SUMMARY REPORT

FOLLDAL PROJECT

FOLLDAL VERK A/S - AMOCO NORWAY OIL COMPANY

APRIL 1982

A Grimsdalen } splittes til hvert sett
B Lesja } rapp. nr.

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SUMMARY AND CONCLUSION

During the 1981 summer field season exploration work in search of Cu-Zn massive sulfide deposits was undertaken in the Folldal area of south-central Norway. This work was conducted by Folldal Verk A/S in conjunction with Amoco Norway Oil Company under the terms of a joint venture agreement establishing a 50-50 joint venture between the two companies.

Work conducted during the season included 2000 line km. of airborne EMmag, regional stream geochemistry, property geochemistry, geophysics, geological mapping, and diamond drilling. Property work was concentrated on three main areas, Grimsdalen, Sivilvangen and RØdalen. In addition, reconnaissance geochemistry and VLF profiles were conducted on numerous airborne anomalies in order to establish priorities for followup.

In the Grimsdalen area an extensive grid of soil geochemistry and magnetometer surveying was completed. Selected areas were covered with CEM and Max-Min surveys also. Two holes were drilled on previously identified turam anomalies, with pyrite being the source of one anomaly but the other remains unexplained. One Max-Min anomaly was identified which warrants drilling, while another area of strongly anomalous Cu-Zn-Pb in soils requires more detailed geophysical follow-up.

A very extensive grid was established in the Sivilvangen area, centered on an old Cu-Zn prospect which has undergone previous drilling and underground investigations. Soil geochemistry, geology, CEM, mag, and Max-Min surveys were conducted on most of the grid. Five diamond drill holes were completed on geophysical targets outlined. Pyrite in graphite was the cause of each of the anomalies. At least three targets remain which will probably warrant drill testing.

In the Rødalen area CEM, mag, and Max-Min surveying were completed on a portion of the target area. Several of the remaining anomalies occur under small lakes and as such will have to be followed up during the winter. There appear to be at least three areas identified to date which will warrant drilling.

Sulfides have been located on surface over several airborne anomalies which remain to be followed up with detailed geophysics. One of these, called Fadalen, is an old Cu-Zn prospect which had limited underground development and production. Several of the others have had surface trenching completed previously.

Two areas were covered by regional stream sediment surveys, Tylldal in the northeast and Lesja in the southwest parts of the project area. One area of moderately anomalous Cu-Zn was indicated for follow-up in the Tylldal area while several creeks in the Lesja area are strongly anomalous in gold.

Significant progress was made during the 1981 season on the project, with several areas identified with drill targets presently outlined and a considerable number of high priority areas indicated for ground follow-up.

RECOMMENDATIONS

On the Grimsdalen grid it is recommended that one hole be drilled to test the strong Max-Min and coincident magnetic anomaly located between L 5200 X - 6000 X, at approximately 800 to 900 Y. The anomaly should be drilled on L 5600 X, 900 Y, drilling grid south at -45^{o}.

Detailed Max-Min surveying should be completed on what appears to be the continuation of the Grimsdalen Zn-Cu zone, from 2700 X to 7000 X, from OY to -600 Y. Of particular interest is the strong Turam-mag. anomaly between 6000 X - 7000 X, at approximately -200-400 Y. In addition a strong geochem. and mag. anomaly occurs on line 3800 X, from 0 to +200 Y. Max-Min should be completed on this area, and if possible, trenching.

On the Sivilvangen grid several areas of coincident EM-Mag.-geochem. anomalies should in some cases be detailed with additional Max-Min and/or CEM and mag. prior to trenching if possible and diamond drilling. The area from L O to 600 N, 300 W - 600 W should be completed with mag. and CEM to detail the EM-mag-geochem. anomaly which occurs at 3+70 W, LO-L 100 N. Another EM-mag-geochem. anomaly occurs from L 2800 N-L 3200 N, at 320 W which should be trenched if possible and if not, drilled. The area from L 2800 N - 4200 N from 100 W - 300 E is quite strongly anomalous in CU-Zn and Pb. This area should be detailed with Max-Min.

Additional CEM and mag. should be completed in the area from L 600 S - L 500 N, from 700 W - 1000 W.

In addition to the above areas an airborne EM anomaly occurs in the approximate area of 1500 - 2500 S, 800 - 1000 W which occurs along strike from a reported Cu-pyrite showing. This should be followed up with ground geophysics.

In the RØdalen area drill targets have been indicated at L 3000 N, 200 E, L 4800 N, 1+50E, and L 5200 N, 400 E. Additional geophysics is recommended over the area covered by small lakes, with work to be completed in early spring. Soil and rock geochemistry analysing for Cu, Pb, Zn + Au should be done over the continuation of the anomalies north of the present grid area.

One particularly strong part of one of the airborne EM-mag. anomalies occurs at approximately 8000 - 9000 N and a separate grid should be established to follow up this anomaly.

Ground geophysics and geochemistry should be completed over all of the anomalies on which sulfides have been noted on surface. There are in addition several anomalies which are totally covered which should be followed up. In all there are approximately 15 additional anomalies to complete detailed ground geophysics and geochemistry on.

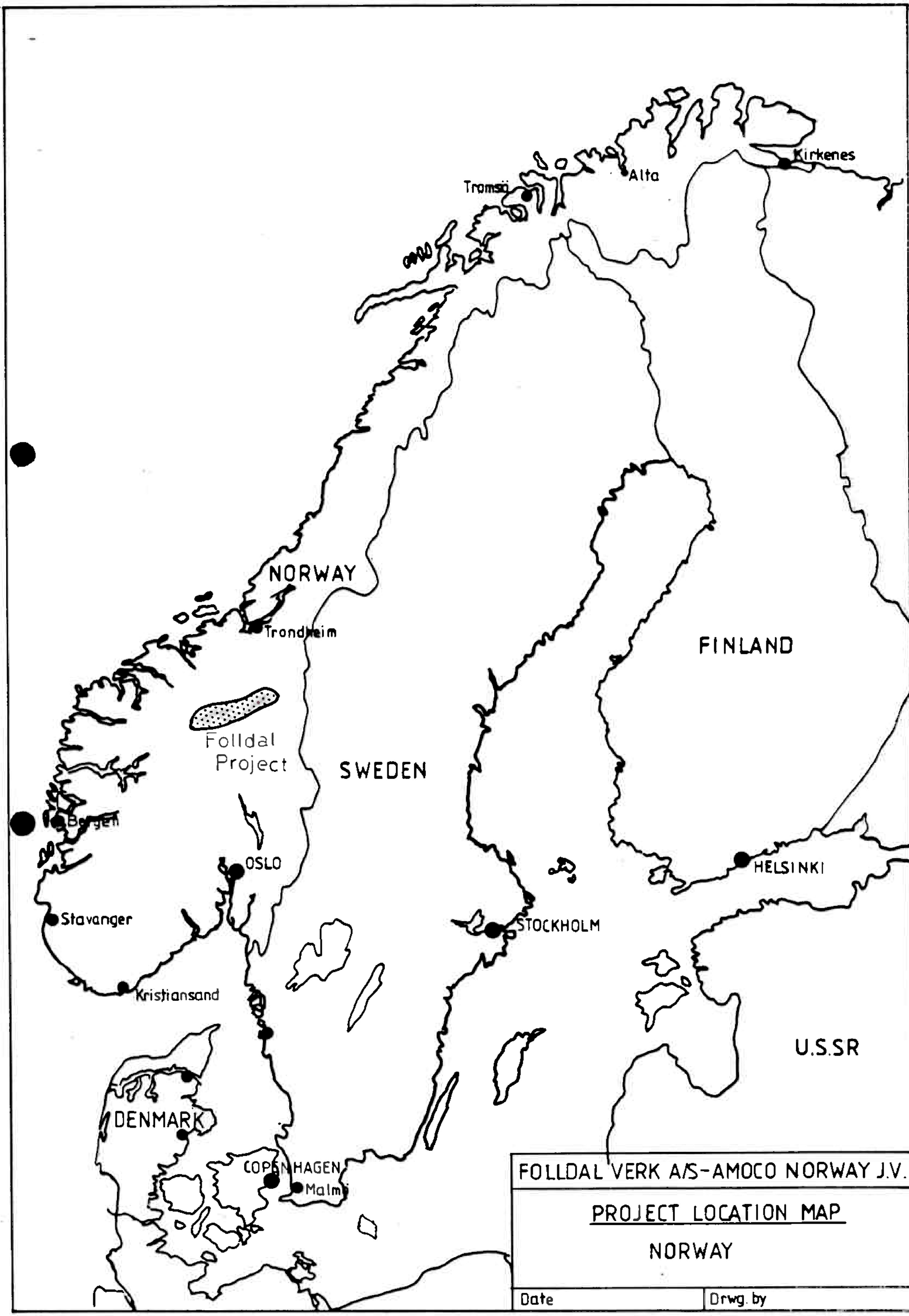
Two main areas have been identified near Folldal which should be covered by ground geophysics and geochemistry also. One of these is the extension to the east of the main Høvre horizon and the other is between the Nordre and Søndre deposits, between Geiteryggen and Storhovda.

The continuation of the volcanic belt towards Røros in the north end of the project area should be flown by helicopter borne EM-mag. early in the 1982 field season. This will involve approximately 2000 line km. of surveying.

Ground geochemistry and mapping should be completed on anomalous Au areas indicated in the Lesja area and Cu-Zn areas in the Tylldal area.

INTRODUCTION

A program of ground and airborne geophysics, regional and detailed geochemistry, geological mapping and diamond drilling was carried out in the Folldal area of south-central Norway during the summer/fall of 1981. This was the first season of a longer term joint venture established for the purpose of exploration in the Folldal area between Folldal Verk A/S and



FOLLDAL VERK A/S-AMOCO NORWAY J.V.

PROJECT LOCATION MAP

NORWAY

Date | Drwg. by

Amoco Norway Oil Company. Work during the first season was concentrated on areas of previously known mineralization with some work also on followup of airborne anomalies. Numerous target areas have been identified for ground follow-up in 1982, with several drill targets presently outlined on the areas which were covered by ground work in 1981.

LOCATION AND ACCESS

The project area is 250 km north-northwest of Oslo. The main highway from Oslo to Trondheim crosses the western part of the area. Several other paved highways cross the area as well as numberous small secondary roads. The main railway line between Oslo and Trondheim crosses the western part of the area, with a second major railway running along the south-eastern and eastern part of the area which also runs from Oslo to Trondheim. The main service supply centers are Dombås, Folldal, and Tynset.

JOINT VENTURE AGREEMENT

Work to date has been conducted under a "Heads of Agreement" which was dated June 01, 1981. This agreement provides for a 50/50 joint venture over the period 1981-1986, with the provision that either party may elect to withdraw from the venture at any time after September 01, 1983. This would be effected by written notice to the other party before December 01 of any year, with subsequent withdrawal effective January 01 of the following year. The following is the framework of expenditures agreed upon:

TOTAL PROJECT

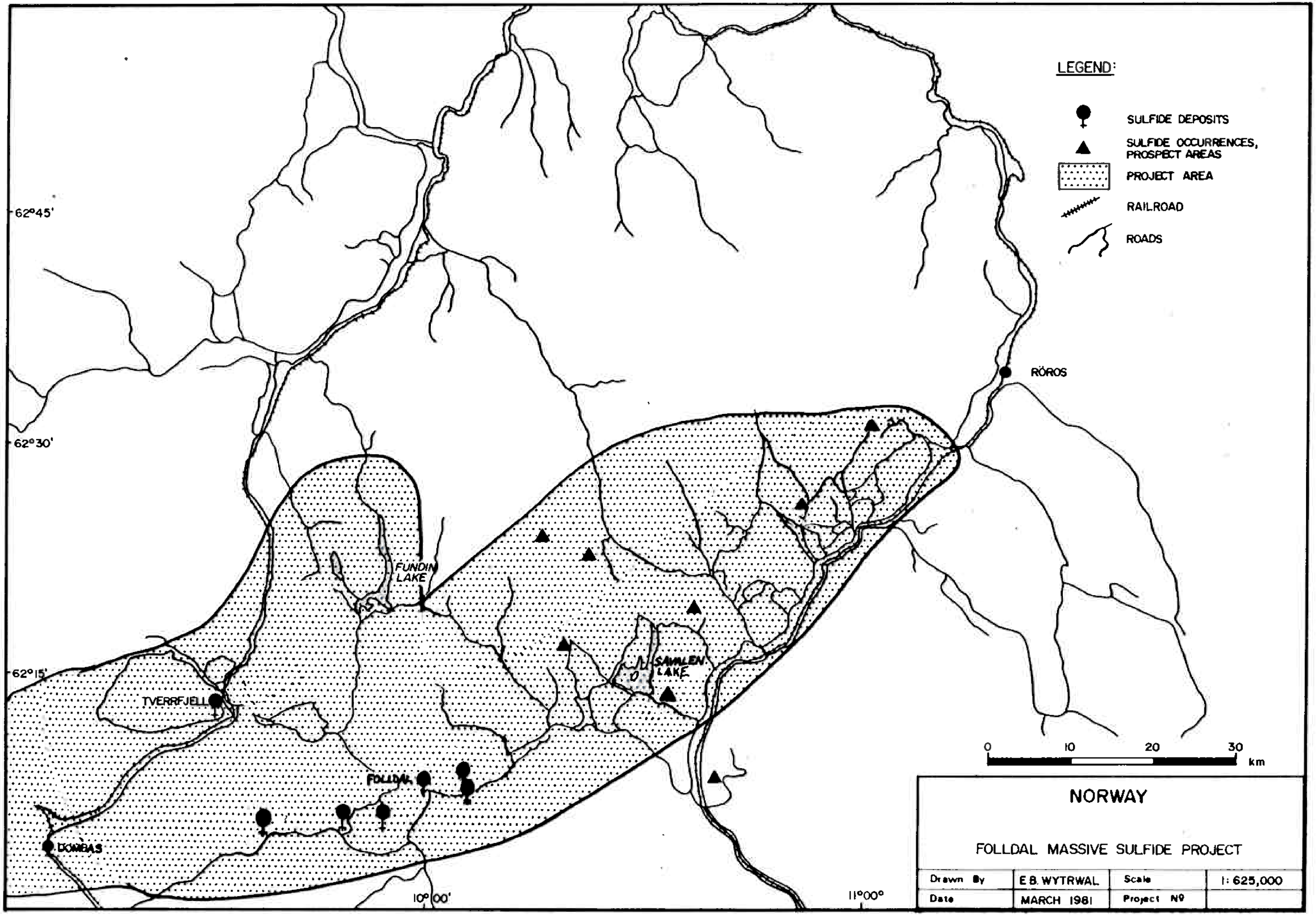
1981	2,500,000 Nkr.
1982	4,500,000 Nkr.
1983	5,000,000 Nkr.
1984	5,500,000 Nkr.
1985	6,000,000 Nkr.
1986	6,500,000 Nkr.
Total	30,000,000 Nkr.

