Bergvesenet rapport nr	Intern Journal nr	Internt arkiv nr	Rapport lokalisering	Gradering
BV 1936			Trondheim	
Kommer fra ..arkiv	**Ekstern rapport nr**	**Oversendt fra**	**Fortrolig pga**	**Fortrolig fra dato:**
	LV 10			

Tittel

Geological, geophysical and diamond drilling investigation in the Brannåsen area

Forfatter	Dato	Bedrift
Grenne, Tor	21.01 1982	Orkla Industrier A/S

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Melhus	Sør-Trøndelag	Trondheimske	15212	

Fagområde	Dokument type	Forekomster
Geologi Geofysikk Boring		Brannåsen
Råstofftype	**Emneord**	
Malm/metall		

Sammendrag

GULF - ORKLA

LØKKEN VENTURE

REPORT NO: LV10 DATE: Jan. 21, 1982

TITLE:
Geological, geophysical and diamond drilling investigations in the Brannåsen area.

ORKLA INDUSTRIER A.S.

MINING SECTION, EXPLORATION

Report no: LV(Løkken Venture) 10	Date: January 21, 1982
Title: Geological, geophysical and diamond drilling investigations in the Brannåsen area	
Prepared by: Tor Grenne	Areas name: Brannåsen
Map no., name: 1521 II Hølonda	Coordinates (UTM): NR 425-450, NQ994-NR012
Field work period(s): Sept.-Oct. 1980, June-Oct. 1981	Pages: 10 Map enclosures: 9

Summary (purpose, execution, results):

The main aim of this study was to find the cause of old Turam anomalies in the Brannåsen area. Geological mapping in the scale 1:5000, VLF/magnetometer measurements and four diamond drill-holes revealed that

1. the geophysical anomalies are caused by 'vasskis'/chert horizons, without detectable amounts of chalcopyrite/sphalerite
2. alteration zones with pyrite and minor amounts of chalcopyrite/sphalerite(?) are found in the greenstones stratigraphically below the chert/'vasskis' horizon
3. the regional stratigraphy is inverted. Isoclinal to tight folding has caused strong deformation particularly in the short, right-way-up limbs of the folds.

Indused polarization would be the most efficient method for further investigations. Extension of IP measurements to the southeast should be accompanied by further geological mapping and possibly VLF.

Key words: Geology, chert, 'vasskis', alteration, deformation; Geophysics, Turam, VLF, magnetometer

Project initiated (date): September 1980	Report finished (date): January 21, 1982
Distribution to:	

TABLE OF CONTENTS

Enclosures:

1. Geological map of the Brannåsen area
2. Geological vertical section, profile 1150X
3. Geological vertical section, profile 450X
4. Borehole sections
5. Location of Turam anomalies in the central part of the area
6. VLF dip angle map
7. VLF Frazer contouring map
8. VLF imaginary component map
9. Total magnetic field map

INTRODUCTION

A Turam survey performed by NGU in 1954 revealed a number of anomalies in the area between the rivers Svorka and Trivja east of Åmot, some 8 km east of Løkken (NGU report no 135A). The old data were reinterpreted in report no 135A/1977, concluding that a long, NW-SE-striking conductor was present of a depth of less than 140 m. In the central part of the zone, the Turam data indicated two separate conductors; a weak one at a depth of approx. 35-40 m, and a good conductor at about 150-180 m (encl. 5). These indications were followed up by geological mapping and field investigations during 1980, and further on VLF and magnetometer measurements in 1981. Based on these results, a 4 drill-hole program was carried out during late summer-autumn -81. This report summarizes the results of all works done in the area until now. Thin-section and hard-rock geochemical studies are, however, also planned and will be discussed later in a supplementary report.

The investigated area occupies 2.75 sq.km between the river Trivja to the southwest, river Svorka/lake Svorksjøen to the north and the border between the Meldal and Melhus districts to the east, and is between 200 and 355 metres above sea level. The terrain is largely covered with moraine and marshes, and has in general a relatively low outcrop frequency. The mapping is carried out in the scale 1:5000 on the map sheets Åkermoen CG 120-5-3 and Furuknausen CG 119-5-1.

The area is found in the eastern-northeastern part of the Løkken greenstones, close to the contact to the stratigraphically overlying, mainly sedimentary Lower Hovin Group.

GEOLOGY

Metagabbro

Metagabbros belonging to the Løkken greenstones occur in fault contact with the greenstones, SSW of the investigated area (see encl. 1). They are not studied in detail here, but a thin-section of a coarse-grained variety shows strongly sausuritized plagioclase and partly uralitized clinopyroxene crystals as the main components. A thin doleritic dyke is also seen cutting the gabbro, with chilled contacts trending $360^{g}/35^{o}$.

Greenstones

The primary nature of the different greenstone types that occupy most of the area, is often hard to determine due to the commonly severe deformation of these rocks. During field mapping and also borehole logging, it was however usually possible to separate between pillow lavas and massive, medium to coarse-grained varieties, although both types may show transitions into grennschists as deformation increases.

Pillow lavas alternating with massive greenstones are found all over the area; the latter may however dominate locally. Slightly vesicular greenstones, usually with calcite-filled vesicles are found both as pillow lavas and

massive types; in such cases the latter can be interpreted as massive flows, otherwise they may represent subvolcanic intrusions. A few dykes (or sills), with fine-grained chilled margins have been observed during field mapping and also in boreholes. Apparently non-vesicular and sometimes variolitic pillow lavas do also occur.

In the central and southwestern parts of the area, mostly in a broad 'zone' trending NW-SE along strike, the greenstones have very often an anomalous content of disseminated sulphides. Occasionally pillow lavas have a concentration of sulphides between the individual pillows; doleritic dykes with mineralization along margins are seen; and here and there one can find sulphides forming networks of thin, apparently early (pre-deformational) veins. Quartz and sometimes epidote veining may accompany this sulphide mineralization, likewise an alteration of the mineralized metabasites. This alteration is seen a few places in the field and in drill-cores as anomalously coloured greenstones, varying from greyish-green through light grey to brownish-grey or bluish-grey, or sometimes abnormally strong green colours. By comparison with stringer-zone alteration rocks in the Høydal area, these colours most likely reflect varying degrees of albitic and chlorite alteration, respectively.

Anomalous greenstones of another type is seen mainly in the drill-holes (see encl. 2, 3 and 4). These are conspicuously coloured (reddish-brown) by a relatively high hematite content, particularly along pillow margins and in veins cutting the greenstones. Usually carrying a high proportion of calcite, the rock type is very soft and hence rarely seen in outcrop. In boreholes a fragmental, almost breccia-like appearance is common. It is not clear, however, whether this reflects the depositional nature of the rock, or if the structure may have been caused purely by veining and this particular hematite-calcite alteration of the volcanics.

