GEOLOGICAL SURVEY OF CANADA
OPEN FILE 3922

Expedition report: MV *Hamilton Banker*, 1999, Georges Bank, Gulf of Maine

Brian J. Todd[1], Bruce D. Wile[1], Darrell E. Beaver[1], Robert Murphy[1], Michael Belliveau[2] and Jennifer Harding[1]

1. Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2
2. Geoforce Consultants Ltd., P.O. Box 696, Dartmouth, Nova Scotia B2Y 3Y9

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1. Introduction - *B.J. Todd*

1.1 Cruise overview

Georges Bank is located beyond the southwestern end of the Scotian Shelf at the entrance to the Gulf of Maine, approximately 200 km south of Yarmouth, Nova Scotia (Fig.1). The bank is divided by the international boundary between Canada and the United States of America (the Hague Line). On the regional nautical chart (Canadian Hydrographic Service, 1990), the morphology of the Canadian portion of the bank appears flat with water depths ranging between 60 and 90 m. The shallowest area on the bank is approximately 40 m in depth. The northern and eastern edges of Georges Bank abut Northeast Channel which is a major morphological feature separating Georges Bank from Browns Bank and is a deep water oceanic inlet to the Gulf of Maine. The bank is bounded to the south by the continental slope.

Geological Survey of Canada (Atlantic) (GSCA) cruise "99 Hamilton Banker" to Georges Bank took place from October 5-26, 1999 on board the MV *Hamilton Banker* (Fig. 2), a 32 m-long Deep Sea Trawlers (DST) shark fishing vessel with a home port of St. John's, Newfoundland. (Originally, the ship was built as the MV *Sjovaer* in 1977 by Solstrand Slip and Båtbyggeri A/S, Tomrefjord, Norway). The *Hamilton Banker* was mobilized from September 27 to October 5 at the DST facility in Lunenburg, Nova Scotia.

The overall scientific objective of this cruise was to improve our understanding of the distribution of sediments and sedimentary bedforms on Georges Bank which, in turn, will lead to an improved interpretation of the geological history of the bank and the dynamics of modern sedimentation. Specific objectives of the cruise were to obtain acoustic geophysical data, sea floor sediment samples and seabed photographs over (and extending beyond) regions of Georges Bank that had been previously surveyed using a Simrad 1002 multibeam system from the Deep Sea Trawlers vessel *Anne S. Pierce*. The multibeam data were collected and processed by the Canadian Hydrographic Service (CHS) in the summer of 1999.

The cruise was divided into two phases, the first phase being the geophysical survey, and the second phase being the sediment sampling and sea floor photography.

Phase 1 of the cruise, the geophysical survey, took place from October 5-18. Building

on data previously collected for GSCA on Georges Bank (Geonautics Limited, 1982), a grid of regional survey lines was extended over the bank to a depth of approximately 200 m, the lower depth limit of the multibeam survey. Based on multibeam bathymetry and backscatter maps of Priority Area 1 supplied by CHS (Fig. 1), a more detailed suite of survey lines was collected in this region.

Phase 2 of the cruise, the sediment sampling and sea floor photography, took place from October 20-25.

The *Hamilton Banker* was operated under the direction of Captain Carvel Eisenhauer; the captain and crew of the vessel ably assisted in the survey and the sampling (Table 1). Scientific staff included personnel from GSCA and contract employees (Table 2). During Phase 1, watchkeeping was done on a six-hour rotation (Table 3). During phase 2, all scientific staff took part in operations from 0600-1800 (AST).

1.2 Scientific equipment and layout

The layout of scientific equipment on board the *Hamilton Banker* is illustrated in Figure 3. The foredeck was not used and all equipment was located aft of the bridge. The GPS antenna was fixed to the railing on the deck above the bridge. Inside the bridge, a table was constructed extending from midships to the port side. This was used for operation of navigation computers, graphic recorders and expedition log note keeping (Fig. 4). Adjacent to the port bulkhead, an electronics rack housed the sidescan sonar controls, the digital logging equipment and the Trackpoint II electronics (Fig. 4).

On the port deck just aft of the bridge was the Trackpoint II boom pivot location (Figs. 3, 5). When the ship was travelling to and from Georges Bank, the boom was kept in the horizontal position illustrated. On site, but before the geophysical survey was underway, the capstan on the foredeck (Fig. 3) was used to lower the boom. The beacon extended below the draft of the ship when the boom was vertical, as illustrated in Figure 3 (upper).

The geophysical equipment (sidescan sonar and Huntec Deep Tow Seismic (DTS)) were deployed from the stern using an A-frame constructed expressly for this purpose by CFFI (Fig. 6). The sidescan was deployed from the starboard side of the stern and the Huntec DTS was deployed from the port side. The winches were powered by a compressor secured to the starboard deck forward of the stern (Fig. 3). Figure 7 illustrates a test deployment of

these two instruments with the ship secured at the dock. Initial tests used the stern crane to push the top of the A-frame aft. This technique proved unsuccessful and, as a solution, an hydraulic ram was attached to the port vertical leg of the A-frame.

Geological sampling was carried out from the stern using the A-frame to deploy a van Veen grab sampler and sea floor cameras.

This report is intended to provide a description of day-to-day activities on board the ship, to provide an overview of technical aspects of the equipment used, and to present a summary of the geophysical and geological data obtained during the *Hamilton Banker* expedition to Georges Bank. In the following narrative account of the day-to-day activities (Section 2), reference is made to instrumentation and data which are fully described in later sections of this cruise report.

References

Canadian Hydrographic Service, 1990. Chart L/C 4255, Georges Bank, eastern portion. Scale 1:175 000.

Geonautics Limited, 1982. A geophysical survey of the Georges bank, Georges Basin and Northeast Channel area of the Gulf of Maine. Geological Survey of Canada, Open File Report 978, 3 volumes, 153 p., 4 appendices, 21 charts.

List of tables

Table 1: List of Clearwater personnel.

Title	Name	Phase
Captain	Carvel Eisenhauer	1, 2
Mate	Douglas Dorey	1, 2
Chief Engineer	Michael Penny	1, 2
Second Engineer	Gary Bennet	1, 2
Cook	John Dodge	1, 2

Table 2: List of scientific personnel.

Title and duties	Name	Affiliation	Phase
Chief Scientist	Brian Todd	GSCA	1, 2
Scientist (Sampling and photography)	Vladimir Kostylev	GSCA	2
Technologist (Sidescan and recording systems)	Bruce Wile	GSCA	1
Technologist (Sampling and photography)	Robert Murphy	GSCA	2
Technologist (Navigation)	Darrell Beaver	GSCA	1, 2
Technologist (Huntec system)	Michael Belliveau	GF	1
Watchkeeper (Sidescan)	Patrick Campbell	CSR	1

GSCA: Geological Survey of Canada (Atlantic)
GF: Geoforce
CSR: Canadian Seabed Research

Table 3. *Hamilton Banker* 1999 Phase 1 watchkeeping roster.

Time (AST)			
0000-0600	**0600-1200**	**1200-1800**	**1800-2400**
Beaver, Belliveau	Wile, Campbell	Beaver, Belliveau	Wile, Campbell

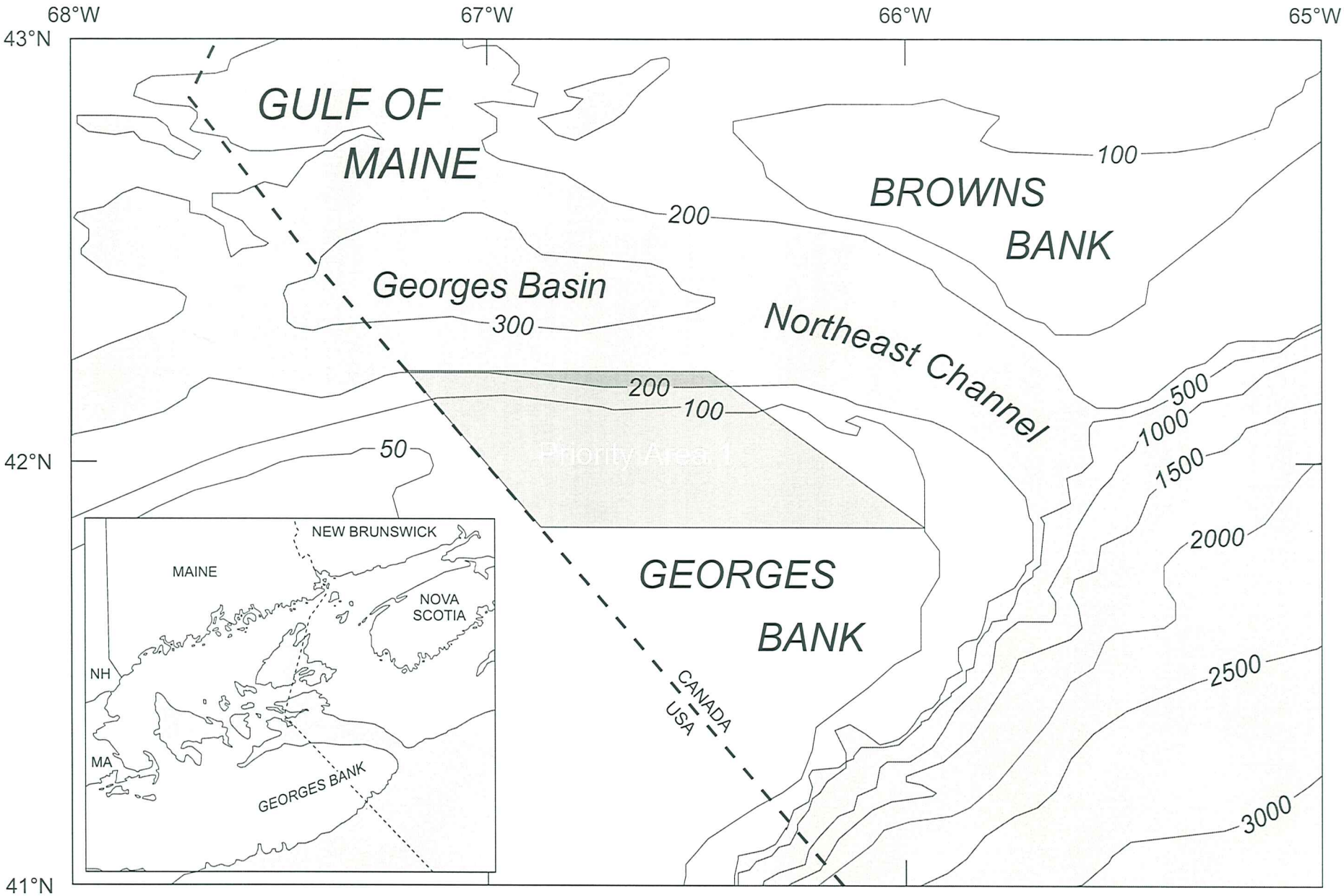


Figure 1. Location map of Georges Bank. Priority Area 1 is shown on the northern portion of the bank. International boundary is shown by dashed line. Isobaths are in metres.

