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Tittel

Geological observation in Gomsdalen, with special respect to the orientation and shape of the ore-bearing gabbro. Geiranger

Forfatter	Dato	Bedrift
B Lieungh	1976	Sulfidmalm A/S

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Stranda	Møre og Romsdal	Trondheimske	12192	Ålesund

Fagområde	Dokument type	Forekomster
Geologi	Rapport	Gomsdalen
Råstofftype	**Emneord**	
Malm/metall	Cu Ni	

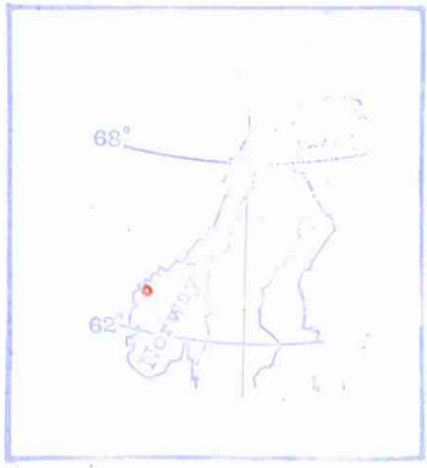
Sammendrag

Se ogsåBV 534 og BV 533

FOR FALCONBRIDGE NIKKELVERK A/S
A/S SULFIDMALM
PROJECT 905-9

Geological observation in Gomsdalen, Geiranger with special respect to the orientation and shape of the ore-bearing Gabbro.

By
B. Lieungh



Report No. 441/76/9

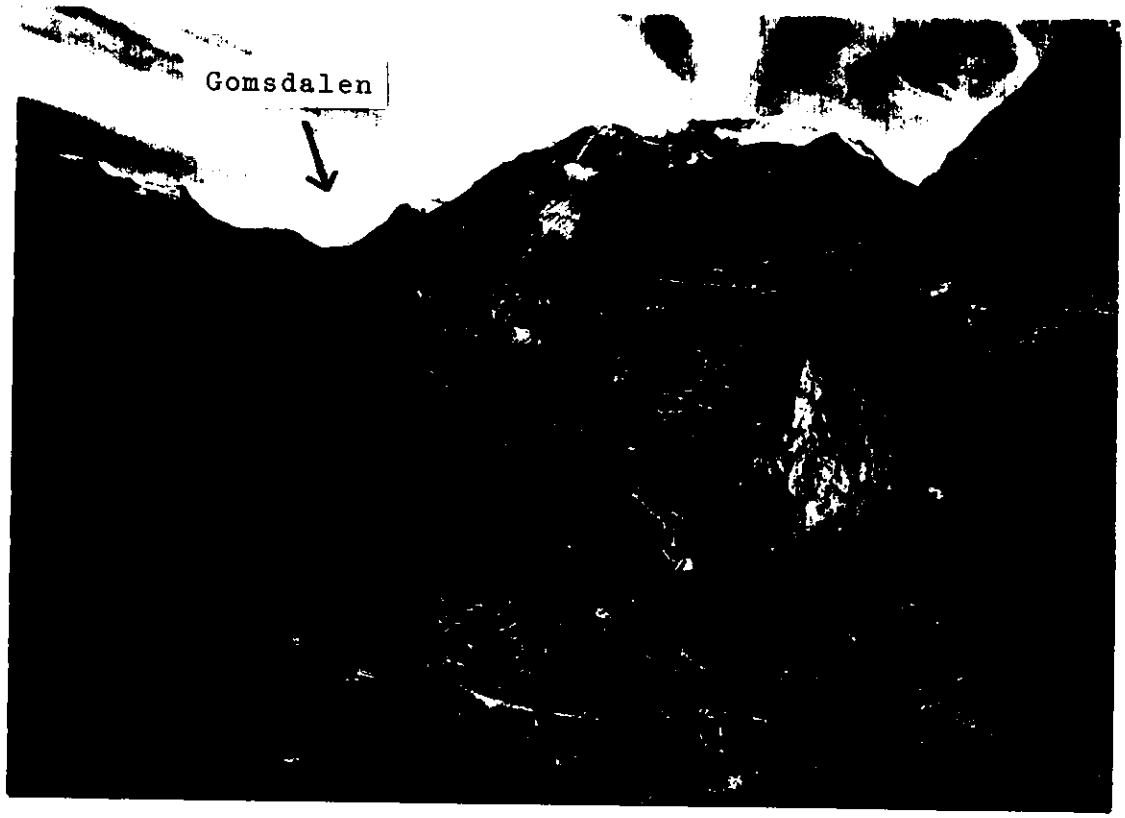


Fig.1

View from Geiranger towards Gomsdalen.

SUMMARY

The Ni mineralization in Gomsdalen, Geiranger is connected to a gabbroic body of limited size. The gabbro has the form of a long (at least 1500 m) rod folded in isoclinal folds F_1, along the longest axis (fig.9). This rod dips gently (7°) towards ESE, parallel to the regional F_1 -axis. The gabbroic rod is possibly a boudinaged part of a originally more extensive gabbro sheet. The Ni-mineralization occurs as limited rod-like lenses in a soup of weakly impregnated gabbro.

LOCATION

The Gomsdalen (Gausdal) area is situated 650-900 m above sea level, 6.5 kms from the Geiranger village on the north west coast of S-Norway. Steep mountains of 1400-1600 m height surround the valley. No road lead to the valley, only a bad path which is only walkable under good summer conditions. All equipment has to be transported into the valley by helicopter (see map no. 1 and fig.1).

INTRODUCTION

The main work was carried out around the VLF-EM anomalies in the Gomsdalen and Storevatn grids - more regional trips were made to get a better "view" of the tectonic style of the area.