The chert formation

Particularly in the northwestern and western part of the investigated area (see geological map, enclosure no 1), cherts are frequently occurring as units with thickness varying from a few centimetres up to several metres. They are usually found as light grey to light green quartzites with minor amounts of sericite, actinolite or epidote. Darker grey varieties do also occur, resembling the socalled 'svartfjell' ('black rock') in local mining terminology, that often contains some stilpnomelane, (seen in one outcrop here) and/or magnetite.

The cherts are massive or banded, and may show transitions into more impure, tuffaceous cherts or alternations between chert and tuffaceous laminae. Commonly the cherts contain minor amounts of disseminated Fe-sulphides, mainly pyrrhotite, giving the outcrops a conspicuous rusty weathering surface. Sometimes one can see more compact, fine-grained pyrrhotite/pyrite ('vasskis') in the cherts, forming layers with thickness ranging from one centimetre to one metre. These 'vasskis' layers are finely laminated, with more or less chert-(quartz)-rich sulphide laminae in the millimetre scale, and may also contain a few purer chert laminae.

Within the chert formation at a few localities, there also occur jasper as thicker, massive reddish units. Between Olsslettmyra and Stormyra (see geological map, enclosure 1) the chert formation appears to grade from the sulphide-bearing greyish type to predominantly jasper along strike towards SE, with the jasper lying stratigraphically on top of (NE of) the former type.

Greenstone-jasper conglomerate

This unit occupies the lowermost part of the Lower Hovin Group that is stratigraphically overlying the Løkken greenstones. It forms the NE boundary of the investigated area, in the hillsides south of lake Svorksjøen. The fragmetns, which vary from angular to somewhat rounded, and from a few centimetres to 1 m across, are predominantly composed of greenstone and jasper (with a highly variable ratio), together with sporadic limestone fragments in a green matrix.

Later intrusives

Hølonda porphyrite dykes (andesitic porphyrite) occur at several localities in the western-northwestern part of the area (see encl. 1). Their apparent thickness vary from about 1 m (drill-hole 1) up to 50 m. The rock type is generally more massive than the greenstones, at least in their interior, less sheared parts. It is usually relatively dark greyish with lighter green somewhat diffuse plagioclase phenocrysts less than 1 cm across.

Quartz-feldspar porphyrites or locally felsites have been found at a few localities. They occur as dykes with thickness up to a few metres, both within the greenstones and the greenstone-jasper conglomerate. In thin-section they show quartz- and/or plagioclase phenocrysts in a fine-grained granoblastic aggregate of quartz, plagioclase, sericite, leucoxene and some scattered sphene crystals. The sericitized plagioclase phenocrysts are euhedral, or form glomeroporphyritic aggregates up to 10 mm across, while the quarts crystals (of the same size) are more subherdral

to euhedral. Taking composition, field relationships and texture into account, the rock would classify as a quartz diorite, or more precisely a porphyritic micro-quartz diorite.

STRUCTURAL RELATIONSHIPS

In the central-northwestern part of the area, a chert formation can be traced about 1.5 - 2 km as one more or less continuous horizon. The same unit is found in the bore-holes, and appears to be very useful for an evaluation of the structural pattern in the area. It must be noted here that, although it seems possible that the more sporadic chert outcrops in the southwestern and extreme northwestern part of the map (encl. 1) belong to the same horizon, this can hardly be proved, due to the apparent complex faulting.

As seen on the map and on the interpretation of the bore-hole sections (encl. 2 and 3), the rocks appear to be deformed into tight to isoklinal folds.

A variably developed axial plane foliation is related to this folding, forming the regional schistosity which is generally dipping 30-50° SW. In the central part of the area where there is relatively good structural control, these early folds are plunging approximately 10-15° towards SSE. The asymmetric folds are apparently inclined towards ENE, with their long limbs extending SE-wards from synform fold hinges (see map, encl. no 1). The short, overturned limbs are very often completely sheared out and are seen in the field and in drill cores as zones of intense deformation, usually developed as strongly foliated greenschists with no primary structures or textures preserved. Along some of these nearly discrete zones which apparently have taken up most of the shear movement during deformation, there has been a considerable displacement, and actually the shear zones may constitute 'small-scale thrust' planes, where the 'thrust sheets' have been moved towards NE above the underlying rocks (as far as their present position is concerned).

These early structures were later deformed, probably by one (or more) phase of open folding that gave rise to a kink-banding (seen locally in finely laminated or foliated rocks) and dip variations (from 25° SW to locally 60° to NE).

Later faults are found all over the area (see map, encl. 1), striking mainly in three directions: 35, 100 and 140g. Small displacements (a few tens of metres) can be seen at the contact between the greenstones and the Lower Hovin Group and at intersections with other faults. Larger-scale movements have occurred along the two parallel faults that follow the river Svorka in the extreme north, where the northern sides

appear to have been down-faulted (based on the re-appearance of the chert formation), the NW-SE-oriented fault through the SW part of the area, with uncertain relative movements, and in particular along the faulted contact between the greenstones and the metagabbro to the southwest, along Slættbekken.

The regional stratigraphy is inverted, as the Lower Hovin greenstone-jasper conglomerate is found structurally beneath the greenstones. The inversion is confirmed by pillow structures seen in less deformed parts of the greenstones, exclusively indicating that the sequence is upside down. This may seem self-contradictory in an isoclinally to tightly folded sequence like this, but can be explained by the much more intense shear deformation that apparently has taken place along the short, right-way-up limbs of the folds.

GEOPHYSICAL MEASUREMENTS (KBC, TG)

This chapter gives a short interpretation of the VLF and magnetometer results with reference to the old Turam data.

Data

Profile direction: SE-NW, 334^g
Profile intervals: 50 metres
Measurement intervals: 25 metres
VLF station: NAA - 17.8 kHz
Measurement area: 0.5 sq.km

Interpretation of results

On the dip angle map (enclosure no 6) there appears to be one distinct conductor, anomaly no 1. This is probably caused by a mineralization zone (or possibly two zones, see below) dipping fairly to SW. It corresponds very broadly to the Turam anomalies mentioned in the introduction, interpreted as two parallel, separate conductors (encl. no 5). The VLF anomaly may be regarded essentially as a single one, although it is possible that it is separated into two along strike. The other anomalies are weak, dipping SW like the main one. The VLF anomalies are also indicated on the Frazer contouring map (encl. no 7). From the total magnetic field map (encl. no 9) higher anomalous values corresponding to the VLF dip angle anomaly no 1 can be seen.