AMOCO FUNDING OBLIGATIONS

100% - 1 - 10,000,000 Nkr.
80% - 10 - 15
65% - 15 - 30
50 % greater than 30

LAND STATUS

Folldal Verk presently has claims on Grimsdalen, Sivilvangen, RØdalen, Fadalen, Tronfjell and all of the old producers in the Folldal area.


LEGEND:
SULFIDE DEPOSITS
SULFIDE OCCURRENCES, PROSPECT AREAS
PROJECT AREA
RAILROAD
ROADS
62°45'
62°30'
62°15'
10°00'
11°00°
RÖROS
FUNDIN LAKE
SAVALEN LAKE
TVERRFJELL
FOLLDAL
DOMBAS
0
10
20
30
km
NORWAY
FOLLDAL MASSIVE SULFIDE PROJECT
Drawn By
E.B. WYTRWAL
Scale
1: 625,000
Date
MARCH 1981
Project Nº

HISTORY AND PREVIOUS DEVELOPMENT

Mining within the district dates from 1748 with the first production of copper from the Folldal deposit (Hovedgruve). Production from this deposit continued intermittently until 1940. Two other deposits located 5km. east of Hovedgruve were also past producers, the Nordgruve producing from 1936-70 and the Sondregruve from 1950-65. A fourth deposit, the Nygruve located 5 km. south-west of the Hovedgruve produced from 1940-52. Two other prospects which have not been placed into production are Grimsdalgruve and Grimsdalen which occur 5km. and 16km. respectively west of the Nygruve deposit. Present production is from only one deposit, the Tverrfjellet which lies 27km. north-west of Folldal.

Most of the deposits in the old Folldal district were relatively small in size but the grades were slightly better than the presently producing Tverrfjellet. The original Hovedgruve contained 3mm tonnes of 1.5% CU, 3% Zn, 0.3% Pb, and 35% S. The Nordre deposit contained 2.5mm tonnes of 1.3% Cu, 3.2% Zn, and 0.2% Pb and 34% S.

The Sondregruve and Nygruve were both less than one million tonnes of similar grade. The two deposits from which no production has been achieved are Grimsdal Gruve which contains 2,5mm tonnes of 0.85% Cu and 1.3% Zn, and Grimsdalen which contains 10mm tonnes of 0.3% Cu, 2.8% Zn, 0.15% Pb, 10-15 g/t Ag, and 25-35% S. Very little information is available on the precious metals contents of the deposits in this part of the district. Most of these deposits average 2-4m in width except for local thickening by folding.

The currently producing Tverrfjellet in the western part of the area began production in 1968 with initial reserves of 19mm tonnes averaging 1.0% Cu, 1.2% Zn, 36% S, 0.1 g/t Au, and 10 g/t Ag. This deposit consists of a series of lenses over a strike length of 1km. averaging 12-15m in width.

NAME	PRODUCTION	TONNAGE (MM Tonnes)	Cu	Zn	Pb	PPm Ag	PPm Au	S
Fadalen	1722-28							
	1739-47							
	1783-88	0.1	?	?				
Hovre (Folldal)	Discontinuous							
	1748-1940	3	1.5	3.0	0.3	-	-	35
Rødalen	1751-1810							
	1911-1914	0.4	1-4%	?	-	?	?	?
Røstvangen	1908-21	0.4	2.6	1	-	10-80	0.3-2.0	43
Sivilvangen	1915-17	1200 tons (testing)	1.5-2.5	?>6%	?			
N.Geitryggen	1936-70	2.5	1.3	3.2	0.2	31	0.2	34
Nygruve	1940-52	0.3						
Sondre	1950-65	0.5						
Grimsdal	-	3.0	0.8	1.2	0.008	-	-	32
Grimsdalen	-	10.0	0.3	2.8	0.15	10-15	-	25-35

Other deposits within the project area from which limited production has been recorded are Rødalen, Røstvangen, Fadalen, and Sivilvangen.

Folldal Verk has conducted ground geophysics and diamond drilling in various parts of the project area, with most emphasis being in the immediate vicinity of the past producers. Most of the work was conducted prior to 1971 and has been guided primarily by Turam ground geophysics with limited use of horizontal loop surveys. In addition, most of the area has been covered previously by stream sediment samples.

REGIONAL GEOLOGY

The area lies in the southwest end of the larger Trondheim greenstone belt of Cambro-Ordovician age. These volcanics and sediments were deposited in the Caledonian geosyncline which extended throughout the length of Norway. Regionally there are two main bands of volcanics along the structure, one along the west referred to as the Støren Group and one along the east, called the Hersjø Formation. Structurally (and possibly stratigraphically) overlying these is the Gula Group of meta sediments and thin mafic metavolcanics. The metasediments consist of mica schists, quartzites, limestones, and calc-silicate garnetiferous biotite-schists.

The Støren Group is mainly mafic pillow lavas, breccias, amphibolites, tuffites with interbedded cherty sediments, and grey-green chloritic phyllites. This contrasts with the Hersjø Formation which is made up of mafic volcanics with locally thick sequences of felsic volcanics, or "quartz keratophyres".

Underlying the volcanics on both sides of the main structure are simlar sequences of amphibolites and serpentinites, mica schists and finally augen schists and quartzites (sparagmites).


PETROGRAPHISCHE KARTE
des
sudlichen Trondheim-Gebietes
Masstab 1:100 000
Keratophyre (felsics)
Ultramafic
HJERKINN
FOLLDAL
ALVDAL
N

Most of the main sulfide deposits occur within the two volcanic belts although there are several occurences associated with the mafic horizons in the Gula schists and also the underlying mica schists.

The deposits are fairly typical massive sulfide volcanogenic deposits, being predominantly pyrite, chalcopyrite, and sphalerite with variable amounts of magnetite. Alteration zones are generally chlorite, sericite, and quartz. The deposits can be divided into two slightly different types however, with those in the western more mafic belt being more closely related to sulfide-oxide iron formations and higher in total tonnage but lower in grade than those in the eastern belt. The deposits in the eastern belt belong to a more fully differentiated sequence of volcanics which include considerable felsic flows, tuffs, and pyroclastics. They are generally smaller in size but higher grade than those in the western belt.

The sulfide deposits which occur in the underlying mica schists are generally small tonnage, high grade copper deposits. Those in the overlying Gula schists are also generally fairly small but can be quite high grade copper and have appreciable Ag-Au contents.

SUMMARY OF PROPERTY WORK - 1981

1. Grimsdalen Property

An extensive grid was established over the Grimsdalen property based on the location of a previous grid. Soil sampling was completed over approximately half of the grid, while a magnetometer survey was completed over most of it. Max-Min and CEM surveying were completed over selected portions of the grid. Two core drill holes were drilled on previously defined Turam-geochem targets totalling 505.9 meters.

The geochemical survey was concentrated primarily along strike from the area of previous drilling which defined a zone totalling 10mm tons of nearly 3% Zn. The geochem. survey has outlined an area of strongly anomalous Cu-Zn-Pb over a strike length of 600 m. This occurs slightly off-set but along strike from the zone of known mineralization. A weak Turam with mag. occurs coincident with the east end of this anomaly. A strong Turam-mag. anomaly occurs along strike to the west of this geochem anomaly also, in an area not covered by soil sampling. Detailed Max-Min surveying should be completed over the whole area from 2700 X to 7000 X, from OY to -600 Y. In addition a strong geochem-mag. anomaly occurs on line 3800 X from 0 to +200 Y. This should be covered with Max-Min and, if possible, trenching.

Min-Max surveying was completed over a geologically favourable area on the grid where an old Turam survey had indicated an anomaly. The zone is along one of the felsic horizons and is marked by extensive silification and chloritization, with considerable gossan developed in the soils. A strong Min-Max anomaly was defined over the zone but widths appear to be relatively narrow. Although the Min-Max response indicated a fairly narrow source overall it does show it to widen towards the western end, particularly on line 5600 X.

The favourable geology and the fact that the EM anomaly is quite strong would indicate that the zone should be drill tested, with one hole at 5600 X, 900 Y, drilling grid S at -45^{o}. Unfortunately geochem surveying was not completed over this portion of the grid.

The first of the drill holes which were drilled in 1981 was sited to test a weak Turam geochemical anomaly. Minor pyrite was noted in the hole but the anomaly remains unexplained. The second hole was drilled to test a Turam anomaly and was extended to test a zone of gossan in felsic volcanics. Pyrite was found to be the cause of the Turam anomaly, while pyrite with minor sphalerite and chalcopyrite was intersected in the felsic volcanics. A ten meter interval in the felsic volcanic assayed 0.31% Zn. CEM surveying over the gossan zone indicated only a very weak anomalous response however, and as such the potential of the zone would appear limited.

2. Sivilvangen

A large grid was established in the Sivilvangen area, the south part of which was centered on an old Cu-Zn prospect. This prospect has undergone limited underground exploration in 1915-17, with more extensive diamond drilling having been conducted on the deposit by Orkla during the 1950-1979 period. The deposit appears to be rather narrow, with most of the reported intersections being less than 2 m. The average grade of the mineralization was about 6% Zn and 1-3% Cu however.

CEM, mag., and VLF surveys were conducted over most of the grid, with Max-Min being completed over more select areas. In addition, most of the grid was covered with soil sampling. A limited gravity survey was also conducted over the Sivilvangen deposit. In addition detailed geological mapping was conducted over most of the grid.

Most of the grid area is underlain by mafic and felsic volcanics interbedded with greywacke type sediments and graphitic sediments. These graphitic horizons are very extensive and numerous. They often have pyrite and pyrrhotite associated and make very good geophysical targets.

From the work to date it appears that there is very limited potential to the extension of the known mineralization at Sivilvangen. There are however, other targets on the grid which will warrant drill testing.

Five drill holes have been completed to date totalling 765 meters. Two of the holes were sited to test strong EM anomalies 500 - 800m. along strike to the north of the Sivilvangen deposit, while the other three were from 1000 - 1500m. along strike to the south. All holes intersected graphite with variable amounts of pyrite and pyrrhotite.

The soil geochem survey indicated several areas of interest, some of which have coincident EM-mag. anomalies. These areas should be followed up with additional geophysics and trenching if possible prior to drilling. The area from LO to 600 N, 300 W - 600 W should be covered with mag. and CEM to detail the extensions of the EM-mag-geochem. anomaly which occurs at 3+70 W, LO - L 100 N. Another EM-mag-geochem. anomaly occurs from L 2800 N- L 3200 N, at 320 W. This anomaly should be trenched if possible and if not, drilled. Another area centered at L 2800 N - 4200 N from 100 W - 300 E is quite strongly anomalous in Cu-Zn-Pb. This is near a zone of mineralization drilled in 1970 by Folldal Verk, with 2.8% Cu and 1.98% Zn/0.85m being the best intersection. This area should be detailed with Max-Min.

An airborne EM-mag anomaly occurs in the area of L 600 S - L 500 N from 700 W - 1000 W. This should be covered with CEM-mag. Another airborne anomaly occurs in the area of

1500 - 2500 S from 800 - 1000 W. This lies along strike from a reported Cu-pyrite showing and should be followed up with ground geophysics.

Selected sections of the series of airborne anomalies continuing north of the present grid area should be covered with geophysics and soil geochemistry also, particularly between Bjørkåsen and Tonnvola.

3. Rødalen

CEM, mag., and Max-Min surveying was completed in the Rødalen area in 1981. This grid work was conducted to follow up airborne anomalies which extend from an old Cu prospect at Rødalen north to another past producer at Røstvangen. Both of these deposits are primarily copper with minor zinc but with appreciable gold contents. The mineralization consists of massive pyrite-pyrrhotite and chalcopyrite with variable amounts of magnetite. The sulfides actually appear to be very closely associated with banded magnetite iron formation. These sulfide-magnetite formations occur within the Gula Group of biotite schists along the contacts of laterally extensive but narrow cummingtonite rich mafic to ultramafic volcanics. These ultramafic bodies are widely distributed throughout the district and are characterized by abundant radiating clusters of acicular cummingtonite crystals with heavy concentrations of magnetite and in places pyrrhotite directly associated. These bodies have been noted at Rødhammeren, Snausjøvola, and Lomsjøvola.