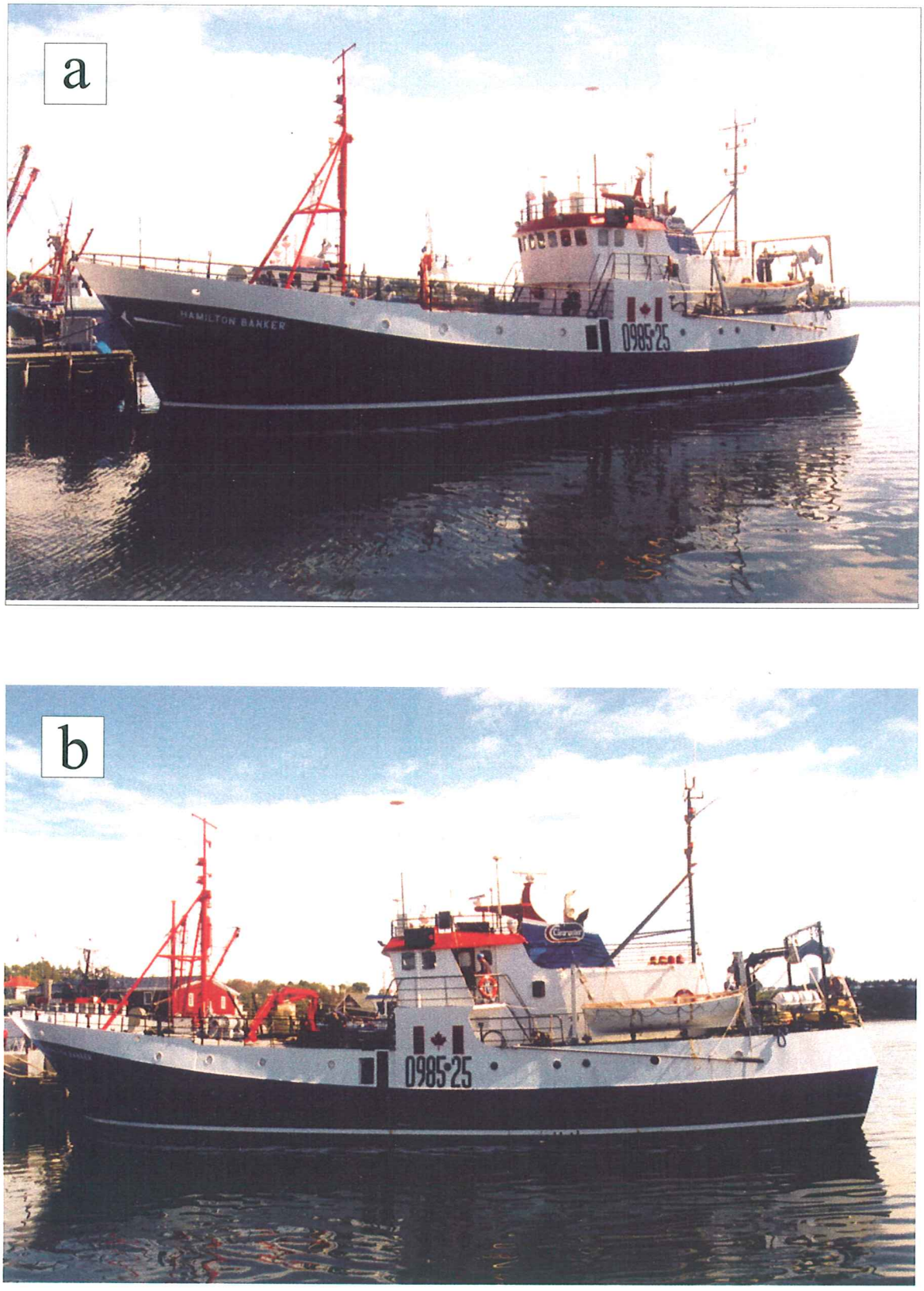


Figure 2a, b. The MV *Hamilton Banker* in Lunenburg, Nova Scotia.

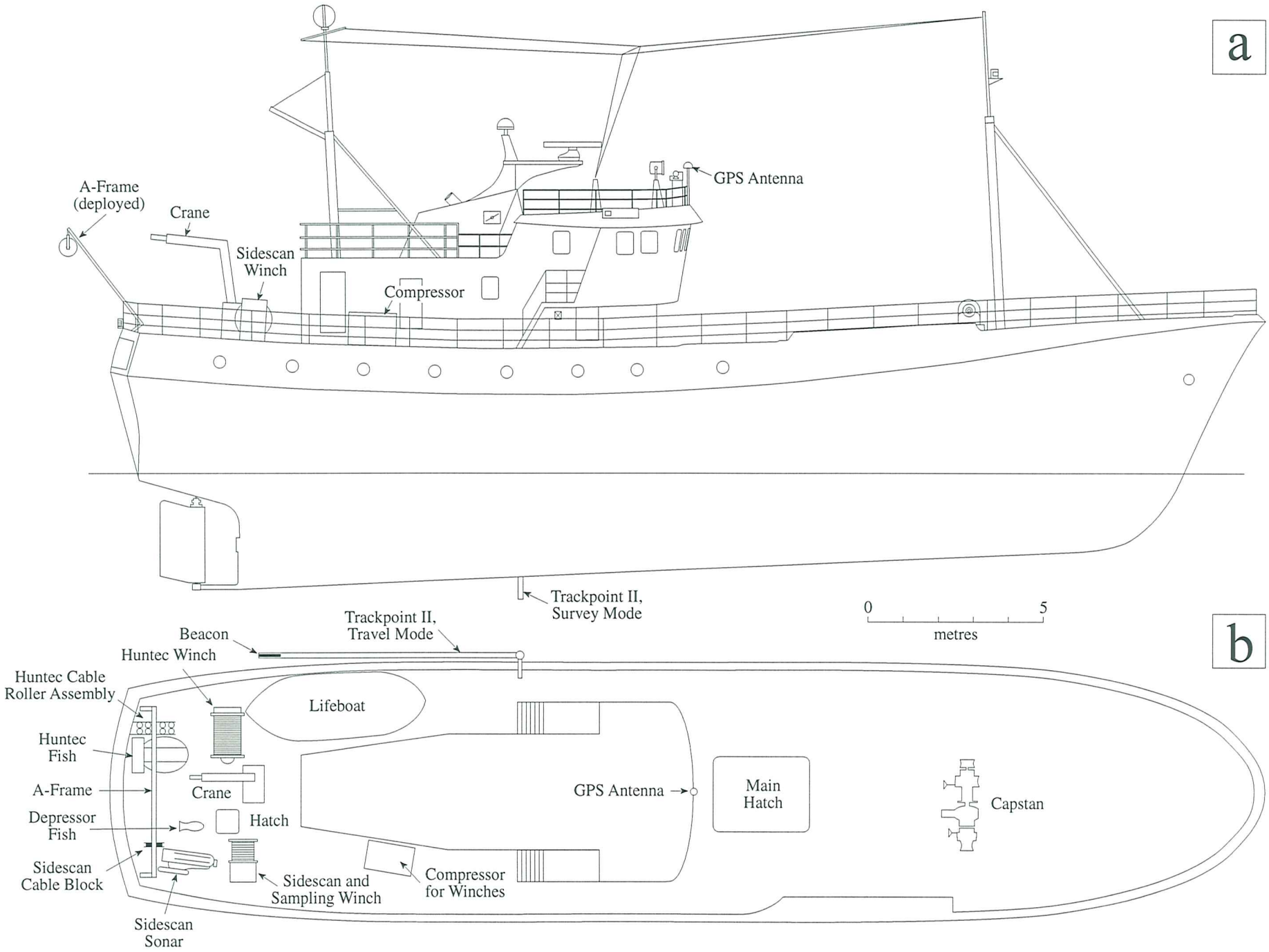


Figure 3. Layout of scientific equipment on the *Hamilton Banker*. (a) Elevation view of starboard side. (b) Plan view.

Figure 4a, b, c. Geophysical electronic equipment layout on the bridge of the *Hamilton Banker*.

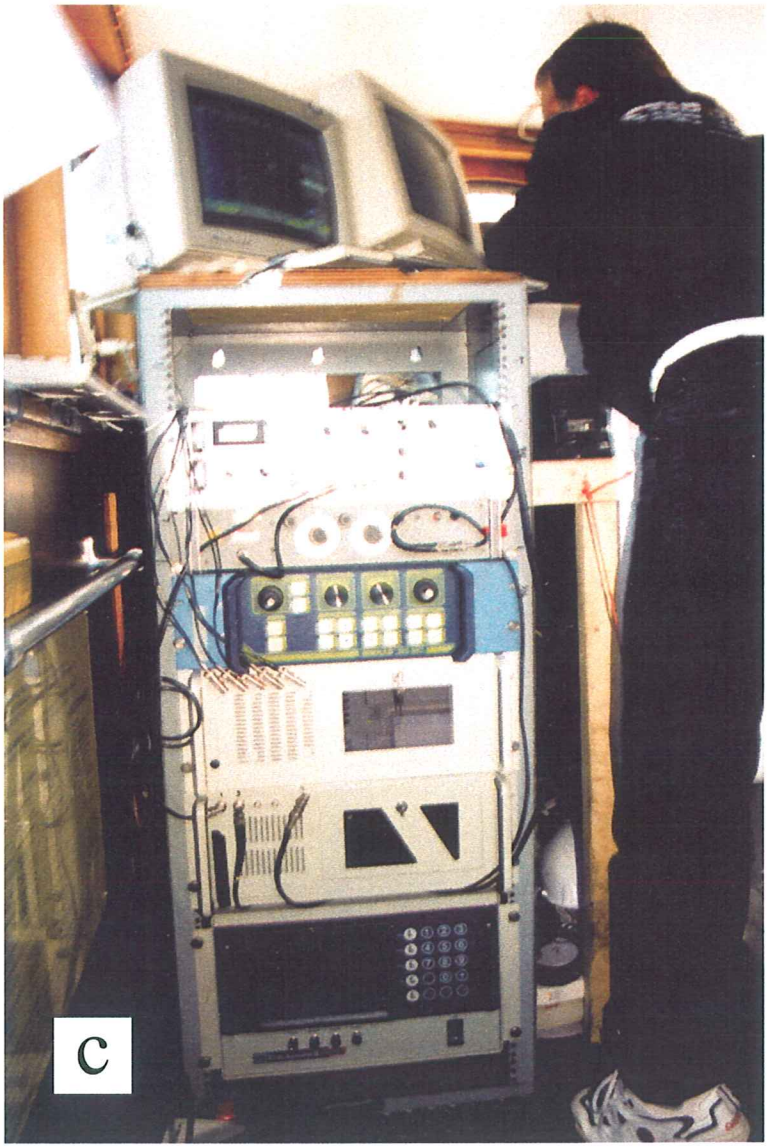


Figure 4a, b, c, continued.

Figure 5a, b, c. Trackpoint II boom in the travel position, port side of the *Hamilton Banker*.

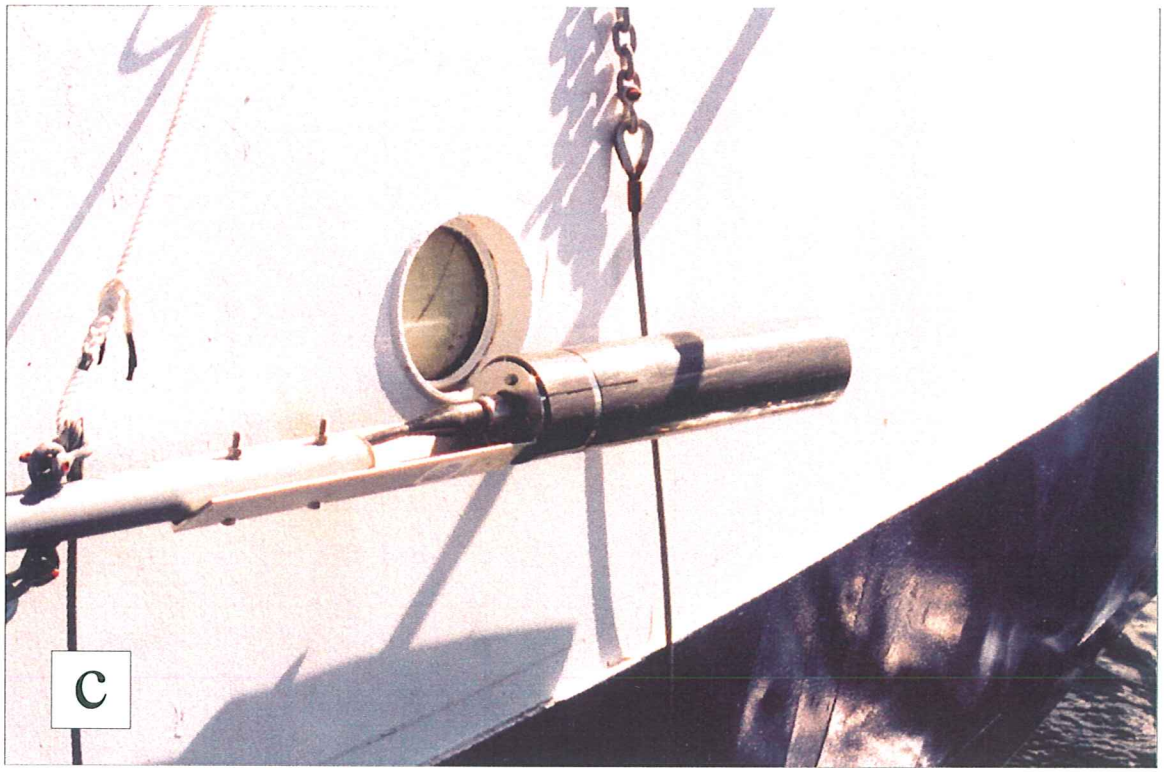


Figure 5a, b, c, continued.

