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Tittel

Grong Gruber A/S: Exploration and Ore Potential in the Grongfield, Central Norway

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Fagområde	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt)
Geologi Geofysikk Geokjemi		Joma Skorovas GjersvikVisletten Skiftesmyr Godejord Rosset Finnbur Annlifjellet

Råstoffgruppe	Råstofftype
Malm/metall	Cu,Zn, Py

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Gjennomgang av prospekteringsmulighetene i Grongfeltet, beregnet på utenlandske prospekteringsselskaper
Engelsk tekst med kartbilag.

G R O N G G R U B E R A/S

EXPLORATION AND ORE POTENTIAL

IN THE

GRONGFIELD, CENTRAL NORWAY

7894 Limingen
February 1982

Arve Haugen

I INTRODUCTION

1. Background.

Grong Gruber A/S operates the Joma deposit, which is a base metal bearing, massive sulphide orebody. Production is 400.000 tonn/y. The company is controlled by A/S Sydvaranger, Årdal og Sunndal Verk a.s., Elkem a/s and A/S Sulitjelma, with equal parts each.

The deposit is located in the northern part of the geologically important Grongfield. The Grongfield has been the main target for the exploration activity of Grong Gruber A/S for the last 10 years. Before, in the construction periode, small scale prospecting was done.

From 1972 to -75 it was a cooperation with Norwegian Geological Survey (NGU).

The Grongfield is situated in the middle of Norway, approximately 250 km north of Trondheim and just west of the Norwegian-Swedish border, lat. 64°45'N, long 13°15'E. Position shown fig. 1.

The field comprises of approximately 3.200 km^2. The elevation is from 50 m to about 1000 m, with the greater part being montainous areas at 5-600 m.

The main deposits of the area were all found around 1900. Due to the area's supposed national importance as a pyrite producer, a legal act was imposed in 1918, giving only the State exclusive right to produce in the area. Apart from the Skorovas Mine, all other activity then came to a stand still.

Grong Gruber commenced production in late 1972. In the same year the company got an exclusive right to prospect in the Grongfield. The agreement in connection with this right, expired in 1981. The act of 1918 was terminated in 1975. No other company have been active in the field since Grong Gruber A/S started mining ten years ago.

2. Geology of the Grongfield.

The Grongfield is part of the allochthonous greenstone belt of the Central Norwegian Caledonides. The rocks are metamorphosed and of Lower Paleozoic, probably lower to Middle Ordovician age. They occure as a depressed segment of the larger Seve-Køli Nappe Complex (fig. 2). The Nappe Complex is bordered to the north and south, respectively by the Børgefjell and the Grong-Olden basement culminations.

Massive sulphide deposits of the area are associated with a sequence of basaltic volcanics of submarine origin, but also with compact rhyodacitic flows and their spilitized aphanitic equivalents (keratophyres). The volcanic sequence is intruded by composite gabbros, diorites and granodiortes (trondhjemites). The eruptiv rocks are overlain by polymict conglomerates, calcareous flysch sediments, quartzites and phyllites (also graphitic).

Structurally there are two main stages of folding, complicated with componental sliding movements. The massive sulphide deposits in the Grongfield are of the stratiform type with a simple mineralogical composition. Cu and Zn are the only base metals of

importance, with Ag as a minor component. The main deposits (fig. 2) are Joma with 19 Mt, Skorovas with 10 Mt and Gjersvik with 1,5 Mt (has not been mined).

It is postulated that the depositional environment of the ores was of back-arc basin for Joma and of an ensimatic island arc for Skorovas and Gjersvik.

3. Summary of prospecting.

The whole of the Grongfield was covered with geological mapping in scale 1:100.000 in the early -20's. A new mapping was undertaken in scale 1:50.000. This was completed in 1977.

Geophysical coverage was scarce, when the exploration started. NGU had done a coarse airborn survey in 1960's. Therefore a helicopterborn EM- and magnetic survey was done i 2 stages, first in 1972, then in 1974. The aim of these surveys was mainly the greenstone units, but other areas with known mineralization were also covered.

A variety of ground geophysical methods have been used in the follow-up stage. Grong Gruber A/S uses teams equipped with VLF-EM, magnetics and horisontal-loop EM in these surveys. More sophisticated surveys have been contracted from NGU. These include IP, TURAM, SP, resistivity, Mise-á-la-masse (CP).

A regional stream sediment sampling program had been started in the late -60's by NGU. In 1975 most of the area of exploration interest was covered with 14.500 samples. On a detailed scale, some soil sampling has also been tried, but this seems not to have had any success, probably due to the erratic glacial cover.

The area comprises many sulphide showings of which some have been trenched in the early days (1900-1920). Most of these, including a large number of anomalies from the helicopter-born surveys, have been subject to ground follow up. The main part of these seemed through testing to be barren pyritic conductors. A fair amount warranted more extensive work. During the exploration period 16 targets have been tested with drilling. Due to limited means, drilling had to be concentrated to the most promising objects. Some of these are not drilled extensively enough. Still other objects in the area need to be investigated with drilling.

The exploration period has not resulted in any economic deposits, but the Skiftesmyr deposit in the Sanddøla area in the south of the field is proved to contain 3,1 Mt, averaging 1,19% Cu and 1,87% Zn. Further north, the Visletten deposit is confirmed, containing 0,8 Mt, averaging 0,92% Cu and 3,86% Zn. East of Skorovas, and perhaps still more interesting, west of Gjersvik, signs of stringer zones have been established.