The deposit at Rødalen had limited production from 1750 to 1810 and 1911-1914. Average grades are not available as it was hand picked ore. The surveying on the Rødalen grid has indicated two discontinuous parallel horizons, both of which have excellent conductivities and generally concident magnetics. One of the zones appears to be a continuation of the horizon associated with Rødalen, while the other is parallel to it and may be more closely related to an iron formation. This second one however, appears to flank a zone of very high magnetics and has a smaller mag directly associated, possibly indicating that it is a sulfide zone adjacent to an iron formation.

The Røstvangen deposits at the north end of the belt produced from 1908 to 1921 and averaged 2.6% Cu, 10-80 ppm Ag, and 0.3-2.0 ppm Au (total 400000 T).

Additional geophysics and geochemistry remain to be done to the north of the present grid. There are also several small lakes within the present grid area which should be covered with geophysics early in the spring.

At the present time there are probably three targets which warrant drilling, two of them along the Rødalen horizon and one on the flanking anomaly. These anomalies are located at L 3000 N, 200 E, L 4800 N, 1+50 E, L 5200 N, 400 E.

4. Fådalen

The Fådalen Cu-Zn prospect occurs within the Gula Group of biotite schists.

The prospect had limited production from 1722-1788. No information is available as to grade. On surface it appears very narrow, less than 3m. The airborne survey indicated a strong EM-mag anomaly over the deposit and continuing along strike 1200m north and 2300 m to the south. There were a couple of other prospect pits located along strike from the main one, all of which fall within the airborne anomaly.

Ground geophysics and geochemistry should be conducted over the entire length of the airborne anomaly outlined in order to outline the widest sections.

5. The following anomalies are ones which have been located with VLF on the ground and on which sulfides have been located:

   a. Snausjøvola -pyrrhotite-pyrite observed. Appears to be same horizon as Fådalen. A second anomaly is located on the south-west side of Snausjøvola which has pyrrhotite and magnetic associated with one of the cummingtonite rich mafic ultra- mafic bodies.

   b. Lomsjøvola - pyrrhotite, traces of chalopyrite in cummingtonite rich bodies similar to (a). A separate anomaly on the south side of Lomsjøvola appears to be associated with a narrow zone of mafic volcanics. Oxidized rock on surface indicates that sulfides should be the cause of this anomaly also.

   c. Rødhammeren - pyrrhotite, traces of chalcopyrite, in cummingtonite rich bodies similar to (a) and (b).

All of these anomalies should be followed up with detailed ground geophysics.

6. Other anomalies which should be followed up with detailed ground geophysics include:

   a. Stralsjøen
   b. Fiskhjørn
   c. Storgjotkletten
   d. Tonnvola
   e. Kringletåsen and Tuna R area
   f. Bjørkåsen to Fådal area
   g. Nyvangåsen

7. LESJA AREA

This area which lies in the south west end of the project is underlain by mainly ultramafics and mafics equivalent to the "serpentine belts" which occur on both sides of the main synclinal structure. The area was mapped and covered by stream sediment sampling during the 1981 season. The sampling indicated several drainages anomalous in gold, with the best values being 150-190 ppb Au. There are six areas which should be followed up with more detailed soil sampling and prospecting in 1982.

8. Tylldal Area

The Tylldal area lies in the east northeast part of the project area and is underlain mainly by mica schists and mafic tuffs of the Hummelfjell formation. Stream sediment sampling conducted in the area in 1981 indicated only one area that will probably warrant additional follow up. This is near Brydal, draining Storvola, and is anomalous in Cu, Zn, and Pb.

9. Folldal Area

Regional geological mapping began in the Folldal area in 1981, concentrating on the areas around the old deposits. In addition compilation of old drilling and geophysical data from the Folldal area was also begun.

Two main areas have been identified for additional ground geophysics. The first is along the horizon of the old Hovre deposit to the east which should be covered with Max-Min and magnetometer surveys. A previous Turam survey has indicated a weak anomaly extending along this horizon. Depending upon the results of the Max-Min surveying this area may also warrant surveying by pulse Em to test for wider zones at depth.

The second area which should be covered by Max-Min is between the old Nordre mine and the Søndre, extending west from Geiteryggen. This area is along a keratophyre horizon with some pyrite and traces of chalcopyrite on surface. It has not been covered by previous Turam surveys.

A - GRIMSDALEN

Ewald Triller
Institut f. Geochemie
J.W. Goethe-Universitæt
Senckenberg-Anlage 28

D-6000 Frankfurt a.M.

To
Dr. Johann Heim
Folldal Verk A/S
Rusellløkvegen 26

N-Oslo 3

Geological Map of the Area between Kattuglehø and Grimsdal, Dovre/Oppland

Report

1. General remarks
2. Petrology
3. Quartz-carbonate concretions, quartz bodies, and quartzites
4. Tectonics
5. Description of units
6. Sample list

N-2580 Folldal, October 1981

Geological Map of the Area between Kattuglehø and Grimsdal, Dovre/Oppland

1. General remarks

Along the staked-out profiles x = 3800 to x = 6800 all geological data available were collected and the petrology plotted onto grid paper on a scale 1 : 5.000. Where there were no outcrops on these profiles striking 323° in 200 m distances, the nearest outcrops were plotted. Between the profiles only the more striking features such as big quartz bodies and iron hydroxide zones were mapped out. If necessary the grid was extended by using compass and altimeter with the aid of the 1 : 50.000 map 1519 III Hjerkinn.
This applies especially to the steep slope southeast of the southernmost peak of Kattuglehø, where there exists no survey at all. However even there the map should be fairly exact.
To the map belong two field books with detailed outcrop descriptions (in German), a geological section, and two cover sheets showing strike/dip and fold axes respectively. All angles refer to 360° circle.
For better orientation the conspicuous moraine at the upper end of Veslebekk valley and the topographic mark on the eastern top of Storberg were plotted on both the map and the cover sheets.

2. Petrology

The true thickness of the whole sequence between the Kattuglehø Gula Group rocks and Grimsdalen road is about 1.700 m along section I, assuming an average dip of about 33°.
About two thirds of the sequence are greenschists and amphibolites, the rest leucocratic meta-volcanics. The term green-

schist was used as a collective name. Next to greenschists sensu strictu (meta-volcanics) it comprises chlorite schists, phyllites, albite chlorite phyllites, carbonate phyllites and gneiss phyllites (after SYMPOSIUM 1967). These rocks may in part be of sedimentary origin but are probably mostly meta-tuffites. Rocks of probably prevailing sedimentary.origin such as mica schists, a few gneisses rich in muscovite, and some graphite schists are of minor importance.
Transitions between most rock types occur. Greenschists with an appreciable amount of amphiboles macroscopically perceptible are called "amphibole schists" in the description (corresponds to "prasinite" in alpine literature). Massive meta-igneous rocks with a light (or even white) groundmass and amphibole phenocrysts were called "amphibole keratophyre" and given the keratophyre signature, regardless of the amount of amphibole.
The most common transition is that between greenschists and meta-tuffs of keratophyric composition. Colour and feldspar content do not always correspond, so the distinction had sometimes to be arbitrary.
Some of the greenstones may well prove to be spilites, i.e. basaltic rocks characterized by the assemblage albite-chlorite, which are commonly associated with quartz keratophyres and keratophyres.
Many greenschists and amphibole schists and even some of the more massive amphibolites contain light (to dark) brown carbonate, probably ankerite to siderite. In some gneisses, probablekeratophyric meta-tuffs, brown carbonate was found, too. In the felsic rocks it is always disseminated, whereas in the greenschists and amphibole schists it can be enriched in layers as well.
Many greenschists contain carbonate besides pyrite, which could be seen at the few fresh samples. If the rock displayed fresh carbonate besides rusty points, the latter where supposed to be weathered sulfide. If the rock showed rusty points but no fresh carbonate, this was marked with capital

R in the field books.

3. <u>Quartz-carbonate concretions, quartz bodies, and quartzites</u>

Many greenschists having carbonate in the groundmass also contain quartz-carbonate concretions. In general they are of fist to bread-loaf size, but can exceed one meter in diameter. The main constituents are quartz and the brown carbonate already mentioned. Sometimes additional white carbonate was found. The carbonate content decreases with increasing size of the concretion, quartz becoming the main constituent. But even in most quartz bodies exceeding one meter in size, which are often isolated from the country rock, brown carbonate is still found. Then they often contain light brown to pink garnet as accessory mineral.
The smaller concretions are sometimes folded.

Several big quartz bodies could be mapped out, the biggest one 70 x 35 m in size. Their genesis is of special interest as zones rich in iron hydroxide are bound to the unit which is richest in quartz bodies. The zone of brown weathered greenschists folllowing the southeastern rim of that unit might perhaps finally turn out to be a gossan. The big quartz bodies look like vein quartzes but prooved to be more or less conformable. They can laterally dissolve into numerous small bodies ("quartz-rich" signature) or even disappear completely, but normally appear again after a few hundred meters, generally bound to felsic rocks. Beyond the area mapped they continue westwards.
Some of the bigger quartz bodies contain greenschists or mica schists which may have been pressed in during orogenesis.
The only accessory mineral found is pinkish to light brown garnet, most probably the same garnet that occurs in the much smaller quartz bodies of certain sedimentary to early diagenetic origin.

Following STANTON (196) the stable coexistence of pyrite and siderite (at 25°C and 1 atm total pressure) requires a slightly to fairly reducing environment on condition that the solution is fairly basic to slightly acid. If the latter is the case, siderite is stable in the presence of amorphous silica. Thus the big quartz bodies - provided their nature is similar to that of the small ones - may througout have formed during sedimentation or early diagenesis.

What has commonly been called keratophyre or meta-keratophyre in this region actually is more often a quartz keratophyre. (after STRECKEISEN 1978), containing quartz as a constituent next to albite (quartz phenocrysts in many samples).
While keratophyres plot in the andesite field, quartz keratophyres would correspond to dacitic rocks.
Furthermore the quartz keratophyres pass into what STRECKEISEN (1973) calls quartzolites, more or less pure quartzites of igneous origin. All felsic units mapped out are more or less abundant in quartzite and quartzitic gneisses, but they seem to be concentrated in the vicinity of the big quartz bodies and in the zones given the "quartz-rich" signature.
The terms "keratophyre" and "quartz keratophyre" imply secondary albitization of feldspar. Metamorphic alteration of the bulk chemistry is unlikely, as the mineral assemblage indicates only greenschist facies, chlorite and muscovite coexisting, and carbonate between silicates being preserved.
Thus a metasomatic - probably auto-metasomatic - albitization is likely to have happened, which may have been accompanied by silification. Pure silica magmas are at least unlikely, and only the few fine-stratified quartzites including some graphite-bearing quartzites might be interpreted as metasediments.
As there seems to be a relation between the country rock being silicified and the presence of quartz bodies, the latter may as well - at least in part - owe their existence to a metasomatic process.

This does not necessarily contradict the above-mentioned. Early diagenetic or auto-metasomatic, in any case a very early - a "pre-secondary" formation can be assumed.

4. Tectonics

"Schlingen" tectonics as presented by SCHACK-PEDDERSEN (1976) do not meet the actual structure of the area which is far more simple. In the northeastern part of the mapped area the main foliation strikes west. In the central and southwestern part it turns to southwest and in the upper left corner of the map to west again. This may be due to the behaviour of the Kattuglehø Gula group rocks as a rigid block during folding or to the intercalation of big greenschist and amphibolite bodies into unit 10 (see below). However the fold axes do not follow this bend but dip more or less westwards in the whole area.
The easiest way to explain this is assuming rather flat lying folds where a minimal shifting of the fold axis renders possible a great change in strike. Thus the numerous outcrops showing on a much smaller scale narrow flat-lying and slightly westwards dipping folds probably reflect the gross tectonic pattern.
The eastern rim of the Gula group displays exactly the same structural features. The foliation is generally less well-developped, but the few strike values that could be gained agree with those south or east of the propagated nappe border. The fold axes continue to dip slightly westwards.
The main rocks exposed at the edge of the Gula group are brown micaschists and brown gneisses. But there occur also amphibolites as well as leucocratic intercalations that are probably meta-volcanics, even if they are subordinate.
The first rocks of probable sedimentary origin, the micaschists west of x = 6050 appear not far from the Gula group. They look exactly like muscovite schists at x=6120/y=1020

which are intercalated in brown gneisses of the Gula group. All these facts are rather in favour of a conformable sequence than of any tectonical border at the slope of Kattugleho.

5. Description of mapping units

Unit 1: Minimum true thickness ca. 350 m, thereof 210 m mapped out. Greenschists comparatively rich in feldspar, towards southeast carbonaceous, sporadically very rich in carbonate. Minor amphibolite schists, in profile 5500 one layer of massive amphibolite about 10 m thick. In profiles 5400 and 5600 in the uppermost part of the cliff towards Grimsdal a conspicuous iron hydroxide zone in gray and greenschists (can be seen from the Dovre - Faldet road). No other intermediate or felsic intercalations. In the slope about 100 m above the bottom of Grimsdal muscovite schists appear amidst greenschist outcrops.
The rocks are interpreted as basic meta-tuffites that pass occasionally into basic meta-tuffs or into clayey-silty meta-sediments.

