

NGU Report 2001.049

Regional landslide occurrences and possible  
post-glacial earthquake activity in northwest  
Western Norway: Phase A2;  
Penetration echosounding in 5 lakes in  
Sunnmøre and Nordfjord

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Summary:  Five lakes in Ørsta, Volda, and Nordfjordeid communes are mapped using a Knudsen 320 M/P 12 Khz echo-sounder. From the echo-sounding profiles there are made bathymetric maps for the lakes.  The acoustic profiles are interpreted at NGU with regard to disturbances of the lake-sediments - like slides or tectonic shaking. Slides are registered in all lakes. In four of the lakes these slides may have been generated from steep slopes surrounding the lakes, while in the fifth – Storesetervatnet in Nordfjordeid – the disturbances seen, have happened entirely within the lake sediments themselves. Based on the interpretation, we suggest a coring program covering all five lakes to verify the genesis of these disturbances and to date them. Adjustments to the program must be expected during coring when seismic data and cores can be related.		

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## 1. INTRODUCTION

NGU together with Norsk Hydro ASA, the University of Bergen and the Sogn and Fjordane College has set up a project with the following aims;

- Regional compilation of occurrences of slides, avalanches and gravitational faults that may have resulted from earthquakes in northwestern Norway
- Date single events and periods of instability in fjord- and lake sediments

Questions in focus will be:

- Can the Storegga event be recognized in fjord- and lake sediments?
- If so, are there traces in the sediments of similar, younger regional events?
- Are the traces seen in the sediments due to tsunamis, earthquakes or both?
- Do data indicate large earthquakes to be more frequent shortly after the regional deglaciation than recently?

The work will be done by identification and coring of regional seismic reflectors in fjords, near-coastal waters and lakes from Sogn&Fjordane and Møre&Romsdal (Longva et. al 2001). Slide deposits in the cores will be dated. In addition, avalanches and collaps-structures onshore will be tried fitted into the same chronologic framework. The project is done during phases A-E (table) that are reported individually and compiled in a final report.

Phase	Task
A1	Compile a regional seismo-stratigraphy based on interpretation of high-resolution seismic records collected by NGU and Norsk Hydro in near-coastal waters and fjords
A2	Collect and interpret penetration echo-sounding registrations in lakes in the actual area
B1	Sample sea-bottom sediments in near-coastal areas and fjords and collect complementary seismic registrations
B2	Core lake(A2)-sediments
C	Lab.analyses; multi-logger, XRI, sedimentology and dating
D	Compilation of data on rock-avalanches and gravitational faults onshore
E	Final reporting

In this report we present interpreted penetration echo sounding profiles, waterdepth maps and suggest coring localities (Phase A2) from five lakes. The hypothesis behind the study is that if large earthquakes have triggered slides in the fjords, they may also have triggered slumping or sliding in lakes in the area. In one of the lakes, Storesætervatnet in Nordfjordeid, it has previously been documented a repetition of the Vedde ash bed – a 10500 year old layer of tephra – which indicates disturbances of the lake sediments (Mangerud et. al 1984). The aim of this study is thus to find and date possible disturbances in lake sediment and correlate events between lakes and fjords.

## **2. FIELD MEASUREMENTS/FIELD WORK**

### **2.1 Penetration echosounding**

Penetration echo-sounding profiles were run in five lakes in Ørsta, Volda and Nordfjordeid communes. The profiling was done by GeoCore A/S with a Knudsen 320 M/P 12 KHz echosounder (Bjerkli 2001, See APPENDIX). Data were registered in analogue and digital format (as \*.keb-file i binary format).

The following information was stored in analogue and digital format:

- Fix-no. (about 10 sec. interval on analogue) records
- Date
- Time (local time)
- Water depth (12 KHz transducer)
- Sound Velocity, 1430 m/s (provided by NVE)
- Position, lat/long (degree/decimal/minute)

### **2.2 Positioning**

Positioning was carried out with a GPS receiver type MLR-DGPS-FX412. The Svinøy 293.5 KHz was used as differential reference station. The GPS-antenna was placed at the echosounder transducer, and the positions were logged in WGS 84. The DGPS-coverage was satisfying at Rotevatnet, Hovdevatnet, Storesetervatnet and Medvatnet. In Nedstevatnet, the DGPS-coverage was satisfying for lines in NS-direction, but bad for lines in EW-direction due to low azimuth satellites and signal shading by high mountains.

## **3. BATHYMETRIC MAPS AND INTERPRETATION OF PENETRATION ECHOSOUNDER PROFILES**

From the depth measurements, NGU has made contour maps (Maps 1-4). Since a low frequency echo-sounder was used during the profiling, the first reflector is not always the top of the mud. Thus, the maps are not very precise, especially in the lakes where the lake-bottom reflector is weak.

The seismic profiles have been interpreted at NGU with emphasis on disturbances of the sediments, which may have been caused by slides or tectonic movements. Slides are observed in all lakes. In four of the lakes these slides may have been generated from steep slopes surrounding the lakes, while in the fifth – Storesetervatnet in Nordfjordeid – the area around the lake is flat and the disturbances seen must have happened entirely within the lake sediments themselves. Based on the interpretation, we suggest a coring program covering all five lakes to verify the genesis of these disturbances and to date them.

### **3.1 Rotevatnet**

Rotevatnet (47 meter above sea level) has quite steep slopes to the south-southwest, while rather flat terrain surround the rest of the lake (Map 1). Fig. 1 shows a seismic profile across the lake. The upper 3-4 meters of the sediment sequence shows distinct reflectors draping the underlying sediments or bedrock. Hyperbolic reflections (probably due to blocks from slides on the steep slopes) are found at several levels in the sediment sequence. Disturbances in the sediments are found in the south-southwestern end of the lake, but generally there is little disturbance in the stratified sediments in this lake.

### **3.2 Hovdevatnet**

Hovdevatnet is situated 73 meter above sea level (Map 2). The lake-bottom reflector over most of this lake is quite weak (Figs. 2, 3, 4, 5), and the sediments belonging to the upper sequence are acoustically very transparent. A strong, acoustically dark reflector separate an upper and lower sequences in this lake. The lower sequence may be quite transparent with internal reflectors or it may be acoustically dark with limited penetration. On top of this lower sequence, in the western part of the lake, we find frequent "hyperbolic" features interpreted to reflect blocks. Map 2 shows a map with profile lines and bathymetry from the lake.

### **3.3 Storesætervatnet**

Storesætervatnet is a small lake situated 277 meter above sea level (Map 3). Over most of the lake, the bottom reflector is weak (Figs. 6 – 11) and the upper 1-1.5 meters of sediments have an acoustically very transparent character (i.e. Figs. 6, 9), while in other areas the upper sequence is thicker and shows internal reflectors (Fig. 7). A strong reflector separates the two uppermost sequences (i.e. Figs. 8, 9). In Fig. 9 the profile shows penetration down to an acoustically dark and dense layer with a quite hummocky surface. This hummocky surface may reflect disturbed sediments. Fig. 6 shows an acoustically rather transparent sequence wedging out and getting disturbed towards the south. "Blacking" of the penetration echo-sounding records, as shown in Fig. 11, most probably is due to gas in the sediments.

### **3.4 Nedstevatnet and Medvatnet**

Nedstevatnet (9 m a.s.l.) and Medvatnet (12,5 m a.s.l.) are linked trough a narrow "channel" (Map 4). The two lakes together are called Kilsvatna (The Kil-lakes) and are situated between Bjørkedalsvatnet (25 m a.s.l.) and Kilspollen, at sea level. Map 4 shows profile lines and bathymetry from the two lakes.

#### Nedstevatnet.

This is the northern part of Kilsvatna. The lake is surrounded by steep hillsides to the east and partly to the west. Over most of the lake, the bottom reflector is quite distinct, but in places (as also seen at loc. no. M1 in Fig. 12) it may be weaker. In the upper 2 meters of the sediment sequence there are several reflectors, some of them with clear signs of disturbances (Fig. 12). Under this sequence, an acoustically transparent lower sequence follows. An up to 1 meter thick sediment sequence shaped as a wedge, is found in the southern part of the lake. This sequence may represent slide material. The reflector underlying this relatively thin sequence is over most of the lake acoustically quite dark and even. There is little penetration below this reflector.

### Medvatnet.

This lake makes up the southern part of Kilsvatna. The hillside at the western end of the lake is quite steep, but rather flat at the southern and eastern side. The lake-bottom reflector is quite distinct and strong over most of this lake (Figs 13, 14). A profile from the deepest, northern part of the lake shows a c. 3 meters thick sequence with 2-3 reflectors overlying an acoustically dark sequence with limited penetration (Fig. 13). This acoustically dark layer seems to be disturbed, e.g. at loc. no. M2, Fig. 13. There are no clear indications of disturbed sediments in the overlaying sequence in this area. Fig. 14, which is a profile from the south-eastern part of Medvatnet, shows disturbed sediments in the upper sediment sequence. The disturbed sediments seem to wedge out towards the southwestern end of the profile.

## 4. CORING LOCATIONS

Table 1 shows the suggested coring locations in the lakes. The locations are chosen with the aim to uncover the general stratigraphy and the age of the sediments, the age of slide- or sediment-disturbances and to locate and date tsunami-sediments in the cores, if present. One location is chosen in Rotevatnet (Fig. 1), four locations in Hovdevatnet (Figs. 2-5), seven locations in Storesætervatnet (Figs. 6-11), one location in Nedstevatnet (Fig. 12) and two locations in Medvatnet (Figs. 13-14). There is little experience with acoustic profiling in lakes and interpretation of lake sediments from acoustic profiles. Adjustments will thus probably be necessary during the coring program.

Loc. no.	Longitude	Latitude	Location
R1	6° 06.4190'	62° 08.5244'	Rotevatnet
H1	6° 03.2487'	62° 11.0390'	Hovdevatnet
H2	6° 03.1908'	62° 11.3807'	Hovdevatnet
H3	6° 02.6682'	62° 11.1813'	Hovdevatnet
H4	6° 02.5207'	62° 11.3291'	Hovdevatnet
S1	6° 08.3268'	61° 56.7473'	Storesætervatnet
S2	6° 08.3007'	61° 56.7635'	Storesætervatnet
S3	6° 08.2806'	61° 56.7769'	Storesætervatnet
S4	6° 08.2036'	61° 56.7869'	Storesætervatnet
S5	6° 08.5251'	61° 56.6126'	Storesætervatnet
S6	6° 08.3160'	61° 56.4800'	Storesætervatnet
S7	6° 08.5320'	61° 56.6058'	Storesætervatnet
N1	6° 02.8215'	62° 02.2226'	Nedstevatnet/(Kilsvatnet-N)
M1	6° 02.8210'	62° 01.8951'	Medvatnet/(Kilsvatnet-S)
M2	6° 02.8431'	62° 01.9324'	Medvatnet/(Kilsvatnet-S)
M3	6° 02.5915'	62° 01.7113'	Medvatnet/(Kilsvatnet-S)

Table 1

## 5. CONCLUSIONS

Five lakes in Ørsta, Volda, and Nordfjordeid communes have been mapped using a Knudsen 320 M/P 12 KHz penetration echo-sounder. From the echo-sounding profiles bathymetric maps of the lakes have been made.

The acoustic profiles were interpreted at NGU. Slides are observed in all lakes. In four of the lakes, these slides may have been generated from steep slopes surrounding the lakes, while in the fifth – Storesetervatnet in Nordfjordeid – the terrain around the lake is flat and the disturbances seen, must have happened entirely within the lake sediments themselves. Based on the interpretation, we suggest a coring program covering all five lakes to verify the genesis of these disturbances and to date them. So far there is little experience with acoustic profiling of lake sediments. Therefore, adjustments to the program must be expected during coring when the seismic data and the cores can be related.

## 6. REFERENCES

Bjerkli, K. 2001: Akustisk profilering (penetrasjonsekkolodd) i 5 ferskvann, Sunnmøre/Nordfjord. *GeoCore rapport*, oppdr.nr. 034-01-B, 11 s.

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Mangerud, J., Lie, S. E., Furnes, H., Kristiansen, I. L. and Lømo, L. 1984: A Younger Dryas ash bed in western Norway, and its *possible correlations with tephra in cores from the Norwegian Sea and the North Atlantic*. *Quaternary Research* 21; 1, Pages 85-104.