A unique feature is the finding of an area with widely disseminated molybdenite. From 1973, one locality (Fremstfjell, fig. 3) is recognized as a possible porphyry Cu/Mo-deposit. This is a fairly new recognition in Norway.

II COMPILATION OF PROSPECTING MATERIAL

Listed below are items which are of importance in the exploration. Most of this is produced, initiated and contracted by Grong Gruber A/S. The list gives a fairly complete picture of existing prospecting material for the Grongfield and are the property of Grong Gruber A/S.

1. Topography.

a) Official economic maps	1:5.000	
b) Construction of 5 maps of same quality as official maps	1:5.000	9 km^2
c) Official maps, series M 711	1:50.000	
d) Airphoto mosaic	1:20.000	
" "	1:50.000	
Airphotos covering whole Grongfield	1:20.000	
Some of the photos enlarged	1:5.000	

2. Geology.

Map series produced 1922-35	1:100.000	
Map series produced 1972-77	1:50.000	13 sheet

Detailed maps:

Kollung	1972-76	1:20.000
Reinsbakken	1972	1:25.000
Reinsbakken	1973, 1974	1:5.000
Horndahl	1975	1:5.000
NGU	1975	1:20.000
Halls, Yule	1977	1:5.000
Halls, Mellin	1978	1:5.000
Rindstad	1977	1:5.000 , 1:10.000
NGU	1979	1:5.000
Hinde	1979	1:5.000
Ryan	1980, 81	1:5.000

Based on map series 1:50.000, a paper was published i 1979 in NGU 354 by S. Kollung, member of the exploration staff. Other papers in the same publication, deal essentially with the geology of the Grongfield.

Other papers of interest:

Halls et al, 1977: Geological setting of the Skorovas orebody within the allochthonous stratigraphy of the Gjersvik Nappe, Central Norway. In "Volcanic Processes in Ore Genesis-Spec. Pap No 7, Inst. Min. Metall. - Geol. Soc London".

In NGU 360 1980, A. Reinsbakken describes the Skorovas deposit.

Uppsala Caledonide Symposium 1981, excursion B14, gives a good description of the Stekenjokk/Joma areas and the northern part of the Grongfield.

NGU 1975 (G. Gale): Geology and sulphide mineralization in the Sanddøla-Gaizervann area.

3. Geophysics.

Air surveys

NGU	1964	Combined magnetic and EM	500 m line spacing
NGU	1972	Helicopter-born combined magnetic and EM*)	500 km^2 4000 prof.km
NGU	1974	Helicopter-born combined magnetic and EM*)	400 km^2 2900 " "

*) Helicopter surveys done with Sander protonmagn NPM-3, Sander EM3 - coaxial type. Coverage shown in fig. 4.

Ground surveys

NGU	Magn.	1958	1,2 km^2
NGU	"	1974	13,0 "
NGU	"	1980	1,2 "
NGU	TURAM	1957	2,5 "
NGU	"	1971	7,1 "
NGU	"	1973	27,2 "
NGU	"	1974	15,0 "
NGU	"	1977	5,8 "
NGU	"	1980	4,6 "
NGU	IP/RP/SP	1972	1,3 "
NGU	"	1973	0,8 "
NGU	"	1974	1,2 "
NGU	"	1980	1,2 "
NGU	CP	1974	4,5 "
NGU	"	1975	8,8 "
NGU	"	1976	4,5 "
NGU	"	1977	1,5 "
NGU	VLF	1975	4,0 "
Elkem	AMT	1980	2 prof.km

Also EM, CP, SP, VLF in drillholes and IP-expander measurements.

With our own prospecting staff ~ 2-3000 profile km of VLF, Horizontal-loop EM and protonmagnetometer.

4. Geochemistry.

Stream sediment maps 1:50.000 13 sheets

Analysis for 4-10 elements, mostly 6 elements (Cu, Zn, Pb, Ni, Ag, Co) per sheet, coverage in fig. 5.

NGU 1974: Geochemical report on the Grongfield, 4 elements 1:250.000

NGU 1974-77: Reports on geological and geochemical prospecting for Cu/Mo in southern Grongfield 1:50.000

Various geochemical maps on Cu, Zn, Pb, Ni Mo 1:20.000

Soil samples in connection with ground geophysical surveys:

1977	Gjersvik area mainly	1025 samples	12 analyses
1978	Eastern areas mainly	410 samples	16 elements
1979	Harran-area	92 samples	3 elements
1980	Sanddøla	35 samples	4 elements

5. Various investigations.

NGU	1971-74	: Possibility of W in the Grongfield.
NGU	1969,-80	: Quaternary geological descriptions of the northern Grongfield.
NGU	1979	: A review of the possibilities of Mo in the southern Grongfield.
NGU	1980	: A geomathematical integration of prospecting data (Geodataproject).
A/S Sydvaranger	1977	: A review and proposition for further work on the Skiftesmyr deposit.
NGU	1970-77	: 72 reports (objekt-rapporter) On known mineralized showings. Description, sampling, geophysics, analysis.

6. Diamond drilling.

1973-81 Prospectingdrilling in 16 areas 19.200 m

Supplied with coreloggs and analysis.

The cores are 36 mm and are stored in Joma.

Orecalculation on:

Skiftesmyr
Visletten

Preliminary calculations on Finnbur and Godejord.

7. Claims.

Grong Gruber A/S controls a consession area of 400 km^2 in the northern part of the Grongfield. In this area 299 claims, including 185 on the Joma deposit, is rented from the State. Outside the consession area, the prospecting agreement with the State has expired, but we ask for an option concerning the Skiftesmyr deposit.

49 claimes are filed in the Cu/Mo-area.