Unit 2: True thickness about 100 m. Gray to white gneisses and schists, mostly slightly greenish, are the common rock type. In the southern part they are rich in muscovite. In profile 5800 a slightly greenish gray massive fine-grained garnetiferous gneiss occurs, but is yet far from being widespread. A thin layer of massive amphibolite is exposed in profile 5600. The rocks of this unit pass gradually into those of unit 1 by becoming greenish and displaying thin greenschist intercalations.
The sequence can be explained as rather intermediate to acid meta-tuffs with some intercalations of felsic to basic igneous rocks.

Unit 3: A marker between units 2 and 4. Thickness less than 10 m. Greenschist rich in feldspar and comparatively massive, in part even amphibolitic, in profile 5400 bearing big garnets.

Unit 4: True thickness about 75 m. Light gray to white gneisses and schists. Numerous small quartz bodies are a striking feature. Greenish gneisses and thin greenschist intercalations are rare. Supposed to be of exclusive volcanic origin. Mainly quart tophyres and keratophyres and the corresponding meta-tuffs.

Unit 5a: True thickness about 280 m. While along profile 5400 mainly light gray to white keratophyric gneisses (as in unit 4) are exposed, those are of minor importance in the profiles 5800 to 6600. There they often pass laterally or vertically into massive deep-gray gneisses that display garnet and biotite porphyroblasts in a very fine-grained groundmass.
Black laminated shales, some of them containing graphite, seem to be wide-spread, but are poorly exposed. They are often found in the rubble. They occur together with dark gray to sometimes black quartzitic gneisses and quartzites. In profile 6000 and on line x = 5850 some micaschist occurs. At 6600/-278 a brown weathering breccia is exposed. At 6000/-108 a boulder consisting of a massive quartz-pyrite rock was found next to an iron hydroxide zone. Such zones are found at various places but are always of inferior qualitiy.

Unit 5b: Between profiles 5400 and 6200 greenschists are exposed in the midst of zone 5a, a bigger body in the north, a smaller one in the south. Along the constructed section their true thickness is 95 and 25 m respectively, but further northeast they build up more than one third of the whole sequence. Some of the greenschists are carbonaceous, some rich in feldspar. In profile 6200 amphibolite is exposed. The dark gray rocks mentioned above occur again as intercalations, especially the fine-grained gneisses

Unit 5 is supposed to be a sequence of intermediate to basic meta-tuffs, that interdigitate with each other. The amount of

meta-igneous rocks seems to increase towards northeast.
If there is any true meta-igneous rock between profiles 5400 and 6200, it is probably the deep-gray fine-grained gneiss (and the amphibolite in profile 6200). The shales and graphite schists probably represent former tuffites, perhaps even pure sediments.

<u>Unit 6a:</u> True thickness about 265 m, thereof 15 to 25 m felsic intercalations. - Greenschists, in some places containing carbonate, towards north and east more often quite rich in feldspar. Amphibole schists are found besides greenschists between profiles 5600 and 6200. They definitely prevail in profile 5600, where they are accompanied by fine-grained amphibolites. They contain sulfide at 5780/490-520. In some places the greenschists display rusty points of 1 to 2 mm size, which might be weathered sulfide (wide-spread in profiles 6400 and 5800.

<u>Unit 6b:</u> Greenish-gray to gray or even white gneisses and schists, both rich in biotite, are intercalated in the northern part of unit 6a. Two layers could be mapped out, each of them representing a couple of thin gray bands interdigitating with greenschists The area northeast of section 5400 is hidden under moraines. But there is much evidence that at least one layer continues towards northeast. Between the profiles 4000 and 3800 several bands of gray rocks appear again, intimately digitated with greenschists(not on the map).

<u>Unit 7:</u> The rocks of this unit, although chiefly greenschists, were given an extra signature because of the significant iron hydroxide concentration. The greenschists are almost carbonate free. The few meta-keratophyric intercalations that occur, have nearly always changed colour into brown. However gray to white gneisses without iron hydroxide occur between profiles 5600 and 5800 amidst the most striking brown zone.
The by far biggest part of the brown rocks are altered greenschists, mostly blady and often disintegrated into small pieces. Wherever in the whole area these decomposed brown greenschists occur, they are almost always free of vegetation though forming

a very soft ground. This might be due to the concentration of certain cations in the circulating solutions.
If this unit contains a gossan, the latter is intensely leached. Sulfide or sulfate have not been found. At 6000/530 some greenschists display big brown stains. With the exception of point 5800/500 such stains have not been found in the other units. There sulfide occurs in addition.
A bore-hole beginning at 5810/780 (i.e. somewhat southwards of the southern end of the plotted moraine) and dipping 45° in 119° would cross the unit at 55 m and unit 8 (which in part also weathers brown) at a distance of 30 m.

Unit 8: True thickness about 40 m along the constructed section, maximal thickness about 90 m further east. Massive to blady gray to white schists and gneisses, often extremely quartzitic. The gneisses of profiles 5600 to 4800 contain biotite, the amount of this mineral increasing towards northeast. In profile 4800 a biotite gneiss occurs but is of minor importance. Thin muscovite schist intercalations occur, but cannot be mapped out.
The gneisses are sometimes slightly to fairly greenish, especially along profile 4800, where pink garnet is abundant in some places. Along profiles 6200, 5200, 4200, and 3800 there are a few outcrops of amphibole keratophyre. A minor greenschist intercalation occurs east of line x = 4100. At 3800/940 pyrite was found. There and at 3800/960 the greenschists have in part brown colour. The iron hydroxide zones betweenprofiles 5000 and 5200 and at 4120/925 are striking.
The whole unit is extremely rich in quartz. Between line x = 4300 and profile4600 numerou s small quartz bodies are evenly distributed while at x = 3800 the quartz is concentrated in one big body of 70 m length. Some of the gray gneisses contain lapilli. With the exception of the intercalated greenschists the unit can be interpreted as a series of fairly acid to intermediate igneous rocks and meta-tuffs, most of the rocks being rather quartz keratophyres than keratophyres.

Unit 9a: True thickness along the constructed section about 150 m,

maximal thickness further northeast nearly 200 m..
Gray intercalations are very rare, greenschists being by far more important. Profiles 5800 to 5400 are rich in green phyllite to micaschist, 5400 and 5800 contain minor amphibolite.
Amphibole schists are wide-spread along profile 5800 and of minor importance along line x = 6350 and profile 6000.
At 6200, 4400, 4200, and 3800 some brown weathering greenschists occur. Pyrite was found at 5315/1150, 4400/1150, 4400/1135, 4200/1063, 4200/1000, and 4000/1095.
All green rocks of this unit are very often rich in carbonate and contain carbonate-quartz-concretions. Feldspar-rich greenschists are frequent between profiles 5400 and 5800.

Unit 9c: Northeast of profile 4800 the greenschists interdigitate with gray gneisses. The thin greenschist band that follows between these gneisses and unit 10 consists of carbonaceous greenschists and some dark green gneisses west of profile 4600, whereas garnet amphibole "garben" schists follow east of 4400. The latter resemble amphibole keratophyres, but their groundmass is often distinctly green.

Unit 9b: The gray to white gneisses mentioned above form a brown-coloured cliff towards Veslebekk valley. They are rich in garnet. Fine-grained quartzites are abundant. At 4400/1190 some thin graphite schists were found. Pyrite was found at 4000/1160.

The greenschists of unit 9 are interpreted as basic meta-tuffites that sometimes pass into purer sediments (micaschist) or met-tuffs, intermediate or basic igneous rocks being less important. The gray gneisses forming the cliff are probably intermediate to acid meta-tuffs. They often display relictic lapilli.

Unit 10a: True thickness along the constructed section 40 (southern) + 30 m (northern wing), broadening towards north.
Gray to white gneisses and schists, mostly rather massive than schistose, are the common rock. They are quite often distinctly greenish and rarely as pure as those of unit 8. A great part of

the gneisses are quartzitic. Quartzites are concentrated from profile 6800 to profile 6000. Between profile 6000 and line 5900 muscovite quartzites are exposed. They lead over to mica-schists, the latter being intercalated in profiles 5600 to 4600, i.e. in the zone of reduced thickness.
Minor amphibole schists occur from profile 6400 to profile 6800. Amphibolite is only common in profile 6200 and in the upper part of profile 4400.
Amphibole keratophyres occur along line 6330 and profiles 6000 and 5200 and are wide-spread in the northeastern broadening zone (upper profiles 4400 to 3800).
Pyrite was found at 5310/1270, 5350/1250, and 6526/1025. Small iron hydroxide zones in profiles 6400 (greenschist) and 5600 (keratophyric gneiss) are of minor importance.
In section 4800 a biotite gneiss occurs, in the creek between profiles 5200 and 5400 a dark grayish-green gneiss rich in mica. The white to light gray gneisses of the upper wing of profile 6400 contain in part garnet and display locally rusty points. Dark grayish-green gneisses (line 6050) lead over to the massive greenschist and amphibole schist intercalation (unit 10b).

Unit 10b: True thickness along the section about 150 m, a few hundred meters in the western corner of the map.
Next to greenschists amphibolites and amphibole schists are a constituent part of this sequence. They are seldom carbonaceous. Some garnetiferous amphibole "garben" schists occur in profile 5600. Profile 6200 shows an increase of mica content towards the neighbouring micaschist (unit 10d)

Unit 10c: Maximal thickness about 140 m. This unit is the northeastern counterpart to unit 10b. Like that it is intercalated into unit 10a. Greenschists, quite often carbonaceous, and greenish-grayish gneisses. Amphibole schists lack. In profile 4000 some amphibolite occurs.

Unit 10d: True thickness about 30 m. Micaschists of the steep southern slope of Kattuglehø. Some of the rocks are rather phyllites or quartz phyllites with an appreciable amount of quartz lenses. The rocks are in part carbonaceous. Quartz carbonate nodules occur. The micaschist becomes greenish towards west and probably passes into or digitates with the greenschists of unit 10b (no outcrops).

Compared to the other units described, unit 10 is quite heterogeneous. The rocks of unit 10a probably derive from keratophyric magmas, in part from basic magmas, whereas the intercalated and neighboured micaschists and phyllites may have been tuffites to rather pure sediments. The intercalated green rocks derive for the bigger part from basic magmas and tuffs that intercalate with basic meta-tuffites.

Unit 11: True thickness about 40 m along the section, broadening towards north. Greenschists rich in feldspar, often grayish. Amphibolites are a major constituent. They are sometimes very massive. In profile 4800 some biotite gneiss is exposed. Interpretation: Basic to intermediate tuffs and tuffites, basic igneous rocks.

Unit 12: Badly exposed. At 4800/1900 gray and greenish-gray gneisses. At line 6050 gray micaschists and quartz phyllites, that are carbonaceous and contain some quartz carbonate nodules. The following fuchsite-bearing marble belongs already to the Mula group.

Sample List

3740/1125 keratophyre with much chlorite and muscovite. rusty weathered carbonate. Pyrite
3800/940 keratophyre with rusty ?pyrite/?carbonate
4230/1195 keratophyre or quartz keratophyre with black intercalation. ? Graphite
4400/1220 amphibole garben schist with garnet
4790/1025 quartz keratophyre with subordinate pink garnet
4800/1040 keratophyre very rich in muscovite, actually a mica schist
4800/1645 greenish keratophyre
4800/1650 amphibole keratophyre with amphibole or chlorite in the ground mass
4790/1690 brown weathered gneiss rich in mica (biotite and muscovit
4795/1773 dark gray gneisses. Two samples
4800/1910 greenish keratophyre with sulfide
4815/1910 yellow to brown keratophyre, weathered, rusty points (?carbonate)
5390/-75 amphibole keratophyre with white ground mass
5405/-665 greenschist rich in feldspar, big garnets
5440/1515 gray quartzitic keratophyre with gray veins
5430/1520 dark gray gneiss with brownish layers rich in carbonate
5818/-775 quartzitic keratophyre, dark gray, probably containing graphite
5800/-350 massive dark biotite gneiss with rusty points, probably carbonate
5800/-200 keratophyre or quartz keratophyre rich in garnet, containing carbonatic layers
5800/360 amphibole keratophyre with rusty points, maybe sulfide
5780/490 dark green fine-grained amphibolite with sulfide

5790/515 keratophyric intercalation in amphibolite, containing sulfide
5800/1131 fine-grained amphibolite
5600/1215 greenish-gray gneiss, maybe leuco-amphibolite

6000/-875	fine-grained gray gneiss, laminated, biotite porphyroblasts
5988/-370	massive biotitegneiss, perhaps some amphibole layers, with brown rusty points and carbonate layers
6000/-155	ochre brown weathered rock, sulphurous smell
6008/-108	block, no outcrop. Quartz pyrite rock
6060/558	massive dark gneiss, probably a meta-tuff, comparatively fine-grained, many rusty points in the groundmass
6055/795	greenish keratophyre containing sulfide
6050/940	graphite schist
6050/1060	marble with some fuchsite, Gula group base
6200/-450	graphite schist
6197/-382	black laminated quartzite to quartzitic gneiss
6255/-222	gray quartzitic gneiss or quartz keratophyre, fine-grained,with light brown garnets and biotite
6255/-210	the same, passing into amphibole keratophyre
6400/-475	black quartzite or quartz keratophyre, with weathered sulfide (?) in the groundmass
6400/-427	fine-grained laminated gray schist
6390/950	dark gray gneiss
6400/960	mylonite containing graphite
6525/1025	keratophyre rich in chlorite and muscovite, containing big pyrite crystals
6600/-278	brown weathered breccia
6620/-310	black schist
6600/600	amphibole keratophyre
6700/475	greenish keratophyre or quartz keratophyre out of a brown weathering zone
ca 6800/1700	brown gneiss with cavities (former ?sulfide) and manganese hydroxide
4385/1190	graphite schist
3970/1625	quartzitic gneiss

B-LESTA

EN UNDERSØGELSE AF LESJE HORRUNGERNES ULTRABASISKE BJERGARTER MED SÆRLIG HENBLIK PÅ CHROMITFOREKOMSTERNE

Feltrapport

Jørgen Bollhorn

1980

INDHOLDSFORTEGNELSE

INDLEDNING

Det er undersøgelsens formål at klarlægge det økonomiske potentiale af Lesje Horrungernes ultrabasiske bjergarter. Arbejdet udføres på foranledning af Folldal Verk A/S som et led i undersøgelsen af Nord-Gudbrandsdal. Materialet, som er fremkommet ved undersøgelsen, tænkes anvendt til en afsluttende eksamensopgave ved Københavns Universitet.