ROTEVATNET

4n

Loc. no. R1

## Lake bottom

1

卷之三

Fig. 1

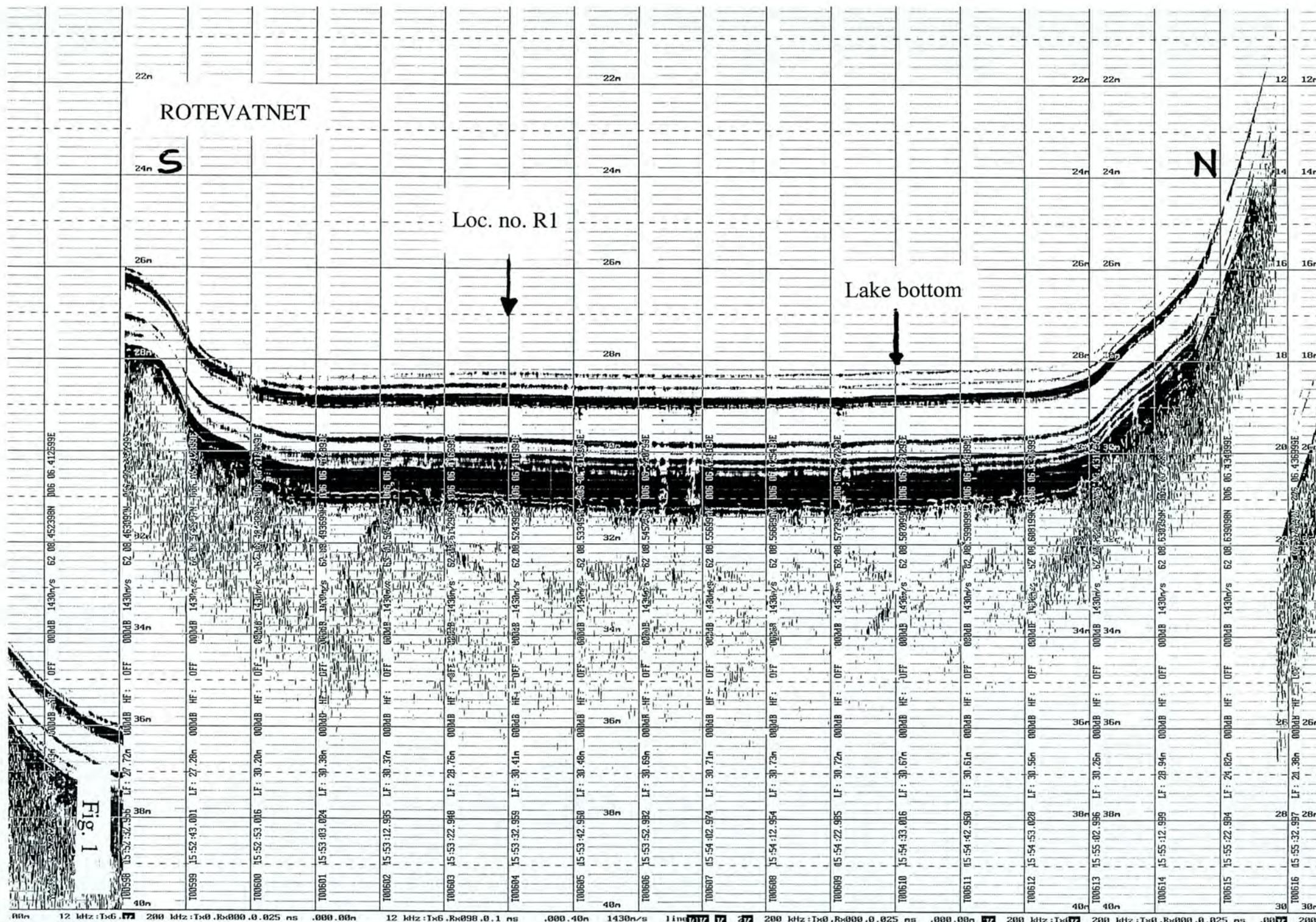
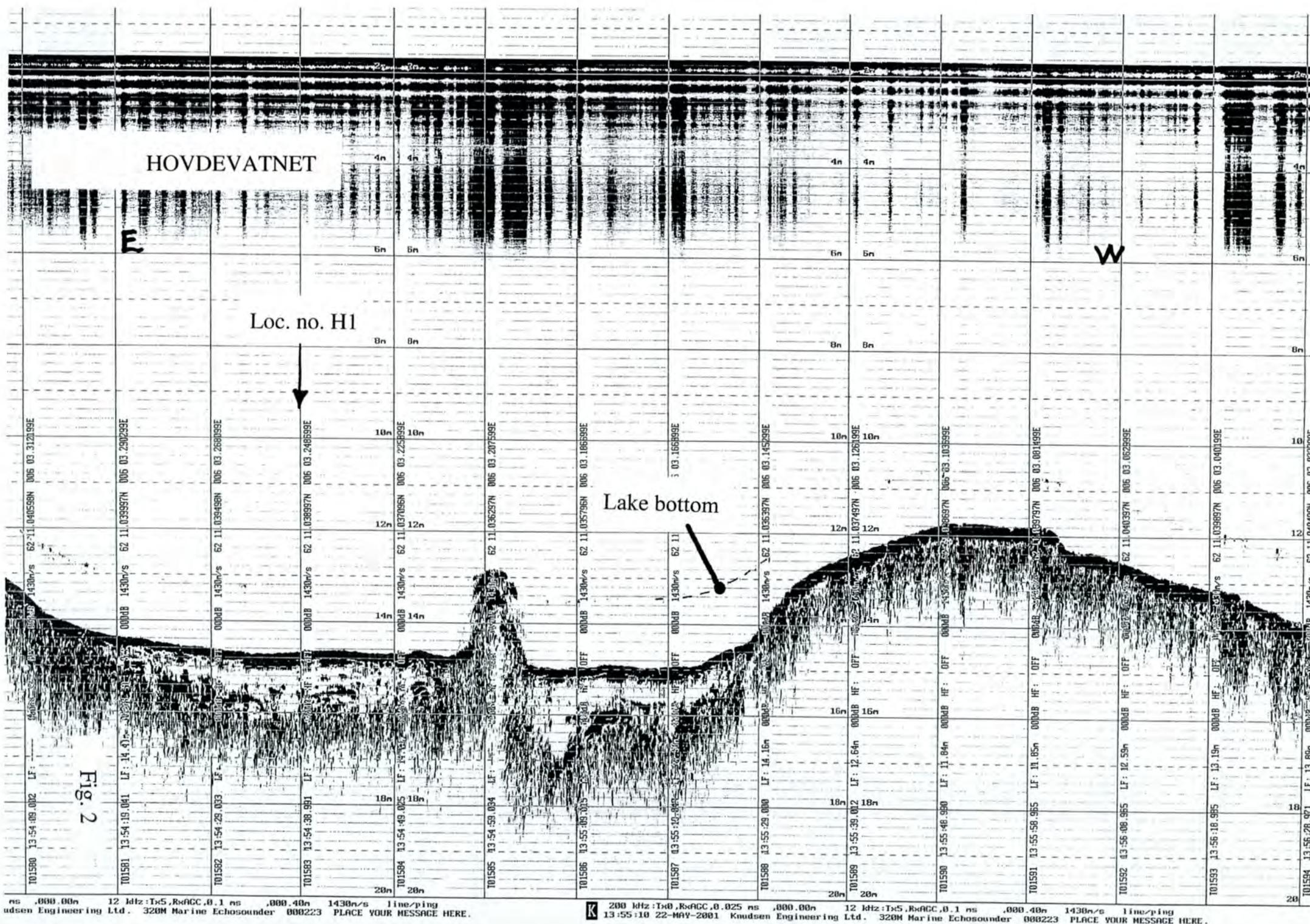


Fig. 2

## HOVDEVATNET

Loc. no. H1

Lake bottom



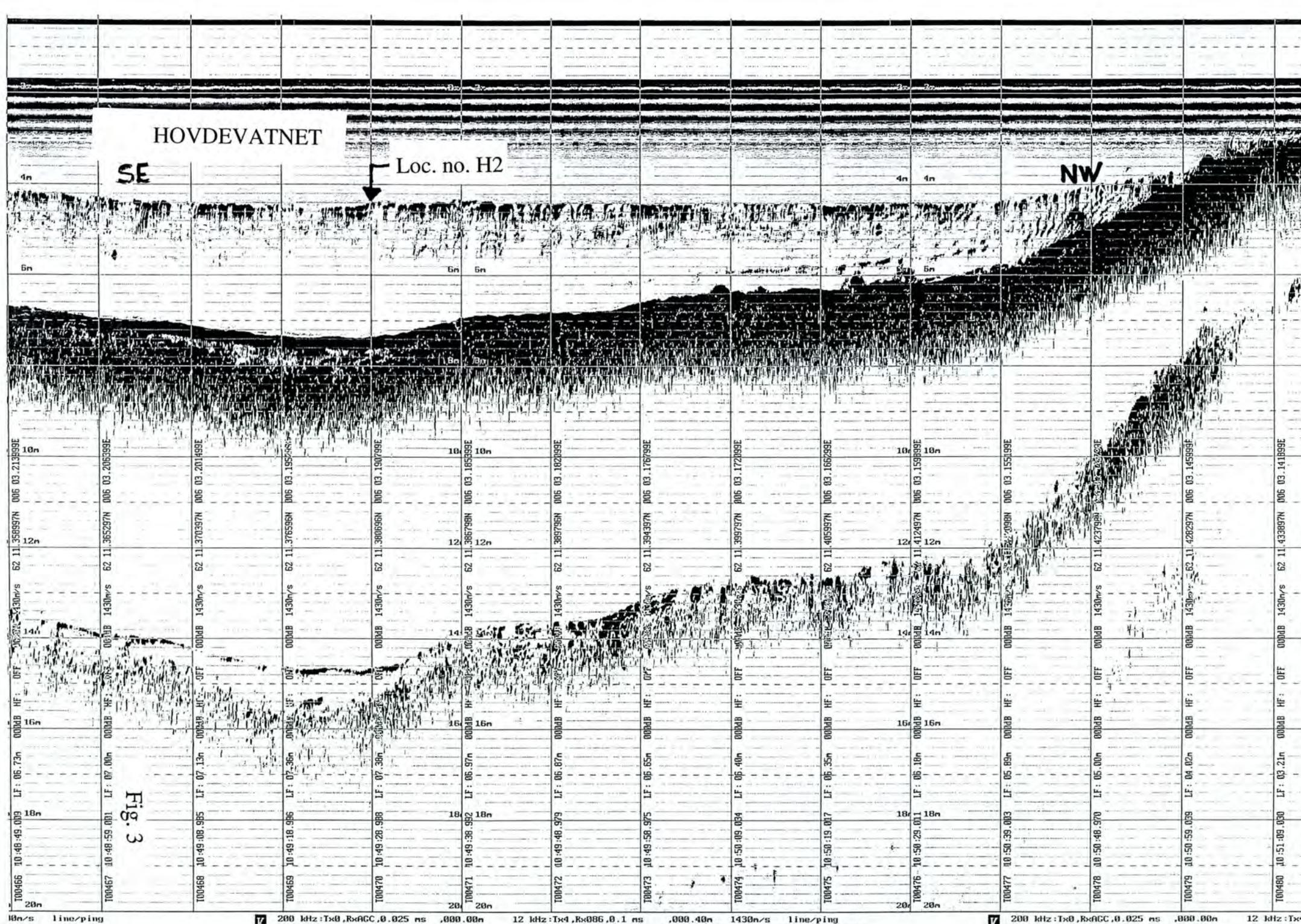
# HOVDEVATNET

SE

Loc. no. H2

NW

Fig. 3



T00954 12:08:59.000 LF: 12.05 460 HF: OFF 000dB 1430ns/s 62 11.171797N 006 02.672298E

Fig. 4

T00955 12:10:55.025 LF: 12.05 HF: OFF 000dB 1430ns/s 62 11.181297N 006 02.668998E

T00956 12:10:18.968 LF: 12.05 HF: OFF 000dB 1430ns/s 62 11.188597N 006 02.665198E

T00957 12:10:29.014 LF: 12.05 HF: OFF 000dB 1430ns/s 62 11.197957N 006 02.660798E

T00958 12:10:39.040 LF: 14.98n HF: OFF 000dB 1430ns/s 62 11.205298N 006 02.655998E

T00959 02:10:49.033 LF: 14.71n HF: OFF 000dB 1430ns/s 62 11.213867N 006 02.651098E

T00960 02:10:59.037 LF: 14.48n HF: OFF 000dB 1430ns/s 62 11.220737N 006 02.647698E

T00961 02:11:08.952 LF: 14.06n HF: OFF 000dB 1430ns/s 62 11.230737N 006 02.644698E

T00962 02:11:18.950 LF: 13.73n HF: OFF 000dB 1430ns/s 62 11.236958N 006 02.640698E

T00963 02:11:28.970 LF: 12.61n HF: OFF 000dB 1430ns/s 62 11.245958N 006 02.627698E

T00964 02:11:39.016 LF: ----- 000dB HF: OFF 000dB 1430ns/s 62 11.254857N 006 02.622298E

T00965 02:11:48.984 LF: ----- 000dB HF: OFF 000dB 1430ns/s 62 11.262297N 006 02.622798E

T00966 02:11:59.031 LF: 12.10n HF: OFF 000dB 1430ns/s 62 11.271396N 006 02.623798E

T00967 02:12:09.037 LF: 11.20n HF: OFF 000dB 1430ns/s 62 11.279988N 006 02.623798E

T00968 02:12:20.043 LF: 11.10n HF: OFF 000dB 1430ns/s 62 11.287988N 006 02.623798E

T00969 02:12:30.047 LF: 11.00n HF: OFF 000dB 1430ns/s 62 11.295988N 006 02.623798E

T00970 02:12:40.051 LF: 10.90n HF: OFF 000dB 1430ns/s 62 11.303988N 006 02.623798E