The Gomsdalen area is not very well exposed, but covered by birch forest and inclined swamps in the lower parts. The steeper parts are often covered by scree material from the surrounding mountains. Some of these scree areas are dangerous to work in because of the constant drop of new blocks.

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The topographical map is a fairly new, modern type and very accurate - but the scale was to small to be used for detailed work.

Larger scaled economic maps are under construction in this area now (1976-77) but for some reason the Gomsdalen area has not been included.

The time for mapping was very restricted, mainly in a period with drilling and drill core logging.

EARLIER WORK

The valley was mapped in 1937 by Nils N. Musæus as a thesis work for the Technical University in Trondheim (see also report 378/75/9). His conclusion was a synclinal formed sulphide impregnated gabbroic plate, gently dipping down into the valley from both the east and west side of the valley. The sulphides were concentrated along the bottom of the plate.

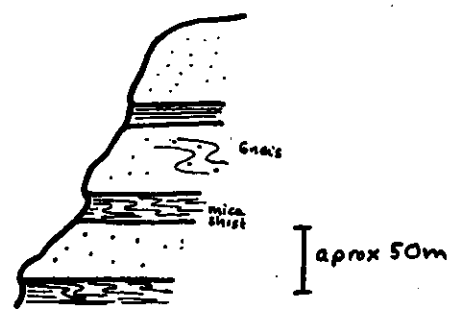
Additional rough mapping was carried out by Sulfidmalm in 1973-74 partly as short visits. The conclusion was that this mapping gave no additional information to that already stated in Musæus's map (see report 271/73/5, 337/77/9 and a memo from Ericsson that same year.) At the same time some VLF and Mag work was carried out mainly over a 800 m area between Sleddalselva and Pilsbekken (see report 271/73/5).

THIS WORK

The general picture of the Gomsdalen geology is a thick sequence of massive medium grained grey-white gneisses alternating with thinner beds of mica gneiss or pure mica schists.

The massive gneisses show in a few places traces of earlier bedding - now intensively folded in an isoclinal manner.

The beds of the massive gneisses are sometimes up to 10-50 m thick with thinner (1-2 m) beds of mica schist. These mica schists very often show fairly isoclinal folds. It is possible that these schist zones represent shear or thrust zones at some localities.



At some spots, especially in the mountain pass between Gomsdalen and Oaldsdalen we found augen gneisses with white or pink coloured augens. The same rock has been reported from some of the drill holes. One is not sure whether these rocks could represent a thrust zone.

The gabbroic rocks are much more restricted in the area than previously reported. The outcrops are mainly located inside the two grids Gomsdalen west and Storevatn east:

1.	Sleddalselva	Gomsdalen west grid	0-0
2.	Pilsbekken area	"	500W-12S
3.	"	"	675W-15S
4.	"	"	700W-50S
5.	Storevasshytta	Storevatn east grid	12E-25S

Sulphide mineralization is observed and assayed in rocks from 1., 2. and 5. 4. contains very limited amounts of sulphides and in 3. there is no observation of sulphides. No sulphides have been found in other rock types.

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In addition to these localities gabbroic rocks have been observed in two outcrops and one group of small blocks in a scree area.

6.	"Storevassnibba"	Geiranger map.	Coord. 01.05E-92.90N	Outcrop
7.	"Geitfjellet"	"	" 00.25E-90.75N	"
8.	"Geitfjellet"	"	" 99.30E-91.40N	blocks

Most of the previously reported gabbroic rocks on both side of the Gomsdalen valley and in the mountain pass north of the valley, are dark mica rich gneisses or pure mica schist with a dark but not black colour.

The ore bearing gabbroic rock is a biotite bearing rock in parts with small (pink) garnets - observed both as massive and schistose rock. For further mineralogical information see report 337.

DESCRIPTION OF THE GABBRO LOCALITIES

1. The gabbroic rocks in Sleddalselva are exposed over a distance of 25 m along strike and 35 m across and are mainly situated in a 5-8 m deep canyon along the Sleddalselva river.

   The gabbro shows a steep folded contact towards the "underlying" mica gneiss in the SW. Weak visible possible primary layers (So) in the "underlying" gneiss show that the gabbro is not cutting through the gneiss but is parallel or subparallel to the primary foliation.

   A dominant secondary foliation (S_1) is masking and partly destroying the earlier structure (So).

This foliation (S_1) is an axial foliation to the folds in the gneiss and the gabbro. On this location it is dipping gently towards SE.

This foliation has previously been considered as a primary foliation and must be the main reason for the idea of a flat or gently dipping gabbroic sill-like body. (see fig. 1)

