Bergvesenet

Postboks 3021, 7002 Trondheim

Rapportarkivet

Bergvesenet rapport nr	Intern Journal nr	Internt arkiv nr	Rapport lokalisering	Gradering
BV 497			Trondheim	**Fortrolig**
Kommer fra ..arkiv	**Ekstern rapport nr**	**Oversendt fra**	**Fortrolig pga**	**Fortrolig fra dato:**
Falconbridge	Sul 346-74-24	Sulfidmalm A/S	Utmål	

Tittel

Regional Exploration in the Steinkjer - Snåsavann area.
Del 1. Geologi, geokjemi, bakkegeofysikk.

Forfatter	Dato	Bedrift
T H Tan	1974	Sulfidmalm A/S

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Steinkjer	Nord-Trøndelag	Trondheimske	17232 17233	Namsos

Fagområde	Dokument type	Forekomster
Geologi, geokjemi, geofysikk	Rapport	Skrattås Sneve Selid Strandheim Tvestad Indbryn
Råstofftype	**Emneord**	
Malm/metall	Cu Zn Pb As	

Sammendrag

Del 2 se BV 969

Denne har vi to eksemplarer av

BV 97 A+B

FOR FALCONBRIDGE NIKKELVERK A/S

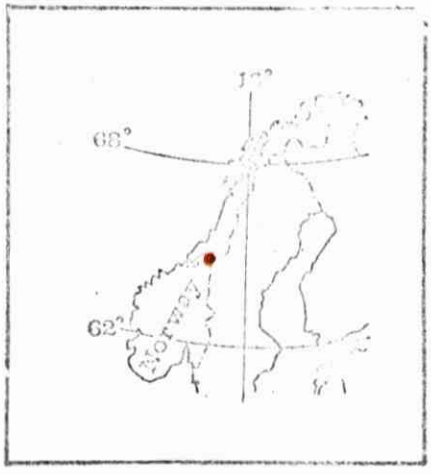
A/S SULFIDMALM

PROJECT 905-24

REGIONAL EXPLORATION IN THE STEINKJER - SNÅSAVANN AREA

1974

T. H. Tan



Report No. 346/74/24

INTRODUCTION

This report deals with the first stage of the regional exploration programme in an area of about 160 sq. kms., lying north and northeast of Steinkjer, carried out in the summer season of 1974. The methods applied in this season were helicopter-borne magnetic and electromagnetic surveys, and a geochemical stream sediment survey for Pb, Zn, Cu and Ni. The main purpose was to explore the area for mineralizations similar to the lead-zinc deposits at Skratås, around which an intensive ground exploration survey was planned in the same summer.

The stream sediment survey was carried out by high school students in the period between mid-May and mid-June. The helicopter survey was carried out by the Aerogeophysical section of the Norwegian Geological Survey (NGU) on a contract basis, during the period of June 17th to June 29th.

The area chosen for this exploration was essentially the zone of metavolcanics and metasediments of the Lower Hovin Group, extending from Steinkjer fjord to Snåsavann, where these rocks disappear under the lake at Tangen. The adjoining rocks to the south, assumed to belong to the Støren Group, were also in part covered, as well as a small portion of the Precambrian basement rocks in the extreme NE of the area.

GENERAL

The exploration area lies in one of the best farming districts in Nord-Trøndelag. The low lying areas between sea level and 100 m altitude, where most of the farmlands are situated, have gently undulating and in many cases flat terrain. The higher lying areas of 100 m to 300 m altitude are used for forestry and can in contrast have quite rugged topography. The mountains Byafjell (or Byaheia), Nordfjellkammen and Guståsen rise to heights of 200 to 300 m.

Highway no. 763, linking the town of Steinkjer with the villages south of Snåsavann, goes through the exploration area, and a large number of public and private roads lead from the highway farther inland. There are therefore no serious communication problems encountered and all the members of the field parties could be based in Steinkjer and drive daily to all parts of the exploration area with Sulfidmalm's car.

../2

The new edition of the topographic maps, based on aerial survey, were not yet available for the Steinkjer-Snåsa district. The only ones available were the 1:100 000 topographic maps of the NGO, based on the field survey of 1885, and 1:50 000 AMS maps, which were only enlargements of the former. These maps were too unsatisfactory for either airborne or ground regional survey, and all the mapping was done with the use of aerial photographs, or mosaics of these photographs. The maps presented in this report are all based on aerial photo mosaics of 1:15 000 scale, except the geological maps which are copied from the original 1:100 000 scale.

GEOLOGY

If one does not count the 1:1000 000 geological map of Norway, no official geological map exists of the present area, except for a map of approx. 250 000 scale, published in the in the Jubilee Volume of Fosdalen Bergverk A/S commemorating this company's 50th anniversary in 1956. The field work was done by H. Carstens, at that time geologist for Fosdalen. The NGU files have got Carstens' field material in 1:100 000 scale and the auther was given permission to copy this for our use.