T00971 02:12:50.055 LF: 10.80n HF: OFF 000dB 1430ns/s 62 11.311988N 006 02.623798E

T00972 02:13:00.059 LF: 10.70n HF: OFF 000dB 1430ns/s 62 11.319988N 006 02.623798E

T00973 02:13:10.063 LF: 10.60n HF: OFF 000dB 1430ns/s 62 11.327988N 006 02.623798E

T00974 02:13:20.067 LF: 10.50n HF: OFF 000dB 1430ns/s 62 11.335988N 006 02.623798E

T00975 02:13:30.071 LF: 10.40n HF: OFF 000dB 1430ns/s 62 11.343988N 006 02.623798E

T00976 02:13:40.075 LF: 10.30n HF: OFF 000dB 1430ns/s 62 11.351988N 006 02.623798E

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T00978 02:14:00.083 LF: 10.10n HF: OFF 000dB 1430ns/s 62 11.367988N 006 02.623798E

T00979 02:14:10.087 LF: 10.00n HF: OFF 000dB 1430ns/s 62 11.375988N 006 02.623798E

T00980 02:14:20.091 LF: 9.90n HF: OFF 000dB 1430ns/s 62 11.383988N 006 02.623798E

T00981 02:14:30.095 LF: 9.80n HF: OFF 000dB 1430ns/s 62 11.391988N 006 02.623798E

T00982 02:14:40.099 LF: 9.70n HF: OFF 000dB 1430ns/s 62 11.399988N 006 02.623798E

T00983 02:14:50.103 LF: 9.60n HF: OFF 000dB 1430ns/s 62 11.407988N 006 02.623798E

T00984 02:15:00.107 LF: 9.50n HF: OFF 000dB 1430ns/s 62 11.415988N 006 02.623798E

## HOVDEVATNET

S

N

Loc. no. H3

Lake bottom

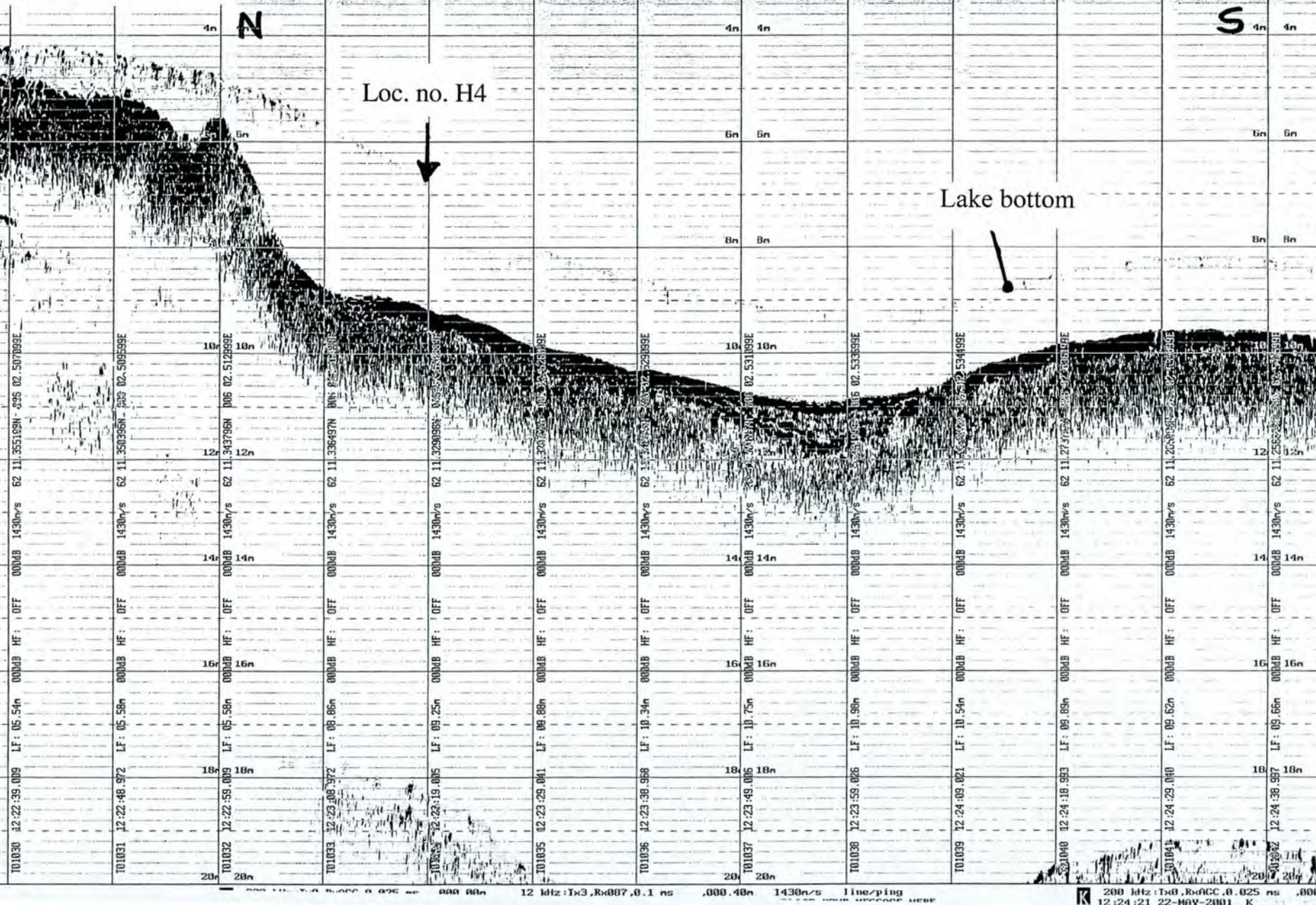
Hyperbolic reflections

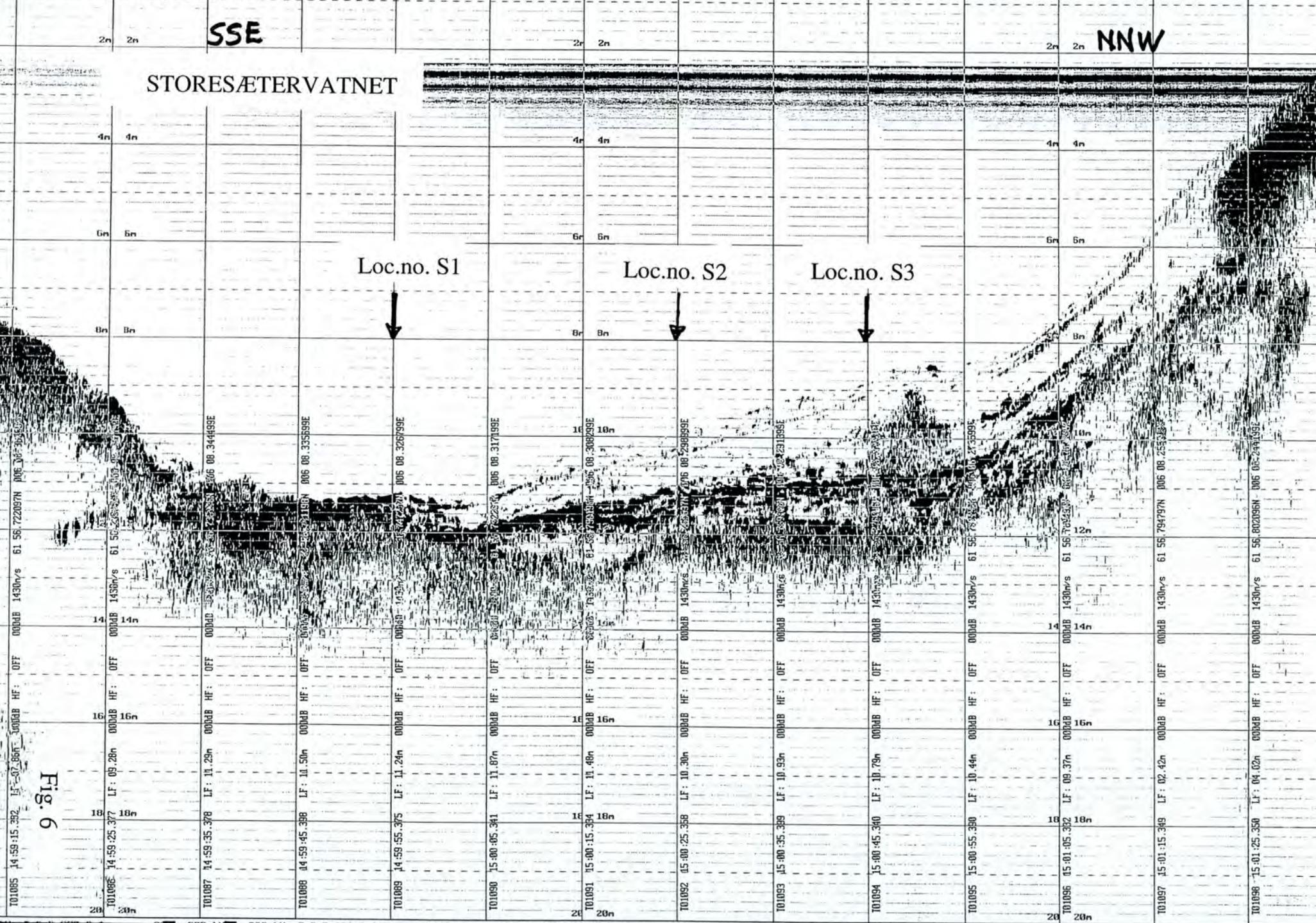
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Fig. 5

101030 12:22:39.009 LF: 05.54n 000dB HF: OFF 000dB 1430m/s 62 11.355198n -335 02.50799E

## HOVDEVATNET





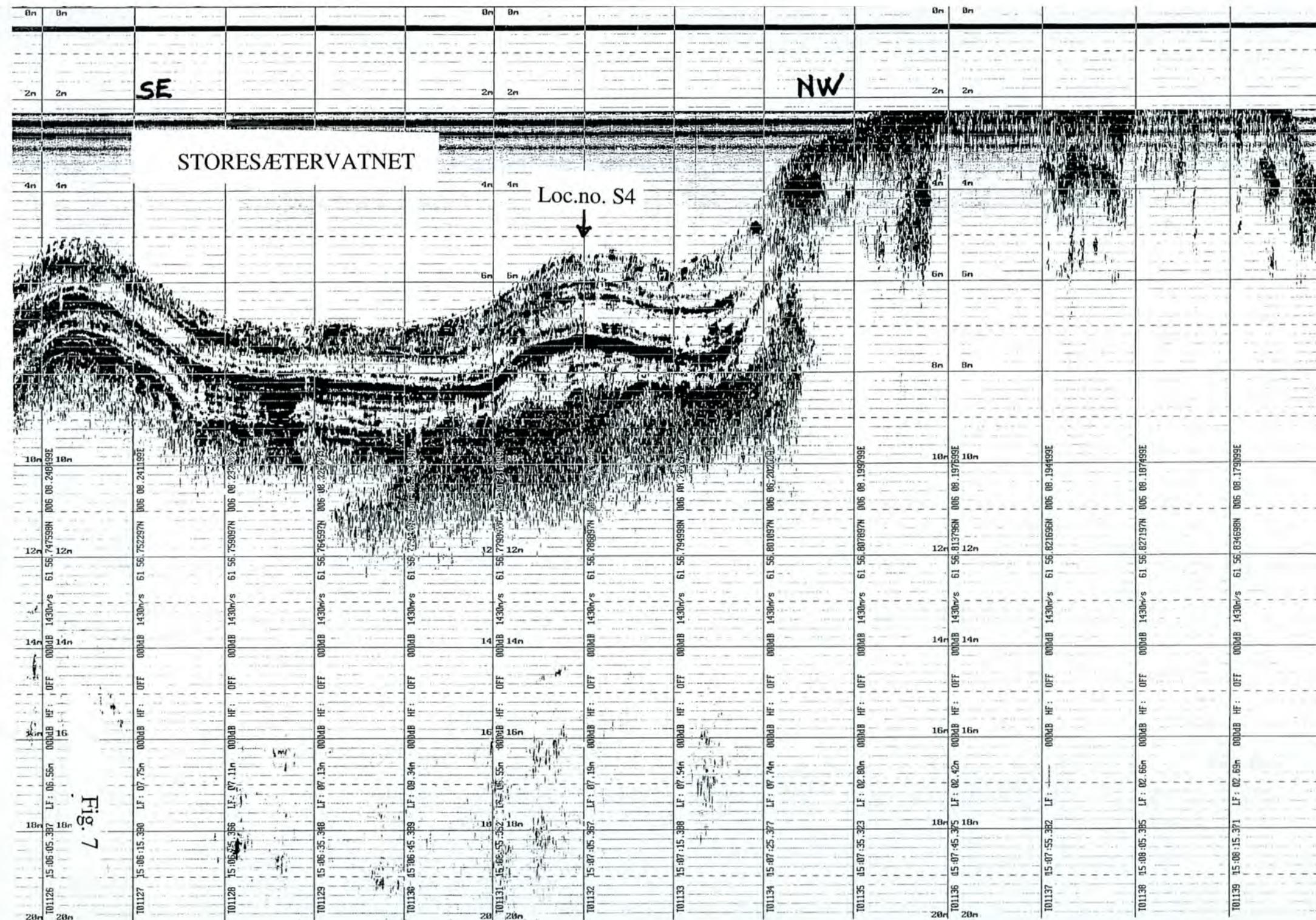


Fig. 8

## STORESÆTERVATNET

W

E

Loc. no. S5

T00799 14:11:35.325 LF : 06.58n 000dB HF : OFF 000dB 1430n/s 61 56.617897N 006 08.453798E