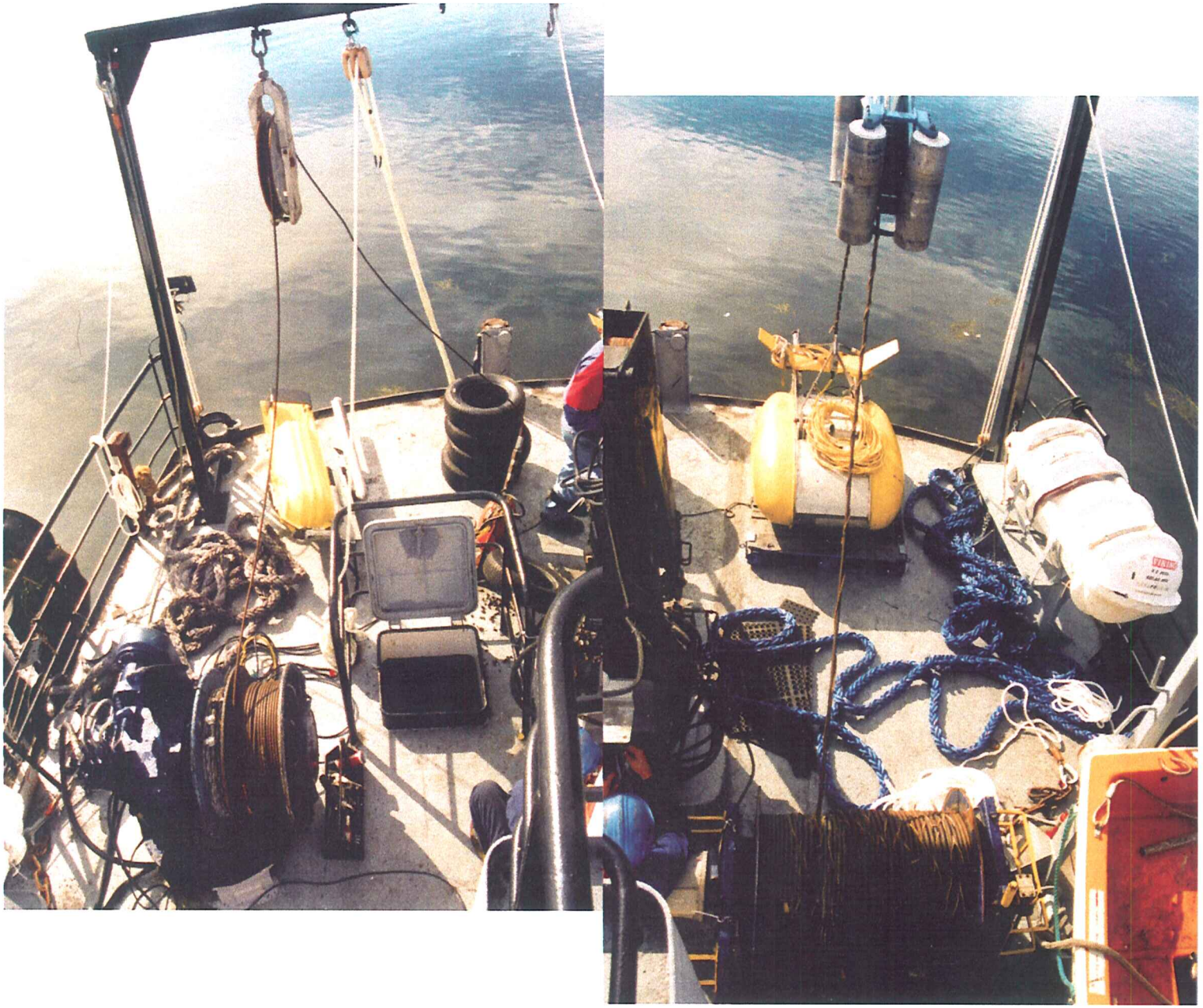


Figure 6. Geophysical equipment positions on the stern of the *Hamilton Banker*.

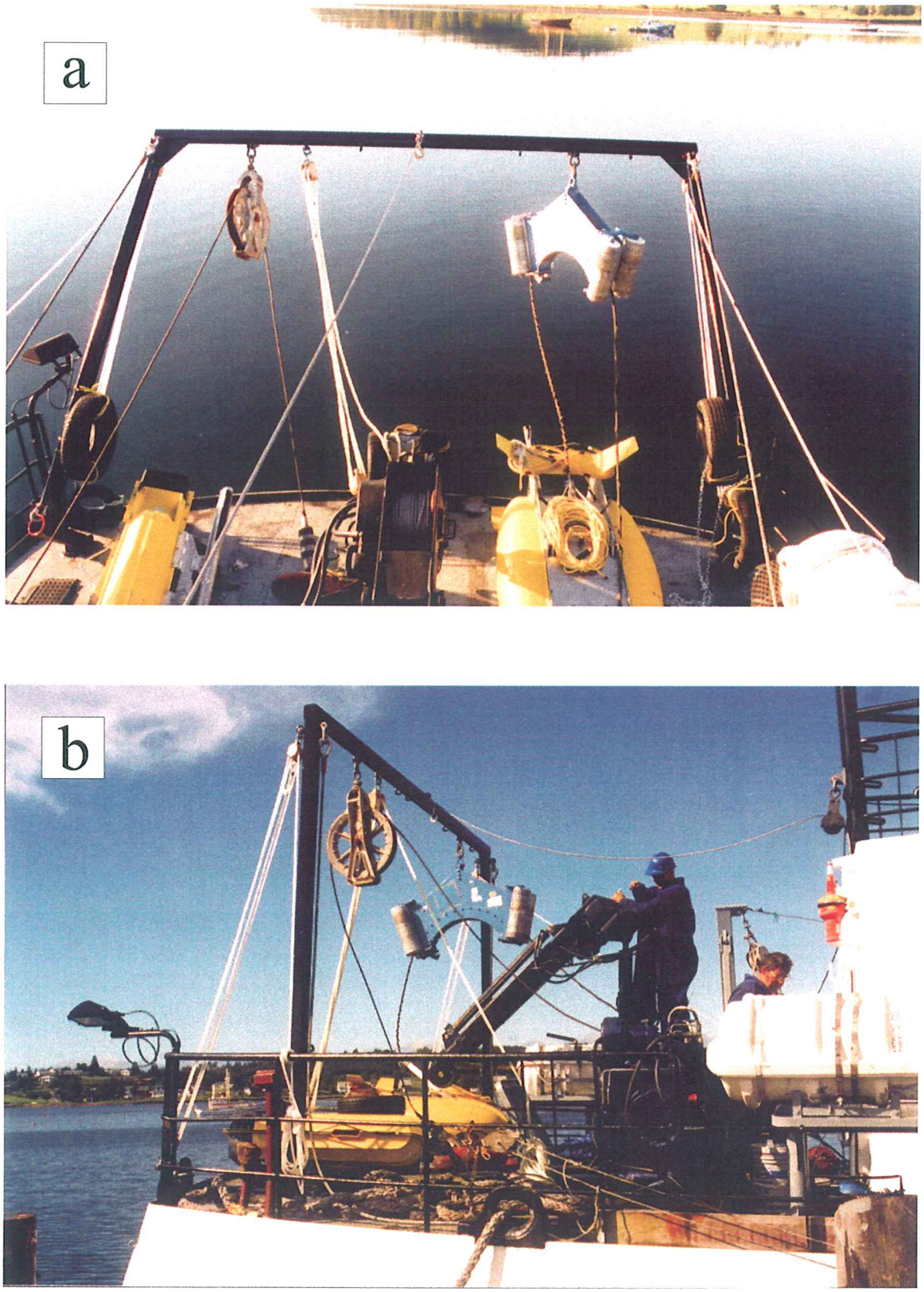


Figure 7a, b, c. Deploying A-frame and geophysical gear from the stern of the *Hamilton Banker*.

Figure 7a, b, c, continued.

2. Cruise narrative - *B.J. Todd*

In this cruise narrative, all times are in Universal Time Coordinated (UTC) unless specified as Atlantic Standard Time (AST), which is three hours earlier than UTC (e.g. 1200 UTC is 0900 AST). Figure 8 shows the extent of the tracklines of the *Hamilton Banker* on Georges Bank. More detailed track charts of the Huntec and sidescan sonar fish positions accompany this Open File Report.

Monday, September 27 (Day 270) to Friday, October 1 (Day 274)

From **September 27 (Day 270)** until **October 1 (Day 274)**, the *Hamilton Banker* underwent mobilization at the Deep Sea Trawlers facility in Lunenburg, Nova Scotia.

Saturday, October 2 (Day 275)

On **October 2 (Day 275)**, the ship departed Lunenburg at 1200 and proceeded offshore Lunenburg Harbour to test deployment of the A-frame and geophysical equipment. The A-frame exhibited a pronounced tendency to swing inboard when the weight of the geophysical instruments was applied. Therefore, the ship returned to dock just after 1500 and the ship's crew and scientific staff disembarked for the weekend.

Monday, October 4 (Day 277)

On **October 4 (Day 277)**, the scientific staff returned to the ship at 1300. During the day, an hydraulic piston was connected to the port vertical support of the A-frame. However, the piston leaked and a part had to be ordered.

Tuesday, October 5 (Day 278)

The piston was repaired on **October 5 (Day 278)** and the A-frame and geophysical equipment were deployed over the stern after 1600. At 1722, the ship departed the dock and steamed into Lunenburg Harbour. All the equipment was deployed again at 1750, and data were logged to ensure that all systems were working properly. At 1844, all gear was brought onboard and the ship steamed for Georges Bank.

Wednesday, October 6 (Day 279)

The ship reached the geophysical equipment deployment position on Georges Bank at 1145 on **October 6 (Day 279)**. The sea state was not high enough to prevent deployment, but conditions did cause some delay while the sequence of activities was carefully considered. In spite of the care taken, the sidescan cable got wrapped around the sidescan fish and this instrument was brought back on board and untangled. By 1215, data were being logged on board as the ship steamed southwest on **line 100**. The course was altered to the south at 1928 for **line 101**.

Thursday, October 7 (Day 280)

On **October 7 (Day 280)**, **line 101** was completed at 0104 and the longest single line of the survey, **line 102**, was run to the northwest along the international border. At 2111, the ship turned to the east and ran for almost three hours along **line 103** before turning southeast along **line 104** at 2345.

Friday, October 8 (Day 281)

On **October 8 (Day 281)**, the Huntec fish snagged fishing gear near the south end of **line 104** at 1436. Data logging was suspended and all equipment was brought on board at 1453. The ship's heading was altered to the northeast to **line 105**. By 1528, the sidescan and Huntec were redeployed. However, data were not logged across the deep water of Corsair Canyon. Data logging was initiated at 1623. At 1747, the ship's course was altered to the northeast on **line 106**.

Saturday, October 9 (Day 282)

Line 106 was run until 0603 on **October 9 (Day 282)**, when the ship altered course to the east to **line 107**. This short line ended at 0702 when the ship altered course to the southeast to **line 108**. **Line 109** to the northeast began at 1734 and ended at 1937. The ship's course was altered to the northwest to **line 110** which was surveyed until 0430 on **October 10 (Day 283)**.

Sunday, October 10 (Day 283)

Line 111 was surveyed to the southeast in deep water (~200 m) along the northern edge of Georges Bank adjacent to Northeast Channel. At 0736, the ship's course was altered to the south-southwest to **line 112** which was surveyed until 1240. **Line 113** was then surveyed to the southwest until 1519, when the ship's course was altered to the south along **line 114**. This line was surveyed until 2207 when the ship's course was altered to the north-northwest on **line 115**.