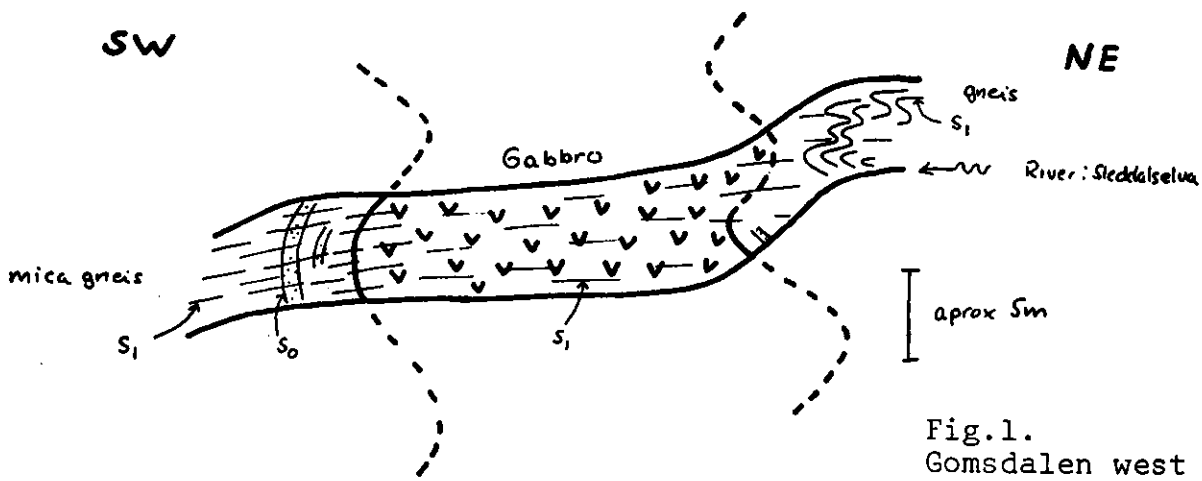

Fig.1.
Gomsdalen west 0/0

The "hanging" contact is not so well exposed and shows a 50° dip towards NE in the river. Large folds in the "hanging wall" on the S-side of the river (not shown on the sketch) indicate the same picture as in the "foot wall".

Diamond drilling (DDH 5-9) later confirmed this picture.

The gabbro is weakly impregnated in most of the outcrops - but some isolated richer lenses are situated in the middle of the gabbro near the river (see report 271 with assays). To get a more complete picture of the gabbro see Drillsection 12W with assay results.

2. The same rock type is exposed in some few outcrops in the Pilsbekken area at 500W-12S.

Again the gabbro is weak but visibly mineralized. A distinct foliation can be seen in this gabbro but the foliation here falls towards NE.

As explained in my drilling report (report no. 440/76/9) the results from DDH-1, 2, 3, 4 and 10 were a bit surprising and not easy to understand. But in fig 2A all the geological information from the area (fig.2B) close to and between drill holes 1, 2 and 3, 4 are projected into a vertical plane (profile 475W) along lines parallel to a dominant foldaxis F_1. The dip of the foldaxis varies between 0-5°E but has here been considered as flat. The same has been done with the information from the 5 drill holes.

As a result we got a folded gabbroic rock limited up-and down-dip but with a possibly strong lineated form parallel to the fold axis.

3. A gabbroic rock without visible sulphides is exposed at 675E-15S. It is a coarse grained and very garnet rich gabbro - different from the ore bearing rock. The garnet can be up to 1 cm across.

4. A very small outcrop of gabbro has been registrated in the steep mountain wall at 700W-50S. The outcrop gives the impression of a closed upright anticlinal with an isolated gabbro in the core. The gabbro is very weakly mineralized. No more of this gabbro has been observed along strike and the impression is that it is a very isolated body.

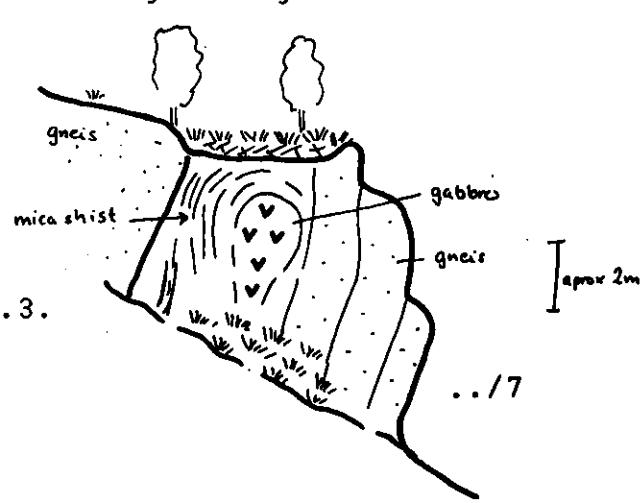

Fig.3.

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Fig.4.

F_2 folds in distinct S_1-schistosity.
Outcrop of weak mineralized gabbro close to the hut, marked VV
Storevatn hut, view from west.

5. A small outcrop of gabbro with some sulphides is situated near the hut at Storevatn. Earlier assays gave 0.54% Ni and 0.60% Cu. The outcrop is limited to the spot marked on the photo - fig.4. In the wall of gneiss rocks behind, a secondary foliation is visible, folded in open folds of F_2 covering the top of the gabbro.

6. A thin steep dipping gabbroic rock is exposed at the top of the ridge east of Storevassnibba, 1330 m above sea level. It was not possible to follow the rock in the field because of snow and block covering. No sulphides were observed.

7. In the very steep NE facing slope of Geitfjellet a medium to coarse grained slightly lineated gabbroic rock is exposed 25 m along strike. The thickness is approximately 5-10 m with the foliation dipping gently to the south. No visible sulphides.

8. In the N-slope of Geitfjellet a few small pieces of gabbroic rock were found in the scree. One of the pieces was slightly mineralized and looked similar to the ore bearing gabbros in Gomsdalen. The other type was more similar to the gabbro at 7.

From the car ferry, crossing the fjord between Geiranger and Hellesylt, it is possible to see the different layers of rusty rocks high up close to the top of the steep mountain wall at Grautnibba and Djevlegjølet (Geiranger map loc. 97E-87N).

Local people in Grande talk about a vegetation poisening they observed years ago in a grassfield at Hysket close to the fjord between the farms Grande and Bringen.

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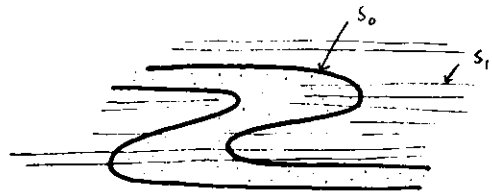
TECTONIC PICTURE

The following is not a complete structural analysis of the area, but an attempt to mention the most important factors that are responsible for the shape and location of the ore bearing gabbro.