T00800 14:11:45.329 LF : 06.46n 000dB HF : OFF 000dB 1430n/s 61 56.618097N 006 08.453798E

T00801 14:11:55.333 LF : 06.34n 000dB HF : OFF 000dB 1430n/s 61 56.618298N 006 08.453798E

T00802 14:12:05.376 LF : 06.08n 000dB HF : OFF 000dB 1430n/s 61 56.614998N 006 08.520298E

T00803 14:12:15.407 LF : 06.42n 000dB HF : OFF 000dB 1430n/s 61 56.613987N 006 08.520298E

T00804 14:12:25.353 LF : 07.74n 000dB HF : OFF 000dB 1430n/s 61 56.613598N 006 08.514998E

T00805 14:12:35.351 LF : 07.05n 000dB HF : OFF 000dB 1430n/s 61 56.612597N 006 08.520298E

T00806 14:12:35.352 LF : 07.35n 000dB HF : OFF 000dB 1430n/s 61 56.612597N 006 08.520298E

T00807 14:12:35.356 LF : 07.74n 000dB HF : OFF 000dB 1430n/s 61 56.612597N 006 08.520298E

T00808 14:12:35.357 LF : 07.05n 000dB HF : OFF 000dB 1430n/s 61 56.612597N 006 08.520298E

T00809 14:12:35.358 LF : 07.35n 000dB HF : OFF 000dB 1430n/s 61 56.612597N 006 08.520298E

T00810 14:13:25.305 LF : 02.82n 000dB HF : OFF 000dB 1430n/s 61 56.611397N 006 08.573998E

T00811 14:13:35.394 LF : 02.49n 000dB HF : OFF 000dB 1430n/s 61 56.618497N 006 08.573998E

T00812 14:13:45.395 LF : 03.43n 000dB HF : OFF 000dB 1430n/s 61 56.623497N 006 08.573998E

Fig. 9

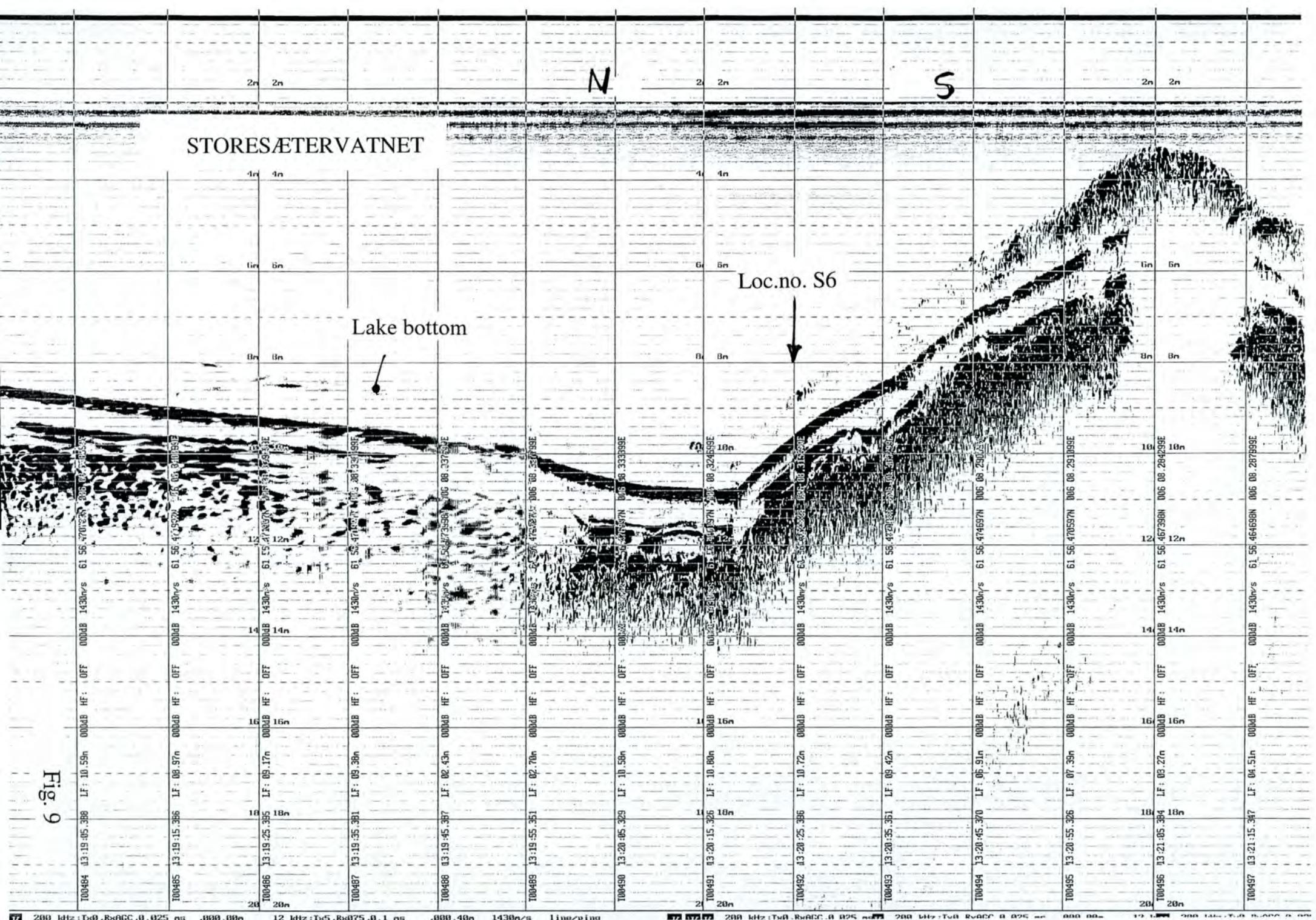


Fig. 10

STORESÆTERVATNET

NE SW

Loc.no. S7

101055 14:54:25.384 LF: 09.15n 000dB HF: OFF 000dB 1430m/s 61 56.64629BN 006 08.521199E

101056 14:54:25.363 LF: 05.87n 000dB HF: OFF 000dB 1430m/s 61 56.641697N 006 08.513399E

101057 14:54:35.385 LF: 05.07n 000dB HF: OFF 000dB 1430m/s 61 56.636197N 006 08.521199E

101058 14:54:45.387 LF: 05.63n 000dB HF: OFF 000dB 1430m/s 61 56.628095N 006 08.525499E

101059 14:55:35.384 LF: 05.46n 000dB HF: OFF 000dB 1430m/s 61 56.628598N 006 08.529599E

101060 14:55:35.389 LF: 05.13n 000dB HF: OFF 000dB 1430m/s 61 56.61797N 006 08.531199E

101061 14:55:15.387 LF: 07.09n 000dB HF: OFF 000dB 1430m/s 61 56.605798N 006 08.531899E

101062 14:55:35.389 LF: 07.23n 000dB HF: OFF 000dB 1430m/s 61 56.597852N 006 08.528999E

101063 14:55:45.387 LF: 07.23n 000dB HF: OFF 000dB 1430m/s 61 56.597254N 006 08.524499E

101064 14:55:45.372 LF: 03.00n 000dB HF: OFF 000dB 1430m/s 61 56.583597N 006 08.524499E

101065 14:55:35.389 LF: 05.00n 000dB HF: OFF 000dB 1430m/s 61 56.583697N 006 08.497299E

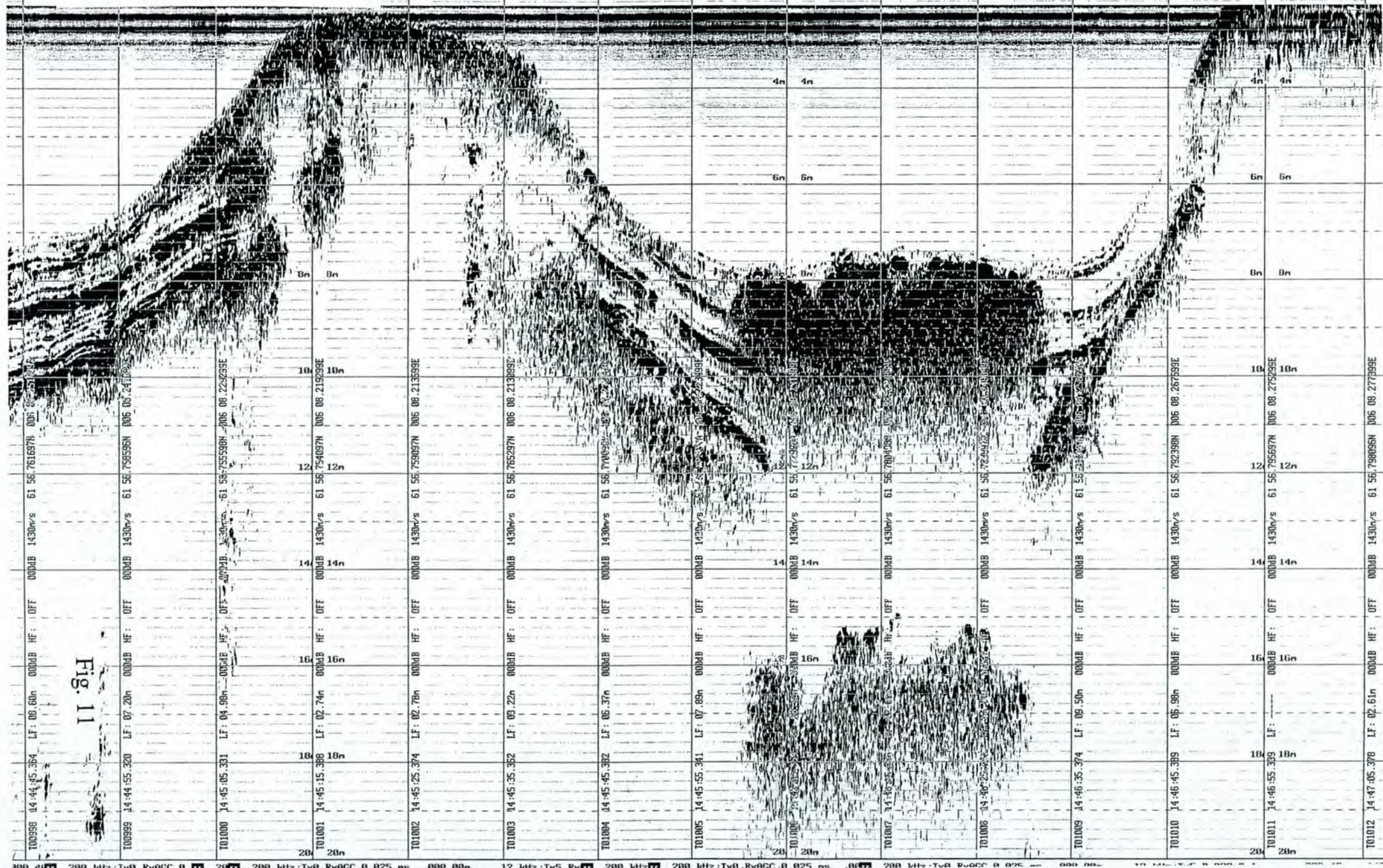
101066 14:56:05.325 LF: 05.25n 000dB HF: OFF 000dB 1430m/s 61 56.592596N 006 08.488599E

101067 14:56:15.373 LF: 06.35n 000dB HF: OFF 000dB 1430m/s 61 56.593298N 006 08.488599E

101068 04:56:25.389 LF: 06.88n 000dB HF: OFF 000dB 1430m/s 61 56.607098N 006 08.488599E

STORESÆTERVATNET

Fig. 11



NEDSTEVATNET (KILSVATNET-N)

SSE

Loc. no. N1

NNW

T00264 15:07:41.055 LF: 19.49n 000dB HF: OFF 000dB 1430m/s 62 02.185798N 006 02.853399E

HIG.