Feltarbejdet er udført i perioden 1/7 - 14/9 - 1980. Der er karteret i et ca. 50 km^2 stort område ved Stor og Vesl Horrungen (kortbladet 1419 II Dombås) samt i et mindre område 20 km inde i Skamsdalen omkring Langvassbekken (kortbladet 1419 I Storskrymten). Der er i forbindelse med karteringen indsamlet ialt 164 prøver. Min vejleder, Dr. M. Ghisler, har i to perioder deltaget i feltarbejdet.

Der er anvendt følgende kortgrundlag:

Geologisk kort i målestok 1 : 50.000 kortblad 1419 II Dombås, upubliceret, udarbejdet af Guezou.

Topografiske kort i målestok 1 : 50.000 kortblade 1419 I og 1419 II.

Flyfoto Widerøe serie 1431 i målestok 1 : 35.000 E 7-8, F 1-7, G 1-6 og H 1-6 samt forstørrelser i målestok 1 : 12.000 G 3-5 og H 3-5.

Områdets geologi eller dele heraf er tidligere beskrevet af Carstens (1916), Scott (1967) og Guezou (1978). Guezou har desuden karteret hele området i målestok 1 : 50.000. Chromit-forekomsterne er beskrevet af Helland (1873). Herudover findes i NGU's bergarkiv en del rapporter om forekomsterne.

Det karterede område ved Horrungerne hører litostratigrafisk til Bottheim Group i Andsberghøj Complex (Guezou, 1978). Andsberghøj Complex ligger som en tektonisk skive mellem sparagmit-lignende kvartsiter og den overliggende Trondheim nappe. Bottheim Group består af glimmerskifre vekslende med amfiboliter og ultrabasiske legemer.

OMRÅDETS BJERGARTER

Der er ved karteringen udskilt følgende 4 bjergartsenheder:

1) Glimmerskifer. En kvarts-biotit-muskovit-amfibol-granat schist. Mængden af glimmer præger denne bjergarts udseende i felten, de glimmerfattige partier er gråhvide, mens de glimmerrige partier er rustbrune og kraftigt forvitrede. Mængden af granat varierer fra 0 til mere end 50 %. Amfibol findes især i cm tynde bånd nær kontakten til amfibolit. Bjergartsgruppen er formentlig af sedimentær oprindelse.

2) Båndet amfibolit. Denne gruppe optræder som op til 60 m mægtige lag i glimmerskiferen. Den karakteriseres bedst som en sort, amfibolitisk schist med op til 30 cm mægtige lyse indslag af feldspatholdigt (trondhjemitisk ?) materiale. Bjergarten består af sort amfibol og plagioklas og er desuden altid granat-førende.

3) Grøn amfibolit. Bjergarten er mørk, grønlig, normalt massiv, og der er flere steder set ofitisk tekstur. På en lokalitet er der muligvis pillow strukturer bevaret. Disse ses som op til 15 x 30 cm linseformede legemer med hvide randzoner. Det har ikke været muligt at bestemme "way-up" i disse pudestrukturer. Ved kraftig deformation bliver bjergarten båndet med vekslende hvide og mørkgrønlige bånd af cm tykkelse. Bjergarten er formentlig af submarin-ekstrusiv oprindelse.

4) Ultrabasiterne i det undersøgte område ved Horrungerne findes som 32 langstrakte legemer. Desuden findes 7 ultrabasit-legemer omkring Langvassbekken i Skamsdalen. Ultrabasiterne er sjældent bevoksede og står oftest frem i terænnet som forhøjninger. Farven varierer fra rødbrun via grågrøn til gråhvid. Størrelsen varierer fra knap 100 m^2 til 1 km^2. Totalt dækker ultrabasiterne ca. 5 % af detundersøgte område. De kan inddeles i tre typer:

1. Olivin-nodul-rig bjergart
2. Finkornet sepentinit
3. Talk-karbonat bjergart

Type 1 består af mørkebrune, afrundede olivin-noduler op til 20 cm i diameter i en gråhvid matrix af talk og karbonat. Denne type dækker ialt kun nogle få hundrede m^2. Den findes på toppen af Kollen, Stor Horungen og i ultrabasiten ved Vesl Horungen.

Type 2 fremtræder i felten som en rødligbrun til grågrøn, finkornet, overvejende massiv serpentinit. På friske brudflader er bjergarten gråsort. Bjergarten indeholder varierende mængder af følgende mineraler: serpentin, talk, karbonat, tremolit, chlorit, samt chromit/magnetit.

Type 3 er en gråhvid talk-karbonat bjergart, hvor karbonaten hovedsagelig findes som brune enkeltkrystaller eller aggregater af en størrelse varierende fra få mm til 5 cm. Aggregaterne er ofte tætliggende og danner af og til en slags linering parallel med strygningen af de omgivende bjergarter. I denne type findes magnetit, dels dissemineret og dels som sekundære slirer af op til 2 cm's tykkelse.

I forbindelse med ultrabasiterne er der på 3 lokaliteter observeret en flere meter bred kontaktzone bestående af forskellige afrundede bjergartsfragmenter i en matrix af talk og karbonat. Denne bjergart tolkes som enten et konglomerat eller en kontakt-breccie.

TIDLIGERE MINEDRIFT

Man har før år 1800 kendt og udnyttet talkforekomsterne i forbindelse med ultrabasiterne omkring Sjongsvatnet. A.Helland skriver herom i Norges Land og Folk, bind VIII, side 35: "I disse bjerge har i ældgamle tider en hel del været hugget til gryder, ligstene etc. Men i umindelige tider har der intet været arbejdet." Der er flere steder i området fundet spor efter denne talkbrydning. Et egentligt talkbrud kan ses i ultrabasiten ved sydenden af Sjongsvatnet (Stelstensberget), se fig.1.

Forskellige selskaber har inden for de seneste år ladet foretage en del boringer på de talkrigeste af ultrabasiterne. På de to små blotninger af ultrabasit ovenfor Filling er der foretaget 4 boringer. På ultrabasiten ved sydenden af Sjongsvatnet er der gennemført mindst 3 kerneboringer. Lokale hytteejere har desuden oplyst, at der for ca. 10 år siden blev foretaget kerneboringer på ultrabasiten nord for Sjongsæter.

Chromit-brydningen foregik i årene 1841-1854 samt 1916-1918. Totalproduktionen er skønnet til 1200 t malm. Gruberne hed Olstad (Nysæter), Aurtand, Halvforhøj,Severine, og Skamsdalsgruberne. Brydningen foregik om sommeren. Malmen blev håndsorteret, inden den blev transporteret til det opsatte pukverk (knuseværk) ved Filling. Knusningen foregik ved hjælp af vandkraft, og malmen blev herefter i trækasser transporteret til Veblungsnes (Åndalsnes) ifølge oplysninger givet af A. Helland i Norges Land og Folk, bind VIII, side 95-96. Transporten både til pukverket og til Veblungsnes kunne kun foregå om vinteren, d.v.s. at der forløb mindst 1½ år fra malmen var brudt til den nåede udskibningshavn. Driften indstilledes i 1854 p.g.a. dårlig økonomi og mangel på malm. I sommeren 1916 blev der igen arbejdet i området, nemlig i Fillingelvens felt (Carstens, 1918), samt i Olstad gruber. Firmaet A/S Lesje Kromgruber opbrugte her aktiekapitalen uden at finde tilstrækkelig med malm (NGU's bergarkiv, rapport nr. 4195). Gruberne må siden have skiftet ejere, idet lensmand Tore Nestande i 1941 forsøgte at sælge gruberne til en bergsingeniør H.H. Smith. Der blev i denne forbindelse udtaget nogle tons prøver fra Severine og Olstad gruberne. Analyserne af disse prøver viste et ugunstigt Cr/Fe forhold på omkring 1:1.

CHROMIT-FOREKOMSTERNE

Der er ialt lokaliseret 28 skjerp/synk og 4 sprænghuller i følgende grubefelter: Olstad/Nysæter, Aurtand, Halvforhøj, Fillingelvens felt, Severine skjerp samt Skamsdalsgruberne. En liste over disse forekomster med angivelse af UTM koordinater er givet i bilag 1. En fortegnelse over samtlige indsamlede malm- og bjergartsprøver ned angivelse af UTM koordinater er givet i bilag 2.

Nysæter/Olstad gruberne ligger i ultrabasiten på nordvestsiden af Dyratjørni. Der er ialt 7 skjerp/synk samt 2 stoller. De to stoller samt skjerp nr.1 (fig. 2) er bevaret, de øvrige anlæg blev af sikkerhedshensyn fyldt op ved sprængning i 1978. Værtsbjergarten til chromitmalmen er hovedsagelig en finkornet serpentinit (type 2).

Det bevarede skjerp er anlagt i trappeform. Det er 10 m langt, 3 m bredt med en dybde op til 4 m (mod syd). I øst- og sydvæggen ses slirer af chromit/magnetit i en malmzone af ca. 40 cm's bredde. De enkelte slirer varierer i tykkelse fra knap ½ cm til 4 cm. Malmzonen hælder ca. 60° mod syd og stryger ca. 50°. Den er opbrudt af flere næsten horizontale normalforkastninger med små forsætninger. De større malmbånd afskæres brat, mens de små i en vis udstrækning afbøjes inden de "knækker". Der er en kraftig variation i Fe-indholdet fra chromit til magnetit imellem de enkelte slirer inden for malmzonen. Udover i malmzonen findes der oxyder som disseminerede korn i bjergarten, hvoraf de udgør omkring 5 %. Disse korn er dog meget magnetiske, og består formentlig hovedsagelig af magnetit.

Skjerpene 4, 5 og 6 har tilsyneladende været af samme størrelse som skjerp 1. Ved 4 og 5 ligger der 2 mindre bunker med sorteret malm, og det fremgår af disse, at malmen har været udviklet på samme måde som ved 1. Ved skjerp nr. 6 er der friske blokke fra sprængningen i 1978 og i flere af disse ses dele af en malmzone svarende til den som iagttages ved 1.

Ved anlæggene nr. 3 er der 3 skjerp, hvoraf det ene har udseende som en påbegyndt stolle. Ved denne ligger der en del malmstuffer, som ligner forekomsten ved skjerp 1, bortset fra at de enkelte slirer når tykkelser op til 10 cm. Lidt syd for anlæg 3 er der resterne af en smedje.

De to stoller ser ud som om de hidrører fra driften i 1916-18. I stollen neden for skjerp 1 ligger der sveller fra et tipvognsspor, og ude i vandet neden for stollen ligger der en tipvognsbeholder. Stollen, der har en retning NNØ-SSV, er 20-25 m lang og har et tværsnit på ca. 2x2 m. Stollen ved nr. 2 har samme længde og tværsnit som den foregående, og retningen er ØSØ-VNV. I udmundingen af begge stollerne iagttages den ovenfor beskrevne kontaktbreccie/konglomerat.

Aurtand/Rødhaug/(Sjang?) grube ligger i ca. 1080 m's højde omtrent midt mellem Kollen og Flisevatnet i den sydlige kontakt af det store ultrabasitlegeme, som strækker sif fra Flisevatnet til Kollen. Gruben består af en dagskæring, en stolle og en synk, der ligger i fortsættelse af hinanden(fig.3). Stollen forbinder dagskæringen med synken. Værtsbjergarten for malmen ved Aurtand samt de øvrige skjerp i den store ultrabasit er finkornet serpentinit (type 2). Malmen kendes kun fra løsblokke. De største slirer har heri en mægtighed på mindst 15 cm. Malmen er tilsyneladende af god kvalitet, den er næsten ikke magnetisk og stregfarven er brun. Der er kun fundet få stuffer med egentlig magnetit, de største viser at de magnetitrige slirer har været mindst 3 cm tykke.

Ca. 500 m ØNØ for Aurtand ligger der 3 skjerp. De to lavest beliggende er ca. 2 m brede, 8-10 m lange og ½-1 m dybe. Der er to små slirer, knap 3 cm tykke, af faststående malm. Begge er af ringe kvalitet, d.v.s. stærkt magnetiske. Små malmfragmenter efter sorteringen af den brudte malm viser at der har været en mere chromholdig malm tilstede. Det højest beliggende af de tre skjerp ca. 100 m vest for de to laveste er ca. 1-1½ m bredt, 6 m langt og op til 1 m dyb. De tre skjerp ligger i en afstand af 50-75 m fra kontakten. Der er ingen faststående malm i sidstnævnte skjerp. Små stykker viser, at der både har været en magnetit- og en chromitholdig malm. Ca. 80 m vest for dette skjerp er der et sprænghul med en enkelt cm-tyk slire af magnetisk malm.