Two WSW-ESE striking greenschist belts were mapped, with limestones and sandstones in between, forming a structure generally known as the "Snåsa Syncline". The Skratås deposit lies in the southern limb, while Fosdalen's iron mine lies in the northern limb of this big fold. Since the publication of this map in 1956, however, Carstens mentions that the greenschist formations also include many types of rocks of sedimentary origin (cf. Carstens, H, 1960, "Stratigraphy and Volcanism in the Trondheim Area", NGU 212 b). In this new paper Carstens presented the following stratigraphic table for the Steinkjer-Malm area.

Upper Hovin Group	Sandstones and shales Polymict conglomerate	(Upper Ordovician)

Lower Hovin Group	Sandstones Gneisses and altered rhyolite tuffs Lund and Snåsa limestones Greenschists and keratophyres Schists Steinkjer conglomorate	**(Lower and Middle Ordovician)**
Støren Group	**Greenstones**	**(Tremadocian-Arenig)**

The ages of these various units were derived from Roberts, Springer and Wolff (1970) "Evolution of the Caledonides in the Northern Trondheim Region" Geol. Mag. 107.

The figures 1 and 2 in this report are copies of Carstens' 1:100 000 geological map of 1956 kept in the NGU files. The legend is modified by the present author to make it more in keeping with Carstens' 1960 publication. (This publication contains no map other than some sketches of very small areas). What was originally indicated as a greenstone formation of the Lower Hovin Group, the legend in the maps presented in this report indicates a formation of metavolcanics and metasediments.

The known mineral showings in this exploration area seem to indicate that the sulfide mineralizations are galena, zincblende and chalcopyrite as found in the Skratås and Marken workings, and pyrite and pyrrhotite (possibly also chalcopyrite) as found in the workings at Sneves plass and Nordtrøa near Selid. These workings are situated in the metasedimentary and metavolcanic formation of the Lower Hovin Group. Some copper mineralization was found near the farms of Tvestad and Indbryn. These showings lie in the rock group below the Lower Hovin group.

Iron quartzites seem to occur at several places in the Lower Hovin Group. These are reported to have been intensely investigated by Fosdalen Bergverk in the nineteen fifties.

STREAM SEDIMENT GEOCHEMISTRY

We used the usual sampling procedure of Sulfidmalm, i.e. stations at 250 meters' distance, sampling of only the "active" sediments as near to the centre of the streams as possible, and the sampled material wet-sieved before placed in the bags. The samples were then mailed to Kristiansand, from there they were shipped to Vancouver. The following elements were analysed: Ni, Cu, Zn and Pb.

The results are presented on map 3 and 4. The anomaly classes for the metal values were worked out in the Oslo office.

The following anomalous areas have appeared:

1. (Map 3). Strong Pb, Cu, Zn and Ni anomalies between Stamvann and Fossemvann. The Cu, Zn and Pb anomalies appear in the northern streams, and are in part caused by the contamination from the dumps of the Skratås workings. In the vicinity of the tributary streams showing these anomalies, there are showings f.ex. the Marken showing), bearing at least zinc-blende, pyrite, galena and minor chalcopyrite.

   The Ni anomalies appear in the southerly stream. The cause of this is still not known, we only know for the moment that this particular stream is running in a greenschist area.

2. (Map 3). Zn and Cu anomalies in the drainage system SW of anom. area 1. This area lies in the strike direction of the Skratås mine and other showings, and one expects that the sulfide mineralization has continued here. A detailed follow up work was already started in the autumn of 1974.

3. (Map 3). Cu, Zn and Pb anomalies in a short stream NE of Skratås mine. The stream flows to the east but disappears when reaching a cultivated field. The cause of the anomaly is not known. The stream runs along the junction between the metasediments and the overlying limestone.

../5

4. (Map 3). Pb and Zn anomalies in several streams flowing towards highway E6 by Rungstad vann. The streams are flowing in the zone of metasediments and metavolcanics, i.e. the same type of rocks as present around the Skratås mine. A sulfide showing and workings (pyrite, pyrrhotite) are known here (Sneves plass).

5. (Map 3). A stream with Pb anomalies, 2 kms S of Fossum-vann. This anomaly lies in the rock unit below the Lower Hovin Group. There is much farming around the area, but this anomaly should be investigated further.

6. (Map 4). Ni, and to a lesser extent Cu and Zn, anomalies in streams running down from Guståsen, W.of Ramstad vann. The rock unit here is the Steinkjer conglomerate, forming the base of the Lower Hovin Group.

7 and 8. (Map 4). Scattered Ni anomalies in streams of Hatling-elva. Lies between two large farming areas (Hatling valley in the north and Ogndal valley to the south - not marked on map), but the anomalies are not believed to be the result of contamination. The rocks here belong to the unit below the Lower Hovin Group.

Because of the intensive farming in the present area, we had anticipated a fair number of anomalous areas directly caused by contamination. During the sampling programme, the samplers discovered that the sewage from the farm-houses were generally released directly into the nearby streams. The lower part of Hatlingelva was not sampled, as the samplers claimed that it had become a large open sewer. For the same reason, many parts of the streams running from the farm houses were left out, when they found these too unpalatable to sample, or when the natural courses of the streams were interfered with. Not all suspected contaminated streams were left out, however. Many of them were sampled, but the possibility of contamination was then marked on the maps. The domestic refuse dumps, when found nearby sampled streams, are also marked. When the results were plotted on the maps, we found that very few anomalous values seem to have appeared in streams where contamination was expected. The only obvious result of contamination seems to be the anomalies in the stream running from Skratås mine.