Monday, October 11 (Day 284)

On **October 11 (Day 284)**, **line 115** was completed at 0220 and the ship's course was altered to the northeast to **line 116**. **Line 117** to the west-southwest was surveyed from 1022 to 1704. The ship's course was altered to the southeast and **line 118** was surveyed until 0052 on **October 12 (Day 285)**.

Tuesday, October 12 (Day 285)

Line 119 was surveyed to the northeast until 0345 when the ship's course was altered to the northeast and **line 120** was surveyed until the Huntec external hydrophone signal was lost at 1408. The Huntec was brought on board by 1430. It was then recognized that the Huntec cable needed to be reterminated due to wear. Therefore, it was decided to proceed to an area of possible paleodrainage channels and undertake a sidescan sonar mosaic survey, hereafter referred to as **Mosaic 1** (Fig. 9 and on accompanying charts). Using only the sidescan sonar, **Line 121** was run to the southwest to Mosaic 1 from 1457 to 1930. The nine survey lines comprising **Mosaic 1** are approximately 6 km long, oriented west-east at a north-south spacing of about 200 m, and number from **122** (starting at 1930) to **130** (ending at 0312 on **October 13, Day 286**).

Wednesday, October 13 (Day 286)

As the Huntec retermination was not complete, the ship steamed west on **line 131** and reached **Mosaic 2** at 0444 (Fig. 10 and on accompanying charts). **Mosaic 2** was chosen to investigate a range of backscatter intensity over flat sea floor and sea floor with sandwaves up to 20 metres in height. The twelve survey lines comprising **Mosaic 2** are approximately 12 km long, oriented west-east at a north-south spacing of about 200 m, and number from

132 (starting at 0444) to **146** (ending at 0737 on **October 14, Day 287**).

Thursday, October 14 (Day 287)

The Huntec fish was deployed early in the survey of **Mosaic 2** (at 0945 on **October 13, Day 286**) on the turn from **line 134** to **line 135**. On **line 145**, navigation problems were encountered at 0420 (**October 14, Day 287**) and the ship circled and came back on line at 0507. By 0700, the sea conditions had worsened. However, **line 146** was completed at 0737 and all equipment was brought on board and secured by 0755. Sea conditions generated by winds of up to 55 knots prevented surveying for the remainder of **October 14 (Day 287)**.

Friday, October 15 (Day 288)

Conditions improved on **October 15 (Day 288)** and the equipment was deployed. Because sea conditions were still a bit rough, some complications arose. A fin was broken off the iron sidescan depressor fish as it was dragged across the deck. The ship's propellor caught the Huntec external eel, but no damage was done. The sidescan fish got tangled in cables as it was deployed and it had to be brought back on board to be reorganized. By 1510, all problems had been overcome, the equipment was successfully deployed, and the ship surveyed to the north-northeast along **line 147**. This line, and **lines 148 to 152**, were designed to investigate possible paleodrainage and current scour features interpreted from the multibeam bathymetry. **Line 152** was completed at 2224 and the ship altered course to the west on **line 153**.

Saturday, October 16 (Day 289)

Line 153 was completed on **October 16 (Day 289)** at 0240 and the ship altered course to the southeast on **line 154**. This line was completed at 1748 and the ship altered course to the north to **line 155**. This line was completed at 1912 and the ship altered course to the north-northeast on **line 156**. This line was completed at 2002 and the ship altered course to the northwest on **line 157**.

Sunday, October 17 (Day 290)

Line 157 was completed at 0755 on **October 17 (Day 290)** and the ship altered course to the east on **line 158**. **Lines 158 to 161**, to the east and south east, completed the

survey of Georges Bank by 2002. **Lines 162 to 165** were run across Northeast Channel and on to southern Browns Bank to provide information for a recent CHS multibeam survey in the region of possible coral habitat. Much of the Northeast Channel was too deep to sidescan sonar because the cable length was short.

Monday, October 18 (Day 291)

Line 165 was completed on **October 18 (Day 291)** at 0004. All the gear was secured on board by 0025 and the ship proceeded to Lunenburg. The geophysical equipment was demobilized while underway and the *Hamilton Banker* reached Lunenburg at approximately 1600 on **October 18 (Day 291)**.

Tuesday, October 19 (Day 292) to Wednesday, October 20 (Day 293)

On **October 19 (Day 292)** and **October 20 (Day 293)** scientific staff continued demobilizing the geophysical equipment and mobilizing the sampling equipment. The *Hamilton Banker* departed from Lunenburg at 1940 on **October 20 (Day 293)** and steamed for Georges Bank.

Thursday, October 21 (Day 294)

On the morning of **October 21 (Day 294)**, the ship reached Georges Bank. However, the sea state had increased during the night and it was not possible to safely launch and recover the van Veen grab or the Benthos camera. Original plans had called for 6 hour-long watches to ensure a continuous sampling survey. However, because of the layout of the ship and the sampling equipment, it soon became evident that three scientific personnel were required on the afterdeck and one on the bridge. Therefore, it was decided that a twelve hour sampling schedule (0900 to 2100) was optimum.

In the afternoon, the sea state had decreased enough to deploy the van Veen grab, but not the Benthos camera. **Stations 1 to 3** were occupied and sampling was suspended.

Friday, October 22 (Day 295)

On **October 22 (Day 295)**, **stations 4 to 16** were occupied by the van Veen grab. The Benthos camera was attempted at **station 4**, but it appeared to fire repeatedly on the deck

both before and after the deployment but not on the sea floor. The smaller, more manageable ice hole camera was inoperable due to a lack of batteries. After **station 16** at 1939, the sea state had increased to the point where further sampling operations were not possible. The ship then steamed for Shelburne to pick up battery packs for the ice hole camera.

Saturday, October 23 (Day 296)

The *Hamilton Banker* arrived in Shelburne at 1100 on **October 23 (Day 296)**. The new batteries were inserted in the ice hole camera and the camera was successfully tested at the dock. At 1800, the ship headed back to Georges Bank.

Sunday, October 24 (Day 297) to Tuesday, October 26 (Day 299)

On **October 24 (Day 297)**, the sea was too rough for sampling. An unsuccessful sampling attempt was made on **October 25 (Day 298)**, after which sampling was suspended and the *Hamilton Banker* returned to Lunenburg on **October 26 (Day 299)** at 1030. The navigation and sampling gear were demobilized.

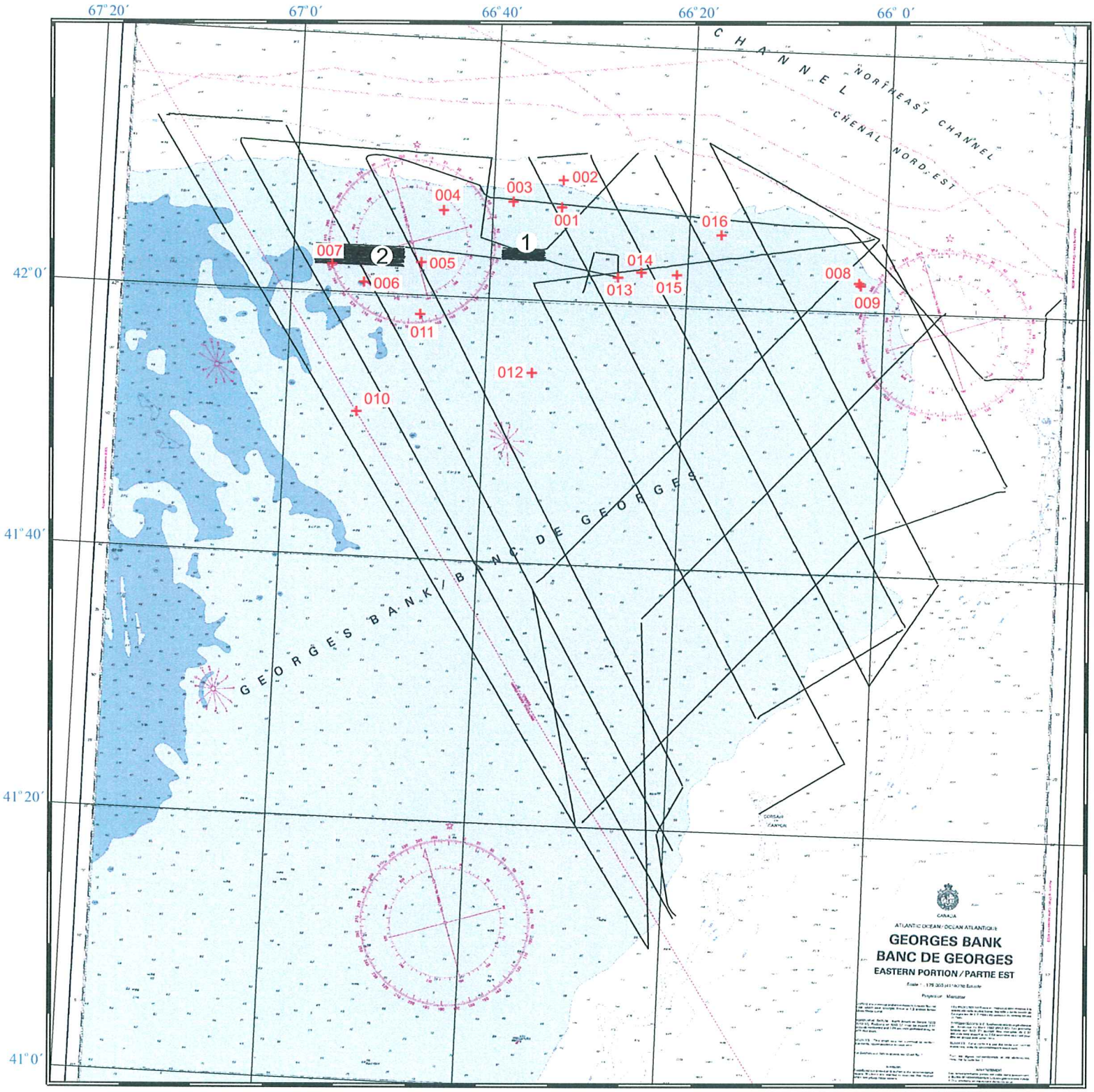


Figure 8. Tracklines of the *Hamilton Banker* on Georges Bank. Sample sites are shown in red and numbered. Mosaic areas 1 and 2 are labelled.

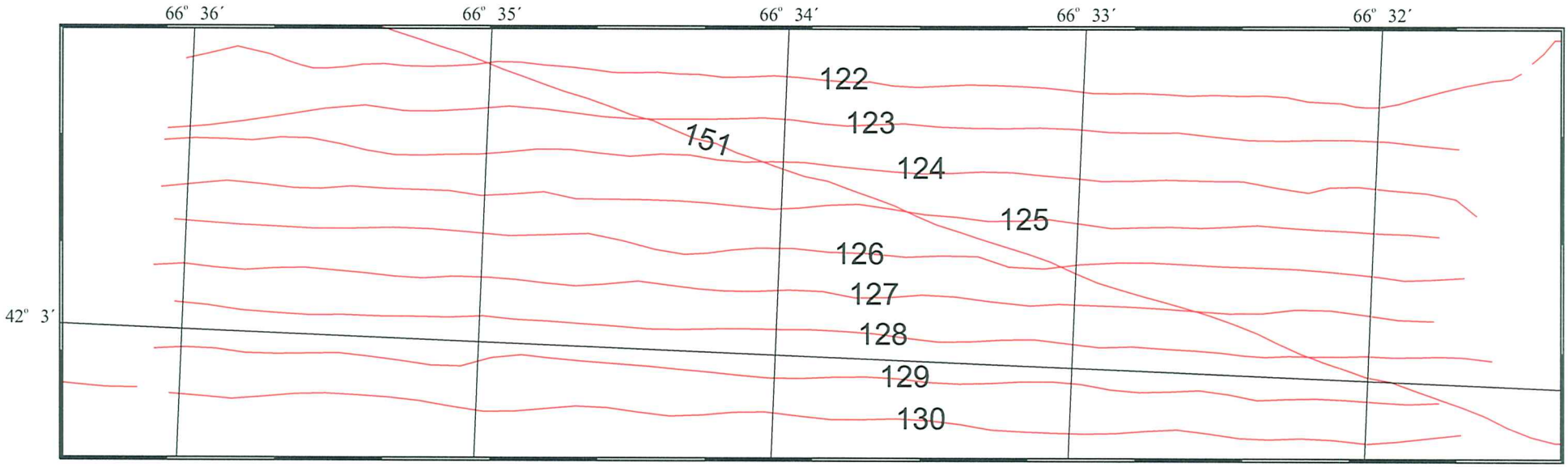


Figure 9. Mosaic area 1.