We rent one private claim on the Finnbur deposit.

1 claim west of Skorovas.

8. All material is filed at Grong Gruber A/S, most of it available via archive key.

Tapes with regional data (geodataproject) are deposited at NGU.

Copies of a great quantity of the material can be retrieved by Grong Gruber A/S at NGU.

III EVALUATION OF VALUE OF THE PROSPECTING MATERIAL

The accumulated prospecting expenses paid by Grong Gruber A/S in the period 1972-81, amount to NOK 13.429.000.

By using the Norwegian price index the present value amount to NOK 19.205.000.

IV PRIORITY IN FURTHER EXPLORATION

1. Greenstone Areas.

As mentioned earlier, sulphide mineralization is located to a volcanic rock sequence dominated by greenstones. The major deposits are mostly located in the thicker parts of the volcanics.

As a result of the recent exploration, interesting mineralization is related to:

1. Volcanic formations in southern part of Grongfield (Sanddøla).
2. Greenstones of the Gjersvik group (northern part).
3. The Joma greenstone in the NE parts of the field.

The Sanddøla area seems to be the most interesting.

a) Sanddøla.

This area stretches E-W along the southern border of the Grongfield (fig. 6). The rocks are massive greenstones with keratophyric lenses and tuffaceous material in great quantities. Mapping has divided the area in 3 separate formations.

In the area, 4 sulphide deposits are known. In addition, a lot of small showings with minor basemetals are registered. The main deposits can be described as follows:

Skiftesmyr deposit: The first geophysical prospecting success. Located as a steep tabular lens in a variety of greenstones with a near connection to keratophyres. The acid rocks are highly pyritized with traces of Zn.
17 drillholes have confirmed 3,1 Mt of 1,19% Cu and 1,87% Zn. The orelens is open in the deeper parts.
Several conductors are located in the same area.

Rosset Grube : Located in the western part of Sanddøla. Due to higher metamorphism, the deposit is connected with amfibolites and zones of acid volcanics.
Drilling has shown a thin, flat lying plate with massive sulphides 0,5% Cu and 2,5% Zn.
In the neighbouring area there are geophysical and geochemical indications which need further investigation.

Godejord Skjerp : Sulphides (massive and disseminated) are confined to basic tuffs, but abundant acid material exists in the vicinity. The orezone is chloritic and highly calcareous. The deposit is special, being one of the two known deposits in the Grongfield which contain Pb, and is unusual because of the high values of precious metals. The deposit seems to consist of small lenses along the strike. Drilling has shown 200.000 t of ore containing max. 1% Cu, 2,5% Zn, 0,2% Pb, 50 ppm Ag and 0,5-2 ppm Au.
No extensive drilling has been done.

Finnbur Grube : Located in the eastern part of the field (fig. 3) and related to tuffaceous rocks. The ore zone is in basic tuffs, but acid equivalents exist near by. The orebody is tabular in shape, dips 60-70^{g} and is fairly regular.
Drilling has confirmed ca. 250.000 t with 0,36% Cu and 3,77% Zn. It is open to depth. In the immediate neighbourhood, there are other mineralized showings. Nearby, a range of geophysical indications also exist.

Generally, many interesting anomal indications are present in the Sanddøla area. The geomathematical analysis which is done, seem to identify large portions of this area as areas of high ore potential. Outside the mentioned localities little or no drilling is done.

b) The Gjersvik Greenstone.

This greenstone sequence belongs to the western part of the Grongfield and consists of 3 greenstone formations. In the middle one of these, both the Skorovas and the Gjersvik deposits are located. In addition, the greenstones host a broad variety of small mineralizations. Most of these have, during the exploration period, not shown basemetals of any importance. But some have aroused interest. The most important of these are (fig. 7):

Visletten skjerp : Predominant lithologies are basic greenstones with a small proportion of acid extrusives. The orezone is related to an acid pyroclastic horizon. Exalite features are prominent in the area.
Mineralization consists of massive and dissaminated sulphides with pronounced banding. Drilling has indicated 0,8 Mt with 0,92% Cu and 3,86% Zn.
Structurally, it should be possible to find further mineralization. Near the geophysical main indication, there are other conducting zones which are not investigated.

Annlifjellet : 5 km W of Gjersvik, a thick felsic volcanic complex with massive metarhyodacite and felsic breccia, is located between more basic greenstones. The felsic rocks are transected by "stringer-zones" of pyrite. The stringer-zone is covered by a thin post-glacial gossan.

Periphal to this area, exhalites, finegrained magnetite and thin horizons of pyrite are found. Geochemical sampling shows presence of small amounts of base metals. Geological interpretation indicates that this area is in accordance with what is widely believed to be the processes of volcanogen ore deposition. A possible massive orebody could therefore exist nearby.

Other showings similar to the two above mentioned, have been recognized, but are little investigated. Those showing basemetals are supposed to be of greatest interest.

2. Mo/Cu-mineralization.

In connection with geological mapping in 1972-74, Mo-sulphide was shown to exist in SE of the Grongfield. Mo-mineralization was localized to the border between trondhjemite and greenstone (fig. 8). This finding was followed by extensive geochemical sampling, which ended in the screening out of 4 areas with marked anomalous Mo-values. Of these the Fremstfjell seemed to be the most interesting (fig. 8).

Preliminary Mo was thought to be localized to cracks and shear zones, but in 1979 a stockwork type of mineralization was found in connection with large areas with pyritic impregnations. Detailed geological mapping in 1980-81 seems to define mineralization as being of Mo-porphyry-type, characterized by rock- and alteration type and crossing Mo/quartz veins.