12

15:07:51.063 LF: 19.49n 28n 000dB HF: OFF 000dB 1430m/s 62 02.192498N 006 02.853399E

28n

T00265 15:08:00.556 LF: 19.12n 000dB HF: OFF 000dB 1430m/s 62 02.202159N 006 02.853399E

16:12n

000dB HF: OFF 000dB 1430m/s 62 02.192498N 006 02.853399E

26n

28n

T00266 15:08:11.008 LF: 19.32n 000dB HF: OFF 000dB 1430m/s 62 02.208595N 006 02.849899E

12n

24n

26n

28n

30n

32n

34n

36n

38n

40n

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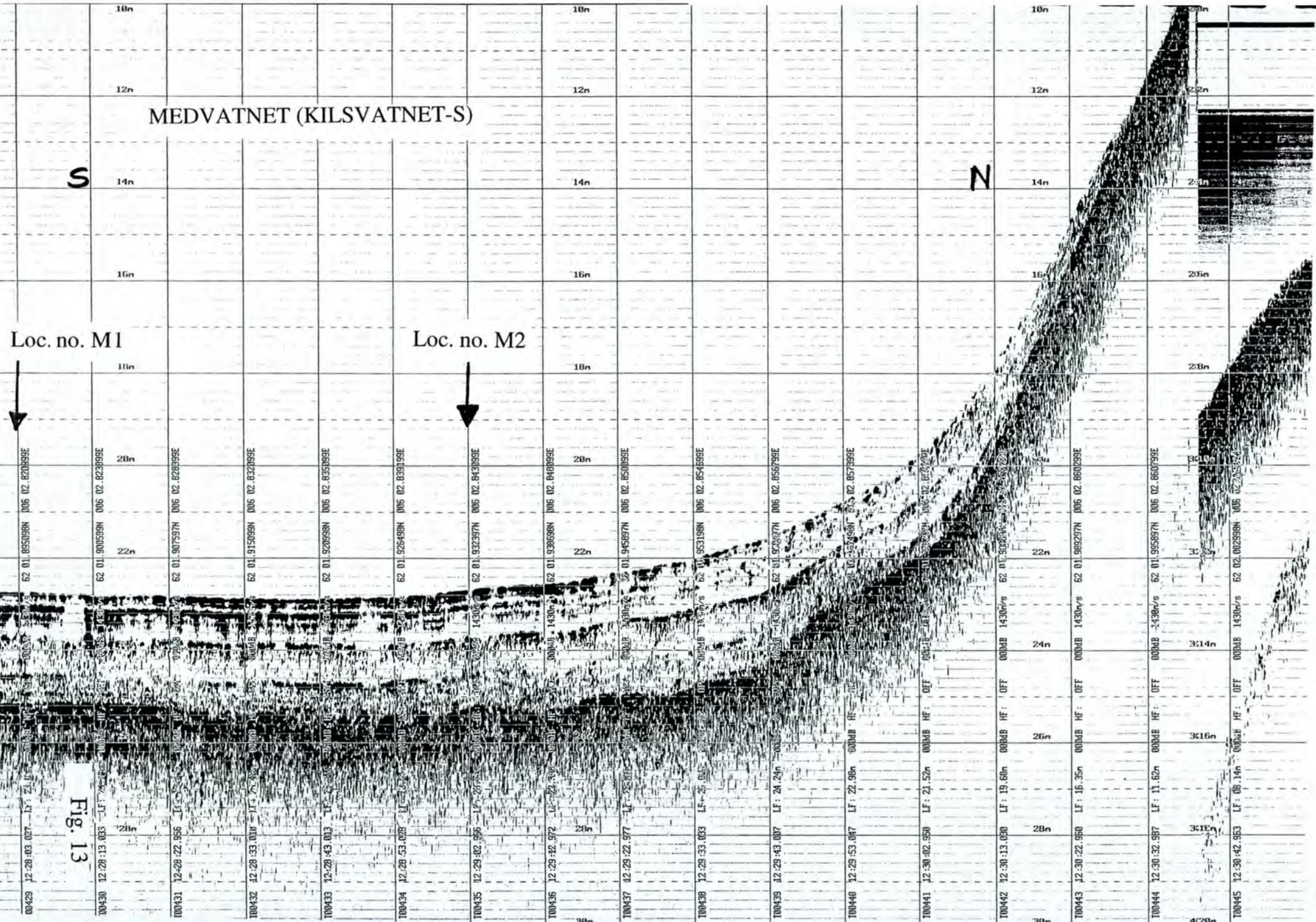


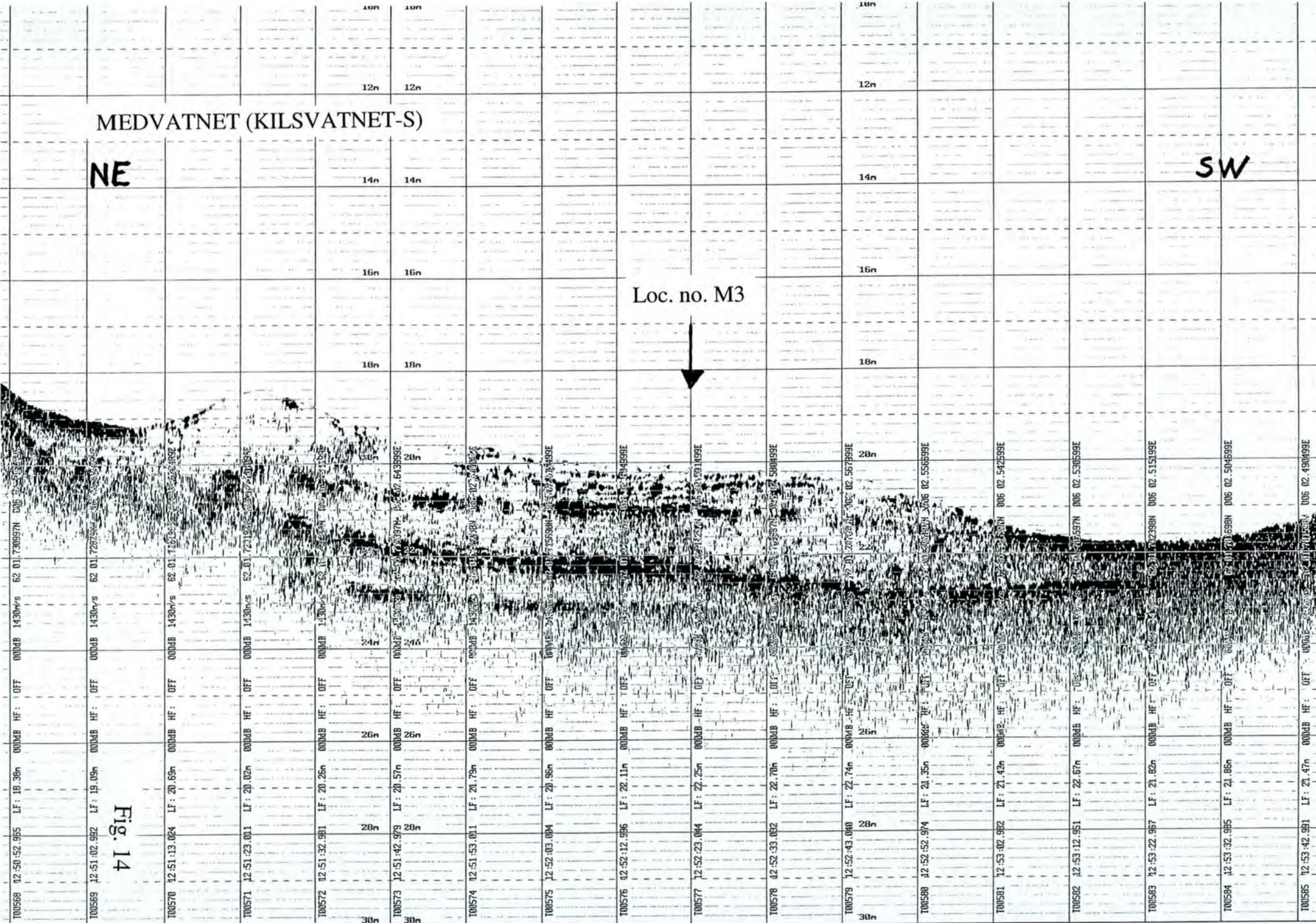
Fig. 13

MEDVATNET (KILSVATNET-S)

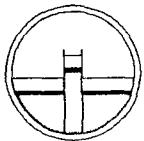
NE

SW

Fig. 14



## **APPENDIX**

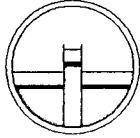


## **Akustisk profilering (penetrasjonsekkolodd) i 5 ferskvann i Sunnmøre/Nordfjord**

NGU oppdrag nr. 293100  
GeoCore oppdrag nr. 034-01-B

### **INNHOLD**

1. SAMMENDRAG
2. INNLEDNING
3. FELTMÅLINGER
  - 3.1 Ekkolodd
  - 3.2 Posisjonering
  - 3.3 Utførelse i felt
4. OVERSIKT OVER DATA



# GeoCore as

ANVENDT MARIN GEOLOGI OG GEOKJEMI  
MARINE MILJØTEKNIKSKE GRUNNUNDERSØKELSER  
TEKNOLOGI FOR MARIN SEDIMENTPRØVETAKING



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GRADERING Fortrolig til oppdragsgiver
---

TITTEL/FORFATTER				
<b>RAPPORT</b>	<b>Akustisk profilering (penetrasjonsekkolodd) i 5 ferskvann, Sunnmøre/Nordfjord</b>			
FORFATTER	OPPDRAVGIVER	OPPDRAVGIVERS REF./KONTAKTPERSON		
Kristian Bjerkli	Norges geologiske undersøkelse	NGU oppdragsnr. 293100 Oddvar Longva		
OPPDRAGSNR.:	ARKIV	ANT.SIDER/VEDLEGG	STED/DATO	GODKJENT AV
034-01-B	034-01-B NGU	11 / akust.. registr.	Trondheim, 27.05.2001	Per Th. Moen 

## Sammendrag

GeoCore har i mai 2001 utført akustisk profilering (penetrasjonsekkolodd) for Norges geologiske undersøkelse i følgende 5 ferskvann i Sunnmøre/Nordfjord:

- Hovdevatnet, Ørstad kommune
- Rotevatnet, Volda kommune
- Medvatnet (Kilsvatnet syd), Volda kommune
- Nedstevatnet (Kilsvatnet nord), Volda kommune
- Storesætervatnet, Eid kommune

Målingene ble utført med Knudsen ekkolodd m/ 12 KHz sender/mottaker og DGPS-posisjonering. Posisjonsbestemmelsene har gjennomgående god diff-dekning med unntak av deler av målingene i Nedstevatnet.

Data er levert NGU i form av papirutskrift av akustikk-registreringene (termisk skriver), CD-ROM med akustikkdata i binærfil-format og CD-ROM med posisjonsdata i \*.xls-format.

---

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Telefon 73 92 19 76  
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Foretaksnr.  
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E-post: [geocore.as@c2i.net](mailto:geocore.as@c2i.net)



## 2. INNLEDNING

GeoCore as har på oppdrag fra Norges geologiske undersøkelse (NGU) utført akustisk profilering med penetrasjonsekkolodd i 5 ferksvann i Sunnmøre/Nordfjord. Oppdraget er utført i henhold til avtale mellom NGU og GeoCore av 15.05.2001.

Målingene er utført i følgende ferskvann:

*More og Romsdal:*

Ørstad kommune: Hovdevatnet

Volda kommune: Rotevatnet  
Medvatnet (Kilsvatnet syd)  
Nedstevatnet (Kilsvatnet nord)

*Sogn og Fjordane:*

Eid kommune: Storesætervatnet

Tidrom for samlet utførelse av oppdraget (mobilisering, feltarbeid, demobilisering og rapportering) var 14. – 28.05.2001.

## 3. FELTMÅLINGER

### 3.1 Ekkolodd

Målingene ble utført med Knudsen 320 M/P ekkolodd med 12 KHz svinger (sender/mottaker). Måledata registreres i analog form på termisk papir og digitalt som \*.keb-fil i binærfil-format.

Det annoteres følgende informasjon både analogt og digitalt:

- Fix-nr. (på analog registrering: pr. ca. 10 sek.)
- Dato
- Klokke (lokal tid)
- Vanndyp LF (12 KHz)
- Lydhastighet, oppgitt av NVE til 1.430 m/s
- Posisjon grad/desimalmin. lengde og bredde

Det ble utført testing/innstilling av penetrasjonsekkoloddet i Rotevatnet, Volda kommune, den 20.05.2001, uten registrering av posisjonsdata i *GeoCore-logg*. Posisjonsdata er imidlertid annotert på de analoge registreringene. Disse registreringene er ikke vedlagt denne rapporten, men de kan fritt stilles til NGU's disposisjon etter ønske.



### 3.2 Posisjonering

Posisjonering er utført med GPS mottaker type MLR-DGPS-FX412.

Som differensiell referansestasjon er benyttet Svinøy 293,5 KHz. GPS-antennen er plassert over senter av ekkolodd-svingeren.

Posisjonsdata, som logges i programmet *GeoCore-logg*, er hentet fra en NMEA 182 GGAD-streng. Det lagres følgende informasjon:

- GPS-tid
- desimalgrad øst lengde/nord bredde
- HDOP-verdi
- diffkode (2=diff, 1=ikke diff blank=ikke satelitt-fix)

Posisjoner logges i datum WGS 84.

Vedlagte posisjonsfiler (CD-ROM) tilsvarer annotering på de analoge registreringene og inneholder:

- Desimalgrader øst lengde
- Desimalgrader nord bredde
- Lokal tid

Det var gjennomgående god DGPS-dekning i Hovdevatnet, Rotevatnet, Medvatnet og Storesætrevatnet.