Ca. 400 m nord for Aurtand findes et skjerp, 6 m langt, 1½-2 m bredt og ca. ½-1 m dybt. Malmen kendes kun fra små stykker. Der er både en magnetit-rig og en forholdsvis god chromitmalm til stede. 500 m NV for Aurtand ca. 100 m fra den nordlige kontakt af den store ultrabasit ligger der endnu et skjerp, 2½ m bredt, 5 m langt og knap 1 m dybt. Der er både en magnetit- og en chromitmalm faststående i hullet. Chromitsliren er 5 cm bred og 10 cm lang, magnetitsliren ca. 2 cm bred og 30 cm lang.

I den vestlige spids af det trekantede ultrabasitlegeme syd for den store ultrabasit ca. 700 m ØSØ for Aurtand forekommer et lille sprænghul 2 m langt, 1 m bredt og ½ m dybt. Der er en ca. cm-tyk magnetisk malmslire i den ene side af hullet.

I den største af ultrabasiterne på sydøst siden af Sjongsvatnet ca. 1.7 km NNØ for Aurtand ligger der i ca. 910 m's højde et mindre vandfyldt skjerp. Det er 2 m bredt, 3 m langt og 2 m dybt. Der er ikke observeret faststående malm, men ud fra de malmstykker, som ligger i to bunker med sorteret malm, kan det fastslås, at der har været både Fe-rig og Fe-fattig chrommalm. Chromitsliren har haft en mægtighed på mindst op til 10 cm.

I den nordligste af ultrabasiterne på SØ siden af Sjongsvatnet er der i sydenden et lille sprænghul. Løse brokker herfra vidner om en stærk magnetisk malmtype, der optræder som op til 10 cm tykke slirer. Der kan endnu ses faststående malmslirer, men disse er knap så mægtige.

Halvforhøj grube ligger i 1410 m's højde 2.2 km SV for Aurtand. Gruben er sprængt ind i siden på ultrabasitlinsen. Snittet er ca. 15 m langt og har en største horizontal dybde på 8 m (fig. 4). Malmen hælder ca. 30° mod NV og har en strygningsretning på 33°. Værtsbjergarten til malmen er en serpentinit, men indeholder større mængder tremolit og magnesit end normalt for type 2. Disse mineraler findes som enkeltkrystaller med en længde på op til flere cm. Der er adskillige slirer og linser samt et enkelt opbrudt bånd med faststående malm. Den største af linserne måler 25 x 50 cm. I den sydvestlige ende af gruben ses to slirer dm-tykke, som er trukket ud parallel med forkastningen, som står vinkelret på malmens strygningsretning. I den nordøstlige ende af gruben ses den største sammenhængende del af det opbrudte malmbånd, som har en mægtighed på knap 7 cm. Al den faststående malm er af den stærkt magnetiske type. God chromitmalm associeret med serpentin er fundet i bunker med sorteret malm ovenfor gruben.

Fillingelvens Felt. Betegnelsen Fillingelvens Felt er først brugt af Carstens (1916), og den dækker over ialt 7 skjerp, som ligger i ultrabasiten lidt neden for toppen NV for Vesl Horrungen (se fig. 5). Værtsbjergarten til malmen i de 7 skjerp er den samme som i Halvforhøj grube.

Skjerp A er 2 m bredt og 3 m langt og knap 1 m dybt. Der er ingen faststående malm i selve hullet, men ovenover ses en knap 10 cm bred, opbrudt malmzone med disseminerede malmkorn. Denne zone kan følges nogle få meter opover. Malmen fra den sorterede bunke, som ligger et lille stykke fra skjerpet, er magnetisk, men synes dog efter stregfarven at dømme at være noget chromholdig.

Skjerp B er ca. 8 m langt og knap 2 m bredt. Det har form af en påbegyndt stolle. Der er ingen faststående malm, men stykker fra en lille bunke på sydsiden af skjerpet tyder på, at der har været en lille smule god chromitmalm. Den magnetiske malm har haft en mægtighed af op til mindst 10 cm. I den ene væg ses en knap 1 m bred zone med op til 10 cm lange tremolitkrystaller.

Skjerp C ligger knap 10 m NØ for skjerp B og lidt oven for dette. Det er 10 m langt og $1\frac{1}{2}$ m bredt. Hullet udvider sig i den østlige ende til 3 x 3 m og ender i en 2 m høj væg. Ca. midt på denne væg ses en 5 x 3 cm chromitslire og 5 cm under en magnetitslire af samme størrelse. Der ligger løse brokker med chromit op til 10 cm's tykkelse og med magnetit op til 40 cm. Ca. 10 m mod nord ligger en bunke med sorteret malm.

Skjerp D er sprængt ind i ultrabasiten. Det er 4 m langt, knap 2 m bredt, og ender i en 4 m høj, halvcirkelformet væg. Når man ser mod nord, er der i højre side af denne væg en ca. 1 m bred zone med dissemineret malm. I venstre side er der en dm-bred karbonatslire. Både den faststående malm og malmen fra bunken 10 m vest for skjerpet er magnetisk.

Skjerp E er 3 m langt, 1½ m bredt og ½ m dybt. Der er en 5 cm bred og knap 20 cm lang slire af magnetisk malm fastsiddende i nordspidsen af skjerpet.

Skjerp F er en 8 m lang og knap 2 m bred V-formet fordybning med nedskredet løssprængt materiale. Der ses en lille smule faststående ultrabasit i østsiden af hullet. Fra de løse brokker kendes op til 5 cm massiv chromit og magnetit. Desuden er der fundet en stuf med 2 cm tykke bånd af dissemineret chromit.

Skjerp G har form af en påbegyndt stolle. Skjerpet udgøres på den vestlige side af en ca. 7 m lang og op til 3 m høj væg, mod syd ender skjerpet i en 5 m høj væg, hvori der er en 1½ m dyb stolle med et tværsnit på 2 x 2 m. I bunden af stollen sidder der en magnetisk malmslire 10 cm bred og 30 cm lang. 3-4 m oppe på sydvæggen ses en malmbolle med et tværsnit på ca.30 cm. Ca. 20 m vest for skjerpet ligger der en mindre bunke med sorteret malm. I denne er der fundet chromit i slirer på op til 5 cm's tykkelse.

Severine Skjerp ligger på nordsiden af Fillingsjörni i 1420 m's højde knap 1 km syd for toppen af Storhorrungen. Skjerpet er ca. 25 m langt, op til 5 m bredt og med en største dybde på 2½ m (se fig.6). Værtsbjergarten til malmen er den samme som ved Halvforhøj og Fillingelvens felt. Ca. midt i skjerpets østvæg sidder der to cm-tykke slirer af magnetisk malm. Desuden er der 3 faststående malmboller i den nordligste ende af skjerpet. Den største af disse består af chromit, 40 cm bred og 1 m lang. De to andre består hovedsagelig af magnetit, 50 x 15 cm. Knap 10 m øst for skjerpet ligger der en mindre bunke sorteret malm.

Skamsdalsgruberne. Ultrabasiterne i Skamsdalen består af 8 stærkt forskifrede serpentinitlinser. Skamsdalsgruberne ligger i den største af disse linser på en strækning af 50 m i den sydlige side af Langvassbekken's elvleje i 1280 m's højde ca. 2.2 km NØ for nordenden af Leirsjøen. Ultrabasitlinsen begrænses mod SV af augengnejs og mod NØ af kvartsglimmer gnejs. Der er ikke fundet amfiboliter i området, og det er derfor rimeligt at antage, at disse ultrabasiter hører til en anden serie end ultrabasiterne ved Horrungerne.

Gruberne består af 3 påbegyndte stoller og et større brydningsrum. Sidstnævnte er ca. 10 m langt, 2 m højt og knap 10 m dybt. På midten samt i den vestlige ende er der ud mod elven konstrueret strosser for at forhindre sammenstyrtning. Den vestligste af de påbegyndte stoller er ca. 2 m dyb, 2 m bred og knap 1½ m høj, de øvrige er kun ½-1 m dybe. Malmen ser ud til oprindelig at have været en sammenhængende chromithorisont strygende 8° og hældende 29° mod øst. Største malmtykkelse har skønsmæssigt været 1½ m. Der ses faststående rester af malmhorisonten med mægtigheder på op til 50 cm. Under chromitmalmen ligger der et sammenhængende lag af magnetit ca. 5 cm tykt, som kan følges over en strækning af 10 m og genfindes på den anden side af elven.

Ovenover gruben ca. 20 m mod syd ligger der en større bunke med håndsorteret god chromitmalm. Der er i enkelte stuffer fundet aggregater af veludviklede biotitkrystaller op til 1 cm lange.

Ca. 500 m nord for Skamsdalsgruberne ligger der et lille skjerp. Dette er muligvis Zachariasgruben omtalt i Helland (1873). Det er ca. 4 m langt, 2½ m bredt og ½ m dybt. I de løse blokke omkring hullet ses magnetisk malm i slirer på op til 10 cm's tykkelse.

RESULTATER AF FELTARBEJDET

1. Områdets ultrabasiter med tilhørende sidebjergarter er kortlagt i målestok 1 : 12.000. De i ultrabasiterne forekommende chromitforekomster er lokaliseret og undersøgt i detaille.

2. Der er ikke fundet nye forekomster af chromit bortset fra enkelte ubetydelige cm-tynde slirer. Alle mineraliseringer blottet i overfladen har været gjort til genstand for undersøgelse i forbindelse med tidligere tiders brydning.

3. Tilbagestående malmpartier i skjerp, sprænghuller og synk i området ved Horrungerne er af overvejende jernrig kvalitet. Sorterede malmbunker nær anlæggene vidner imidlertid om, at den malm der blev brudt, var mere Cr-ri

4. I Skamsdalsgruberne står der forholdvis større partier af rimelig god malm tilbage i de gamle gruber, med lag af op til ½-1 m's tykkelse.

5. Udover de egentlige malmbånd og - slirer er der mange steder i serpentiniterne koncentrationer på omkring 5% malm jævnt fordelt i bjergarten. Disse korn er dog særdeles jernrige og af formentlig ringe Cr-indhold.

6. Der er intet i de geologiske forhold der peger på, at der skulle kunne findes større, brydeværdige koncentrationer af chrommalm. Alle eksisterende mineraliseringer er cm- til dm-tykke slirer, som kun undtagelsesvis når op i meterstørrelse. Malmen er altid stærkt sønderbrudt.

7. Der er betydelige forekomster af talk i området. Det gælder de ultrabasitlegemer, som har gennemgået de stærkeste omdannelser. De har dog som regel et relativt stort indhold af karbonat (magnesit) samt magnetit, som nedsætter kvaliteten af talkmalmen.

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BILAG I

FORTEGNELSE OVER CHROMIT-FOREKOMSTER

Kortblad DOMBÅS 1419 II	UTM-koordinater
NYSÆTER/OLSTAD gruberne	
1. Stolle og synk	95,25 - 96,2
2. Stolle	95,35 - 96,45
3. Tre skjerp	95,4 - 96,4
4. Skjerp	95,35 - 96,35
5. Skjerp	95,3 - 96,3
6. Skjerp	95,35 - 96,25
AURTAND/RØDHAUG gruber	
Dagskæring, stolle og synk	93,0 - 95,5
Skjerp	93,55 - 95,65
Skjerp	93,55 - 95,65
Skjerp	93,4 - 95,7
Skjerp	93,3 - 95,9
Skjerp	92,5 - 95,7
Sprænghul	93,65 - 95,2
Skjerp	92,5 - 97,1
Sprænghul	91,20 - 98,25
HALVFORHØJ grube	
Dagskæring	91,5 - 93,8
FILLINGELVENS felt	
Skjerp A	90,05 - 92,95
Skjerp B	89,9 - 92,95
Skjerp C	89,9 - 92,95
Skjerp D	89,8 - 93,0
Skjerp E	89,8 - 93,05
Skjerp F	89,7 - 93,15
Skjerp G	90,05 - 93,15
SEVERINE skjerp	
Dagskæring	90,5 - 94,95
SKAMSDALSGRUBERNE Kortblad STORSKRYMTEN 1419 I	
Brydningsrum og 3 påbegyndte stoller	03,9 - 06,95
Sprænghul (Zachariasgruben ?)	04,0 - 07,50

PRØVELISTE

Kortblad DOMBÅS 1419 II

Prøve nr.	Beskrivelse	UTM - koordinater
468o1	magnetit oktaedre i talk	92,1o - 97,oo
468o5	magmetit	91,2o - 98,25
468o6	magnetit	91,2o - 98,25
468o7	brecieret chrom-holdig malm	91,2o - 98,25
468o8	talk fra åre	91,2o - 98,3o
468o9	magnesit, talk og dissemineret malm	94,3o - 94,5o
4681o	carbonat fra åre	96,oo - 93,8o
46811	talk m. malm	96,oo - 93,8o
46812	serpentinit m. dissemineret malm	96,oo - 93,8o
46814	amphibolit	92,7o - 97,1o
46815	amphibolit m. granat	92,3o - 96,9o
46816	magnetit	92,5o - 97,1o
46817	brecieret chrom-holdig malm	92,5o - 97,1o
46818	gneiss-finkornet	92,7o - 97,1o
46819	chromit m. tremolit, talk og serpentin	91,5o - 93,8o
4682o	olivin fra "megachrysts"	89,7o - 93,2o
46821	amphibolit m. ofitisk textur	94,1o - 95,2o
46822	chromit	89,9o - 92,95
46823	tremolit fra åre	89,9o - 92,95
46824	magnetit i serpentin	89,9o - 92,95
46825	store tremolit xx m. dissemineret malm	89,9o - 92,95
46826	serpentinit m. dissemineret magnetit	89,9o - 92,95
46827	serpentinit m. talk	89,9o - 92,95
46828	chromit	89,9o - 92,95
46829	massiv magnetit	89,9o - 92,95
4683o	dissemineret magnetit	89,9o - 92,95