A possible primary bedding So is visible in the gneisses and mica schist on some spots - the alternation of schist-gneiss possibly represents the same structure - but could also be shear zones.

This primary foliation So is deformed by an intensive fold phasis with isoclinal folds with more or less horizontal axial planes (see photo on fig.6). Direction of the fold axis is mainly ESE. This folding has created a strong axial plane foliation S_1 which is parallel to So outside the folds.



A strong rod lineation L_1 parallel to F_1 is observed same places (see fig.5) and a similar elongation is visible in quartz and feldspar grains.

A more common lineation is the intersection of S_1-So foliations. This L_1 is of course parallel F_1

Fig 5 Gomsdalen west grid 575W-10N. →

The So and S_1 foliations, fold axis F_1 and lineation L_1 are all later deformed by a fold phasis F_2 with fold axis parallel to or with a sharp angle to F_1 with large open folds as seen in the picture (fig.4). These folds create minor variation in dip and strike direction of the F_1 axis

A very weak fold phasis F_3, only visible at a couple of outcrops has axis orientated angular or right angle to F_1, F_2 axis and causes minor undulations in the dip of these axes.

Fig.6. Fold structures in gneiss, Gomsdalen west grid 300W-200N View towards east.

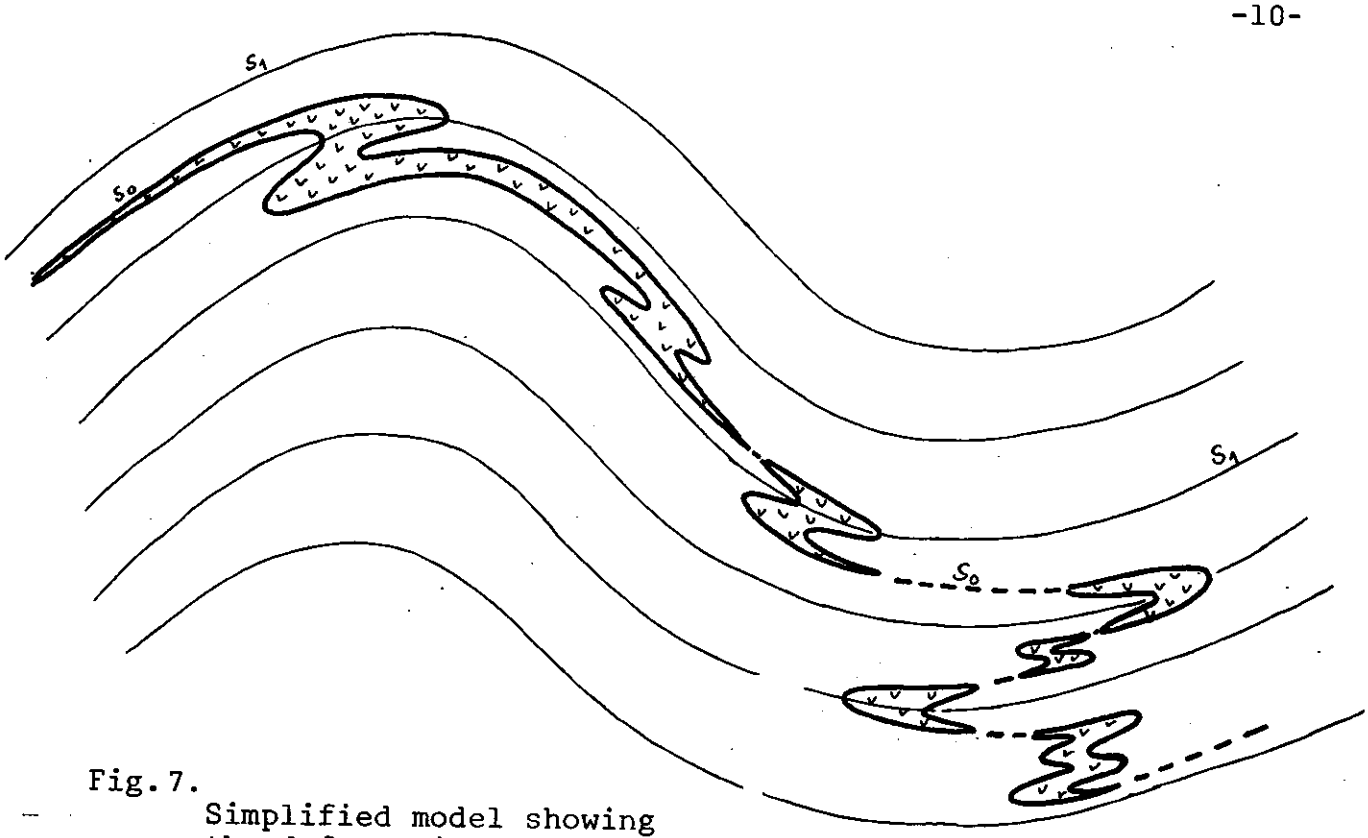


Fig.7.
Simplified model showing the deformation of a presumably original gabbro sheet.
View along F_1-axis

If we look at a profile along this curved line (fig.9) we find that the top of these exposures are orientated along a line dipping approx. 7° towards E and also is very close to the F_1 dip.

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CONCLUSIONS

Based on field data and drill sections we have a gabbroic sill like intrusion - deformed through the different folding phases to separate lineated bodies (fig.7). One of these bodies is located in Gomsdalen. The gabbro has a limited extension up dip and presumably also down dip as indicated in profile 475 fig.2A. It is folded with a fold style similar to what we find in the surrounding gneisses and mica schists.