The VLF anomaly no 1A does not coincide perfectly with the outcrop of the chert horizon, not even in the old prospects where a weak 'vasskis' mineralization can be seen. The anomaly stretches SE from where the upper (southeastern) limb of an antiform crops out about 100-150 metres north of the old workings. The extension of the anomaly is slightly deviating from the strike direction, with a somewhat more south-southeasterly orientation, thus coinciding more with the plunge of the early folds. Taking the deformational

pattern in the area into account, a thicker, more compact 'vasskis' serving as conductor is much more likely to be found in this upper part of upper limbs or within the hinge-zones of antiforms. In the sheared-out lower limbs the chert/'vasskis' will at best be strongly thinned or disappear completely by the deformation. Similarly, anomaly no 1B may be separated from the former, stretching SE-wards from a new antiformal hinge zone or upper limb appearing at profile 1300X. Also the other, weaker VLF anomalies may be explained by the 'vasskis'/chert having the greatest thickness (at shallow depths) in upper limbs or hinge zones of slightly SSE-plunging antiforms. These may correspond to the antiforms that are outcropping just east of Håggåmyra and north of Stormyra (see geological map, enclosure no 1, and interpretation of bore-hole sections, enclosure no 2).

DIAMOND DRILLING

Based on the Turam anomalies, the sulphide mineralization/alteration pattern in the greenstones and the structural/stratigraphical interpretation of the area, a 4 drill-hole program was carried out during the summer/autumn 1981. Four holes were drilled, each between 160 and 190 metres long. Bore-holes 1, 2 and 3 were drilled in profile 1150X (935Y, 1035Y and 865Y respectively), at 60^{o} towards NE (34^{g}). Bore-hole 4 was put 700 metres to the southeast (profile 450X, 850Y), with the same direction. The first two holes were aimed at the Turam anomalies, while the location of the others was directed mostly by the geology.

The structural interpretation of the bore-hole sections is shown on enclosures 2 and 3. The picture conforms well to what may be deduced from the surface geology, although there are several uncertainties in the upper SW part of profile 1150X (enclosure no 2). The extensive shear zones seen in outcrop can be found also in the drill-cores, ranging from a few tens of centimetres up about 10 metres thick with somewhat gradational contacts to less sheared rocks. Large variations in the degree of deformation can be seen also outside these zones.

The chert formation was found in all of the holes (see enclosure no 2, 3 and 4). Apparent thickness is rather constant - about 15 metres - in the deepest intersections with the chert formation, while there are several thin units in the upper SW part of profile 1150X. It is not clear whether this thinning is due to deformation alone or primary lateral variations. A combination of both is perhaps most likely. In some cases the chert formation may also have been

subdivided, for instance by local extrusions/intrusions. This is likely to have occurred in the uppermost 24 (-33?) metres of drillhole no 3 (see enclosure no 4), where a relatively uniform chert appears to be cut by a number of medium-grained doleritic dykes (alternatively massive flows), and possibly also subdivided by a pillow lava flow (between 24 and 31 metres).

Copper/zinc sulphides were not seen in the chert/'vasskis' formation, except at about 6 metres in drill-hole 3 where minor amount of chalcopyrite occur as dissemination together with pyrrhotite. The most compact and thickest 'vasskis' mineralization was hit in drillhole no 1 at a depth of 140 metres below the surface. This is very close to the estimate of 150-180 metres (see enclosure no 5) based on the old Turam data. From this it seems possible that the Turam anomaly is actually caused by this deep conductor, and not by the one that causes the VLF anomaly no 1 as discussed earlier. Concerning the weak, shallow Turam anomaly, this may be caused by the northeastward extension of the thin 'vasskis' seen at about 43 metres in drillhole 1 (see enclosures 2 and 4). A 1 metre thick, compact vasskis was also intersected by drillhole 4. This may be the down-dip continuation of the conductor causing the extensive anomaly just SW of the hill Bjørnåsen.

In the drill-cores one can usually see distinct differences between greenstones stratigraphically above and below the chert formation. Above (generally structurally below) they are in general devoid of sulphide disseminations, and vary from normal to hematite/calcite-rich in some places. Stratigraphically below, the greenstones quite often carry sulphide disseminations (locally veining) and show variable degrees of alteration as described earlier. Pyrite is the main sulphide in this mineralization, with pyrrhotite occurring only locally. In the most altered volcanics one can also find minor amounts of chalcopyrite together with pyrite (bore-holes 1 and 4, enclosure no 4) and a mineral that appears to be sphalerite (bore-hole 3 and 4).

DISCUSSION

Usually the most advanced alteration is found immediately stratigraphically beneath (or occasionally above) the chert horizon (drill-holes 1, 2 and 3). This alteration/mineralization does not necessarily indicate the presence of any hydrothermal 'feeder' zone as seen below the massive Cu-Zn-bearing sulphide deposits in the Løkken area. Thinking of the chert/vasskis as a 'distal exhalite' (based on earlier investigations in the Høydal area), much of this alteration might be explained by the activity of the comparatively warm, chert-forming solutions. The more extensive alteration/mineralization (and the more frequent occurrence of

chalcopyrite/sphalerite) in bore-hole 4 is, on the contrary somewhat more promising. As far as one can see at present, this alteration does not occur close to the chert. It is possible that it forms part of a deeper alteration zone, although it must be emphasized that this is as yet somewhat speculative.

CONCLUSION

The investigations in the Brannåsen area are negative so far, apart from the better understanding of the structural pattern in the more deformed parts of the Løkken greenstones. Also, valuable geological information about the chert formation and its relationship to altered/mineralized metabasalts are obtained by the field investigations and diamond drilling. The geophysical anomalies in this area appear to be caused by 'vasskis' horizons - barren Fe-sulphide mineralization. The more advanced basalt alteration and possible 'feeder-zone' mineralization towards SE, in bore-hole 4, may suggest that an exhalative center is situated in that direction. The stratigraphical relationship between altered/mineralized lavas and the chert suggests that the chert formation is a more distal expression of this episode of sea-floor hydrothermal activity - a distal exhalite. As such, this chert level (in a southwesterly direction) is the most likely site of formation of a proximal Cu-Zn-bearing massive sulphide deposit in the area, if it ever was formed.

RECOMMENDATIONS

Geochemical investigations of the 'vasskis' and alteration rocks are planned. Chemical variations along strike may support the suggestions mentioned above. VLF, Turam and magnetometer measurements have not so far proved to be very valuable here, except VLF which may serve as a tool in tracing the chert formation.