In 1981, 1500 m of diamond drilling was done, primarily to get an idea of the geological control, but also to get information about possible metal values. Drilling also showed that Cu is present in greater amounts than anticipated. Bottom of the mineralization was not reached.

The Mo-sulphides are very finegrained and cover a large area. The mineralization in question is low-grade, but of large tonnage. Work is in progress to estimate the tonnage and quality, althought drilling till now is too scarce to give precise information.

As mentioned, Fremstfjell is one of four areas where Mo-sulphides has been found. Of the other three, only one has been reconnaissed to some degree, and has many points of resemblance with Fremstfjell. The geochemistry and the rocktypes, indicate that also the last two could have mineralization of the same type. Therefore the possibility to find new Mo-mineralization is very promising.

V CONCLUSIONS

The Grongfield constitute an important part of the Central Norwegian Caledonides. Extensive volcanic belts are present, where massive sulphide deposits have been found. Deposits in the area range in order of 1 to 20 MT. Several mineralized areas have potential indicating the possibility of finding new massive deposits.

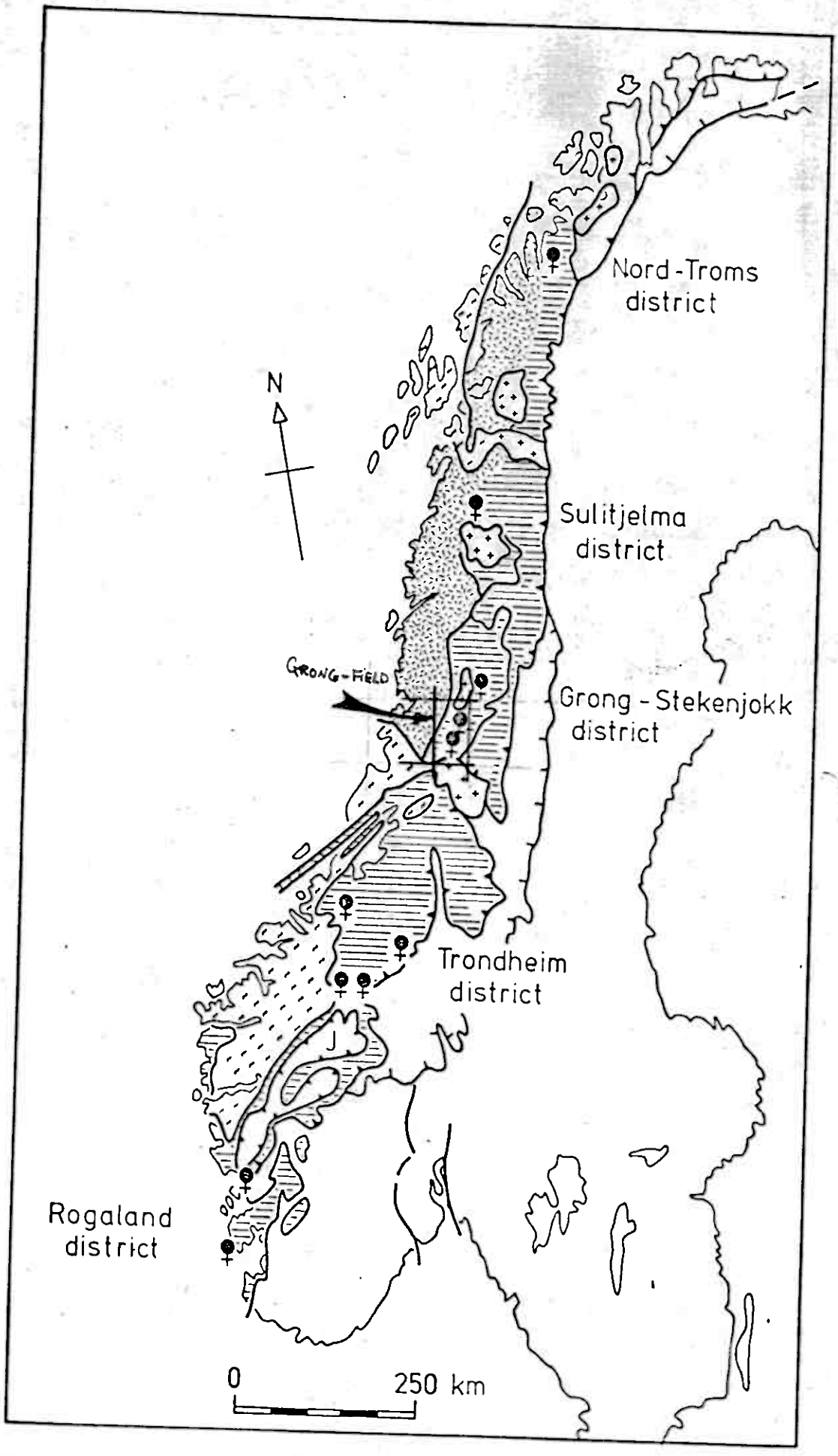
In addition, prospecting the last few years has revealed the existence of Cu/Mo porphyry-type deposits in the southern part of the field. This is a new kind of deposits in the Grongfield (and in Norway). The investigation of them is still far from its conclusion.

In connection with further exploration, and the importance of the greenstones, the Skorovas deposit must be mentioned. It has been mined since 1952, but owing to depleted ore reserves, the mine is schelduled to stop production in 1983. The mine has valuable prospecting material from the mining area. This indicates that there are still unexplored possibilities in the greater Skorovas area.

In agreement with the owners of Skorovas Gruber (Elkem a/s), Grong Gruber A/S will include these data in a combined tender to the parties concerned.