I Nedstevatnet var det tilfredsstillende DGPS-dekning for profil-linjer i NS-retning. Posisjonering av profil-linjene i ØV-retning ble usikre på grunn av overgang til satelitt-plassering med lav asimuth kombinert med signalskjerming av høye fjell.

Det ble oppdaget svikt i *GeoCore-log* under rapporteringen av data. Alle posisjonsdata er imidlertid logget som \*.kea-filer (leses som tekst-filer) i Knudsen-systemet. Posisjonsfil for Nedstevatnet merket ”sikker” er logget i *GeoCore-logg* og manuelt plukket fra annotering pr. 10 sek. i de analoge registreringene. Posisjonsfil merket ”usikker” er logget i Knudsen-systemet hvor tidsangivelsen er gitt i tall-format og ikke tids-format.

### 3.3 Utførelse i felt

Måleinstrumentene ble montert ombord i en 14 fots aluminiumsbåt med 4 hk utenbordsmotor. Feltopplegget er vist i Foto 1 - 3.

Adkomst til Rotevatnet, Medvatnet og Nedstevatnet foregikk uten problemer i jevnt skrånende terreng. For adkomst til Hovdevatnet måtte båten uten utstyr fraktes over en ca. 2 meter lang strandsone med store steiner. For ankomst til Storesætrevatnet ble båt uten utsyr transportert ca. 50 meter på traktorvei over bløt, men steinsatt myr til og fra vannkanten.



Foto 1. GPS-antenne montert over ekkoloddets sender/mottaker



Foto 2. Plassering ombord av ekkolodd, GPS-mottaker og PC for operasjon av samlet målesystem



Foto 3. Tilhenger med målebåt rygges ut i Nedstevatnet



#### 4. OVERSIKT OVER DATA

De analoge akustiske registreringene (termisk printer) er merket:

Hovdevatnet Fra 09:35:24 - Til 12:41:58

Hovdevatnet Fra 12:51:58 - Til 14:26:09

Rotevatnet Fra 14:41:24 - Til 18:14:23

Rotevatnet Fra 18:19:50 - Til 18:51:50

Medvatnet (Kilsvatnet – S) Fra 11:44:02 - Til 13:39:02

Nedstevatnet (Kilsvatnet – N) Fra 14:33:11 - Til 15:20:01

Nedstevatnet (Kilsvatnet – N) Fra 15:26:41 - Til 16:10:40

Storesætervatnet Fra 13:11:14 - Til 14:29:25

Storesætervatnet Fra 14:37:35 - Til 15:19:35

Følgende posisjonsfiler ligger på vedlagte CD-ROM:

Hovdevatnet-posisjon.xls

Rotevatnet-posisjon.xls

Medvatnet (Kilsvatnet S)-posisjon.xls

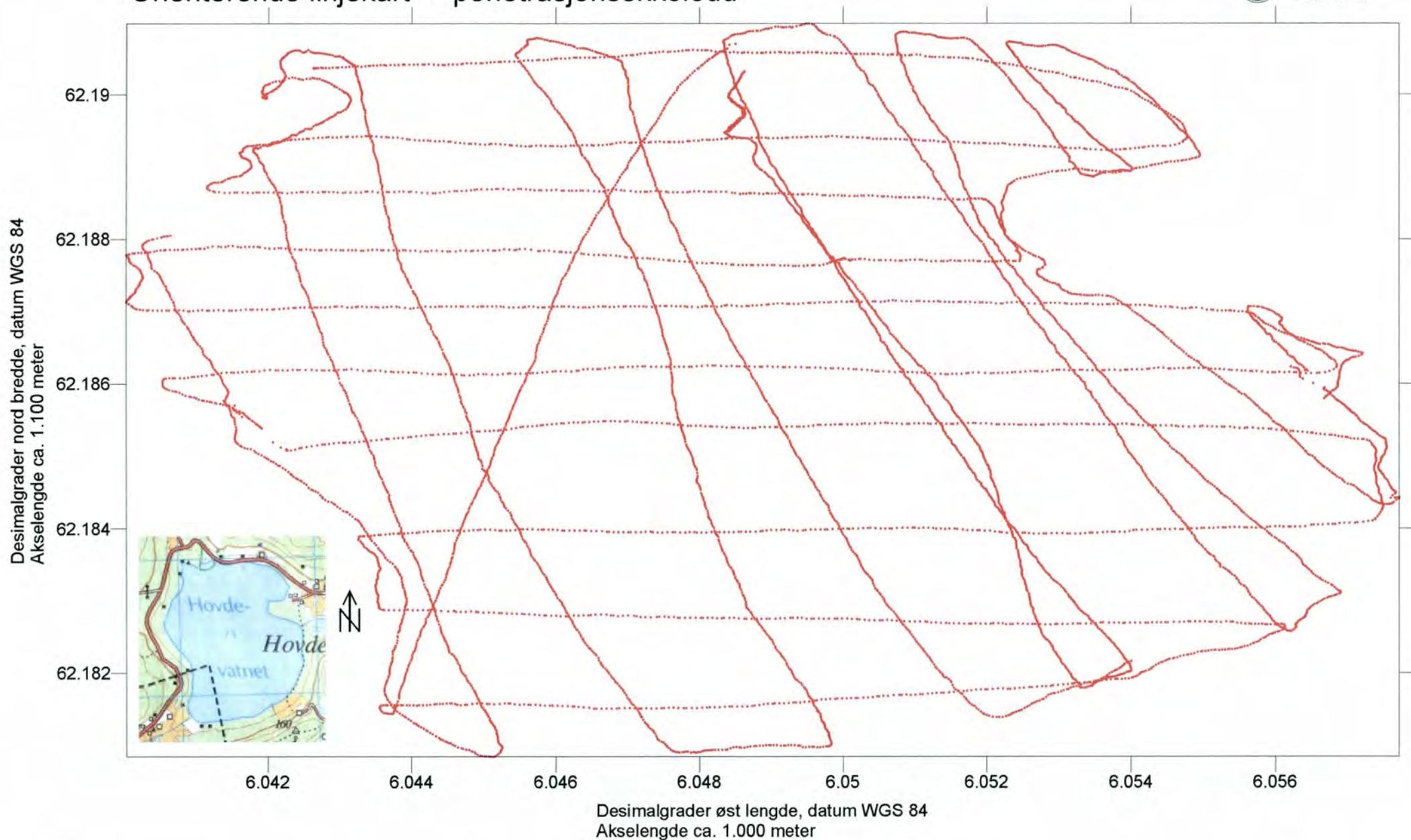
Nedstevatnet (Kilsvatnet N) – sikker posisjon.xls

Nedstevatnet (Kilsvatnet N) – usikker pos.xls

Storesætervatnet-posisjon.xls

Fig. 1 – 5 viser orienterende linjekart for hvert av ferskvannene. Posisjonene er plottet i desimalgrader øst og nord og kartbildet er strukket noe i ØV-retning i forhold til NS-retning.,,

Fig. 1 HOVDEVATNET, Ørstad kommune  
Orienterende linjekart - penetrasjonsekkolodd



Desimalgrader nord bredde, datum WGS 84  
Akselengde ca. 750 meter

Fig. 2 ROTEVATNET, Volda kommune  
Orienterende linjekart - penetrasjonsekkolodd



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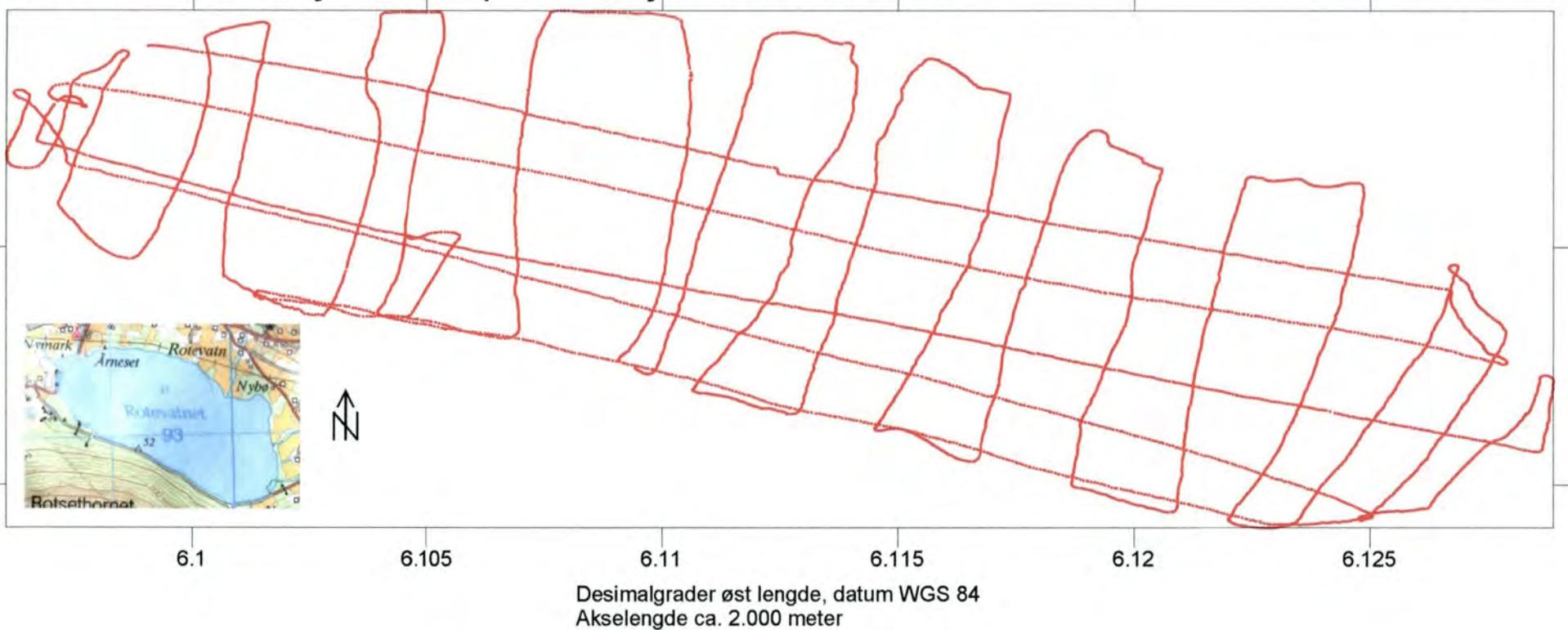


Fig. 3 MEDVATNET (Kilsvatnet syd), Volda kommune  
Orienterende linjekart - penetrasjonsekkolodd



GeoCore as  
034-01-B

Desimalgrader nord bredde, datum WGS 84  
Akselengde ca. 750 meter

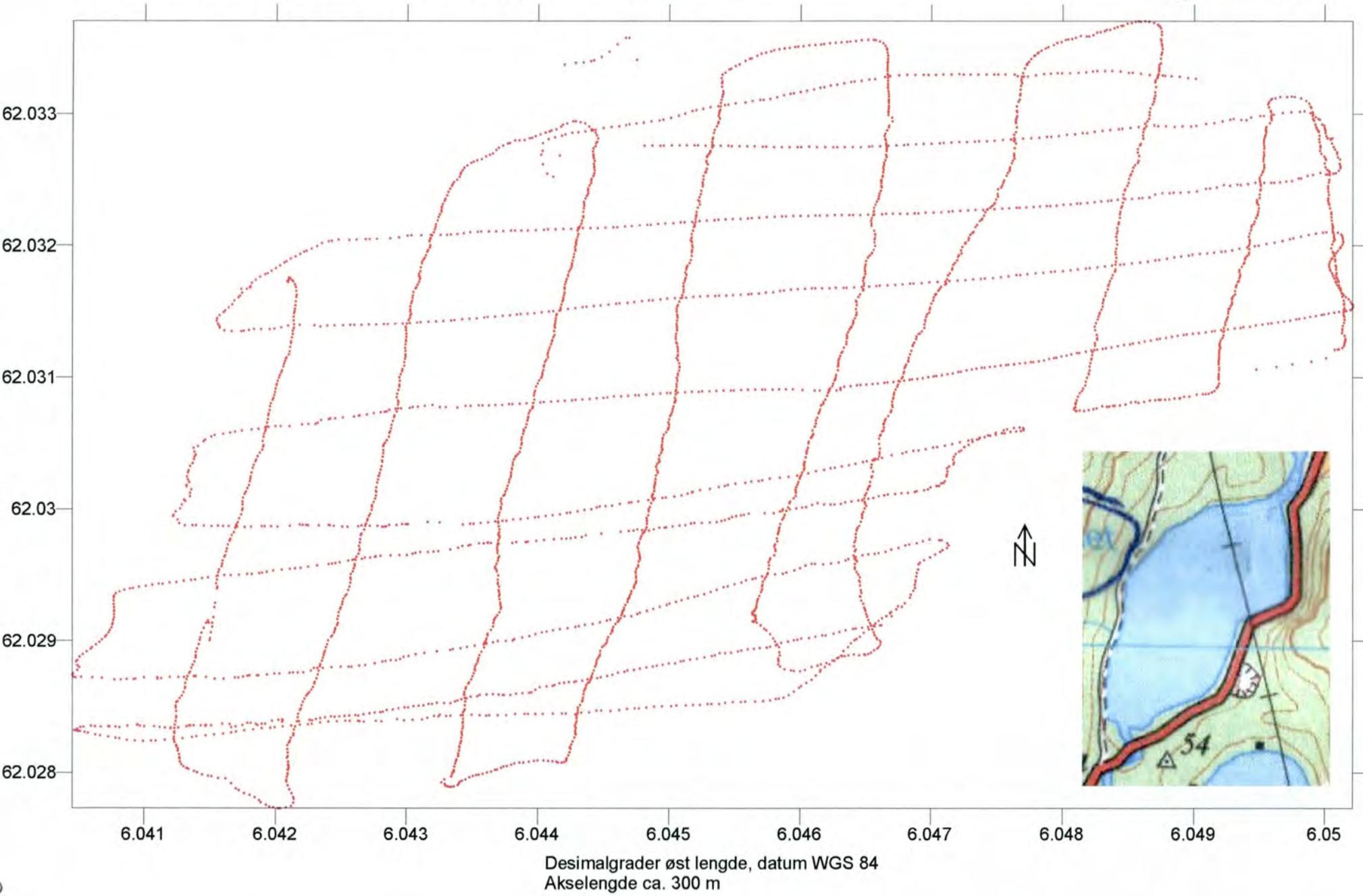


Fig. 4 NEDSTEVATNET (Kilsvatnet nord), Volda kommune  
Orienterende linjekart - penetrasjonsekkolodd