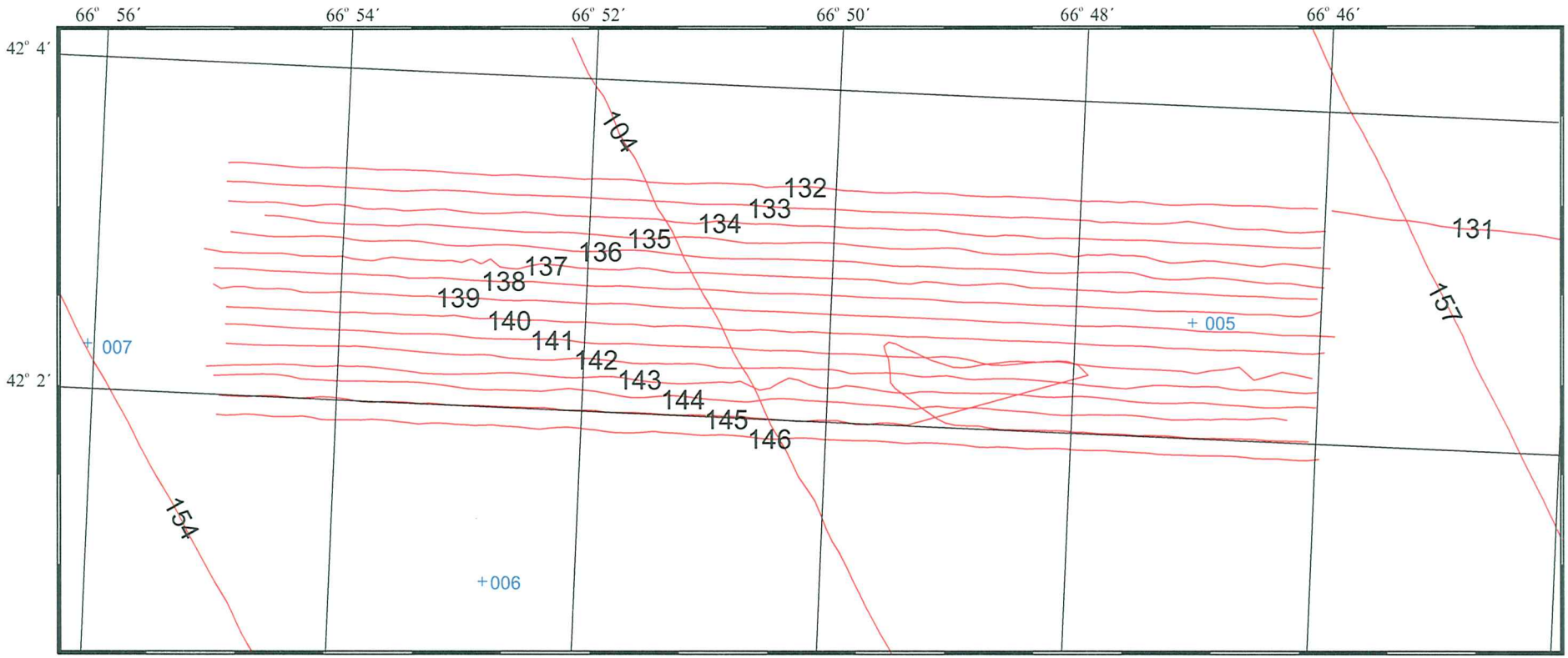


Figure 10. Mosaic area 2.

3. Navigation and positioning - *D.E. Beaver*

3.1 AGCNav and Regulus

Navigation during the 1999 *Hamilton Banker* cruise to Georges Bank was accomplished using AGCNav and Regulus, navigation computer programs which receive input via the serial port in the form of standard NMEA strings. Figure 11 provides a schematic of the navigation hardware configuration. The equipment used on this cruise to generate the NMEA strings included GPS receiver (Novatel 3151R), heading (KVH magnetic compass, adjusted to true north), and an ultra-short baseline acoustic positioning system (ORE Trackpoint II). All NMEA strings were fed into a Baytech multiplexer and then sent to a Black Box splitter. This signal was then fed to the AGCNav master computer and backup, as well as Regulus.

The following NMEA strings were used for positioning of the vessel and towed bodies, and were logged for post-processing:

- $GPGGA: GPS time, latitude and longitude of the GPS antenna in the WGS-84 coordinate system, and various GPS satellite information fields
- $HCHOM: Heading of vessel relative to true north
- $GPVTG: Course over ground in degrees, speed over ground in knots
- $POREB: Proprietary string created by AGCNav which handles ORE Trackpoint II data including, towfish depth, slant range, and bearing
-$POREP: Created by AGCNav to display towfish position

AGCNav was setup on computers on the bridge. The bridge computer acted as the master station, meaning that it received the NMEA strings, displayed the vessel location (and the location of the two towed bodies). The other AGCNav computer on the bridge was used soley as a backup. Regulus was also used for testing.

The logging of the navigation data was done on two AGCNav computers and Regulus. AGCNav has a file naming convention based on the ship's name, Julian day, and file number that day. An example would be BANK285A.00E, where BANK are the first four letters of the ship's name, 285 is the Julian day, and "A" means it was the first file created on day 285. Each day the navigation data was backed up from both logging computers onto CD-ROM on the master computer. The raw navigation files (.00E) were converted to files

which contain only time, latitude and longitude (.00A) using ETOA file conversion software. The .00A files were then plotted using the program APLOT to view the navigation and to ensure that there were no data gaps. If data gaps were found, the data from the backup logger was used to fill the gaps.

During the cruise, the RTCM differential GPS correction signal (using 293, 312 and 316 kHz) was lost several times. As well, the GPS satellite signal was lost. During these periods, the ship's positioning was accomplished using only stand-alone GPS, with positional accuracy of approximately 30 metres. The status of the GPS can be found in the $GPGGA string and, if required, some of the data might have to be removed at a later date.

3.2 ORE Trackpoint II

A 3° offset was entered into the Trackpoint based on the observed bias. Visual inspection during towfish deployment agreed with this adjustment. Two transponders were tracked simultaneously in ORE's Fish Track mode: one was fitted to the Huntec DTS (transponder 6, transmit frequency of 19 kHz and receive frequency of 22 kHz) and the other to the Simrad 992 sidescan sonar (transponder 3, transmit frequency of 17 kHz and receive frequency of 26 kHz).

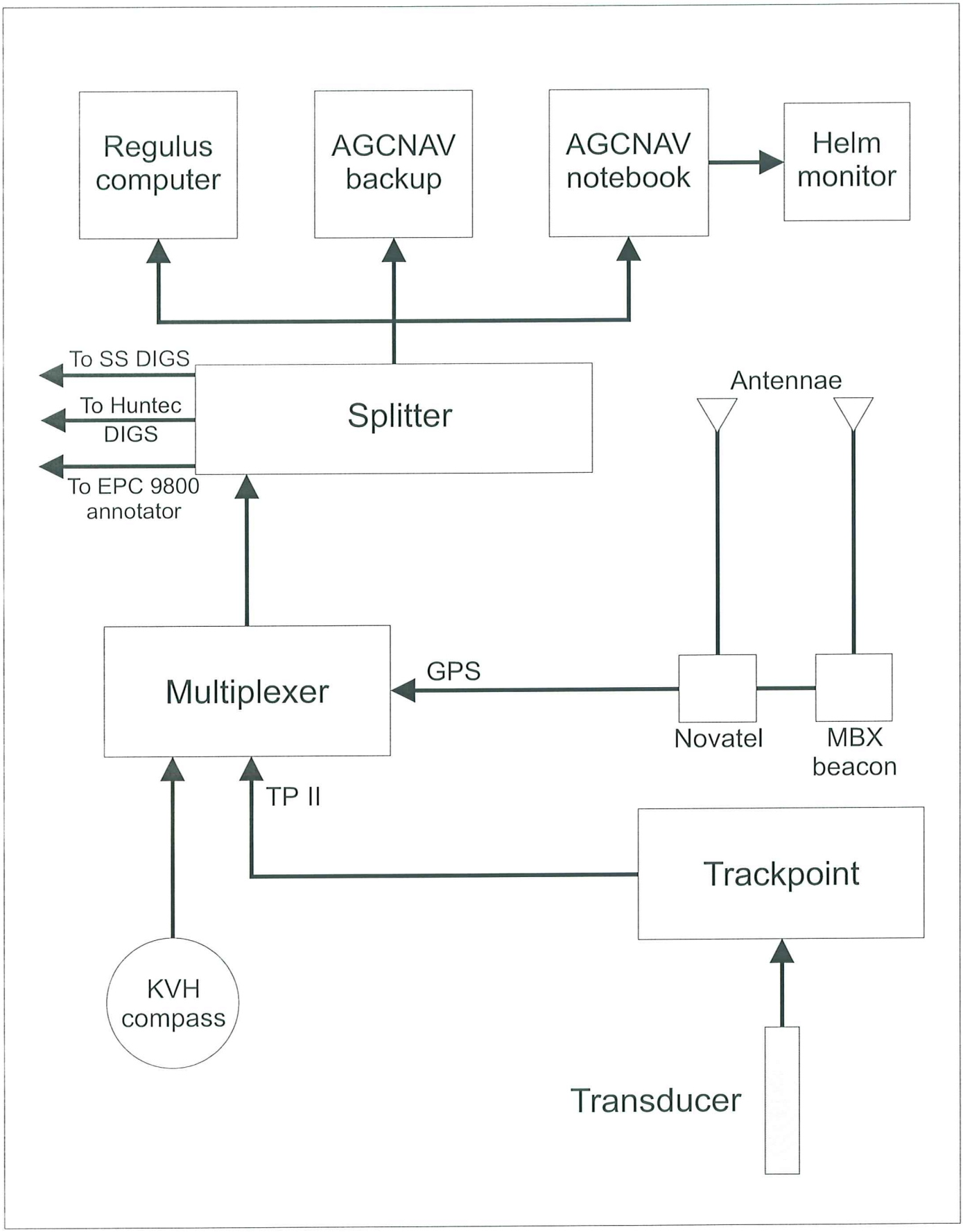


Figure 11. Schematic of navigation hardware configuration on the *Hamilton Banker*.

4. Geophysical survey

4.1 Overview - *B.J. Todd*

Pre-cruise planning and daily refinement of the ship's geophysical survey tracks on the *Hamilton Banker* cruise were based on careful study of the multibeam bathymetric and backscatter data provide by the Canadian Hydrographic Service. Targets and selected areas identified on these data sets were traversed by the ship using differential GPS for accurate navigation. The advantage that the multibeam data provides to enhance the usefulness of the conventional geophysical survey profiles cannot be overemphasized.

The objective of the geophysical survey was to collect regional geophysical survey lines across Georges Bank and to infill and augment data collected during the regional1982 *Fogo Isle* cruise, and CSS *Dawson* 89-001 and CSS *Hudson* 92-01 cruises on northern Georges Bank. To this end, 1847 km of Huntec DTS and sidescan sonar data were collected (Track plot 1). The data were output on plotters (Table 1) and, simultaneously, digitally recorded (Table 2). Data were of medium to high quality, due to the changeable sea state during the survey period.

4.2 Sidescan sonar system - *B.D. Wile*

The Simrad 992 sidescan sonar operated at dual frequencies of 120 kHz and 330 kHz with a 200 m range on each channel (400 m total insonification width). The fish was maintained 20 m or more above the sea floor.Hard copy was output on an Alden 9315 thermal grey scale printer (120 kHz). All four channels of sidescan data were recorded by an AGC DIGS digitizer and written to Exabyte 8 mm tape. Figure 12 provides a schematic of the sidescan system on the ship.

Two problems with the Simrad system were encountered:

1. The neutrally buoyant package became tangled in the A-frame lifting rope on two occasions. Also, the tow weight hit an obstruction on the deck and a fin was broken off.

2. The umbilical between the depressor and the neutral package should be redesigned. It failed on the last day of the survey at the termination point on the neutral package.