Induced polarization surface measurements mainly in the southern-southeastern part of the area (maybe also southeast of the mapped area) would be of great importance in detecting the sulphide dissemination zones in the greenstones. Together with EM- and IP borehole measurements this is the only geophysical method that can be recommended for further investigations here. Extension of IP investigations towards SE should be accompanied by further geological mapping and possibly VLF for tracing the chert/'vasskis' formation.


BRANNÅSEN
DIAMOND DRILLING
Scale: 1:250
Draw: TG
Trac: AM
Date: 18.1.82
No:
Orkla Industrier As
7332 LØKKEN VERK
Gulf - Orkla Venture
Enclosure no: 4
Report no: 10
LEGEND
Cover
Hølonda porphyrite
Felsite
'Vasskis'; massive/weaker mineralized layers
Chert, light grey to green
Chert, dark grey ('svartfjell')
Tuffaceous sediments
Fine-grained greenstone/pillow structures
Medium-/coarse-grained greenstone
Calcite banding
Zone of strong/intense shearing
Altered volcanics (mostly greyish/brownish-grey)
Hematite-rich (reddish-brown volcanics)
Sulphide disseminations and veining, weak/strong
Fracturing
Chilling direction
Metres
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
Drillhole 4
py, trace amounts
some q/ep veins
py
py, trace amounts
py, trace amounts
py (-cp)
greyish-green
q veins
grey
greyish-green
py (-sl?)
grey
greyish-green
py
greyish-green
py (-sl?)
py (-cp)
greyish-green
q-vein
py (-cp)
q-veins
py
felsite (?)
cc spots
cc/ep/reddish-brown bands
cc bands
reddish-brown bands
core loss
dark purple, cc-rich
py
cc veins
py
q-veins
py, trace amounts
py
po
variolitic (?)
Drillhole 3
po (-cp)
po
po (-py)
po
po
greyish-green/brownish-green
po - py
core loss
po (-py)
core loss
po
core loss
coarse-grained
traces of py
py
sl (?)
trace amounts
py
py
py (-po)
py
light greyish
q-veins, po diss/veins
cc veins
cc-rich, cc veins, locally breccia-like
Drillhole 2
py
py
q veins
py
py
py
cc in vesicles (?)
py in veins
greyish
q/py in veins
po diss.
po (?)
grey/brownish-grey
po (-py)
po (-py) in bands and as diss.
po diss.
po diss.
brownish-grey
po in bands
cc in vesicles and veins
much cc in veins
locally breccia-like
much cc in veins and vesicles
variolitic (?)
traces of py
Drillhole 1
po in cc- and q-veins
vesicular
cc in vesicles and veins
po (-py)
po (-py)
po
cc in veins
po
po (-py) and cc, diss/veins
po diss/cc veins
po/chert
po (-py)
po
coarse grained
coarse grained
po (-cp)
q/ep in veins
py
cc in vesicles and veins
core loss
core loss
bluish-grey/greyish-green, ep/q in veins
py (-cp)
diss. and veins
brownish-grey
cc in vesicles
q in veins
py diss. and veins
grey/greenish-grey
py
py diss. and veins
brownish-grey
po (-py)
locally breccia-like, small jasper fragm.
breccia-like/banded
cc in vesicles
breccia-like/banded
cc in vesicles
breccia-like/banded
cc in vesicles

BRANNÅSEN
Profile 450 x

Scale: 1:1000
Draw: TG
Trac: AM

No: GL 22 C

Orkla Industrier A.s
7332 LØKKEN VERK
Gulf - Orkla Venture

Enclosure no: 3

Report no: 10

300 m.a.s.l.
250
200
150
100

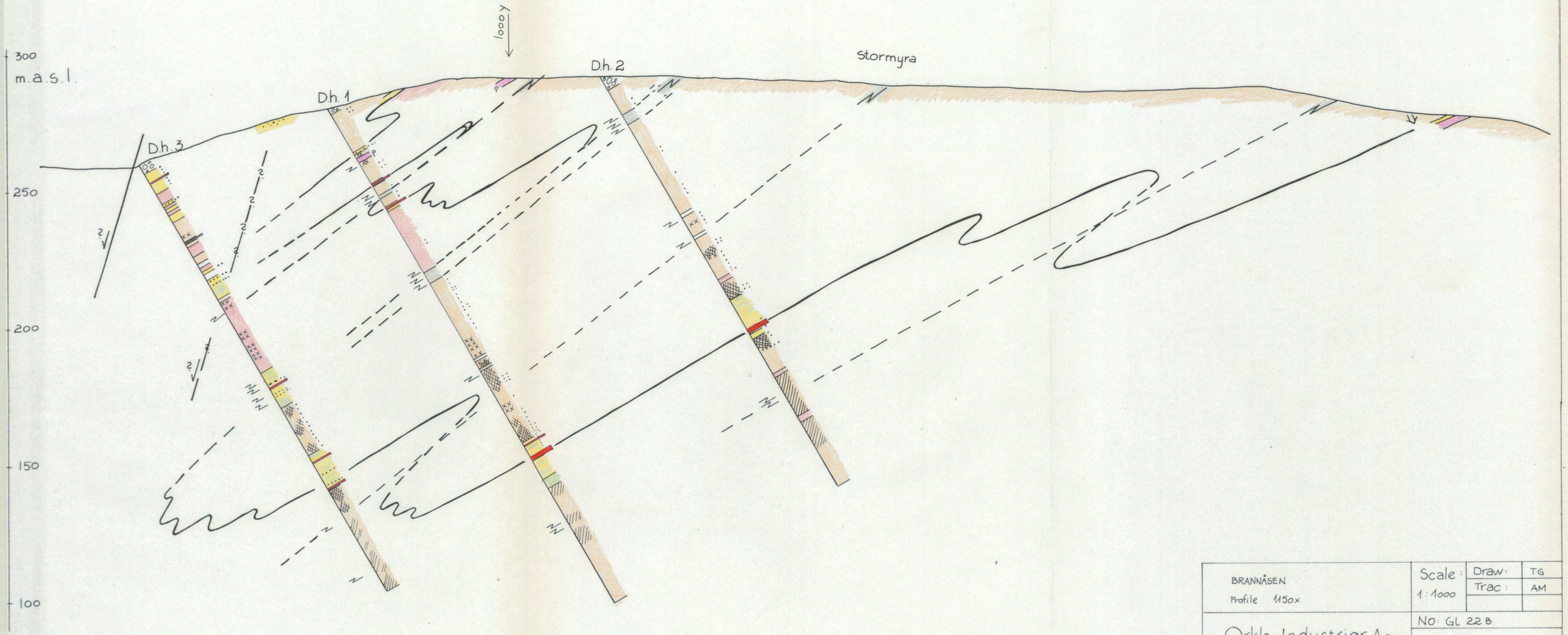
D.h. 4

1000 Y

Bjørnåsen

LEGEND

Cover
Hølonda porphyrite
Felsite
'Vasskis'; massive/weaker mineralized layers
Chert
Jasper
Tuffaceous sediments
Fine-grained greenstone
Medium-/coarse-grained greenstone
Calcite banding
Zone of strong/intense shearing
Altered volcanics (mostly greyish/brownish-grey
Hematite-rich (reddish-brown) volcanics
Sulphide dissemination
Fracturing
Fault
Way up