GeoCore as  
034-01-B

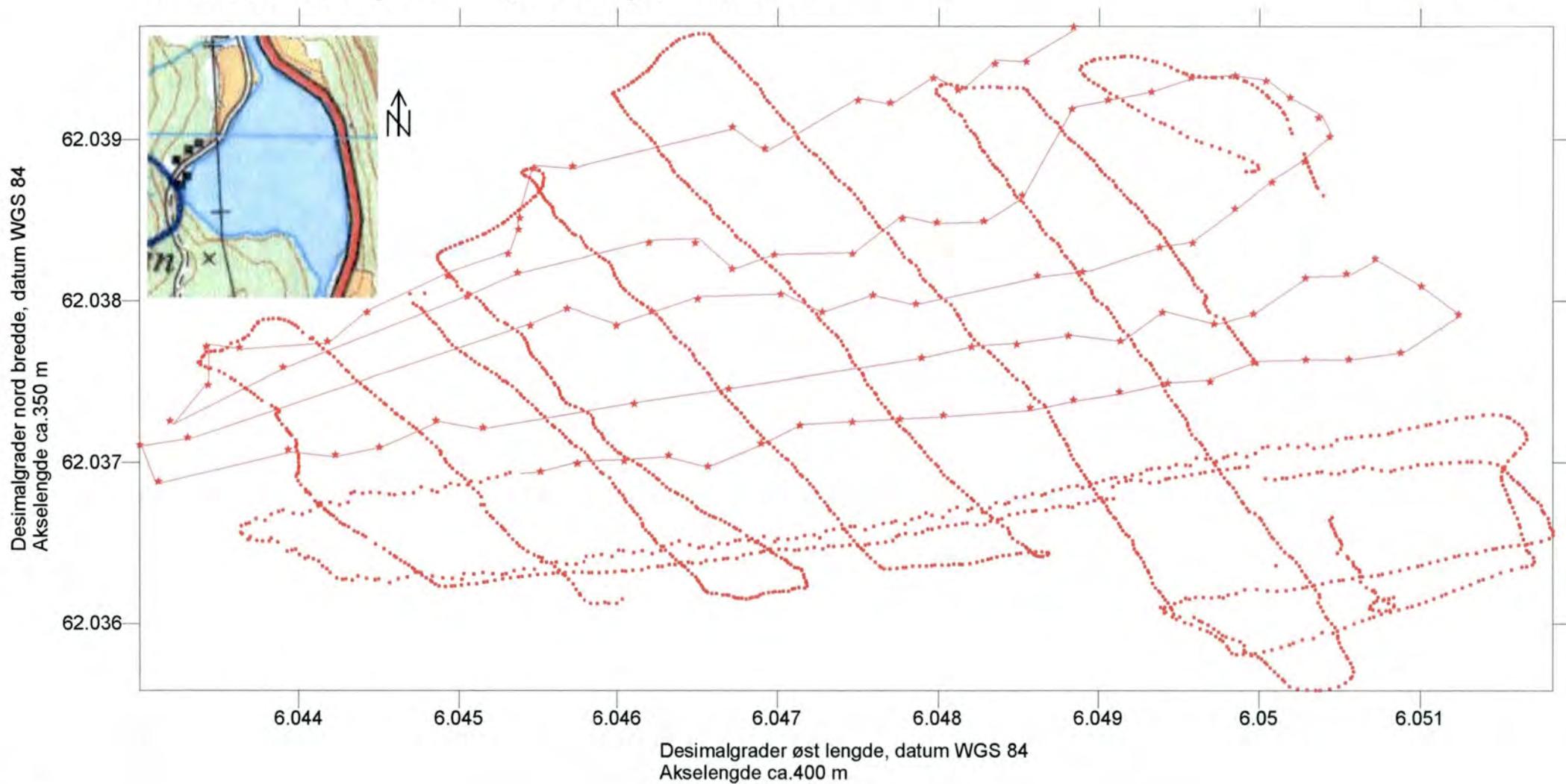
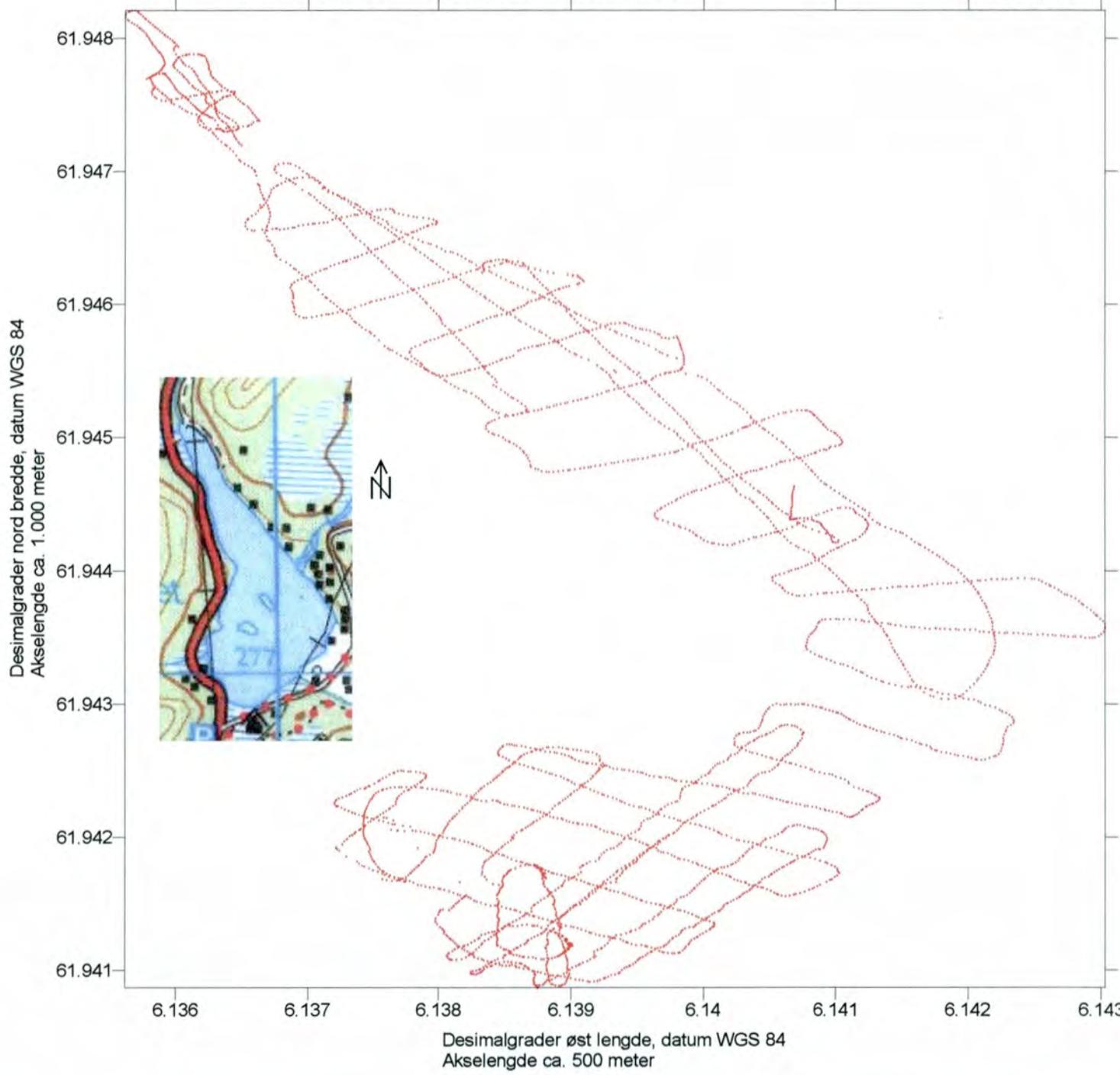
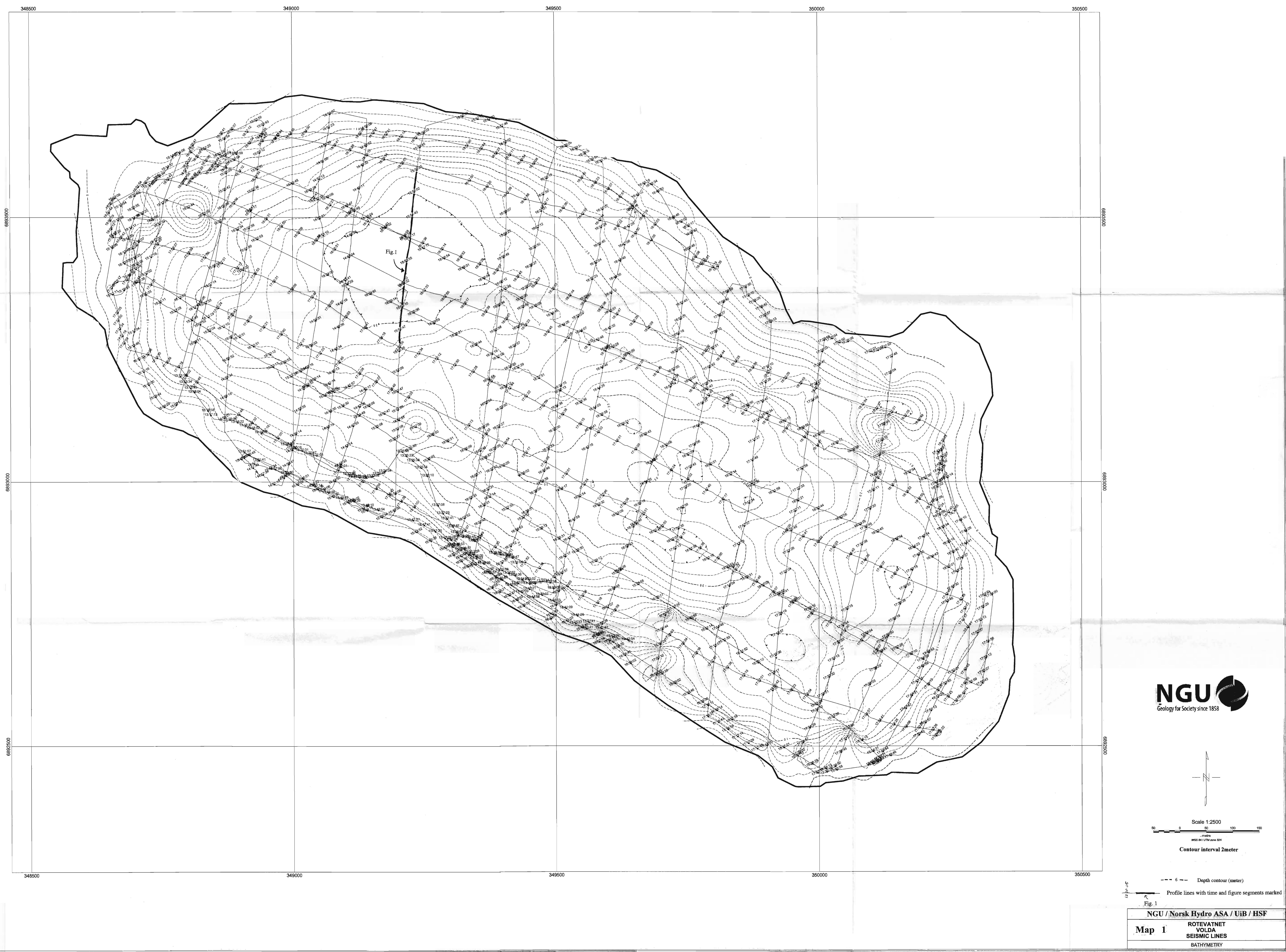