No doubt, there are exploration potentials left in the Grongfield and much material exsists to support further prospecting efforts. Evaluation of the possibilities indicates that priority should be given to the Sanddøla volcanic belt and to the Cu/Mo-porphyry area. At the same time, possibilities in the Skorovas area should also be investigated.

In a later stage the Joma greenstone also will be of considerable interest.


Nord-Troms
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Rogaland
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FIGURE 1

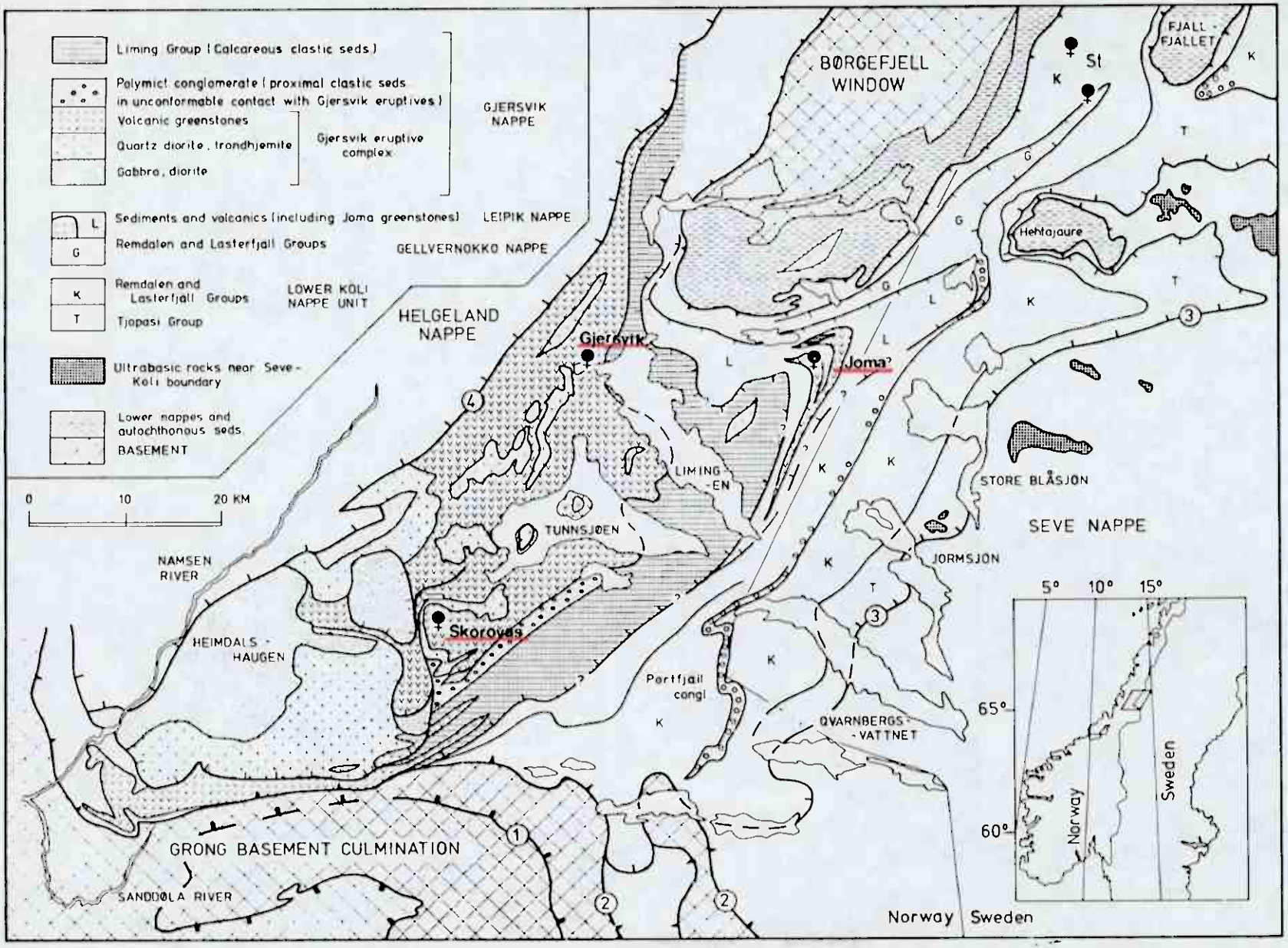
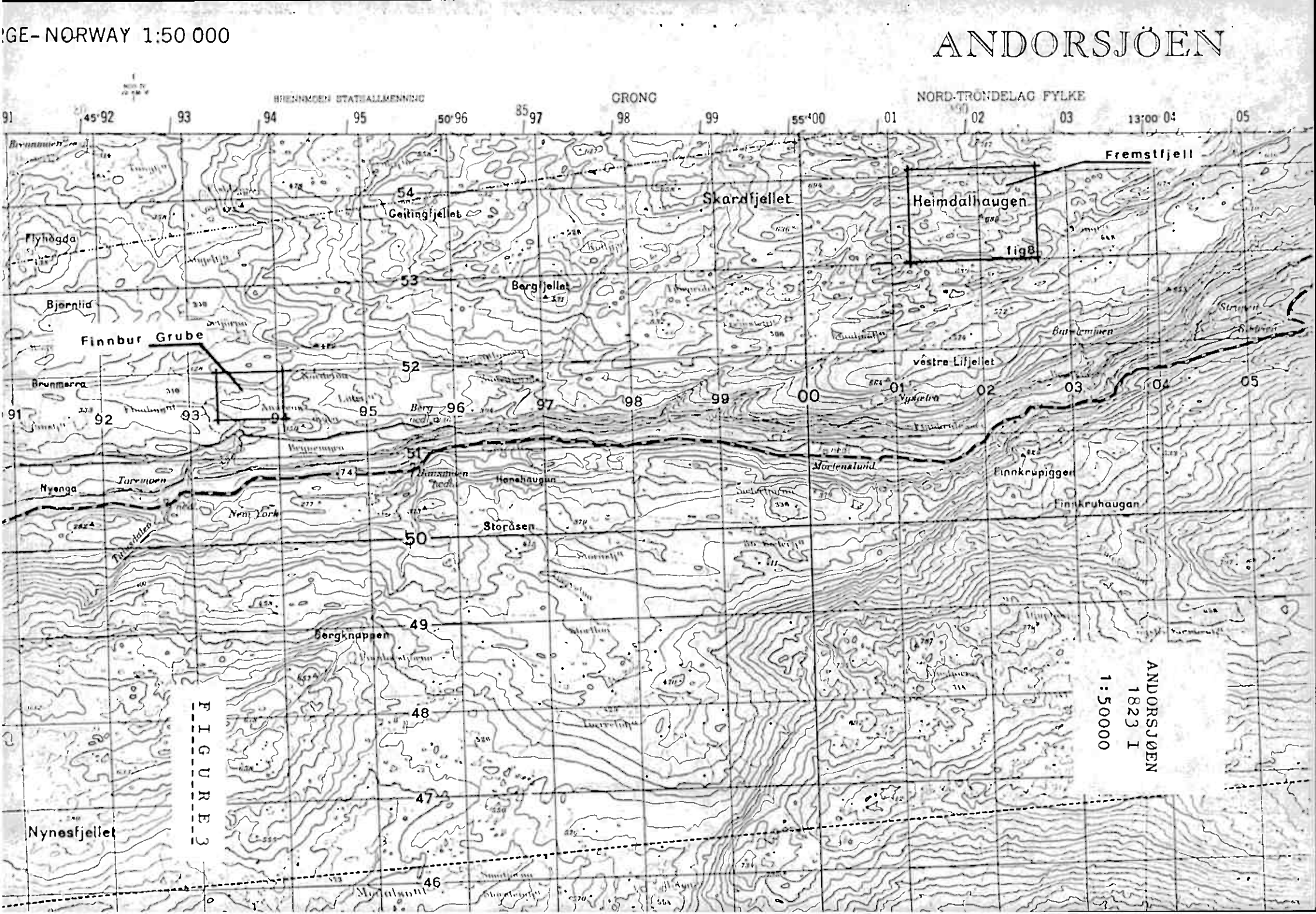