BRANNÅSEN Profile 1150x	Scale : 1 : 1000	Draw :	TG
		Trac :	AM
Orkla Industrier A.s 7332 LØKKEN VERK Gulf - Orkla Venture	NO: GL 22 B		
	Enclosure no : 2		
	Report no : 10		

GEOLOGICAL MAP OF THE BRANNÅSEN AREA

Scale: 1:5000

Draw: TG

Trac: AM

Orkla Industrier As
7332 LØKKEN VERK
Gulf - Orkla Venture

No: GL 22 A

Enclosure no: 1

Report no: 10

Svorka

Svorksjøen

Håggåmyra

Olsslætt-myra

Skjørost-tjønna

Stormyra

Bjørnåsen

Slættbekken

Trivja

LEGEND

Lower Hovin Group

- Greenstone - jasper conglomerate

Løkken Greenstone series

- Jasper
- Chert with occasional 'vasskis' layers
- Alternating pillow lava / massive greenstone
- Dominantly massive, medium / coarse-grained greenstone
- Metagabbro

Intrusives younger than the Løkken greenstones

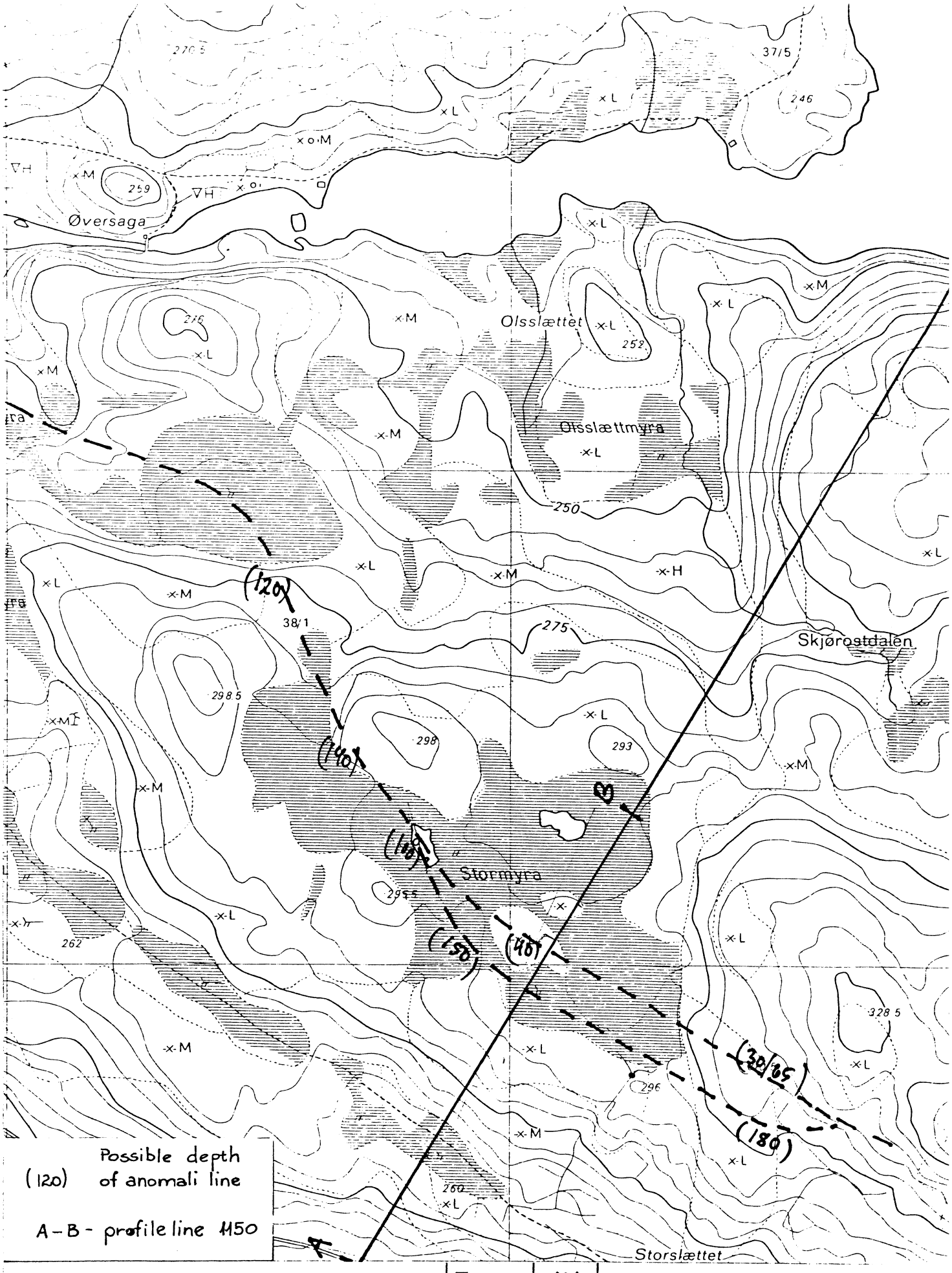
- P P Hølonda porphyrite
- Quartz - feldspar porphyrite / felsite

- Stratigraphic way up
- 30 Strike and dip of layering
- 40 Strike and dip of regional schistosity
- Zone of intense shearing
- Sulphide dissemination
- Prospect / minor workings
- Lithological boundary / inferred
- Thrust / inferred
- Fault / inferred
- Drill hole

N

Scale: 1:5000

0 500m



GULF - ORKLA VENTURE
INTERPRETATION OF
TURAM - MEASUREMENTS
IN THE BRANNÅSEN AREA

1:5000

Trac.	AM
Date	15.1.82
Corrf.	KBC
Report no 10.	

ENCLOSURE No 5.

A-B: PROFILE 1150X.