../6

HELICOPTER GEOPHYSICS

For the full account of the NGU helicopter survey, the reader is referred to the NGU report no. 1269 (in Norwegian), which we received in the middle of December 1974, or its English translation presented in this report as an appendix.

The magnetic maps (figs. 1269-1 and 2 in the NGU report) show long zones of very low magnetic anomalous values, only 400-500 gammas over the background value of 50700 - 50800 gammas. These magnetic anomaly zones could be related to the basic volcanics, or possibly the iron quartzite - beds in the area. The strike of these magnetic zones seem to lie more or less parallel with the rock boundaries mapped by Carstens.

Maps no. 5 and 6 in this present report show the real (inphase) and imaginary (out-of-phase) EM-anomalies, copied from the figures 1269-3/5 and 1200-4/6 of the NGU report of the helicopter survey.

A large number of weak EM anomalies were detected in this survey, but it was rather disappointing to note that the Skratås deposit had not caused any anomaly. The highest anomalies were found north of Steinkjer town (map 5), and along the south bank of Snåsa lake (map 6), they both seem to appear over areas with extensive farmlands.

Large anomalous areas, with a maximum of 20-30 ppm in either the real or imaginary readings (or both), were measured over the lakes of Reinsvatn and Fossemvatn (map 5) and on both sides of Hatlingelva (map 6). The anomalies along Hatlingelva also seem to appear over extensive farming lands.

The farming at these particular areas seem to take place over flat, low-lying terrain, known for its marine clay. These clays are known to be saline, and are also known to have caused airborne EM anomalies elsewhere around the Trondheimsfjord. It would therefore seem quite probable that the EM anomalies here are caused by the conductive clays.

A number of EM anomalies, two in map 5 and five in map 6, are found to coincide with the railway lines of "Nordlands-banen" (the Trondheim - Bodø railway). The question so arises whether these tracks, or the possible electrical installations connected with the railway, could in certain conditions cause an EM anomaly. The majority of the flight lines, however, do not show any anomaly when they intersect the railway.

The long in-phase and out-of-phase anomaly area going from Tangen along Tiltneselva, and past Ramstadvann to the SW (map 6) seems to occur just along the boundary of the Steinkjer conglomerate and the underlying rock unit.

The only EM anomalies coinciding with geochemical anomalous areas seem to appear on map 5 (cf also map 3): one small EM anomaly with 5 ppm contours occur in geochemical anomaly no 2 by Svenningsvann, and the other EM anomaly appears in geochemical anomaly area no. 1. Both these lie within the Skratås grid, where detailed VLF, soil geochemistry and geology survey were carried out, a comparison with these will be dealt with in the report of the survey within the Skratås grid.

As to the other EM anomalies, no possible connection could be noted with known geological or other surface features on the ground.

These anomalies should be checked on the ground in the following summer. A definite priority list will not be discussed here.

The NGU report also gives a discussion on the various conductivities of the rocks causing the EM anomalies (cf. NGU report, figure nos. 1269-7 and 8). By comparing the in-phase and out-of-phase EM-readings and using the response-curves issued by Sanders Geophysics Ltd, a certain measure of the conductivity could be arrived at, the value of which is the product of two quantities sigma which is the specific conductivity, and t which is the thickness of the conducting body, assuming that this conductor appears as a relatively thin vertical sheet. A high sigma.t value (over 50) indicates a very strong conductor, sigma.t between 2 and 10 a weak conductor, and sigma.t values below 2 indicates a bad conductor. The NGU report suggest that the highest priority should be given to the anomaly characterised by sigma.t 100, situated on or near Byafjell on map 5. This anomaly should certainly be checked, but, since even the most promising deposit in the area, Skratås, gave no anomaly at all during the H-EM survey, it is felt that also anomalies with low sigma.t which are not caused by obvious surficial conditions like, f.example, saline marine deposits and electrical installations, should be given a good check.

../8

SHOWINGS IN THE STEINKJER - SNÅSAVANN AREA

During the 1974 field season, visits were made to a number of showings which were either registered in the mining archives of the NGU, or were shown to the author by mr. Jarle Raaen, Sunnan. Grab samples were made of the mineralized rock, and the essay results were received in the beginning of March 1975.

Sneves plass. (fig.9)

A small working, not very easily accessible because of a water filled hole just at the entrance. The "ore" is a massive sulfide, fine-grained pyrite, which is brecciated and the fissures filled with quartz and coarse-grained pyrite. The thickness is 50-75 cm. The surrounding rocks are greenschist/greenstone, (consisting of chlorite, epidote and probably amphibole). Foliation is folded, fold axis N250°E and plunge 25°W. The locality lies in the same formation as the Skratås deposit.

Essay of grab samples: Less than 0.05% Cu, less than 0.5% Zn, less than 0.5% Pb, less than 0.5% As, 20.3% S, 20.8% Fe.