46831	massiv magnetit	89,8o - 93,o5
46832	massiv chromit	89,7o - 93,15
46833	chlorit m. magnetit oktaedre	89,85 - 93,oo
46834	gneiss	95,4o - 94,7o
46835	gneiss	95,4o - 94,7o
46836	granatamphibolit	95,4o - 94,75
46837	hvidt bånd i amphibolit	95,5o - 94,75
46838	gneiss	95,6o - 94,8o
46839	gneiss	95,6o - 94,8o
46852	finkornet serpentinit	93,5o - 95,8o
46853	chrom-holdig malm	93,55 - 95,65
46854	chrom-holdig malm	93,55 - 95,65
46855	chrom-holdig malm	93,55 - 95,65
46856	talkåre i serpentinit	93,55 - 95,65
46857	chromit	93,55 - 95,65
46858	chromit	93,55 - 95,65
46859	magnetit	93,55 - 95,65
4686o	chrom-holdig malm	93,55 - 95,65
46861	serpentin, talk og tremolit	93,9o - 95,95
46862	carbonat fra åre	93,9o - 95,95
46863	dissemineret malm	93,9o - 95,95
46864	magnetit	93,85 - 95,8o
46865	serpentin åre	93,8o - 95,7o
46866	magnetit	93,4o - 95,7o
46867	magnetit i serpentin	93,4o - 95,7o
46868	chrom-holdig malm	93,4o - 95,7o
46869	chrom-holdig malm	93,4o - 95,7o
4687o	chrom-holdig malm	93,3o - 95,7o
46871	chrom-holdig malm	93,3o - 95,7o
46872	chromit (transporteret malm)	95,2o - 94,15
46873	serpentinit	92,95 - 96,45

46874	quartz-muskovit-granat gneiss	92,95 - 96,45
46875	serpentinit m. talk	92,55 - 95,75
46876	chromit i serpentin	92,5o - 95,7o
46877	magnetit i serpentin	92,5o - 95,7o
46878	carbonatåre	93,1o - 96,oo
46879	gneiss m. opblandet amphibolit	92,2o - 95,45
4688o	amphibolit	92,2o - 95,45
46881	gneiss	92,2o - 95,45
46882	amphibolit	92,2o - 95,45
46883	carbonat fra bolle i kontakten	92,2o - 95,45
46884	gneiss m. amphibol	93,7o - 95,4o
46885	gneiss m. bånd af amphibol	93,7o - 95,4o
46886	amphibolit m. biotit	93,7o - 95,4o
46887	amphibol m. granat	93,7o - 95,4o
46888	amphibolit m. biotit	93,65 - 95,4o
46889	amphibolit	94,o5 - 95,7o
4689o	bånding af pyroxen? i serpentinit	93,4o - 95,7o
46891	massiv magnetit	93,3o - 95,9o
46892	chromit	93,3o - 95,9o
46893	chrom-holdig malm	93,3o - 95,9o
46894	hvide xx i serpentinit	93,3o - 95,9o
46895	chlorit	92,2o - 95,45
46896	grøn amphibolit	93,9o - 95,3o
46897	sort amphibolit	93,9o - 95,3o
46898	hvidt bånd i sort amphibolit	93,9o - 95,3o
472o1	chromit	95,35 - 96,25
472o2	rullesten	95,2o - 96,3o
472o3	serpentinit rullesten	95,2o - 96,3o
472o4	serpentinit rullesten	95,2o - 96,3o
472o5	rullesten	95,25 - 96,45
472o6	rullesten	95,25 - 96,45

47207	rullesten	95,25 - 96,45
47213	magnetit	93,65 - 95,20
47214	chromit m. serpentin, carbonat og talk	91,50 - 93,80
47215	omdannet chromit xx	91,50 - 93,80
47216	chromit	90,05 - 93,15
47217	chromit-holdig malm	90,05 - 93,15
47218	magnetit	90,05 - 93,15
47219	carbonat pseudomorphoser på talk	90,00 - 93,10
47220	magnetit	90,00 - 93,10
47221	chrom-holdig malm	90,05 - 92,95
47222	chromit	90,05 - 92,95
47223	magnetit	90,05 - 92,95
47224	carbonat rullesten	89,95 - 92,95
47225	carbonat rullesten	89,95 - 92,95
47226	rullesten	89,95 - 92,95
47227	rullesten	89,95 - 92,95
47228	olivin "nodul"	89,95 - 93,05
47229	olivin "nodul"	89,95 - 93,05
47230	konglomerat	89,95 - 92,95
47231	chromit	89,80 - 93,00
47232	chromit	89,80 - 93,00
47233	magnetit	89,80 - 93,00
47234	chlorit med magnetit oktaedre	90,10 - 92,95
47235	gneiss m. sulphider	90,10 - 92,90
47236	magnetit i carbonat-serpentin	89,70 - 93,15
47244	chromitbånd i serpentin-talk-carbonat	93,00 - 95,50
47245	chromit i serpentin	93,00 - 95,50
47246	chrom-holdig malm i serpentin-talk-carbonat	93,00 - 95,50
47247	chrom-holdig malm i serpentin-talk-carbonat	93,00 - 95,50
47248	magnetit	93,00 - 95,50
47249	magnetit	93,00 - 95,50

4725o	chromit i serpentin-carbonat	93,oo - 95,5o
47251	magnetit i serpentin	92,5o - 95,7o
47252	massiv chromit	9o,5o - 94,95
47253	massiv magnetit	9o,5o - 94,95
47254	serpentinit m. store tremolit xx	9o,5o - 94,95
47255	talk-carbonat m. dissemineret malm	9o,5o - 94,95
47256	serpentinit m. talk-carbonat	9o,5o - 94,95
47257	serpentin-talk m. dissemineret malm	9o,5o - 94,95
47258	chrom-holdig malm	9o,5o - 94,95
47259	magnetit	9o,5o - 94,95
4726o	chromit	9o,5o - 94,95
47261	chromit	9o,5o - 94,95
47262	chrom-holdig malm	9o,5o - 94,95
47263	amphibolit m. granat	9o,45 - 95,3o
47264	olivin? relicter	9o,45 - 95,3o
47265	serpentin-talk m. dissemineret malm	95,35 - 96,25
47266	chrom-holdig malm	95,35 - 96,25
47267	chrom-holdig malm	95,25 - 96,2o
47268	chrom-holdig malm	95,25 - 96,2o
47269	chrom-holdig malm	95,25 - 96,2o
4727o	magnetit-holdig malm	95,25 - 96,2o
47271	malm i serpentin	95,25 - 96,2o
47272	malmslire + dissemineret malm i serpentin	95,3o - 96,3o
47273	bånd af chrom-holdig malm i serpentin	95,3o - 96,3o
47274	magnetit-holdig malm	95,3o - 96,3o
47275	chromit i sort serpentinit m. talk	95,4o - 96,4o
47276	chromitslirer i serpentin	95,4o - 96,4o
47277	chromitbånd i serpentin	95,4o - 96,4o
47278	magnesit i talk	95,35 - 96,45
47279	talk	95,35 - 96,45
4728o	rullesten	95,25 - 96,2o

47281	konglomerat	95,25 - 96,2o
47282	rullesten	95,25 - 96,2o
47283	konglomerat	95,25 - 96,2o
47284	rullesten	95,35 - 96,2o
47285	rullesten	95,35 - 96,2o
47286	rullesten	95,35 - 96,2o

Kortblad STORSKRYMTEN 1419 I

468o2	chrom-holdig malm	o3,9o - o6,95
468o3	chrom-holdig malm	o3,9o - o6,95
468o4	brecieret chrom-holdig malm	o3,9o - o6,95
47239	skifret ultrabasit m. olivin relicter	o5,25 - o9,7o
4724o	skifret serpentinit	o4,3o - o8,35
47241	chromit	o3,9o - o6,95
47242	chromit m. glimmer xx	o3,9o - o6,95
47243	magnetit i serpentin	o3,65 - o6,9o

Kortblad AURSJØEN 1419 IV

46899	hornblendit (randfacies)	84,2o - 13,3o
469oo	pyroxenit	84,2o - 13,3o

Kortblad ALVDAL 1619 III

472o8	konglomerat	81,5o - 95,5o
472o9	talkskifer	81,5o - 95,5o

Kortblad FOLLDAL 1519 II

47212	konglomerat	42,8o - 85,6o,

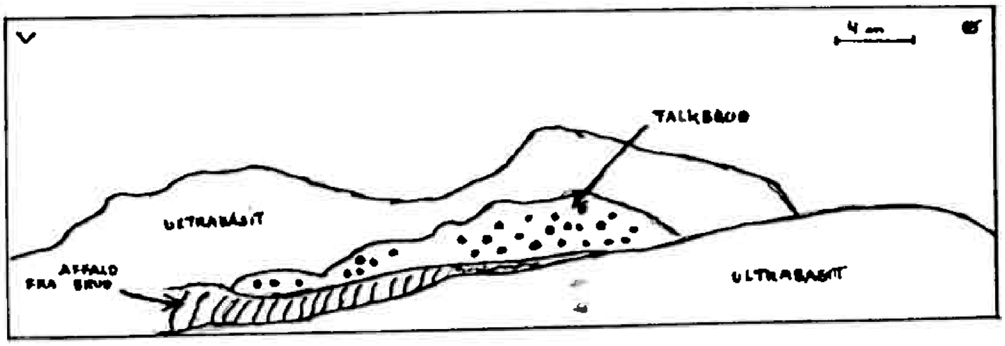


FIG 1. SKITSE AF TALKBRUD I ULTRABASIT
VED SYDENDEN AF SJONGSVATNET (SET MOD NORD).

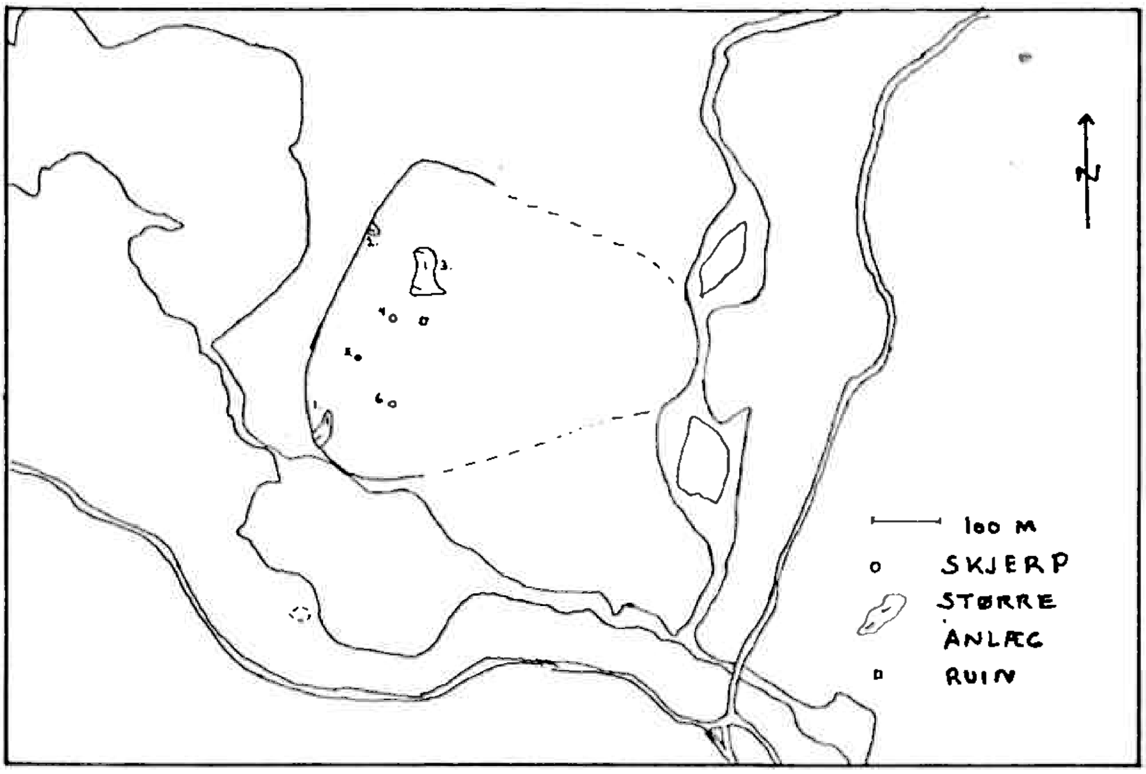


FIG 2, SKITSE AF OLSTAD/NYSÆTER GRUBERNE

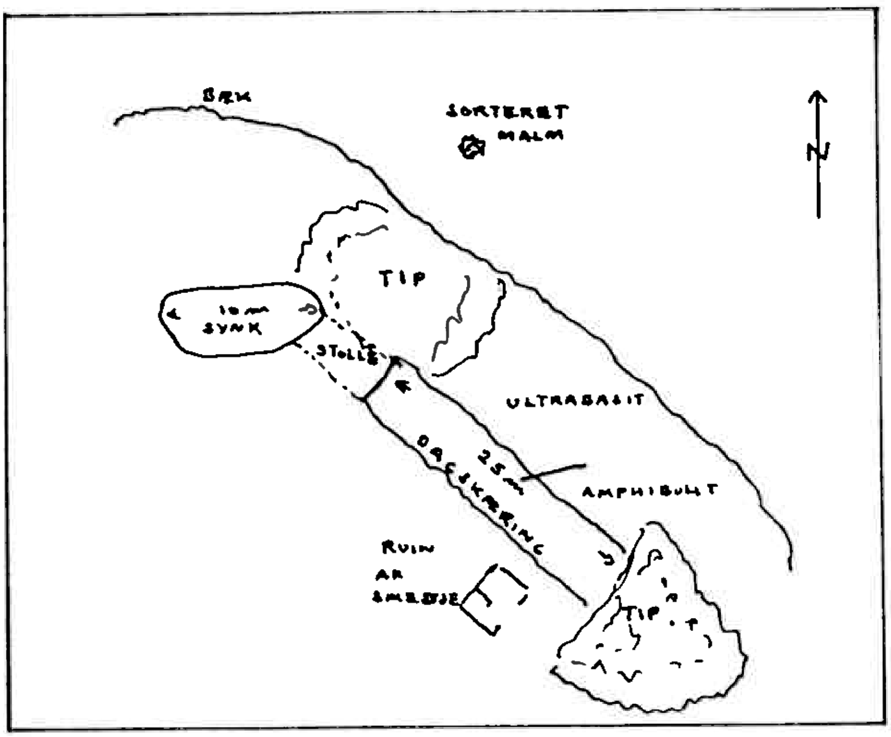


FIG 3. SKITSE AF AURTAND GRUBE.