Interpretation of VLF anomalies:

---- strong
..... weak
||||||||||| very weak

BRANNÅSEN
VLF - anomaly map (instr. Paulsen)
Dip angle Station NAA

Orkla Industrier A s
7332 Løkken Verk

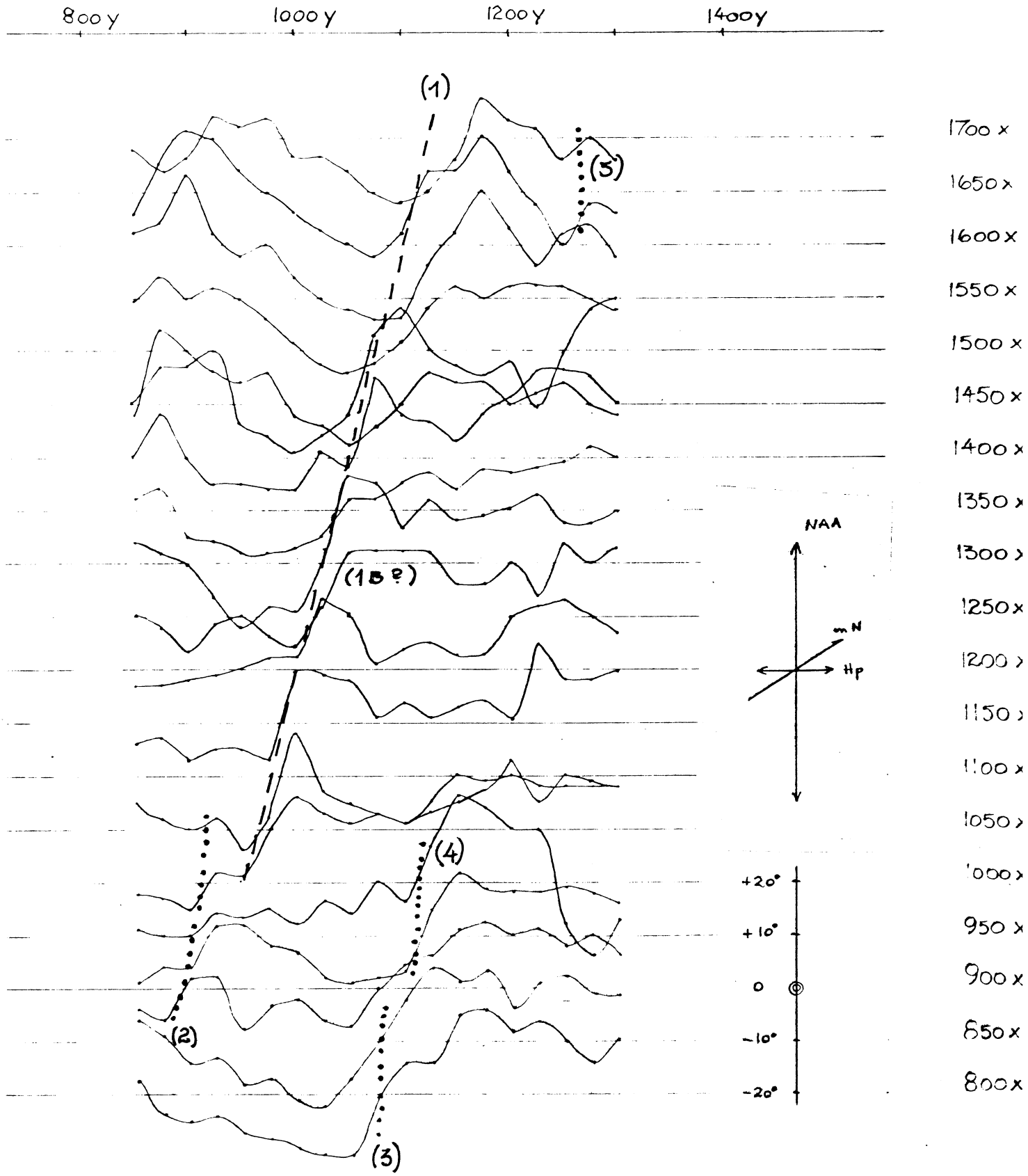
Gulf - Orkla Venture

Scale	Draw	KL
1:5000	Trac	AM
		GGr KBC

No : GfI E4

Enclosure no 6.

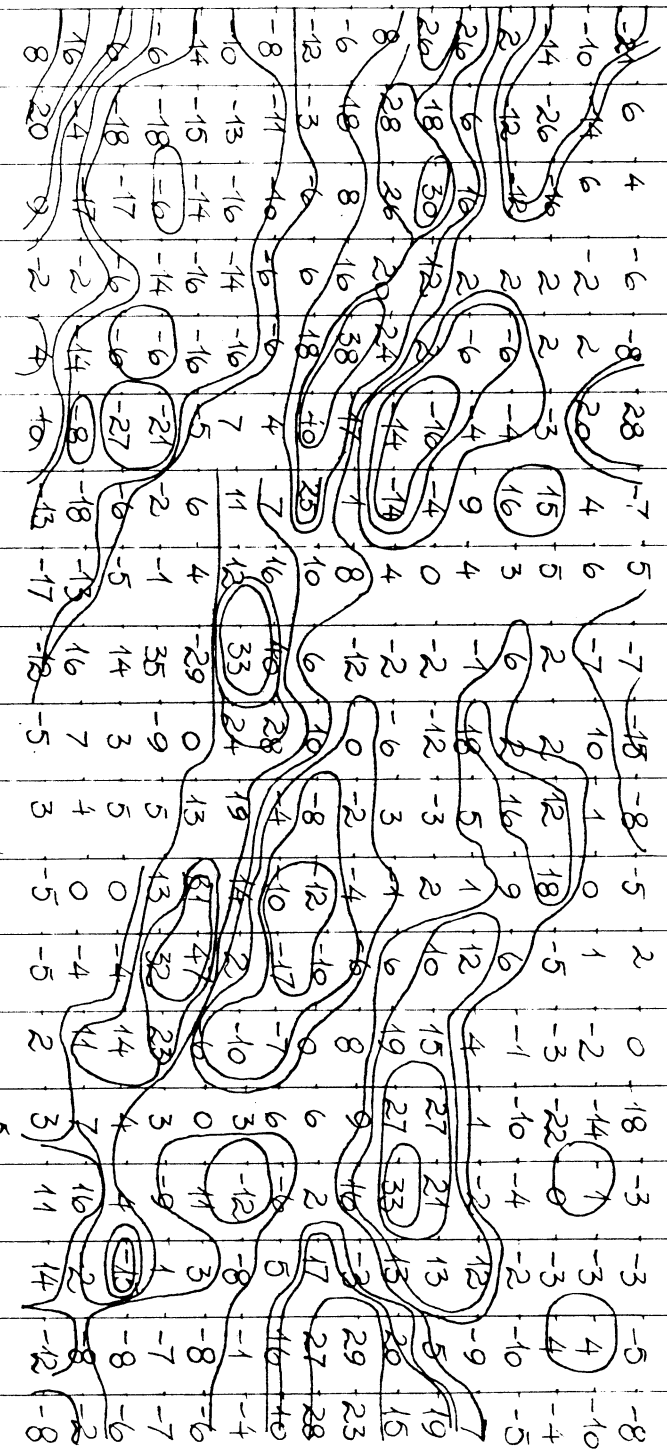
Report no 10.