Selid adit. (fig.9)

The mineralization is inside the adit, which was not accessible because of the high water level. The "ore" could only be studied from the dumps outside the workings. The mineralization is very much like the one at Sneves plass. The rocks at the adit entrance is a light green schist, very similar to the chloritized/sericitized grits around the Skratås mine. The locality is probably in the same rock formation as the Skratås deposit.

Essay of grab samples: Less than 0.05% Cu, less than 0.5% Zn, less than 0.5% Pb, less than 0.5% As, 19.6% S and 32.4% Fe.

Strandheim (Tangen). (fig.10)

This showing is also inside a little adit. The surrounding rock is a somewhat brecciated arkosic rock. According to Carstens' geological map, it is situated just above the "Steinkjer conglomerate" - which is regarded as the base of the Lower Hovin Group - but the conglomerate itself was not found exposed here.

Inside the adit there was a 40 cm wide rust zone, carbonate rich, with an approx E-W strike and dipping to the N. Some py was identified.

Essay of grab sample: 0.05% Cu, less than 0.5% Zn, less than 0.5% Pb, less than 0.5% As, 4.7% S.

Tvestad. (fig.11)

This locality lies in the rock unit under the Lower Hovin Group, and belongs either to the Støren group or even to the underlying Gula schist group. The showing is a very small outcrop, only a few meters large. The mineralization seems to be spread unevenly through the outcrop. The rock seems to be mainly a very dense quartzite, somewhat arkosic, but there are some variations in the rock composition:

Sample 111A: Mica schist, fine- to medium grained, with felspar porphyroblasts. Cp along the planes of schistosity.
Essay of grab sample: 0.32% Cu, less than 0.5% Zn, less than 0.5% Pb, less than 0.5% As, 1.5% S and 13.2% Fe.

Sample 111B: Light coloured, fine grained quartzose to gneissoze schist. . Very weakly cp mineralized.
Essay of grab sample: 0.05% Cu, less than 0.5% Zn, 0.5% Pb, less than 0.5% As, 1.4% S and 10.8% Fe.

Sample 111C: Dark, nearly black, dense quartzite. Finely impregnated with sulfide.
Essay of grab sample: 0.19% Cu, less than 0.5% Zn, less than 0.5% Pb, less than 0.5% As, 1.4% S and 10.8% Fe.

Indbryn.(fig.11)

The showing is fairly large outcrop at the boundary between a cultivated ground and a pine forest. The rocks in that outcrop are banded gneiss, hornblende gneiss, hornblende-bearing mica schist, probably also hornblende schist. Strike N-S, dip 30°W. The rocks are generally unmineralized, but at one place where a lot of blasting had been carried out there were several unevenly mineralized blocks showing cp and sp. It was not possible to make out how wide this mineralization was, but it could hardly be more than a meter or so.

Essay from the grab sample (rather rich): 0.39% Cu, 4.6% Zn, less than 0.5% Pb, less than 0.5% As, 7.9% S and 13.5% Fe.

HOLDEN

HJELLEBOTN

MALM

STEINKJER

STEINKJERFJORD

BEITSTADFJORD

UPPER HOVIN GROUP

limestone

sandstones, arcosic quartzites
polymict conglomerate

LOWER HOVIN GROUP

limestone

"greenschist", metasediments, metavolcanics

sandstone, micaschist, conglomerate
steinkjer conglomerate

STOREN GROUP (?)

greenschist

limestone

amphibolite

micaschist lime-silicate gneiss

INTRUSIVES

gabbro diorite

granddioritic gneisses

granitic gneiss

Regional exploration

STEINKJER SNÅSAVANN 1974

GEOLOGICAL MAP

after H.Carstens, 1956-57, copied from unpublished material in NGU files

⅛ SULFIDMALM

SCALE 1:100 000	OBS.		
	DRAW.		
	TRAC. BL	7-75	
	CHK.		

MAP NO. 1

MAP SHEET

A.s Terrkopi. 2000. A 2. E 9 gl. 10-71. Sentrum Tr...

UPPER HOVIN GROUP

- limestone
- sandstones, arcosic quartzites polymict conglomerate

LOWER HOVIN GROUP

- limestone
- "greenschist", metasediments, metavolcanics
- sandstone, micaschist, conglomerate steinkjer conglomerate

STOREN GROUP (?)

- greenschist
- limestone
- amphibolite
- micaschist lime-silicate gneiss

INTRUSIVES

- gabbro diorite
- granddioritic gneisses
- granitic gneiss

Regional exploration

STEINKJER SNÅSAVANN 1974

GEOLOGICAL MAP

after H. Carstens 1956-57, copied from unpublished material in NGU files

⅛ SULFIDMALM

SCALE	OBS.	
1:100 000	DRAW.	
	TRAC BL	7-75
	CHK.	

MAP NO. 2

MAP SHEET

A.s Terrkopi. 2000. A 2. E 9 gl. 10-71. Sentrum Trykkeri.

