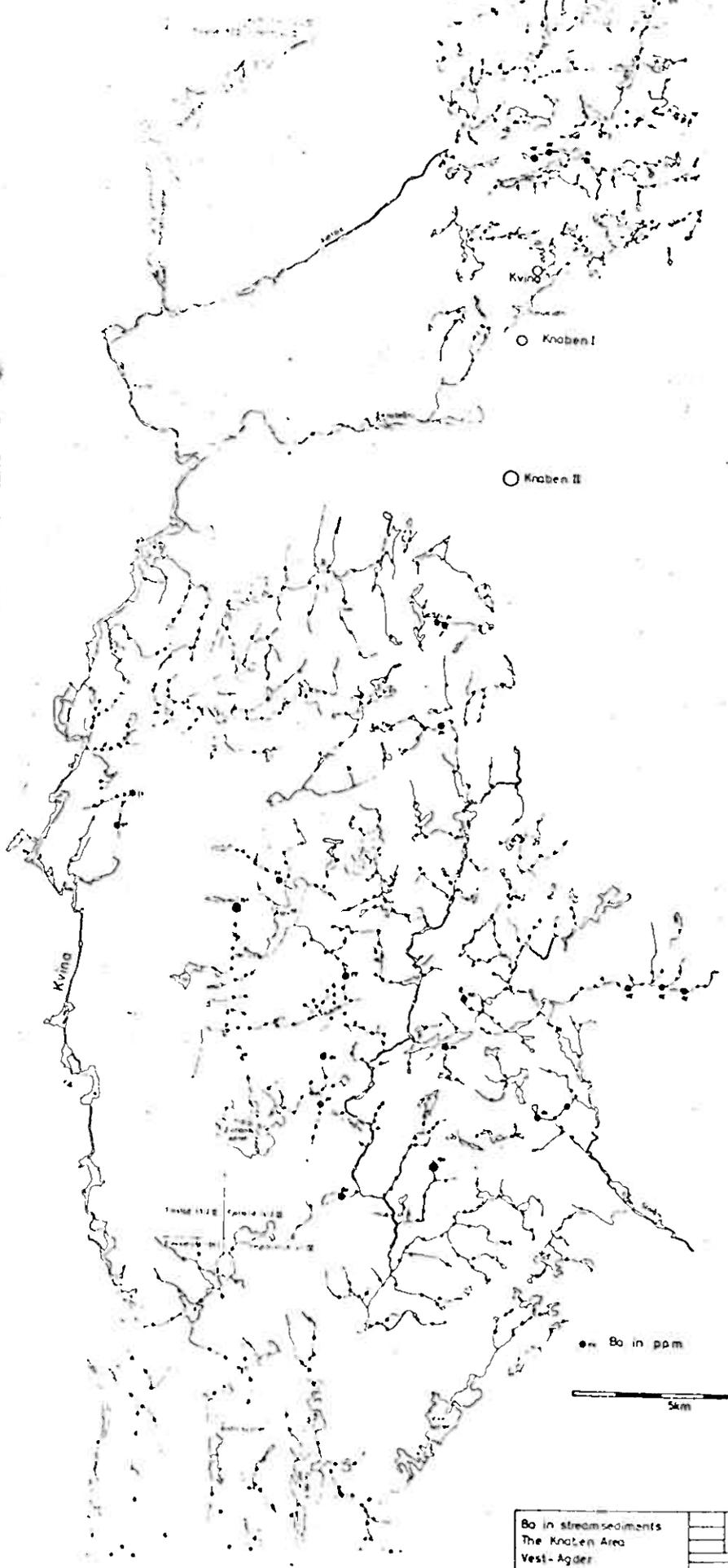
Geochemistry

Streamsedimentsampling as shown in map p.1.