4.3 Huntec Deep Tow System - *M. Belliveau*

Equipment description - The PGC Huntec DTS system was used on this cruise (Table 1, Fig. 12). The maximum power output of this system is 540 joules (30 mfd storage capacitance) with an ED10 F/C Boomer and multi tip sparker source. The internal single-element LC10 hydrophone was configured as Seismic #1. The externally-towed Benthos Mesh 15/10P streamer hydrophone was connected as Seismic #2 (Table 2).

The ED10 boomer source is depth-compensated and outputs a highly repeatable broadband pulse, capable of resolving 10 centimetres vertically. Peak output intensity is 118 db relative to 1 micro bar at 1 metre, with a pulse duration of 110 microseconds. The sparker source has twenty, # 22 awg, solid core tips. Sparker peak amplitude and pulse width are depth dependant.

The deck equipment consisted of a Huntec Model 1000 Oceanographic winch, which included a multi-way slip ring and a 305 metre, fourteen conductor, armoured tow cable. The winch was powered by the SSS 220 VAC, 25 HP hydraulic pump unit. The tow cable was handled by a 36 inch diameter roller cluster rigged on the centre position of the aft A-frame.

The lab instrumentation consisted of the Huntec Systems Console and DC high voltage power supply (PCU). The Systems Console houses the Bottom Motion Compensator circuits, the +24 volt fish supply, and modules for signal processing and tape outputs. The Huntec Mk III PCU provides DC power to the boomer in switchable ranges from 2 to 6 kilovolts.

Graphic display and signal processing - The two Huntec seismic channels were displayed on a EPC 9800 dual channel recorder. Seismic #1 (internal LC10 hydrophone) was processed by the systems console's Adaptive Signal Processor (ASP) module and then displayed on Channel A of the EPC recorder. Seismic #2 (external streamer) was passed through a Krohn-Hite filter with a low pass setting of 3500 hertz, for display on Channel B of the EPC recorder.

Data recording - The Huntec signals were recorded on the AGC DIG unit #5: a digital, four channel logger with 8700 Exabyte tape drive (software version 2.33) (Table 3).

Equipment performance - The only Huntec system problem was a required retermination on Day 285 after loss of external steamer signal made gear recovery necessary. It was noted that about ten outer strands of armour cable were broken. This may have occurred after snagging fishing gear on Day 281, combined with cable strumming.

AGC DIG - The AGC DIG program locked occasionally causing an increase in tape use.

Data quality - The boomer source was used exclusively during the survey. In general, Huntec data quality was good. Occasional cable strumming caused objectionable noise on the internal hydrophone channel. The external streamer had to be checked a couple of times resulting in the underwater E/O connectors being regreased to eliminate intermittent data.

Recommendations -

1) The PGC winch should be modified for remote operation.
2) The fourteen-conductor armoured tow cable performed well, even after a snagged rope bent the cable severely at the towpoint. After several days, and significant cable strumming due to a lack of cable fairing, the tow cable had to be reterminated. At the conclusion of the survey, the tow cable had one broken strand in the outer armour; the cable should be reterminated and have cable fairing applied.
3) The intermittent external streamer did not need to be regreased after the retermination but the old streamer's E/O connection is worn and is suspect. The streamer's tail rope was cut off by the ship's prop and the tail rope and drogue were replaced. Damage to the streamer was not evident but replacing the E/O connection would be advisable.
4) The EPC 9800 had paper feed problems which were fixed by adjusting the machine.
5) Running the Huntec and sidescan systems on the same power pack is not advisable and data quality is compromised.
6) The roller cluster lost the top bolt on the starboard side and caused excessive wear on the large roller. The large roller should be removed, repaired and/or replaced.

4.4 Digital tape recording - *B.D. Wile*

The AGC DIGS for both sidescan and Huntec had only one problem. The DIGS software often locked at the time of a file change (i.e. the automatic hourly change or manual change). The malfunction occurred more frequently on the Huntec DIGS (unit #2). All of the serial data from the MUX going into AGCNav was also passed into DIGS for logging. This

did not appear to cause any problems. After each tape was removed, the "set clock" utility was executed and the drives were cleaned.

References

Geonautics Limited, 1982. A geophysical survey of the Georges bank, Georges Basin and Northeast Channel area of the Gulf of Maine. Geological Survey of Canada, Open File Report 978, 3 volumes, 153 p., 4 appendices, 21 charts.

List of tables

Table 1. ***Hamilton Banker*** **1999 geophysical record inventory.**

Survey Line	Start		End		Huntec Record Number	Sidescan Record Number	Line Length (km) / Comment
	Day	Time	Day	Time			
100	279	1212	279	1928	1	1	59.8
101	279	1931	280	0104	2	2	46.2
102	280	0115	280	2111	3	3	135.2
103	280	2121	280	2345	4	4	17.5
104	280	2351	281	1430	5	5	117.0
105	281	1622	281	1747	6	6	26.5
106	281	1759	282	0603	7	7	95.5
107	282	0616	282	0702	8	8	8.2
108	282	0714	282	1726	9	9	84.3
109	282	1734	282	1937	10	10	17.0
110	282	1949	283	0430	11	11	69.6
111	283	0440	283	0736	12	12	27.0
112	283	0743	283	1240	13	13	39.3
113	283	1247	283	1515	14	14	21.5
114	283	1519	283	2200	15	15	55.8
115	283	2215	284	0220	16	16	34.1

Survey Line	Start		End		Huntec Record Number	Sidescan Record Number	Line Length (km) / Comment
	Day	Time	Day	Time			
116	284	0227	284	1015	17	17	48.1
117	284	1022	284	1704	18	18	48.1
118	284	1711	285	0052	19	19	68.3
119	285	0056	285	0346	20	20	24.0
120	285	0349	285	1415	21	21	77.8
121	285	1457	285	1930	—	22	20.0
122	285	1930	285	2032	—	23	6.0, Mosaic 1
123	285	2037	285	2117	—	24	6.0, Mosaic 1
124	285	2123	285	2208	—	25	6.0, Mosaic 1
125	285	2214	285	2256	—	26	6.0, Mosaic 1
126	285	2307	285	2346	—	27	6.0, Mosaic 1
127	285	2355	286	0036	—	28	6.0, Mosaic 1
128	286	0045	286	0129	—	29	6.0, Mosaic 1
129	286	0138	286	0221	—	30	6.0, Mosaic 1
130	286	0230	286	0312	—	31	6.0, Mosaic 1
131	286	0312	286	0444	—	32	13.5
132	286	0444	286	0613	—	33	12.2, Mosaic 2
133	286	0618	286	0747	—	34	12.2, Mosaic 2

Survey Line	Start		End		Huntec Record Number	Sidescan Record Number	Line Length (km) / Comment
	Day	Time	Day	Time			
134	286	0755	286	0938	—	35	12.2, Mosaic 2
135	286	0955	286	1123	22	36	12.2, Mosaic 2
136	286	1138	286	1311	23	37	12.2, Mosaic 2
137	286	1321	286	1507	24	38	12.2, Mosaic 2
138	286	1515	186	1648	25	39	12.2, Mosaic 2
139	286	1656	286	1810	26	40	12.2, Mosaic 2
140	286	1817	186	2001	27	41	12.2, Mosaic 2
141	286	2007	286	2121	28	42	12.2, Mosaic 2
142	286	2134	286	2325	29	43	12.2, Mosaic 2
143	286	2335	287	0117	30	44	12.2, Mosaic 2
144	287	0131	287	0255	31	45	12.2, Mosaic 2
145	287	0304	287	0536	32	46	12.2, Mosaic 2
146	287	0546	287	0737	33	47	12.2, Mosaic 2
147	288	1527	288	1614	34	48	6.2
148	288	1624	288	1647			3.3
149	288	1658	288	1722			3.2
150	288	1732	288	1835			7.7
151	288	1835	288	2029			12.1

Survey Line	Start		End		Huntec Record Number	Sidescan Record Number	Line Length (km) / Comment
	Day	Time	Day	Time			
152	288	2040	288	2224			11.3
153	288	2238	289	0240	35	49	35.0
154	289	0240	289	1748	36	50	124.7
155	289	1755	289	1912	37	51	12.0
156	289	1912	289	2002			7.6
157	289	2002	290	0755	38	52	99.0
158	290	0755	290	1030	39	53	18.0
159	290	1030	290	1556	40	54	42.0
160	290	1556	290	1658	41	55	8.1
161	290	1658	290	2002			28.2
162	290	2002	290	2057	42	56	8.2
163	290	2057	290	2156			9.1
164	290	2156	290	2304			10.2
165	290	2304	291	0004			9.1

Table 2: *Hamilton Banker* 1999 digital tape start and stop times.

Instrument	Tape Number	Start day/time	End day/time	File nos.
Huntec DTS	1	279 / 1252	279 / 2257	1-10
	2	279 / 2302	280 / 1115	1-14
	3	280 / 1143	280 / 1803	1-7
	4	280 /1806	281 / 1315	1-23
	5	281 / 1315	283 / 1238	1-47
	6	283 / 1247	284 / 0959	1-22
	7	284 / 1005	284 / 2105	1-12
	8	284 / 2153	284 / 2253	1
	9	284 / 2302	285 / 0103	1-2
	10	285 / 0111	285 / 1111	1-10
	11	285 / 1121	286 / 2001	1-16
	12	286 / 2013	286 / 2221	1-3
	13	286 / 2229	287 / 0737	1-12
	14	288 / 1517	289 / 0000	1-13
	15	289 / 0020	290 / 2307	1-60
	16	290 / 2312	291 / 0004	1-7
Sidescan	1	279 / 1212	280 / 0815	1-22
	2	280 / 0900	280 / 1712	1-9
	3	280 / 1715	281 / 2145	1-29
	4	281 / 2200	282 / 2115	1-25
	5	282 / 2116	283 / 1234	1-16
	6	283 / 1247	284 / 0956	1-22
	7	284 / 0959	285 / 2346	1-40
	8	285 / 2355	286 / 0938	1-13
	9	286 / 0955	286 / 1311	1-4

Instrument	Tape Number	Start day/time	End day/time	File nos.
	10	286 / 1316	287 / 0420	1-21
	11	287 / 0507	287 / 0737	1-4
	12	288 / 1516	289 / 2049	1-32
	13	289 / 2055	290 / 1319	1-16
	14	290 / 1325	291 / 0004	1-15

Table 3. Huntec DTS equipment.

Unit description	Serial Number
Tow Fish Body	PGC
ED10F/C Boomer Source	2015
MK5-2 Attitude Sensor Unit	N/A
S500 Energy Storage Unit	1017
Internal LC 10 Hydrophone	N/A
External Benthos 15/10P Streamer	103
Huntec Oceanographic Winch and Power Pack	---
Roller Cluster 36" Dia.	---
Systems Console	102
EPC 9800 Graphic Recorder	104
MK 3 Power Control Unit	120
Krohn-Hite 3550R Filter	N/A
AGC DIG Data Logger	#5

Table 4. Equipment settings.

Parameter	Setting
Fire rate	1.0sec.
PCU power setting	4 kilovolts (240 joules)
ESU power setting	30 microfarad (540 joules max.)
BMC (motion compensation)	Pressure Mode
Display Gain	Seismic #1- Adaptive. Seismic #2- Max. EPC gain
Filter Setting - Internal - External	Seismic #1 - 500 - 6000 hertz Seismic #2 - 300 - 3500 hertz
Processor Gain (System Console)	4 kV int. / 2 kV ext
DTS source	Boomer
AGC DIG sample rate	60 to 110 microsecond
AGC DIG samples per channel	4096
AGC DIG base gain A/D board	4
EPC sweep speed	125, 250, 500 microsecond
EPC print polarity	positive

Table 5. Data recording parameters.