VAS-
AUNE

RUNGSTADVn

STEINKJERFJORDEN

REINSVATNET

FOSSEMVATNET

1

2

3

4

5

KEY:

	Possibly anomal.	Probably anomal.	Anomaly
Ni		20-30	> 30
Cu		20-30	> 30
Zn	60-100	100-400	> 400
Pb	10-15	15-30	> 30

N

0 1 km 2

STREAM SEDIMENT GEOCHEM.

STEINKJER SNÅSAVn SOUTH

SCALE | OBS. | DRAW. | TRAC. BL 7-75 | CHK.

½ SULFIDMALM

MAP NO. 3

MAP SHEET

A.s Terrkopi. 3010. A 1. E 9 gl. 10-71. Sentrum Trykkeri.

SNÅSAVANN

DYNVANN

HATLINGELVA

RAMSTADVANN

TILTNESELVA

TOSK TJERN

KVERNVATN

RAUSJOEN

HENING

6

7

8

N

KEY:

	Possibly anomal.	Probably anomal.	Anomaly
Ni		20-30	> 30
Cu		20-30	> 30
Zn	60-100	100-400	> 400
Pb	10-15	15-30	> 30

0 1km 2

STREAM SEDIMENT GEOCHEM.
STEINKJER SNÅSAV NORTH

Sulfidmalm

4

Steinkjerfjorden

Ogna

Reinsvatnet

Fossemvatnet

BYAFJELL

SKRATÅS MINE

NORD

contour — real (in-phase) component

contour — imaginary (out-of-phase) component

Flylinje med plottet punkt

0 1km 2

REGIONAL EXPLORATION, STEINKJER AREA, 1974

NGU H-EM RESULTS

REAL AND IMAGINARY COMPONENTS

A/S SULFIDMALM

MÅLESTOKK 1:15000

OBS NGU 5-6-74

TRAC THT 2-25

CHA THT 2-25

MAP NO -5-

KEY:

-----(10)---- IMAGINARY (OUT OF PHASE) ANOMALIES in ppm

——10—— REAL (IN PHASE) ANOMALIES IN PPM

——•—— Flylinje med plottet punkt

0 1km 2

REGIONAL EXPLORATION, STEINKJER AREA, 1975	SCALE	OBS. NGU	S-JH
NGU H-EM RESULTS	1:15000	TEKC. TNT	02-75
REAL AND IMAGINARY COMPONENTS		CHK. TNT	04-75
A/S SULFIDMALM	MAP NO	-6	

E6

Rangsjøvann

E6

Snåsa vann
(22 m. a.s.l.)

Stamvann

EMRATÅS MINE

BYAFJELL
(282 m a.s.l.)

STEINKJER N
built-up area

763

"Nordlandsbanen" (Trondheim-Bodø Railway)

Steinkjerfjorden

BYAFOSSEN
built up area

Fossemvatnet
(18 m a.s.l.)

STEINKJER S
built up area

VIKO
built up area

763

Reinsvatnet
(17 m a.s.l.)

763

Ogna

NORD

Sørhen vann
(38 m a.s.l.)