FIGURE 2

Fig. 2 Map showing location of main ore deposits in Grong–Stekenjokk district (Sk, Skorovas, Gj, Gjersvik, Jo, Joma and St. Stekenjokk) and main structural and stratigraphic units that can be distinguished within Köli Nappe. (1) Thrust at base of Olden basement nappe; (2) thrust at base of Seve–Köli Nappe; (3) thrust separating Seve and Koli sequences within Seve–Köli Nappe Complex; (4) thrust separating Gjersvik Nappe at top of Köli Nappe sequence from high-grade metamorphic rocks of Helgeland Nappe Complex. Boundaries based on geological information from Foslie, Oftedahl, Zachrisson, Gee and Gustavson (after Halls et al. 1977)

ANDORSJÖEN


GRONG
NORD-TRØNDELAG FYLKE
Fremstfjell
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Bjørnlid
Finnbur Grube
Brunmerra
Vestre Lifjellet
Nyenga
Torsmoen
Nem York
Storåsen
Finnkrupigger
Finnkruhaugen
Bergknappen
Nynesfjellet
FIGURE 3
ANDORSJØEN
1823 I
1:50000

GRONGFIELD - HELIBORN SURVEYS

Heli-målinger 1972

Heli-målinger 1974

1972 : Fløyet 4000 pr.km - dekket 500 km²

1974 —"— 2400 —"— —"— 400 km²

Namsvatnet

Stora Blåsjøn

Limingen

Tunnsjøen

Sverige

Dorm-sjøn

Gvarnbergsvattnet

Namsen

Sandøla

Laksjøen

Sandsjøen

Løvsjøen

Grongfeltet
1 : 250000

10 km

FIGURE 4

GRONGFIELD — GEOCHEMICAL COVERAGE
Drainage sediments.