AGC DIG Inputs	Description
Ch. #1	Seismic #1 - Internal LC10 hydrophone
Ch. #2	Seismic #2 - External Benthos 15/10P streamer
Trigger	Print delay trigger

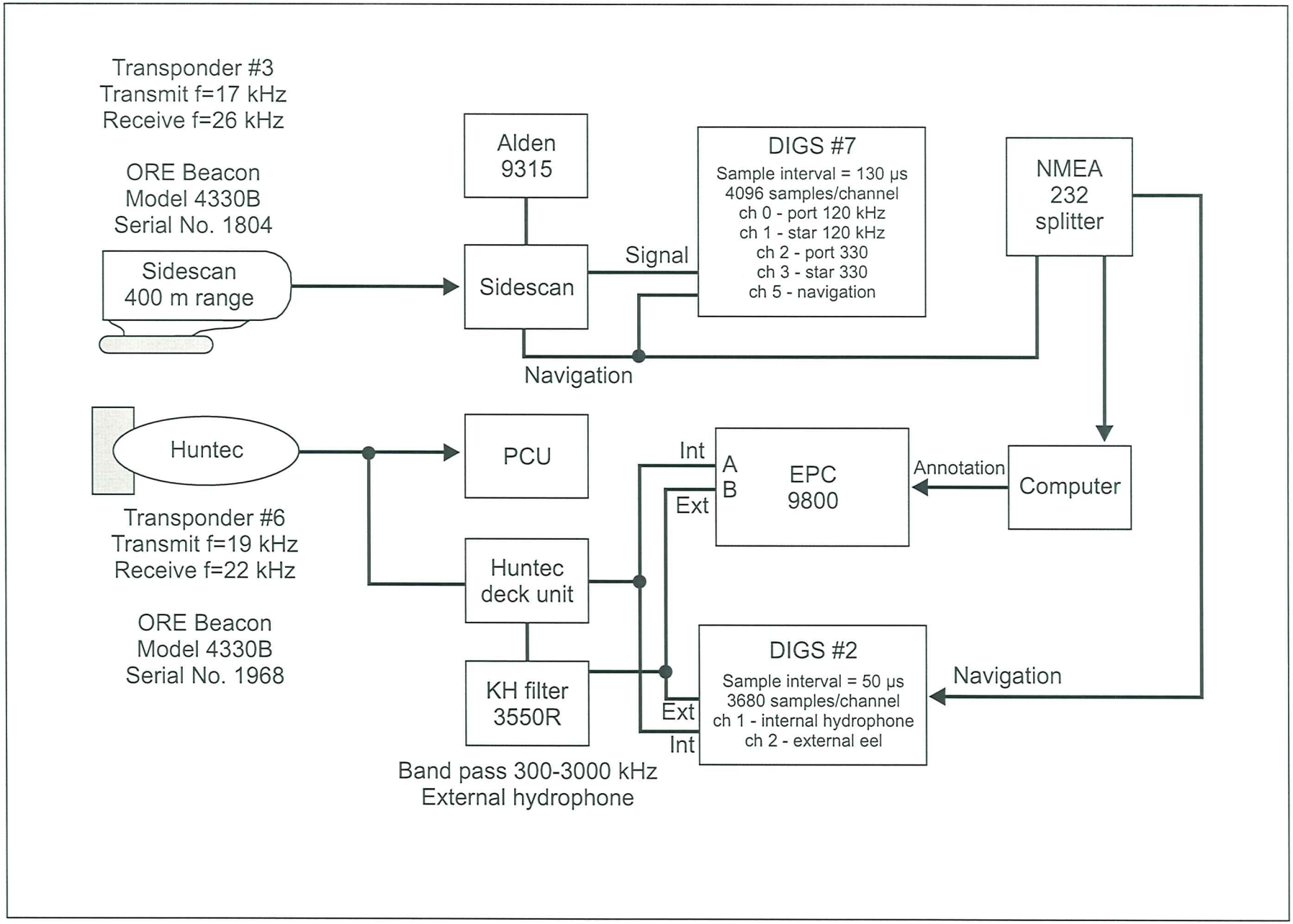


Figure 12. Schematic of Simrad sidescan sonar (upper) and Huntec DTS (lower) systems on the *Hamilton Banker*.

5. Geological sampling - *B.J. Todd and R. Murphy*

A van Veen grab sampler with a capacity of approximately 0.01 m^3 was used to obtain samples from the sea floor (Fig. 13). The van Veen grab was deployed over the stern using the starboard winch (Fig. 6). Sixteen stations were sampled (Table 1, Fig. 14). These sites were selected for sampling on the basis of the multibeam and/or geophysical information (Fig. 15).

Sample volumes in areas of sand were satisfactory. However, in areas of hard sea floor, the van Veen was able to obtain only small volumes of gravel. This may have been exacerbated by the strong currents; the angle of the winch cable was, more often than not, far off vertical. Therefore, the instrument may not have tripped on the sea floor in a manner most suited to sediment retrieval. To ensure more complete sediment retrieval on future Georges Bank surveys, an IKU grab is recommended.

List of tables

Table 1. Georges Bank grab sample information.

Station No.	Day/Time (UTC)	Latitude (°N)	Longitude (°W)	Water Depth (m)	Comments
1	294/1858	42.12376	66.550565	77	Priority Area 1- medium tone backscatter; Sediment - rounded to subangular cobbles in brown coarse sand
2	294/2003	42.15834	66.54982	143	Priority Area 1 - west-east trough on northern slope of Georges Bank; Sediment - rounded to subangular cobbles and pebbles over grey clay, a few small bivalves and shell fragments
3	294/2048	42.128335	66.63277	91	Line 157 - in prominent "hole", 165 m NW of target on first try, collected almost nothing; 55 m NW on second try, bagged together; Sediment -cobbles from both attempts bagged in same sample bag
4	295/0911	42.113388	66.750086	69	Priority Area 1 - Medium-toned backscatter; first attempt got one flat rock; second attempt got no sample, bottom must be hard
5	295/1027	42.044973	66.784125	62	Priority Area 1 - Barchan dune; Sediment - medium to coarse sand, pebbles, shell fragments and a scallop shell
6	295/1104	42.015796	66.879081	53	Priority Area 1 - Bedform field, darkest return on backscatter map; Sediment - fine to medium grained sand
7	295/1127	42.037888	66.934133	73	Line 154 - depression on north end of line; Sediment - medium to coarse grained sand, shell fragments
8	295/1216	42.03982	66.044373	68	Line 102 - Possible till (?) outcrop in a depression; Sediment - coarse grained sand and some shells
9	295/1235	42.036396	66.04147	62	Line 102 - On a large bedform; Sediment - sand and rounded pebbles

Station No.	Day/Time (UTC)	Latitude (°N)	Longitude (°W)	Water Depth (m)	Comments
10	295/1418	41.84972	66.880793	62	Line 102 - Possible till (?) outcrop; Sediment - first try, low volume of sand, second try, fine grained sand, broken shells
11	295/1532	41.977431	66.781543	62	Priority Area 1 - lightest tone in backscatter map; Sediment - cobbles, pebbles, little sand
12	295/1639	41.908596	66.58808	66	Priority Area 1 - Bedform; Sediment - clean, brown sand
13	295/1800	42.035758	66.451025	86	Priority Area 1 - Paleochannel (?); Sediment - first try, rounded pebbles, second try failed
14	295/1832	42.04337	66.412078	86	Priority Area 1 - Paleobeach (?); Sediment - rounded pebbles, cobbles and sand
15	295/1858	42.041878	66.351981	84	Line 108 - Possible till (?); Sediment - rounded pebbles, cobbles and some sand
16	295/1939	42.096371	66.279878	86	Line 120 - Possible till (?); Sediment - pebbles and sand

Figure 13. Van Veen grab sampler.

Station 1

Station 2

Station 3

Station 4

Figure 14. Grab sample deck photographs, 1999 *Hamilton Banker*.

Station 5

Station 6

Station 7

Station 8

Figure 14, continued.

Station 9

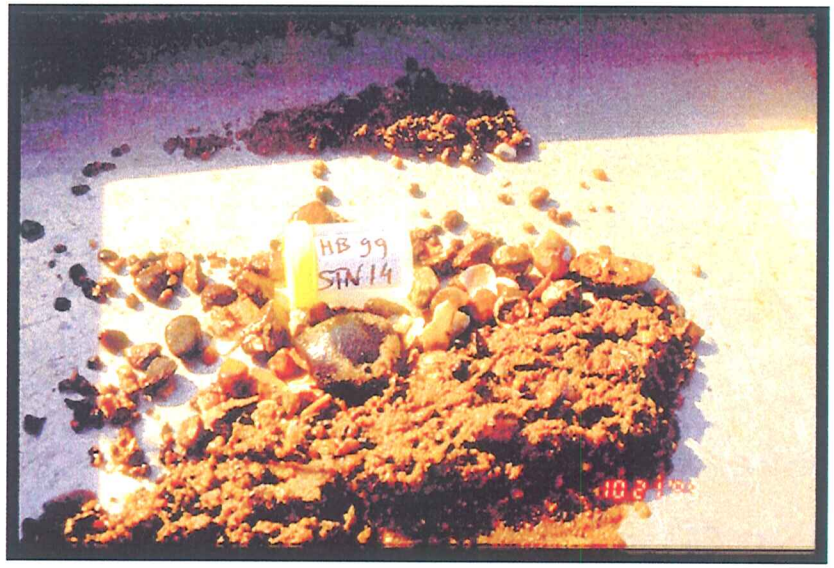
Station 10

Station 11

Station 12

Figure 14, continued.

Station 13



Station 14

Station 15

Station 16

Figure 14, continued.