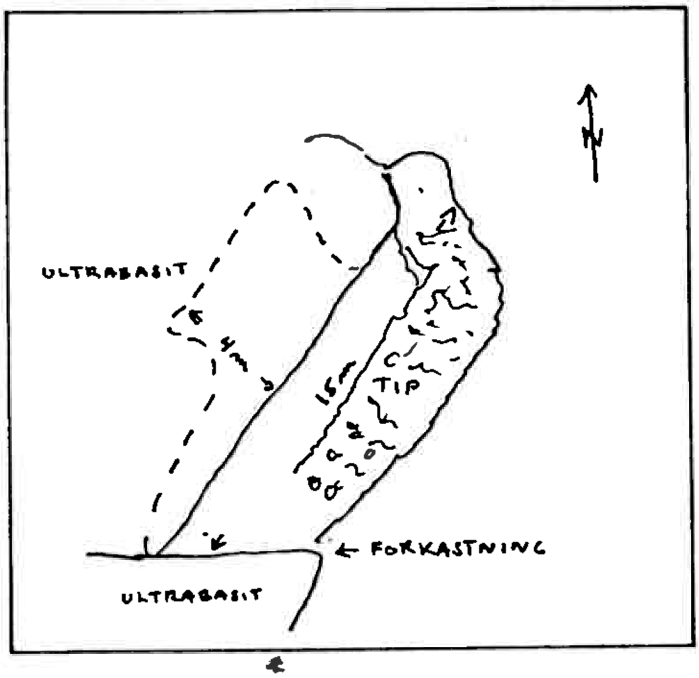


FIG 4. SKITSE AF HALVFORHØJ GRUBE

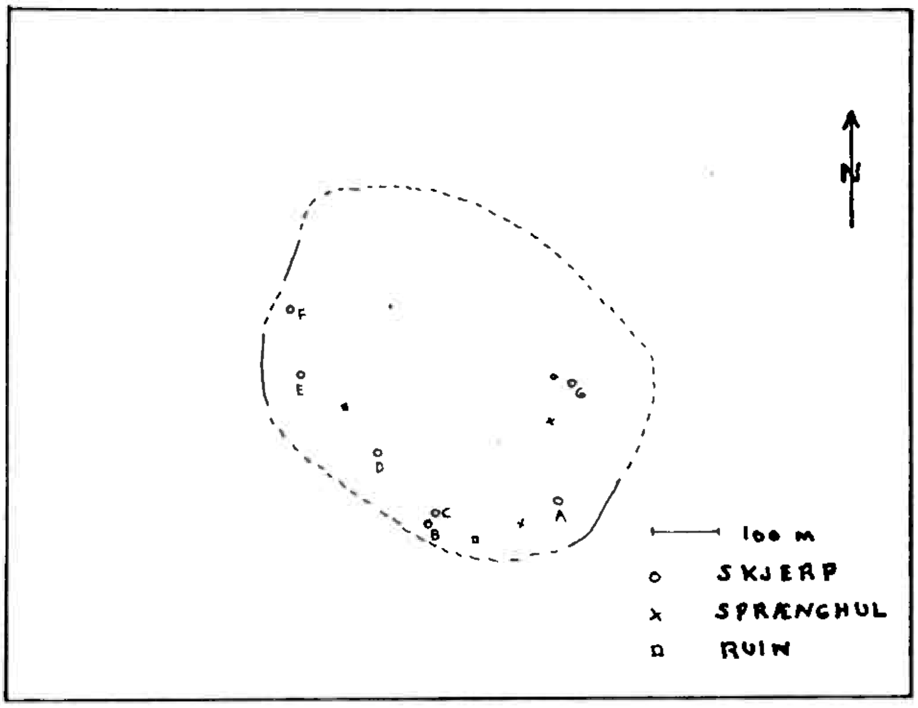


FIG 5. SKITSE AF FILLINGELVEN'S FELT

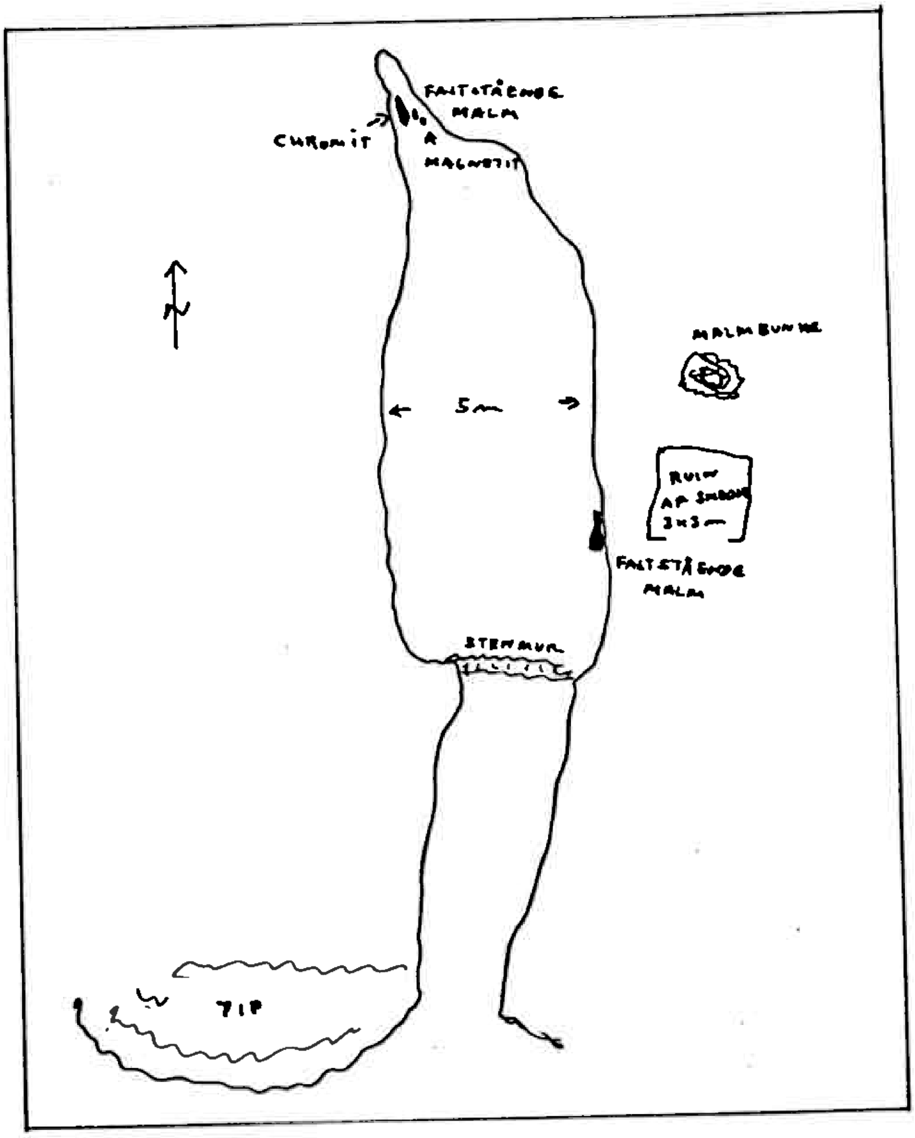
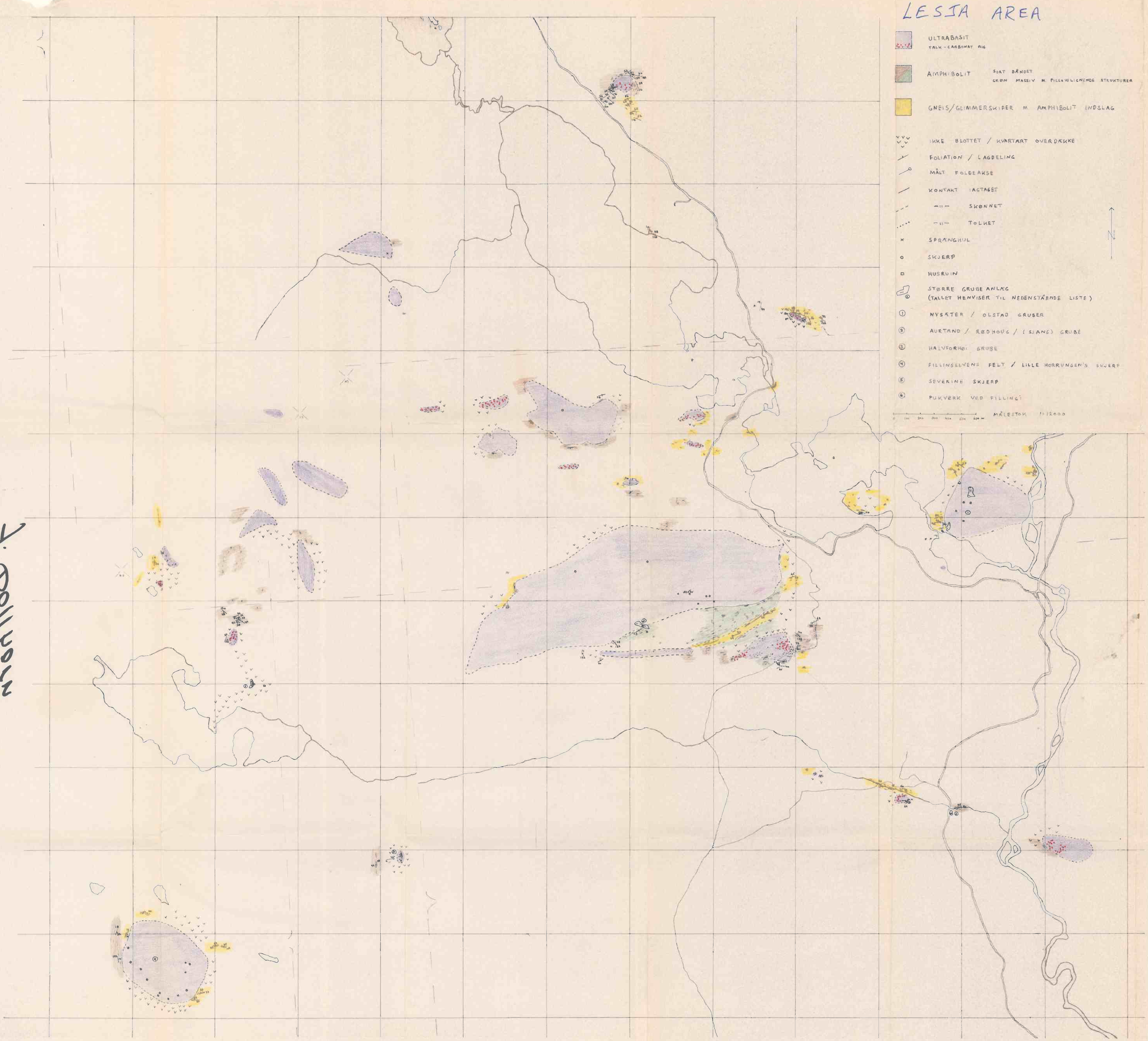


FIG 6. SKITSE AF SEVERINE SKJERP



LESJA AREA
ULTRABASIT
TALK-CARBONAT RIG
AMPHIBOLIT
SORT BÅNDET
GRØN MASSIV M. PILLOWLIGNENDE STRUKTURER
GNEIS/GLIMMERSKIFER M AMPHIBOLIT INDSLAG
IKKE BLOTTET / KVARTÆRT OVERDÆKKE
FOLIATION / LAGDELING
MÅLT FOLDEAKSE
KONTAKT IAGTAGET
—II— SKØNNET
—II— TOLKET
SPRÆNGHUL
SKJERP
HUSRUIN
STØRRE GRUBE ANLÆG
(TALLET HENVISER TIL NEDENSTÅENDE LISTE)
① NYSÆTER / OLSTAD GRUBER
② AURTAND / RØDHOUG / (SJANG) GRUBE
③ HALVFORHØI GRUBE
④ FILLINGELVENS FELT / LILLE HORRUNGEN'S SKJERP
⑤ SEVERINE SKJERP
⑥ PUKVERK VED FILLINGI
MÅLESTOK 1:12000
N