Due to the strong lineation in the country rock we should expect a long extension of the gabbro along strike. (see fig.8). Looking at the VLF-EM map (Report No. 439/76/9) and the fact that the mineralization is limited to the gabbroic rock-we find such a long extension.

If we look at the three mineralized exposures at Storevatn, Pilsbekken and Sleddalselva they are all situated along a slightly curved line 1500 m long parallel to the F_1 lineation strike. (Fig 9)

A minor brake between Sleddalselva and Pilsbekken is probably due to the decrease in sulphide content. Another possibility is that the gabbro dips out in the air.

Between Pilsbekken and Storevasshytta we have a similar brake in the VLF-EM anomaly - but the reason here is probably that the gabbro continues through the overlying mountain masses, as a rod, and that these overlying rock masses mask the conductor.

East of Sleddalselva the gabbro rod dips into the Geitegga mountain and can not be traced further on the surface. In the western part of Storevatn it dips out in the air, but we do not know how long the extension along dip is so the gabbeo is probably exposed under the covering on the other side of Storevatn until it dips out in the air.

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As mentioned earlier the sulphide mineralization is limited to the gabbro rock. Because of the strong deformation it is reasonable to think about the ore as long thin lenses in a matrix of gabbro.

Further prospecting must be based on regional geological mapping trying to locate more of these gabbro-rods or sheets which are expected to exist in the region.

Geophysically an airborne (helicopter) EM-survey with flight lines vertically on the F_1 direction should have the best possibilities to pick up new conductors. But the terrain is extremely rugged with very difficult aero-dynamic conditions - combined with the problem of a constant level above surface.

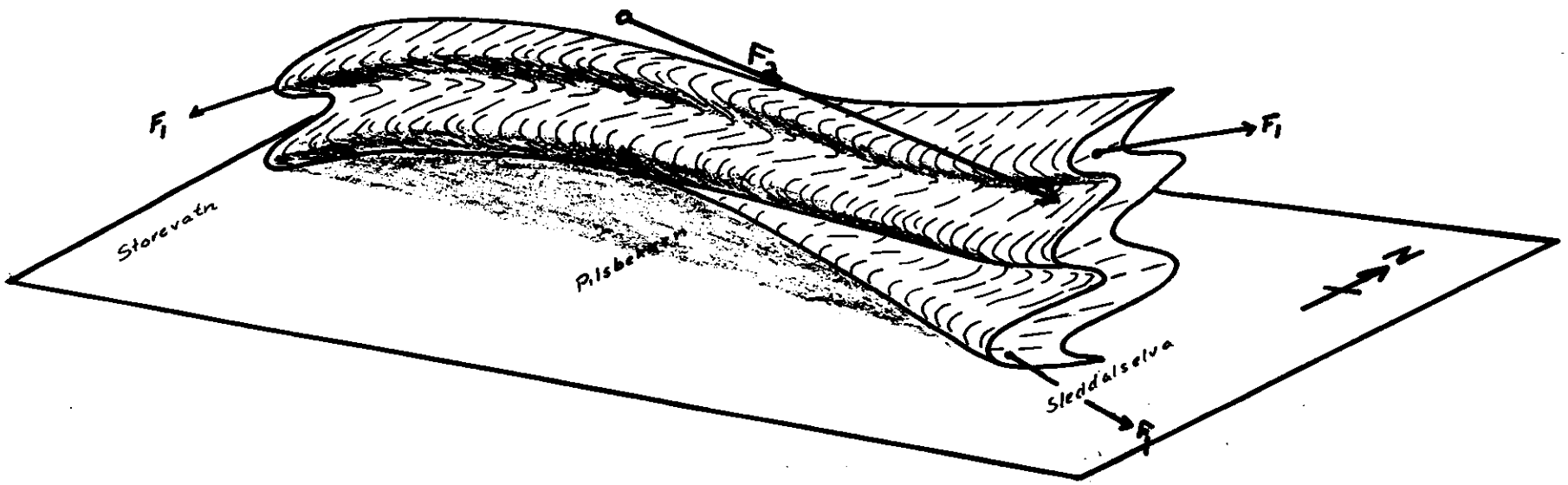
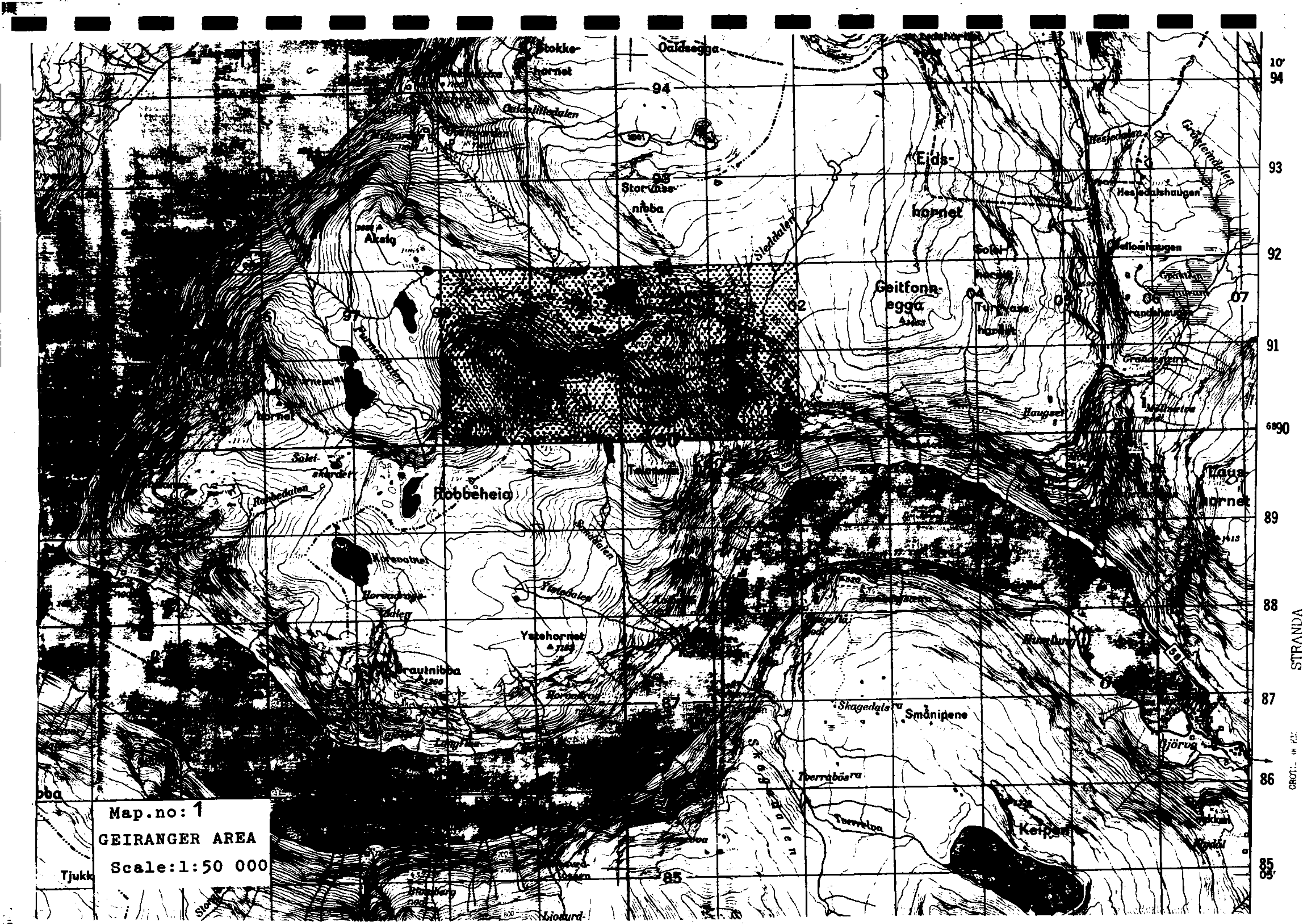