763

1 FARMLANDS, PROBABLY MOST OFTEN ON MARINE CLAY DEPOSITS

2 SWAMPS

FORESTS, AND OTHER GROUNDS NOT SUITED FOR FARMING

Flylinje med plottet punkt

0 1km 2

REGIONAL EXPLORATION, STEINKJER AREA 1974

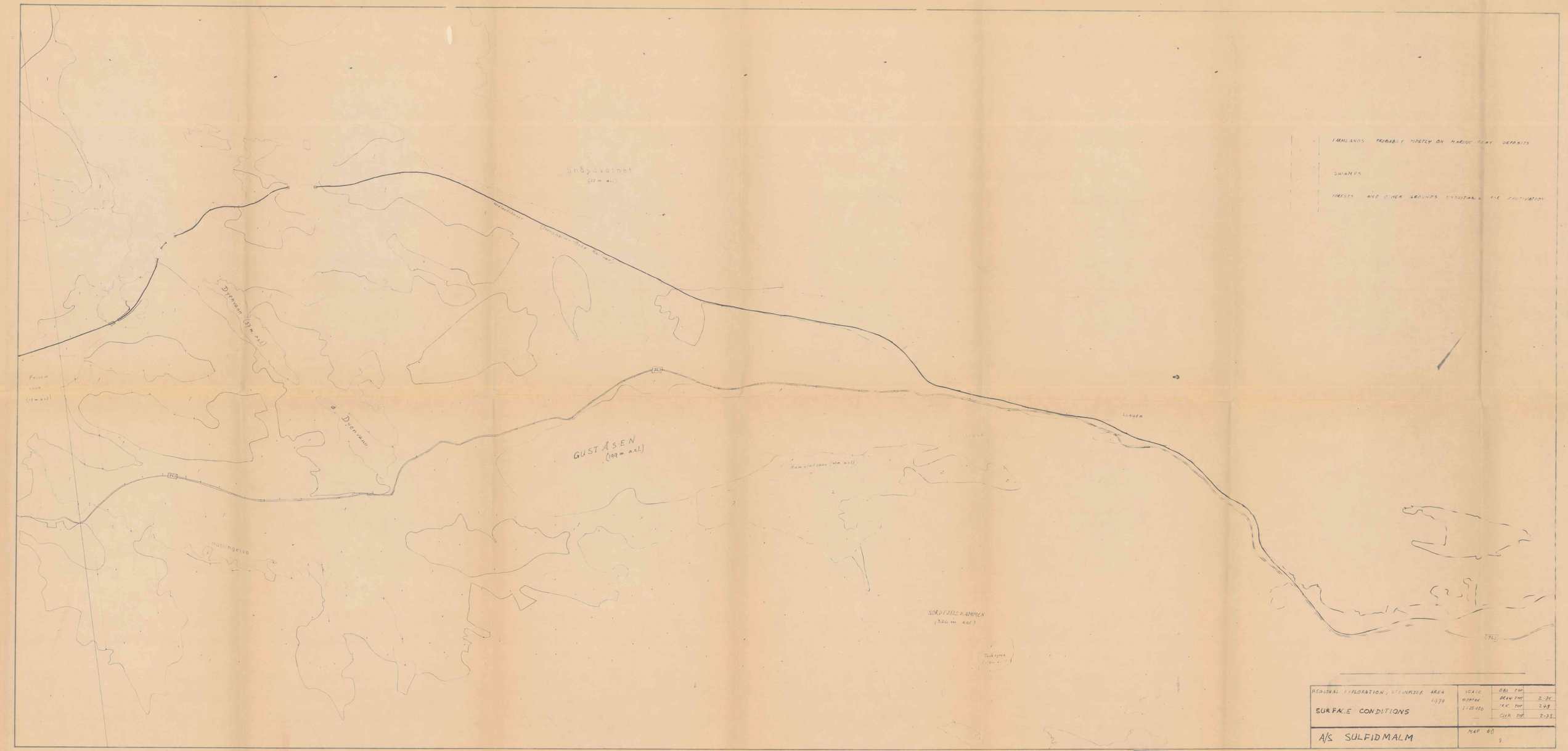
SURFACE CONDITIONS

A/S SULFIDMALM

SCALE approx 1:15000

OBS THT 7-4
DRAWN THT 2-75
CHK THT 2-75

MAP NO. 7



REGIONAL EXPLORATION, STEINKJER AREA 1979	SCALE	OBS TVP	
	OFFSET	DRW TVP	2-26
SURFACE CONDITIONS	1:15.000	TEK TVP	2-25
		CLR TVP	2-25
A/S SULFIDMALM	MAP NO	3	