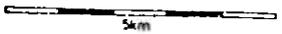
27th March 1980

Øyvind Gvein
Øyvind Gvein

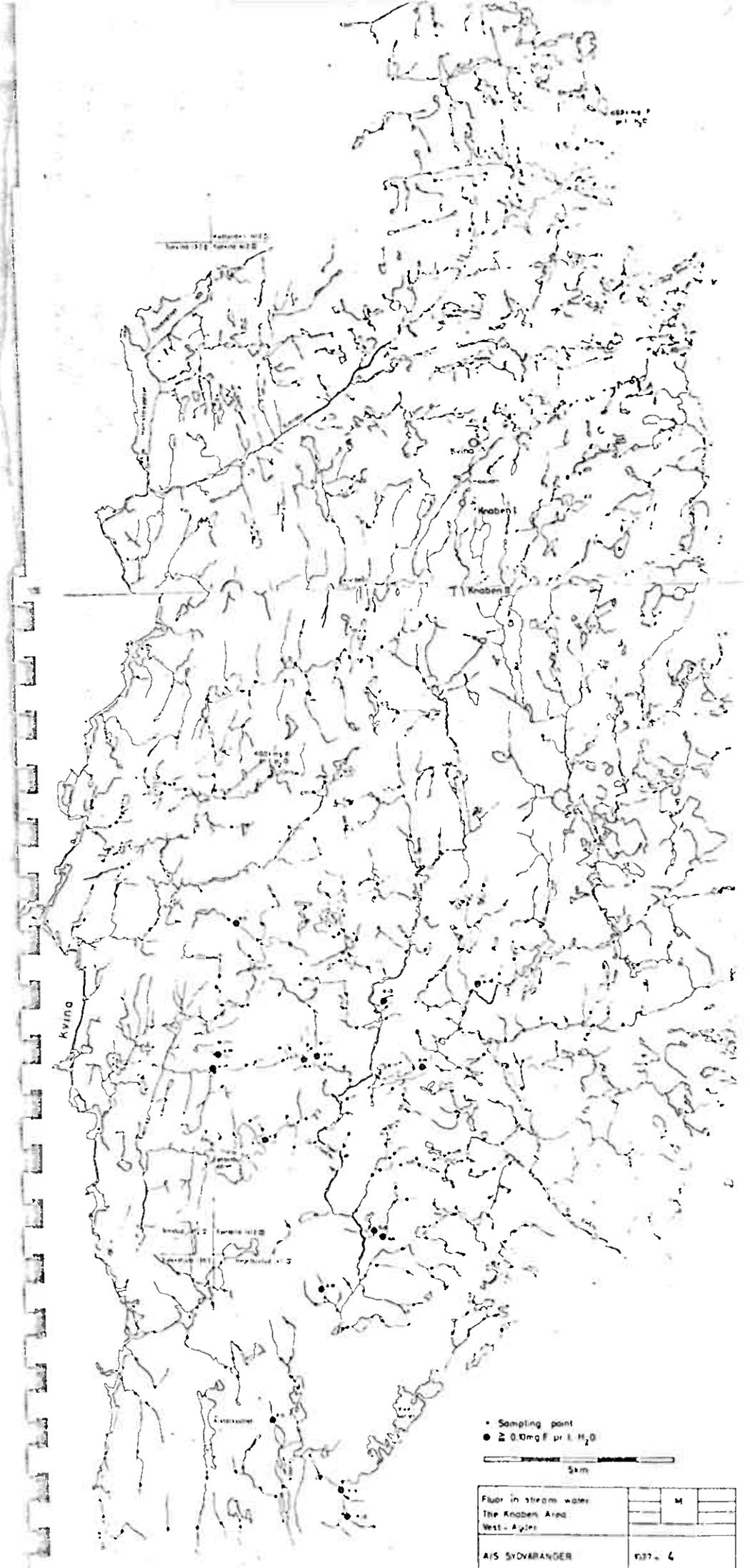
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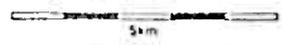
● Ba in ppm