Fig.8.

Indicated form of the mineralized gabbro in Gomsdalen, Geiranger.


Map.no: 1
GEIRANGER AREA
Scale:1:50 000
Stokke-
hornet
Oaldsegga
Storvass-
nibba
Aksla
Eids-
hornet
Geitfonn-
egga
Turrvass-
hornet
Hesjedalen
Hesjedalshaugen
Robbeheia
Robbedalen
Yatehornet
Smånipene
Skagedalen
Keipen
Björdal
Haugset
STRANDA
10'
05'
94
93
92
91
6890
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87
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02
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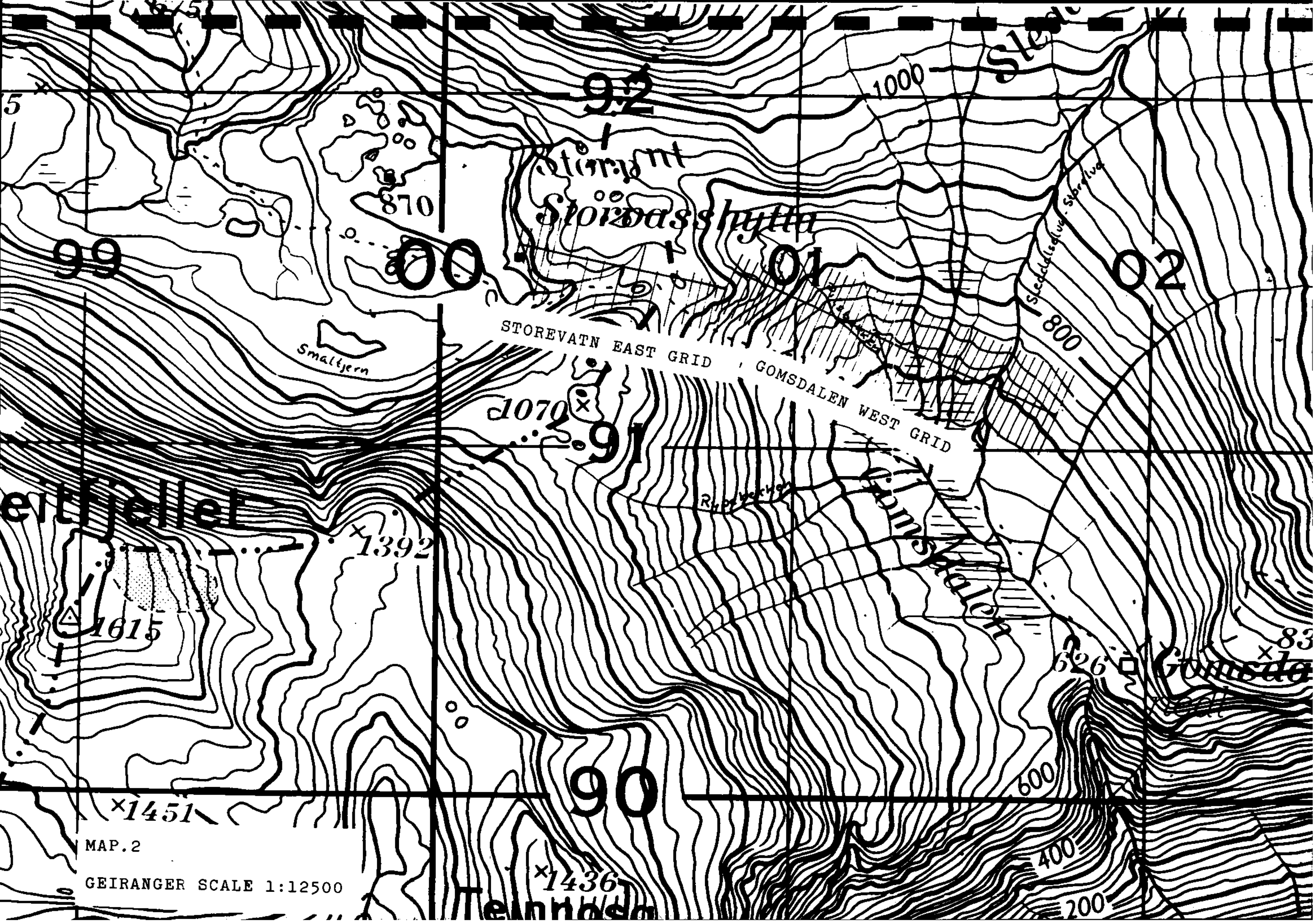