Systematic sampling

Orientation survey

Grongfeltet
1 : 250 000

0 10 km

FIGURE 5

GRONG

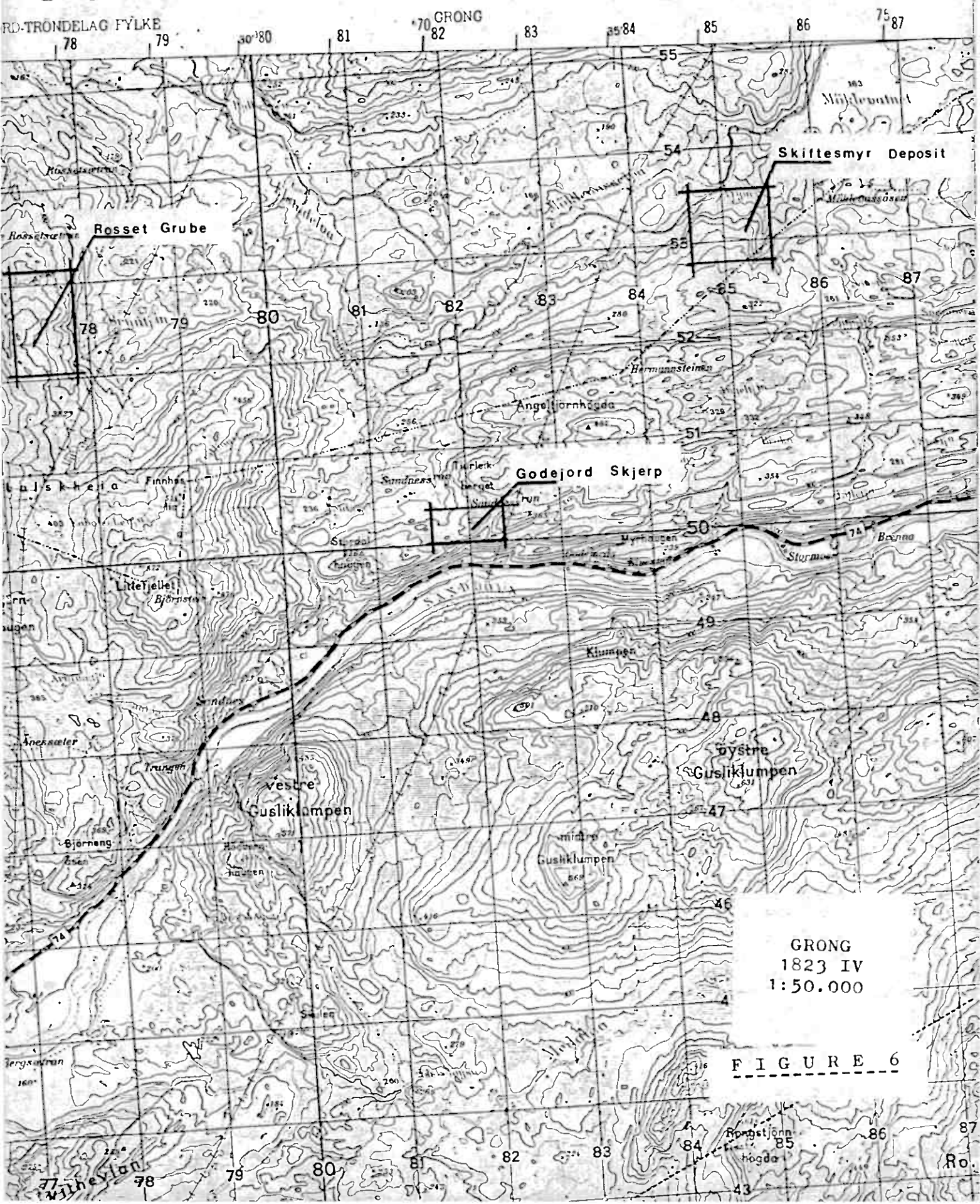
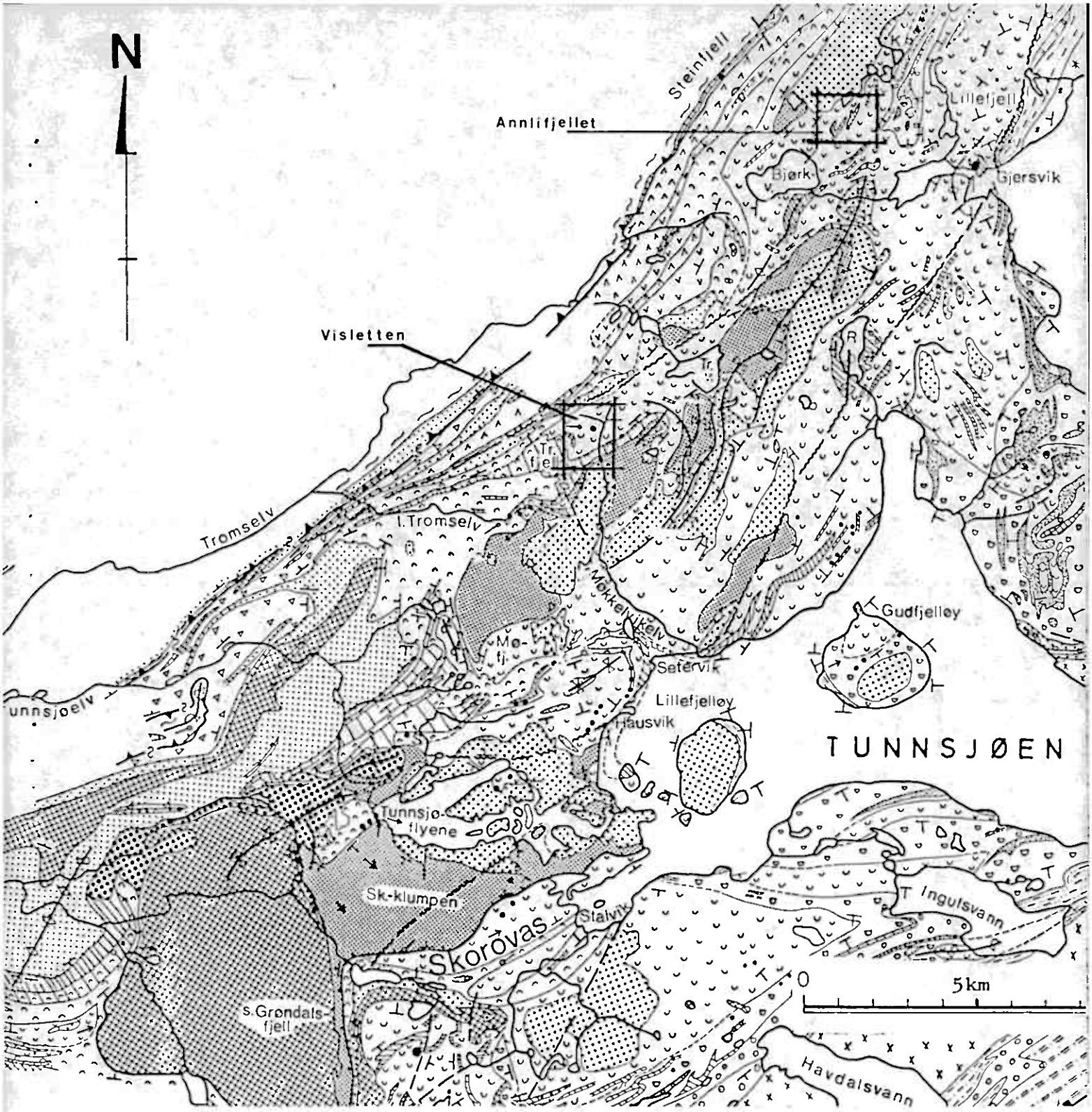