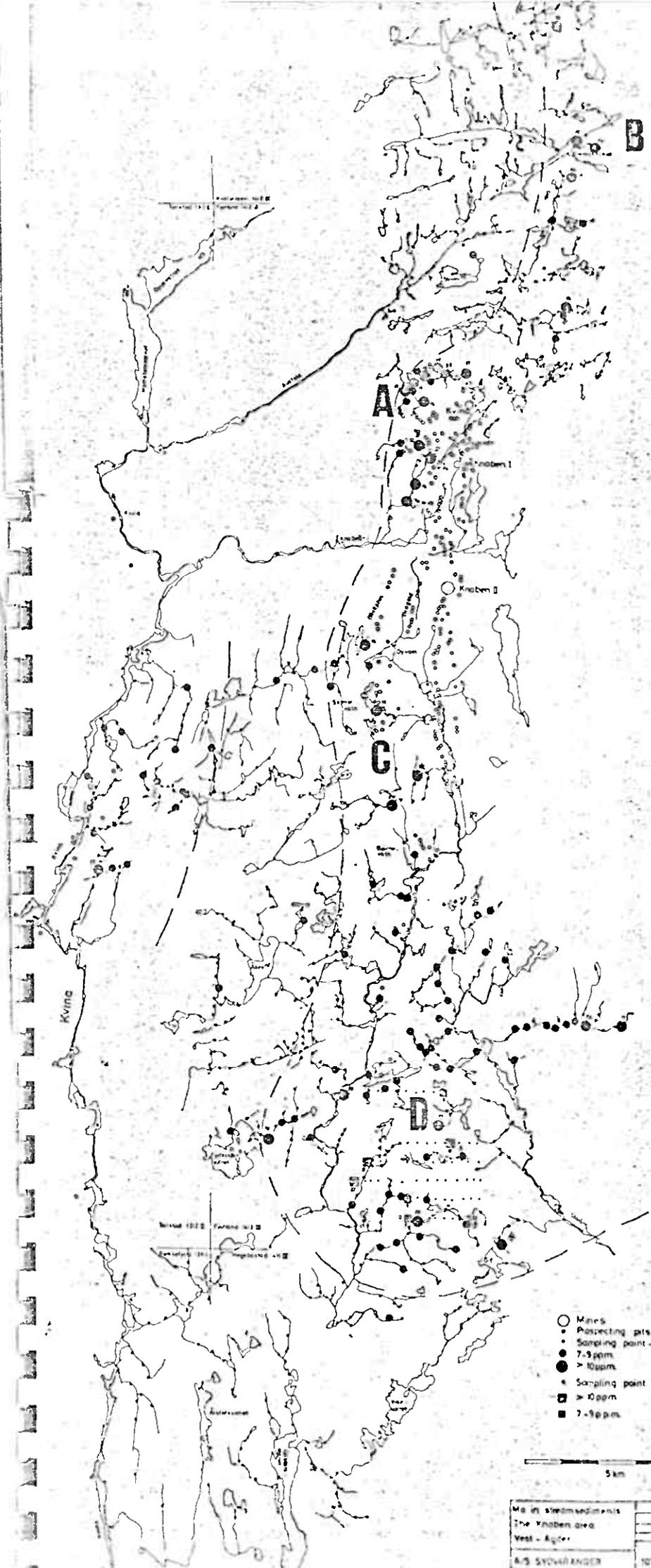
| | | | |
|---|----------|--|--|
| Ba in stream sediments The Knaben Area Vest-Agder | | | |
| A/S SYDVARANGER | 1077 - 3 | | |