MAP.2

GEIRANGER SCALE 1:12500

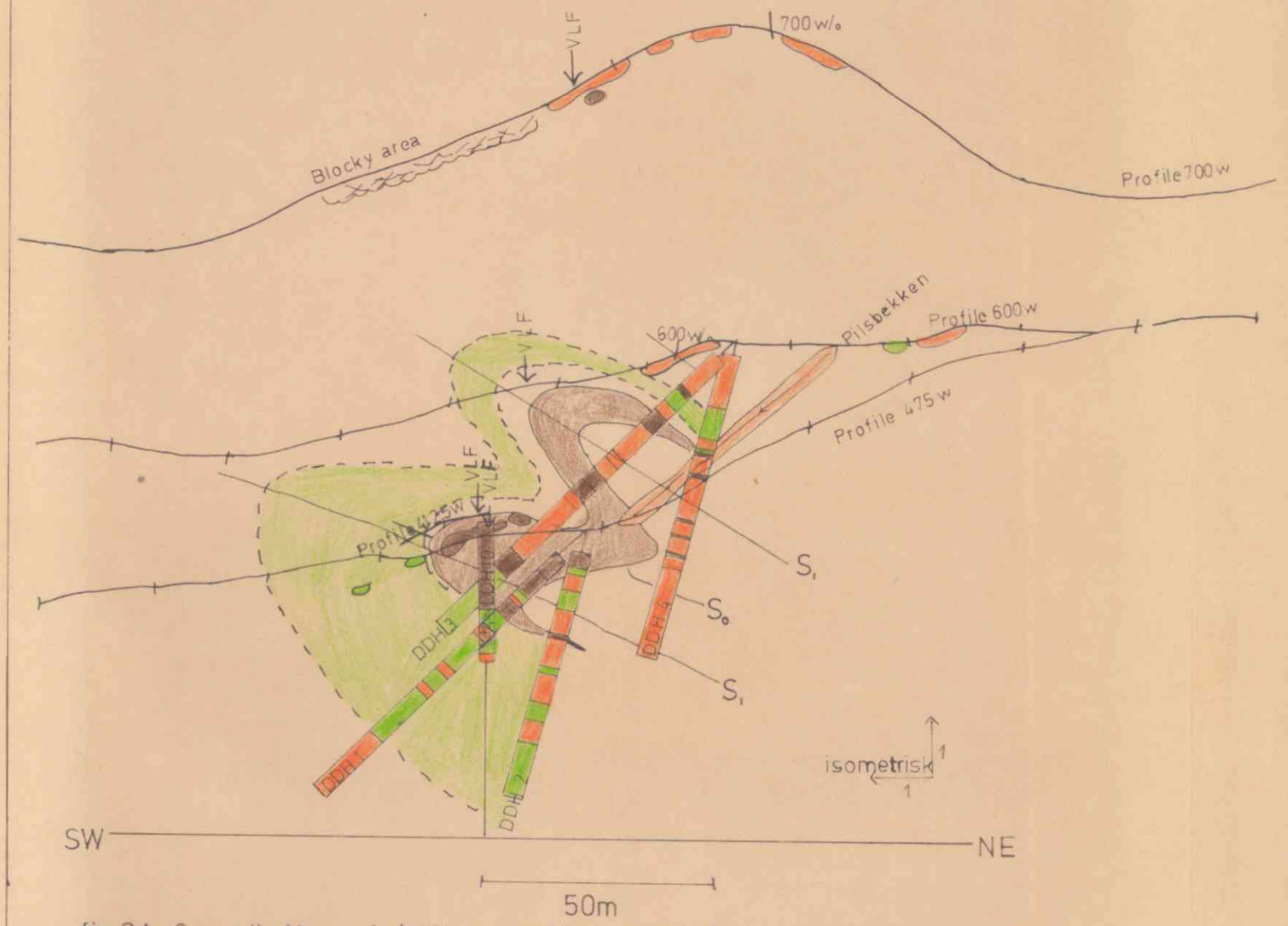


fig 2A Compilation of drilling profiles projekted along Profile horisontal lines paralell F-axsis (and strike of S_1).