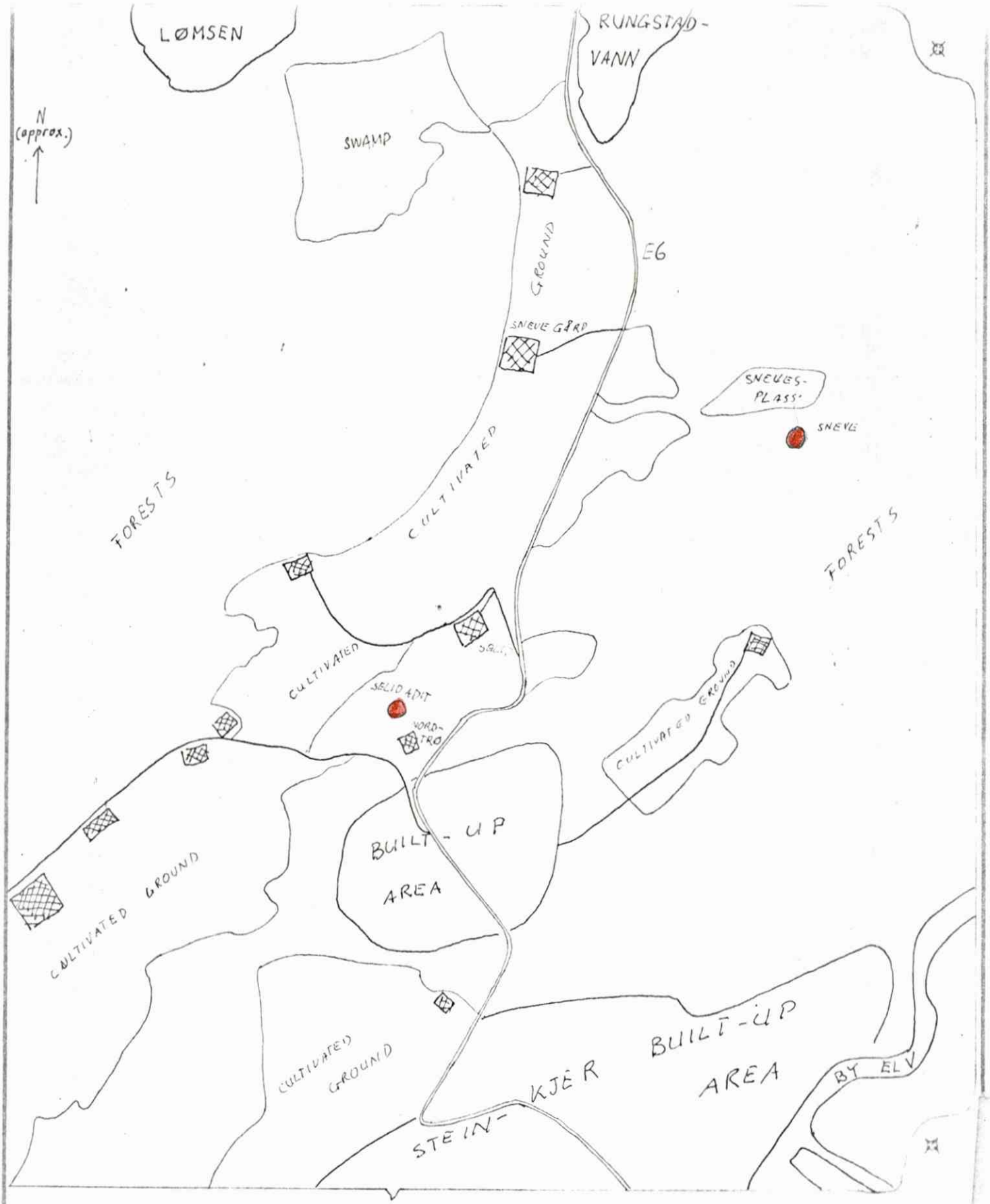
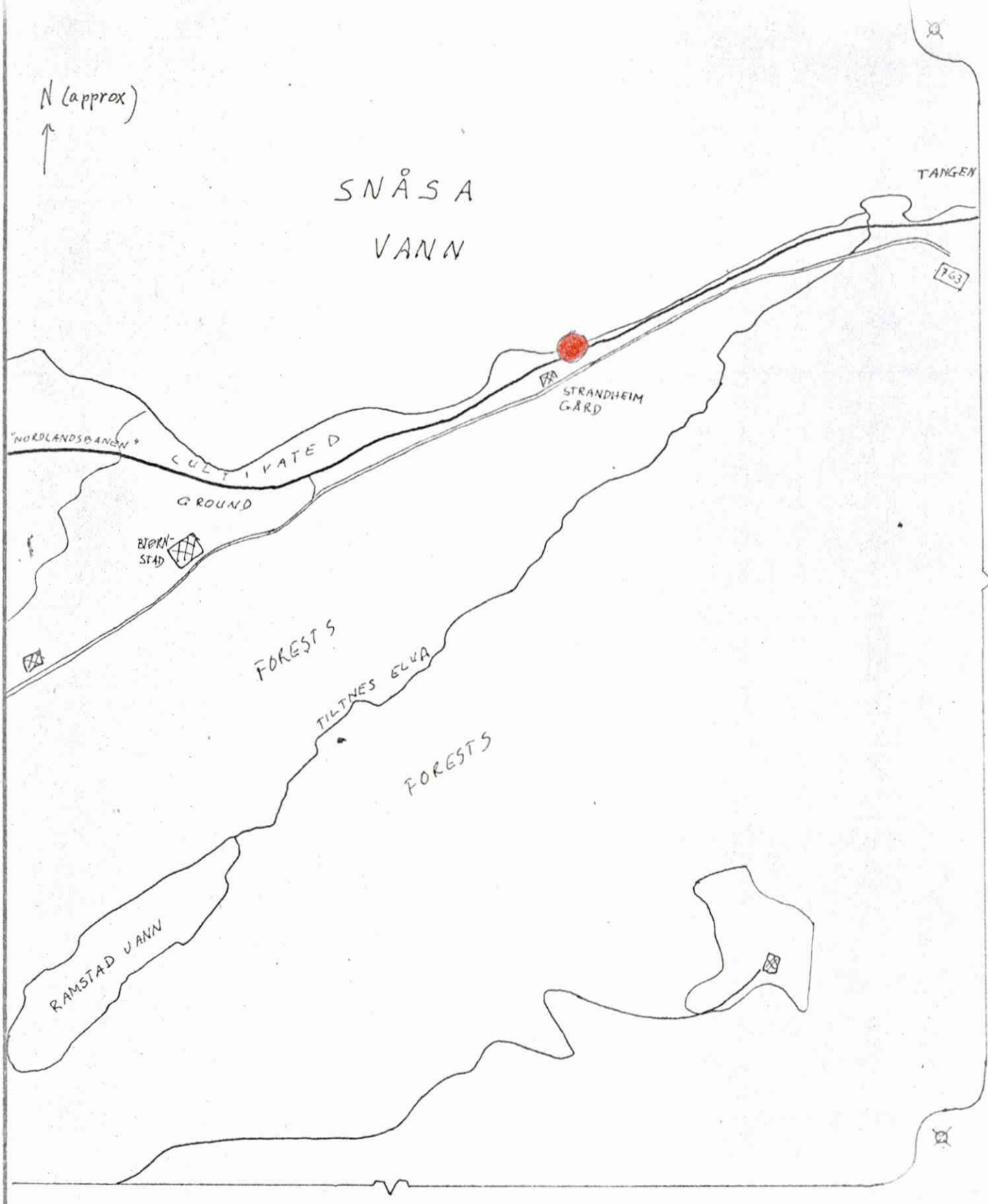