BRANNÅSEN VLF-anomali map (instr Paulsen) Fraser contouring intervals station NAA	Scale: 1:5000	Draw: Trac: 	 AM GGr. KBC
Orkla Industrier A.S. 7332 Løkken Verk Gulf - Orkla Venture	No: Enclosure no 7. Report no 10.		

800 y 1000 y 1200 y 1300 y

1700 x
1650 x
1600 x
1550 x
1500 x
1450 x
1400 x
1350 x
1300 x
1250 x
1200 x
1150 x
1100 x
1050 x
1000 x
950 x
900 x
850 x
800 x



BRANNÅSEN
VLF-anomali map (instr. Paulsen)
Imaginary component Station NAA

Scale: 1:5000

Draw: KL
Trac: AM
Agr KBC

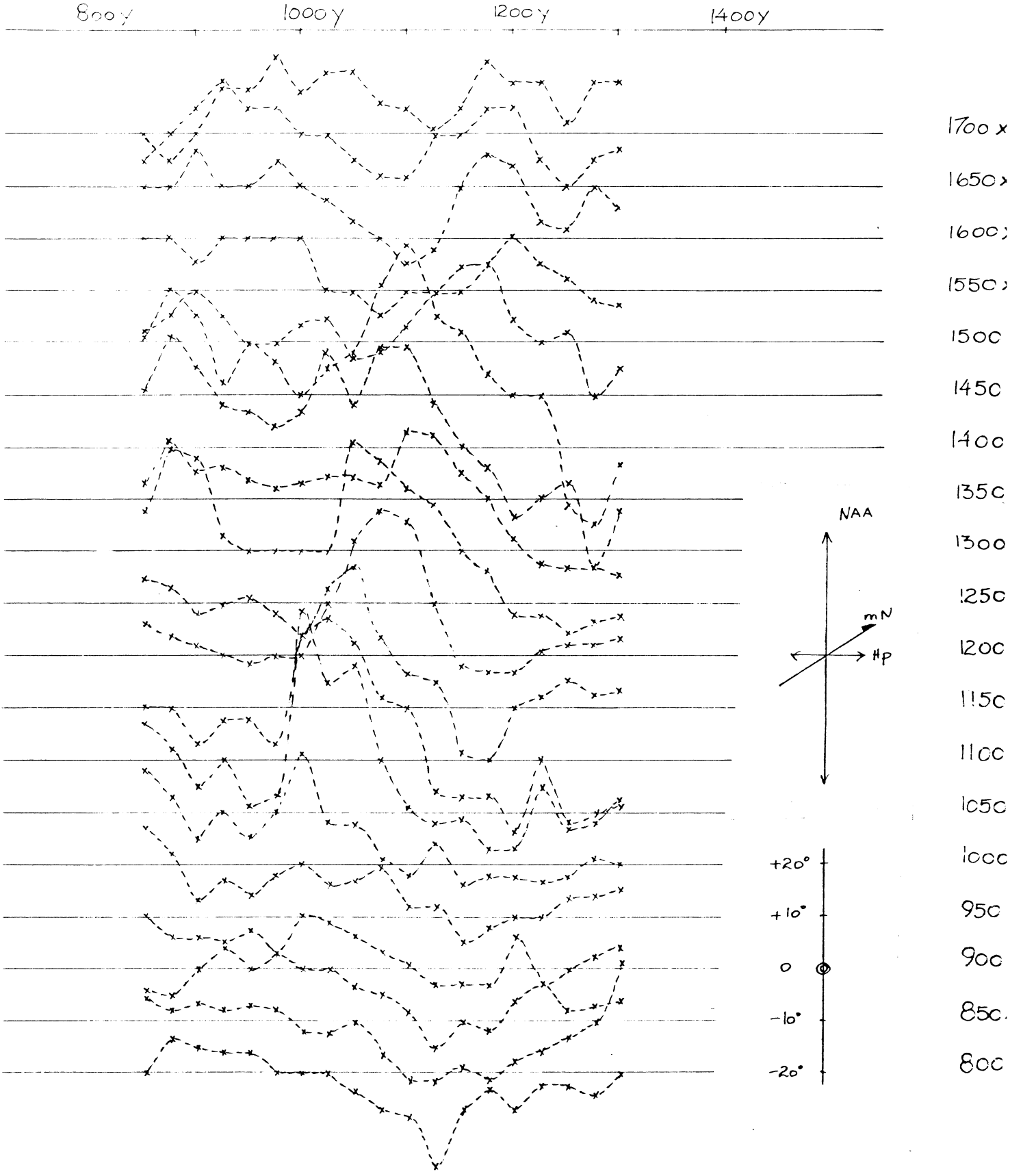
Orkla Industrier A.s
7332 Løkken Verk

Gulf - Orkla Venture

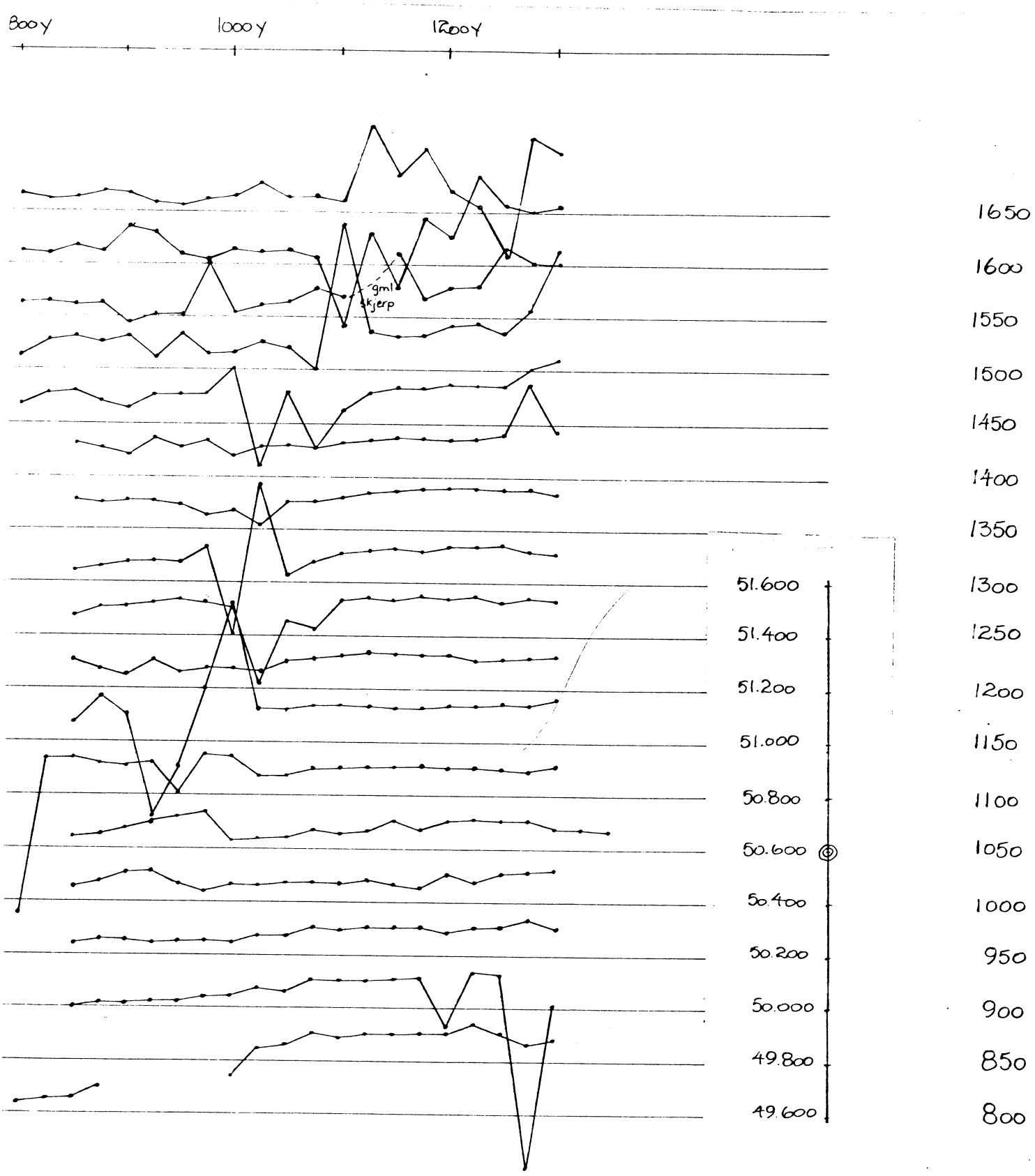
No: GfI E5

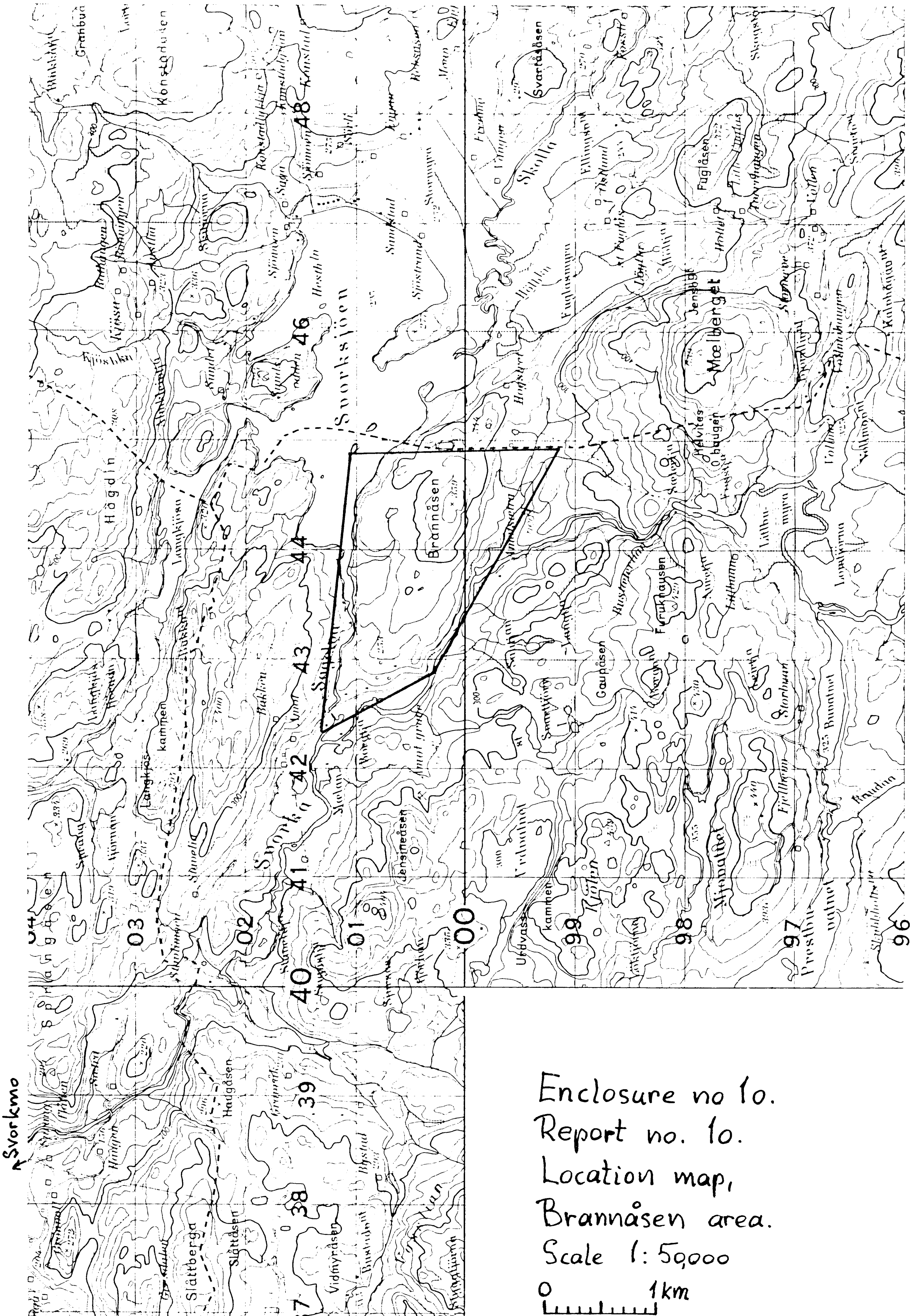
Enclosure no 8.

Report no 10.



BRANNÅSEN Total magnetic field map 0 - 50600 γ	Scale: 1:5000	Draw:	KL
		Trac:	AM
			GGr. KBC
Orkla Industrier A.s 7332 Løkken Verk Gulf - Orkla Venture	No: GfJ		
	Enclosure no 9.		
	Report no 10.		





Enclosure no 10.
Report no. 10.
Location map,
Brannåsen area.
Scale 1: 50,000
0 1km
N