FIGURE 6

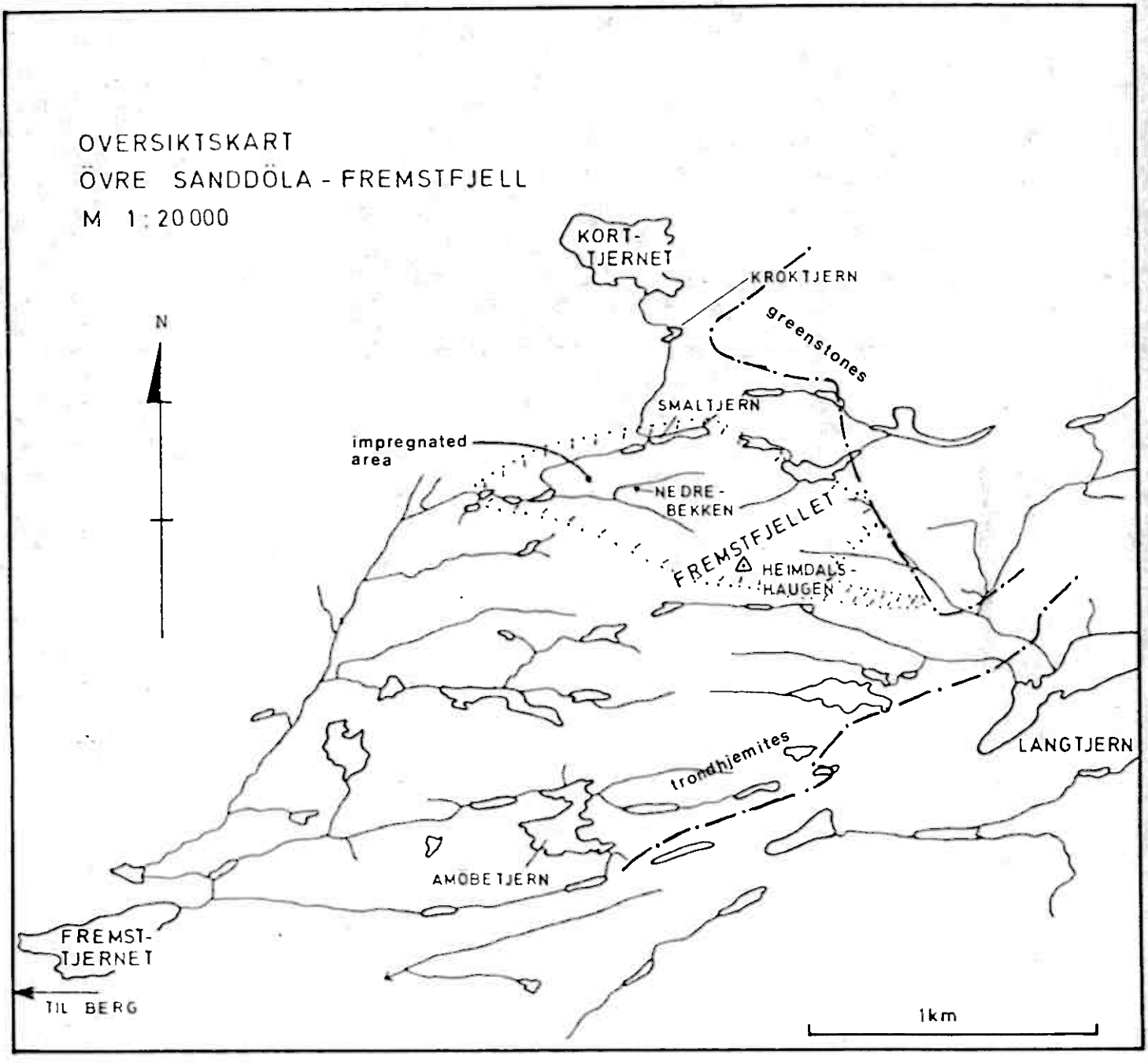


F I G U R E 7

Greenstone-belts in NW Grongfield with Visletten and Annnlifjell.

ᴗᴗᴖᴖ Greenstone
\\\\\ Keratophyre

Grong Gruber A/S


OVERSIKTSKART
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KROKTJERN
greenstones
SMALTJERN
impregnated
area
NEDRE-
BEKKEN
FREMSTFJELLET
HEIMDALS-
HAUGEN
trondhjemites
LANGTJERN
AMOBETJERN
FREMST-
TJERNET
TIL BERG
1km

FIGURE 8