• Sampling point
 ● ≥ 0.0 mg F per l. H₂O



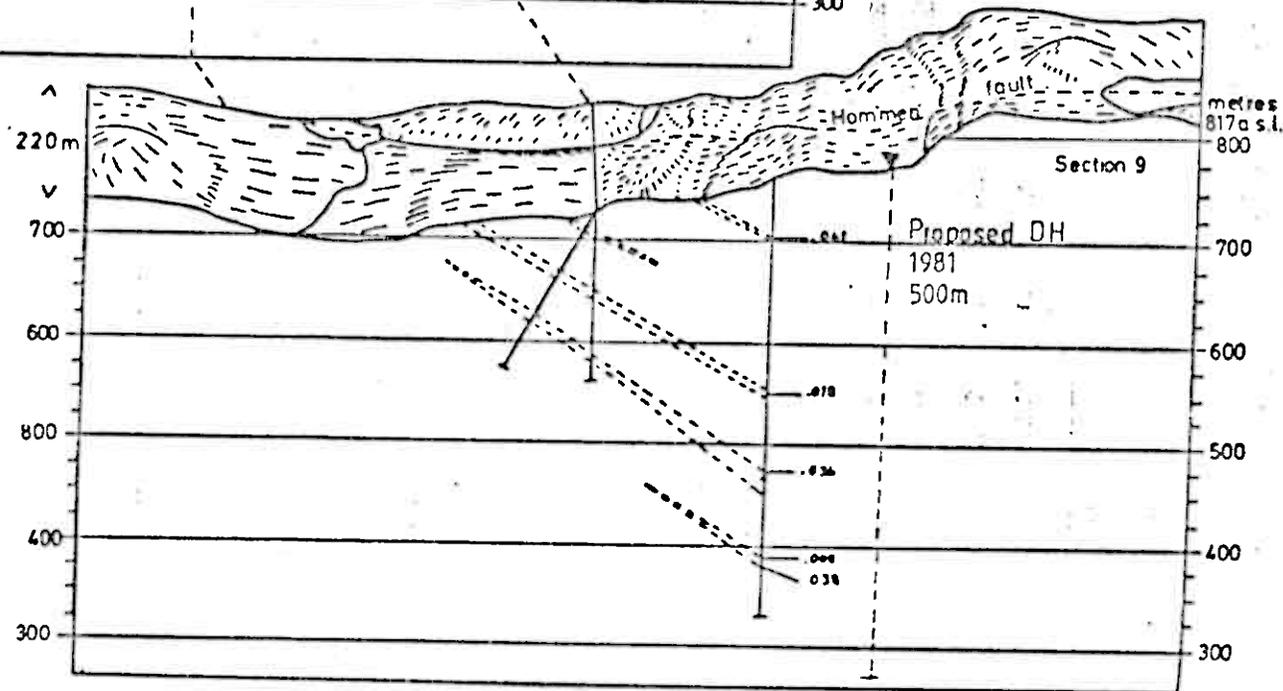
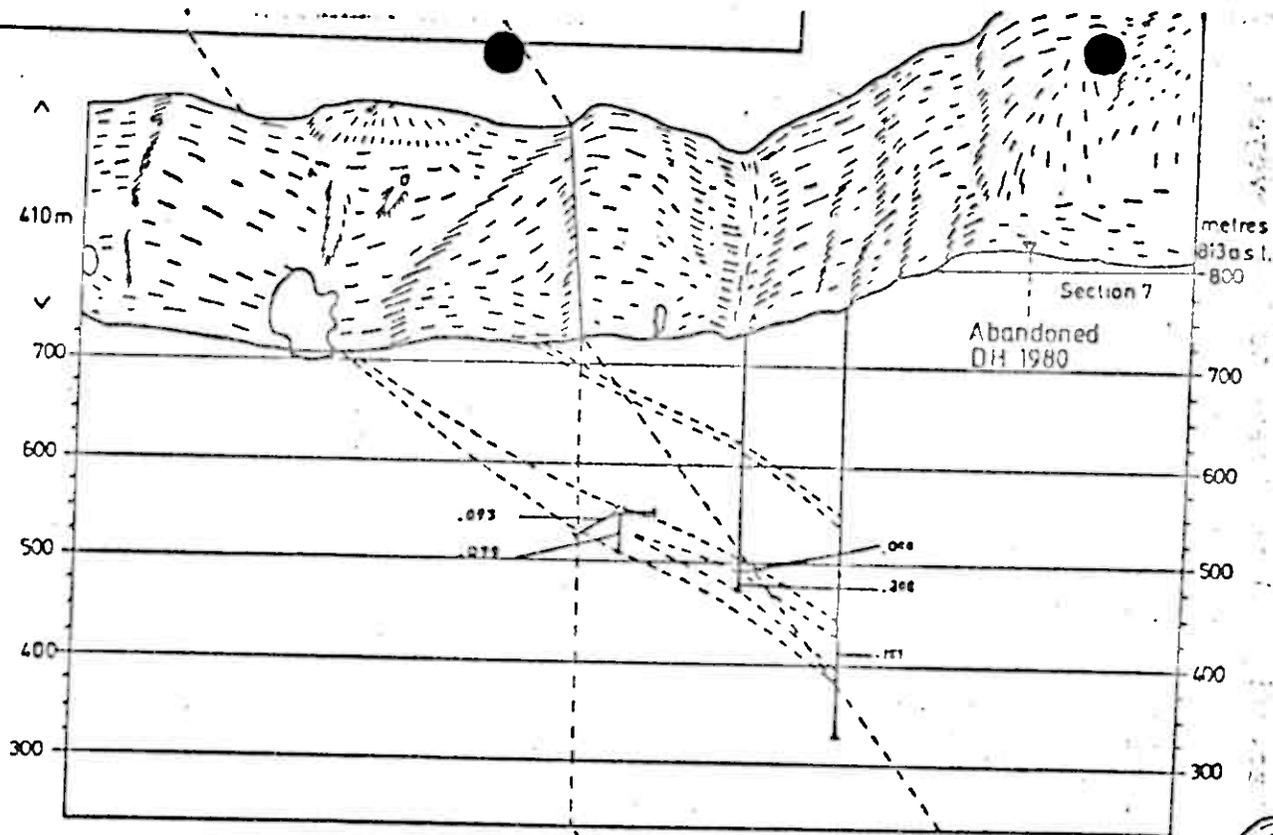
| | | | |
|-----------------------|-------|---|--|
| Fluor in stream water | | M | |
| The Knaben Area | | | |
| West-Agjer | | | |
| A/S SYVÅRÅNDER | 037-4 | | |



- Mines
- Prospecting pits
- Sampling point - stream sediment
- 7-9 ppm
- > 10 ppm
- Sampling point soil
- > 10 ppm
- 7-9 ppm

5 km

| | | | |
|-------------------------|--|------|--|
| Map of stream sediments | | M | |
| The Khaben area | | | |
| West-Agder | | | |
| A.S. SYDVARANGER | | 1977 | |



Minor amounts of MoS₂ on small pegmatites.

MoS₂ on quartzveins
Partly detailed mapped.

Minor amounts of MoS₂ on quartzveins.

No finds. My be MoS₂ in overburden; ice-transported from north.

Kvinga

- Mine
- Prospecting pit
- Sampling point - streambed
- 7-9ppm
- 9-10ppm
- Sampling point - soil
- > 10ppm
- 7-9ppm

1 km

| | | | | |
|------------------|--|--|--|------|
| Mt in streambeds | | | | |
| The Kraben see | | | | |
| West - Acker | | | | |
| A/S SYDVARANGER | | | | 1077 |