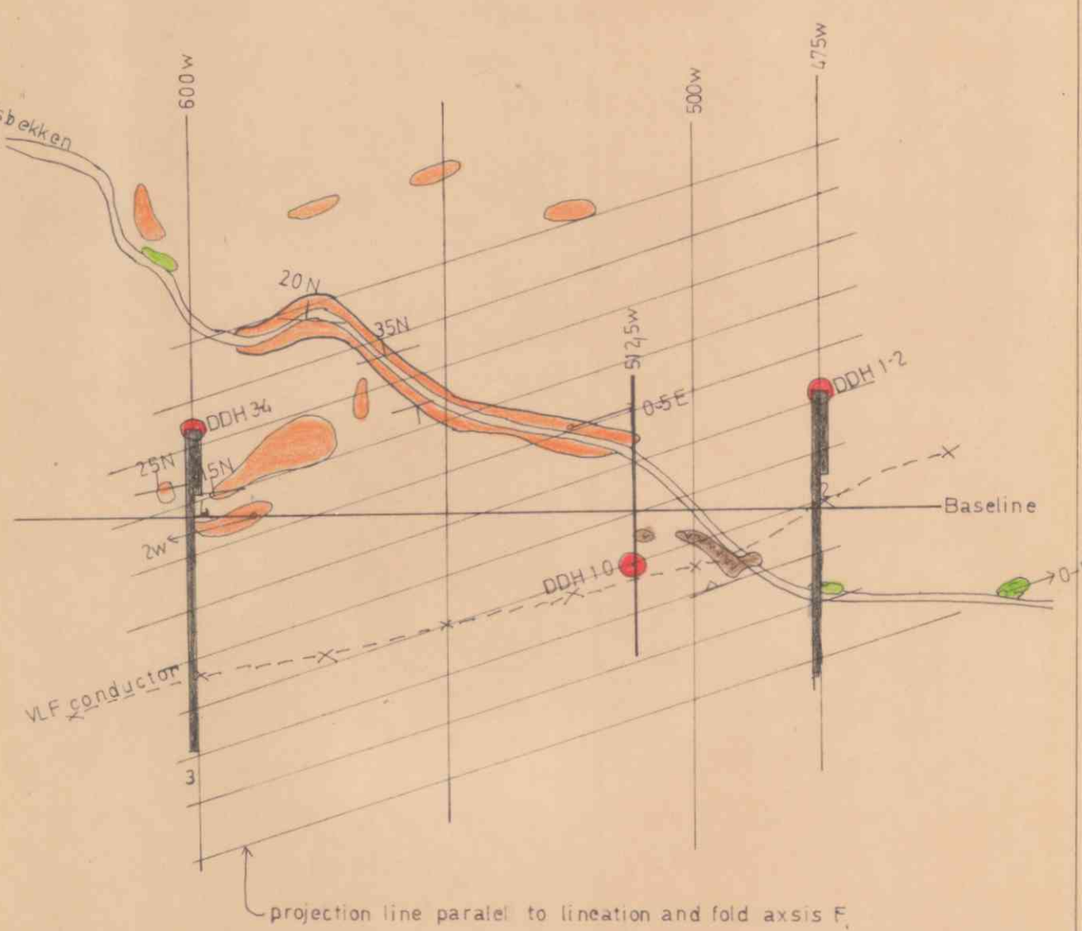
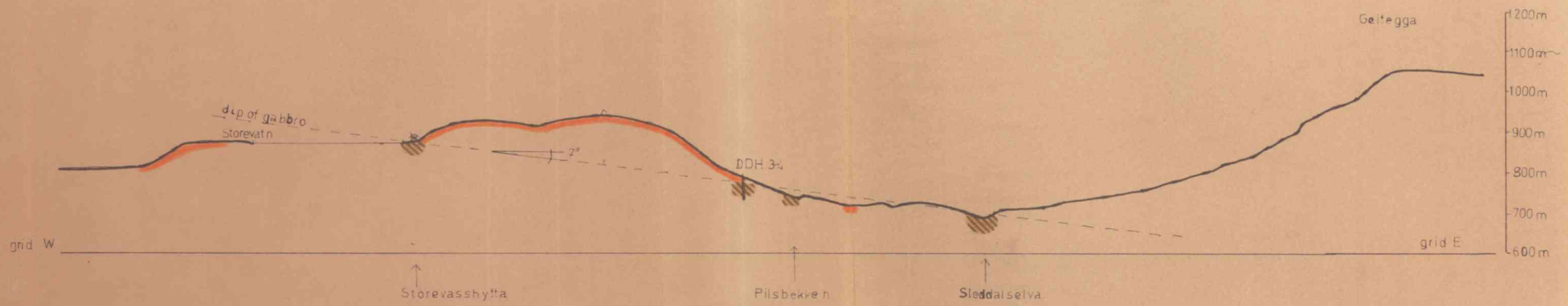


fig. 2B Surface map.

Situation map, DDH 1,2,3,4,10. GOMSDALEN, GEIRANGER.	SCALE 1:1250	OBS. BJL	9-77
		DRAW. BJL	9-77
		TRAC. LH	10-77
		CHK.	
% SULFIDMALM	MAP NO. fig. 2A, 2B.		
	MAP SHEET		



Angular brake in the profile making a minor error in the calculated "gabbro rod" dip

gabbro

0 500m

Isometric

Topographic profile along the mineralised gabbro

GOMSDALEN, GEIRANGER.

⅛ SULFIDMALM

SCALE 1:10000	OBS.	B.L. 76
	DRAW.	B.L. 77
	TRAC.	L.H. 77
	CHK.	

MAP NO. Fig. 9

MAP SHEET

GOMSDALEN West grid, Geiranger.
Geological map.

SCALE 1:1250

OBS. B.L. 11-76
DRAW. B.L. —"—
TRAC. BB 2-77
CHK.

MAP NO.

% SULFIDMALM

MAP SHEET

A.s Terrikopi. 3000. A-1. E 9 gl. 10-71. Sentrum Trykkeri.

Simplified geological map of
Gomsdalen area.
M 1:12 500

- Gneiss, micaschist
- Gabbro
- Fold axis F_1, F_2
- Foliation S_o, S_1
- Axial plane foliation $A_1=S_1$