Fig. no. 9

A/S SULFIDMALM	
REGIONAL EXPLORATION, STEINKJER AREA 1974 SITUATION MAP, SELID and SNEVE SHOWINGS	
SCALE 1:15.000 approx.	DRAWN THT
DATE A-3-75	TRACED THT

MAP BASE: AIR PHOTO no. B12



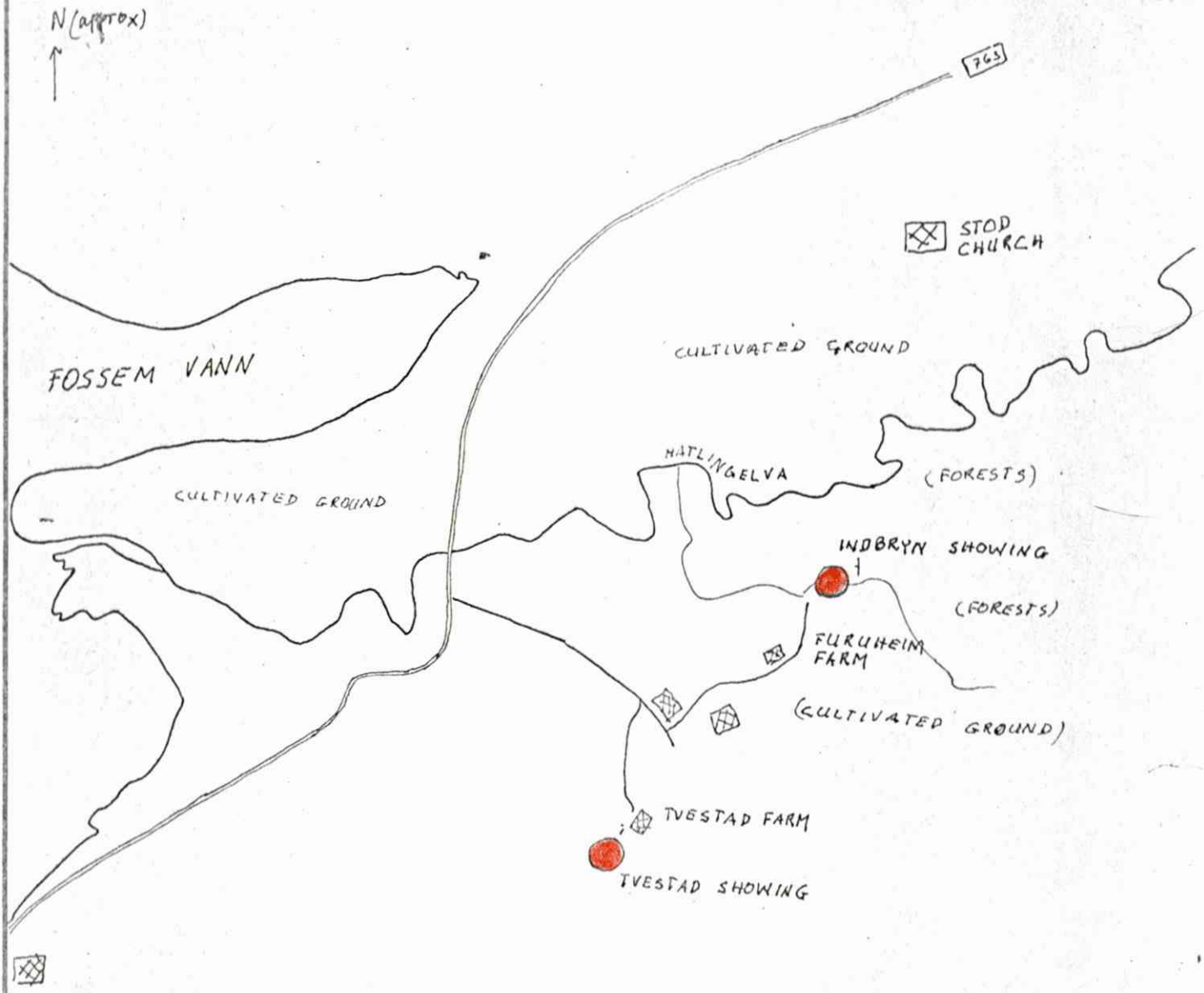
FARMHOUSE

SHOWING

MAP BASE,
AIR PHOTO G27
NORFLY OPPDR. 1218

Fig. no. 10.

A/S SULFIDMALM	
REGIONAL EXPLORATION, STEINKJER AREA, 1974	
SITUATION MAP	
STRANDHEIM. SHOWING	
SCALE 1:15.000 approx	DRAWN TH.T
DATE 15.3.1974	TRACED TH.T



FARMHOUSE

SHOWING

MAP BASE: AIR PHOTO D 18, NORFLY OPPDR. 1218

Fig. no. 11

A/S SULFIDMALM	
REGIONAL EXPLORATION, STEINKJER AREA 1975	
SITUATION MAP TVESTAD AND INDBRYN SHOWING	
SCALE 1:15000 approx.	DRAWN THT
DATE 15.8.1975	TRACED THT