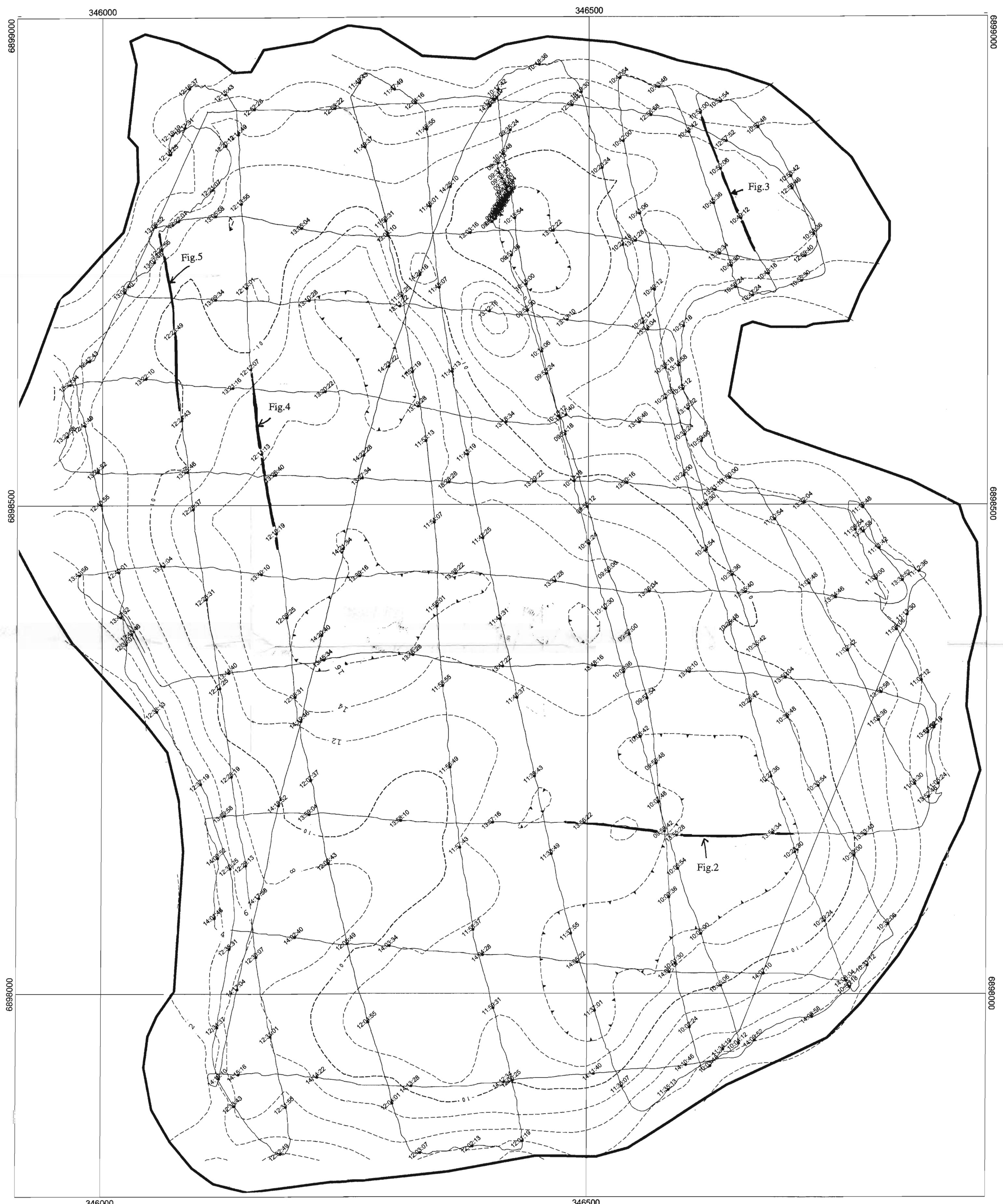
Fig. 5 STORESÆTERVATNET, Eids kommune  
Orienterende linjekart - penetrasjonsekkolodd



GeoCore as  
034-01-B







12 20 05

Fig. 1

— · · · Depth contour (meter)

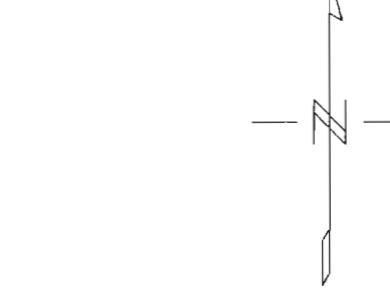
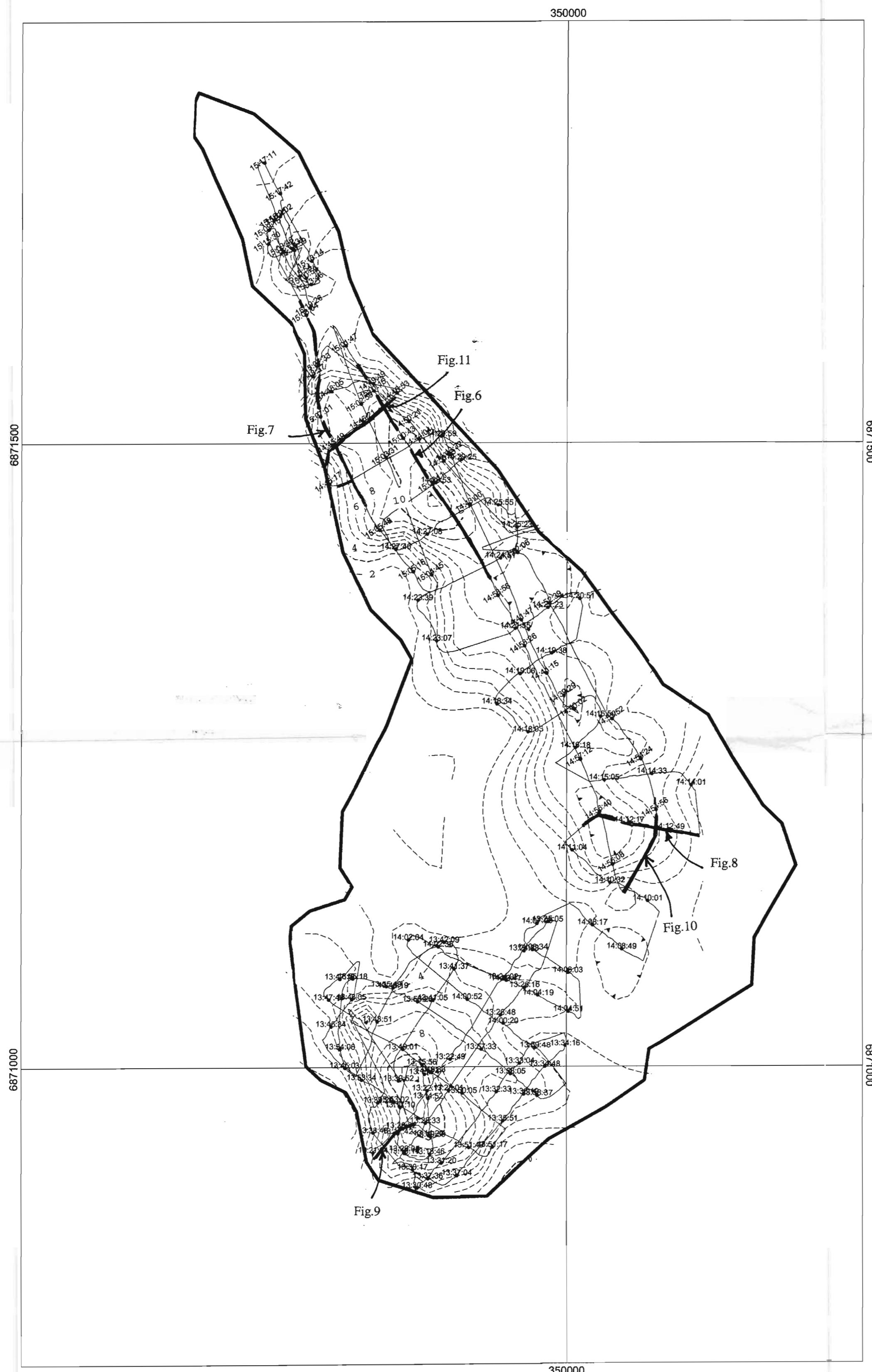
— · · · Profile lines with time and figure segments marked

NGU / Norsk Hydro ASA / UiB / HSF

**Map 2**

HOVDEVATNET  
VOLDA  
SEISMIC LINES

BATHYMETRY



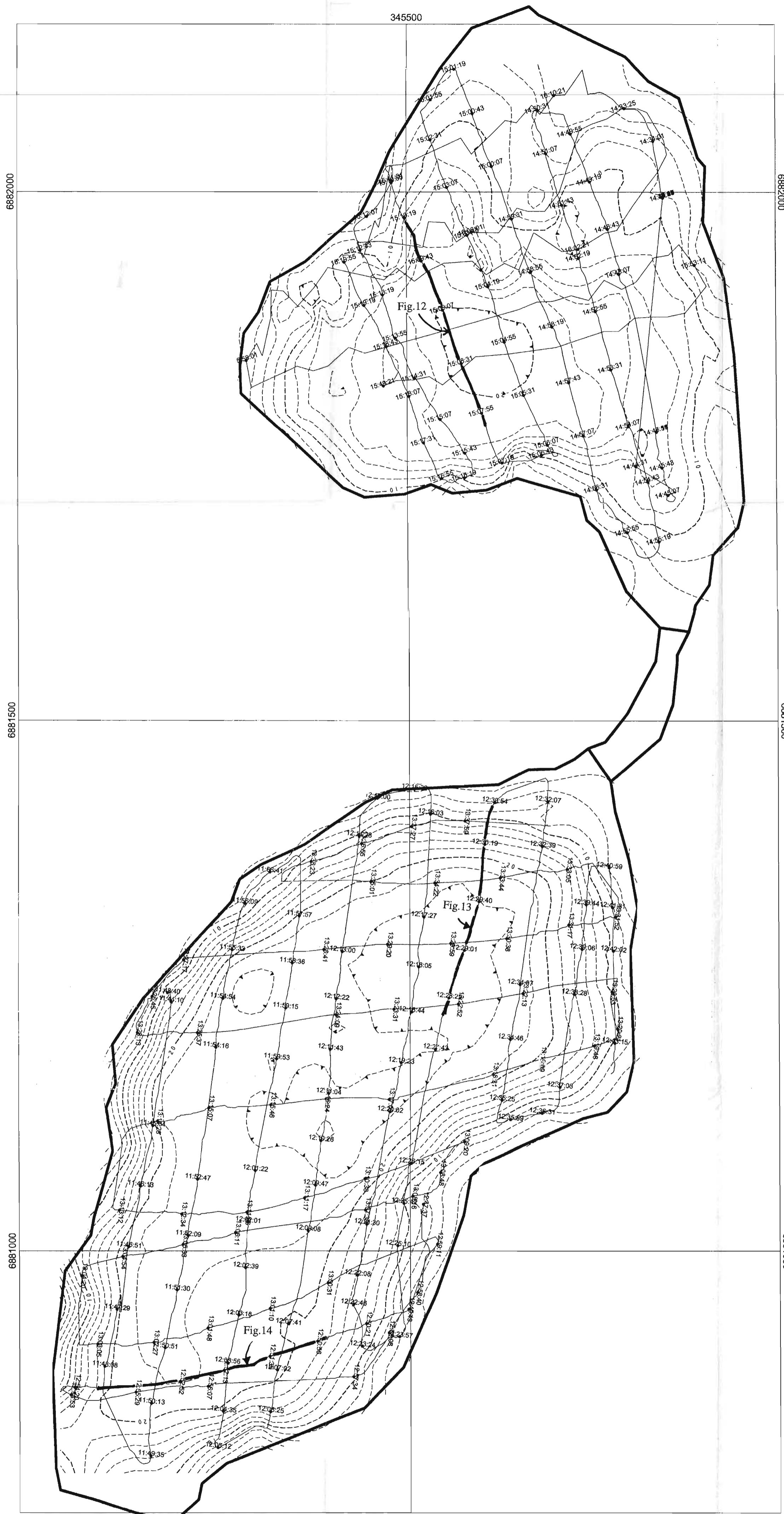
Contour interval 1meter

--- 6 --- Depth contour (meter)  
Profile lines with time and figure segments marked  
Fig. 1

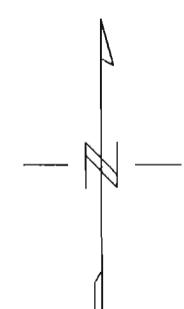
NGU / Norsk Hydro ASA / UiB / HSF

**Map 3**  
**STORESETERVATNET**  
**VOLDA**  
**SEISMIC LINES**

BATHYMETRY



**NGU**  
Geology for Society since 1858



Scale 1:2500  
50 0 50 100 150  
metre  
WGS 84 / UTM zone 32N

Contour interval 2meter

— Depth contour (meter)  
— Profile lines with time and figure segments marked  
Fig. 1

NGU / Norsk Hydro ASA / UiB / HSF

**Map 4**

KILSVATNET  
VOLDA  
SEISMIC LINES

BATHYMETRY