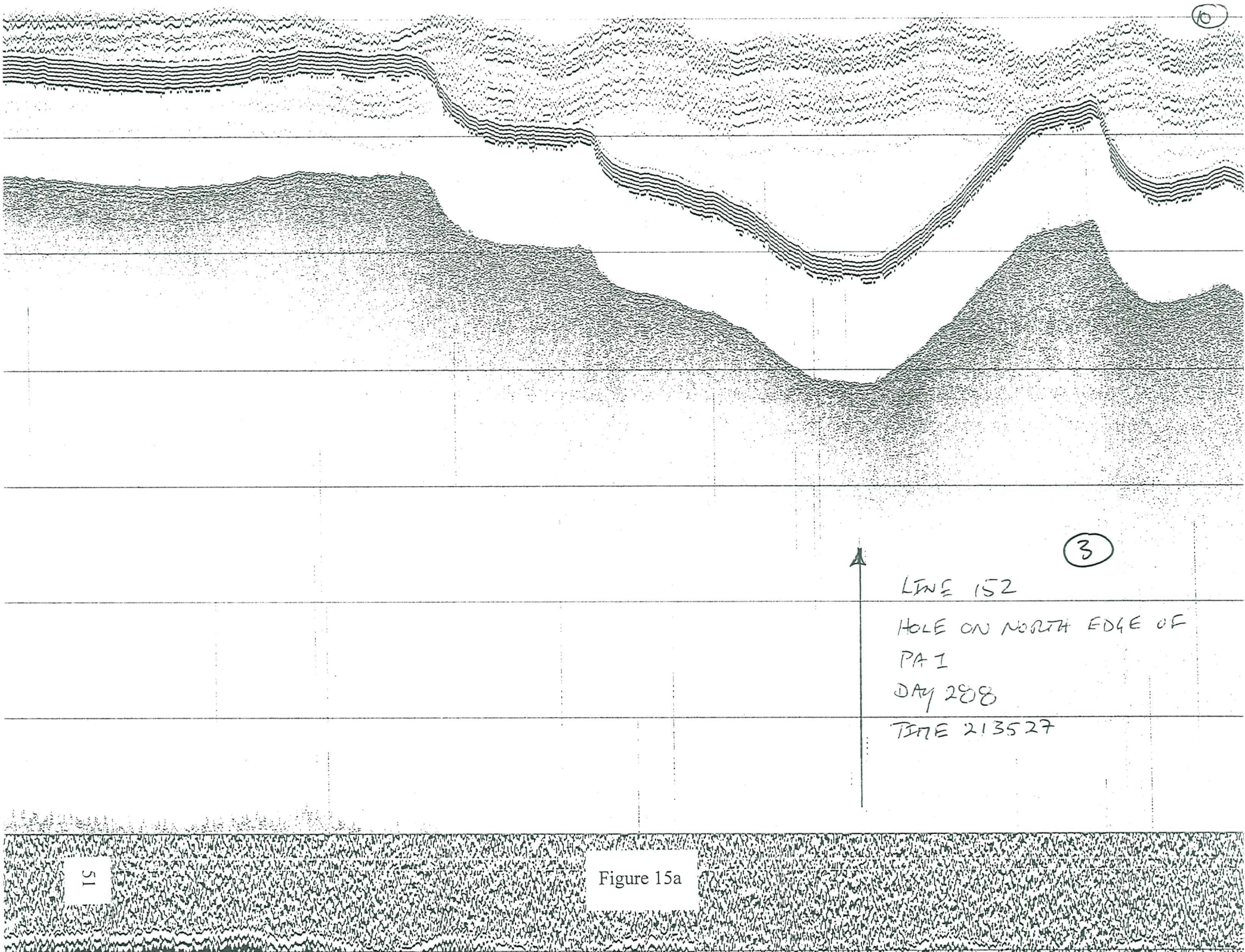


Figure 15a

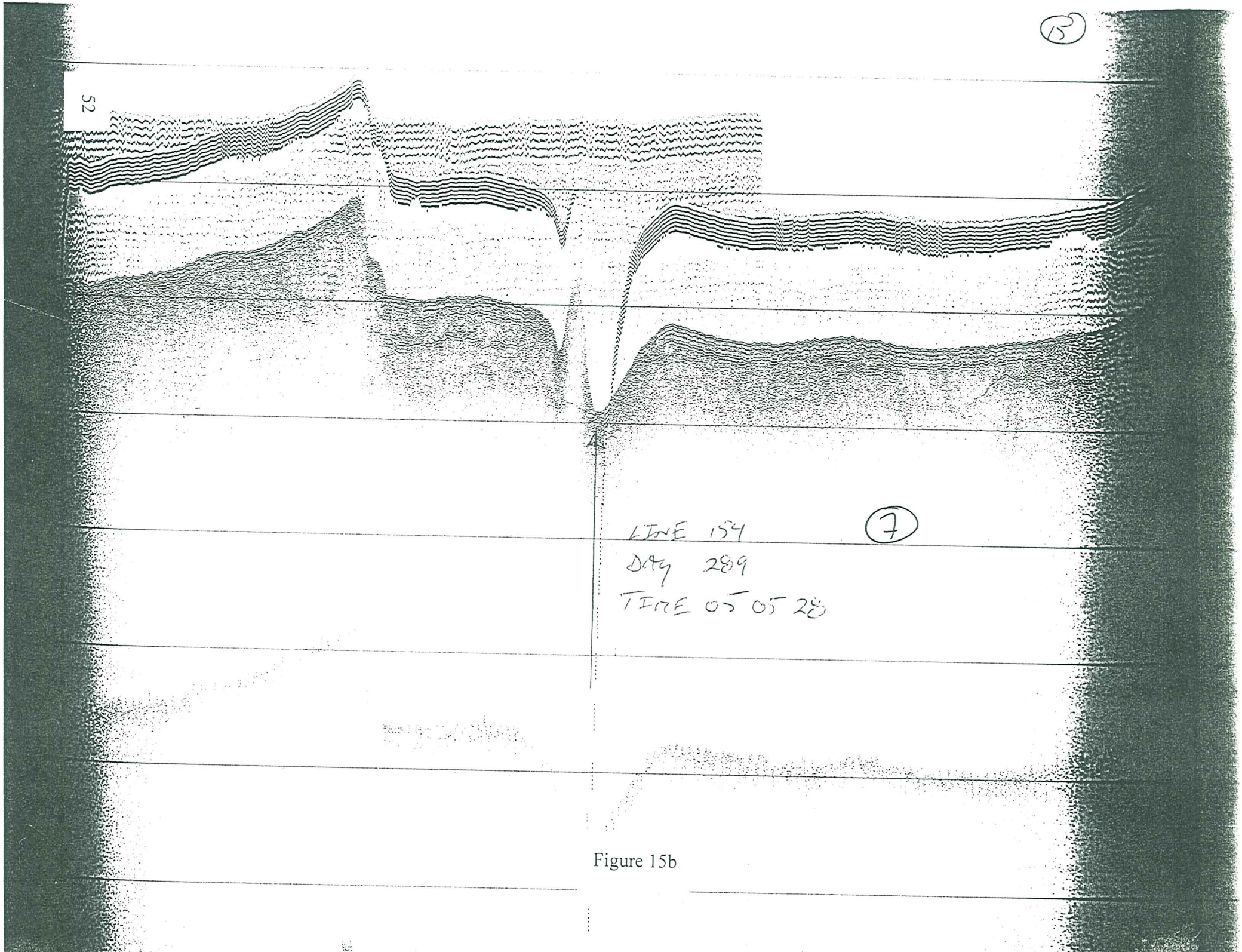
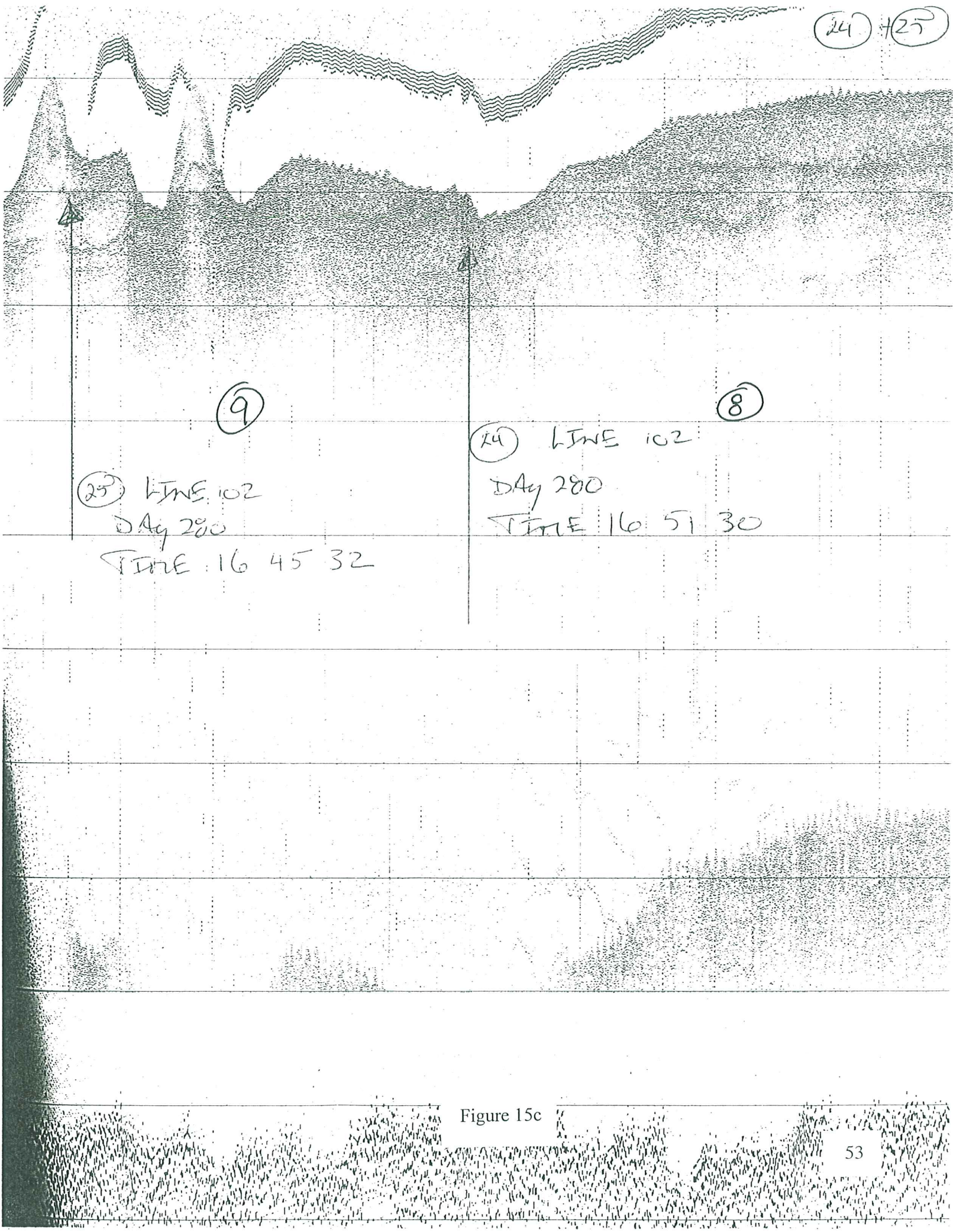


Figure 15b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9
8
24 LINE 102
DAY 280
TIME 16 51 30
25 LINE 102
DAY 280
TIME 16 45 32

Figure 15c

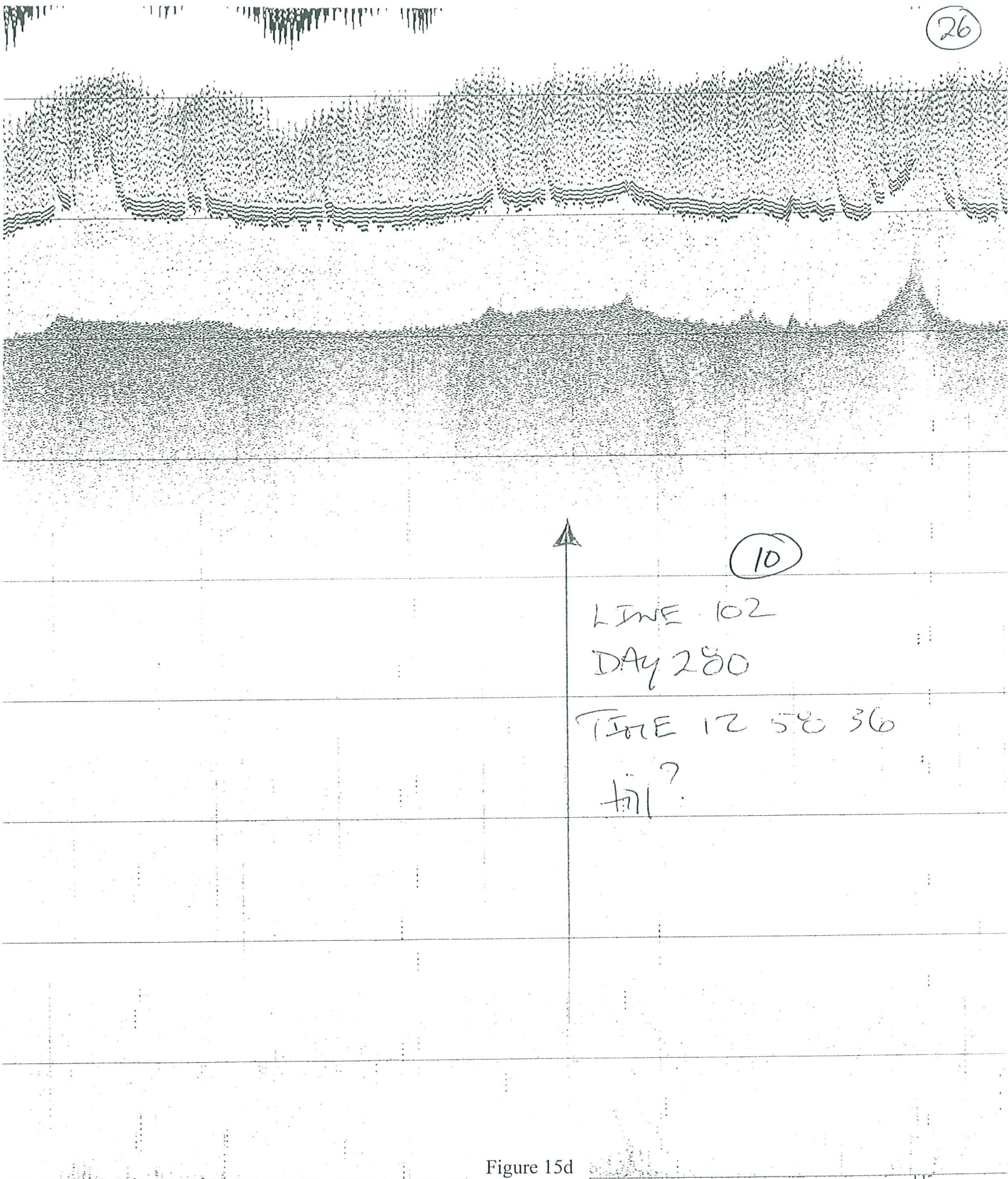

Figure 15d

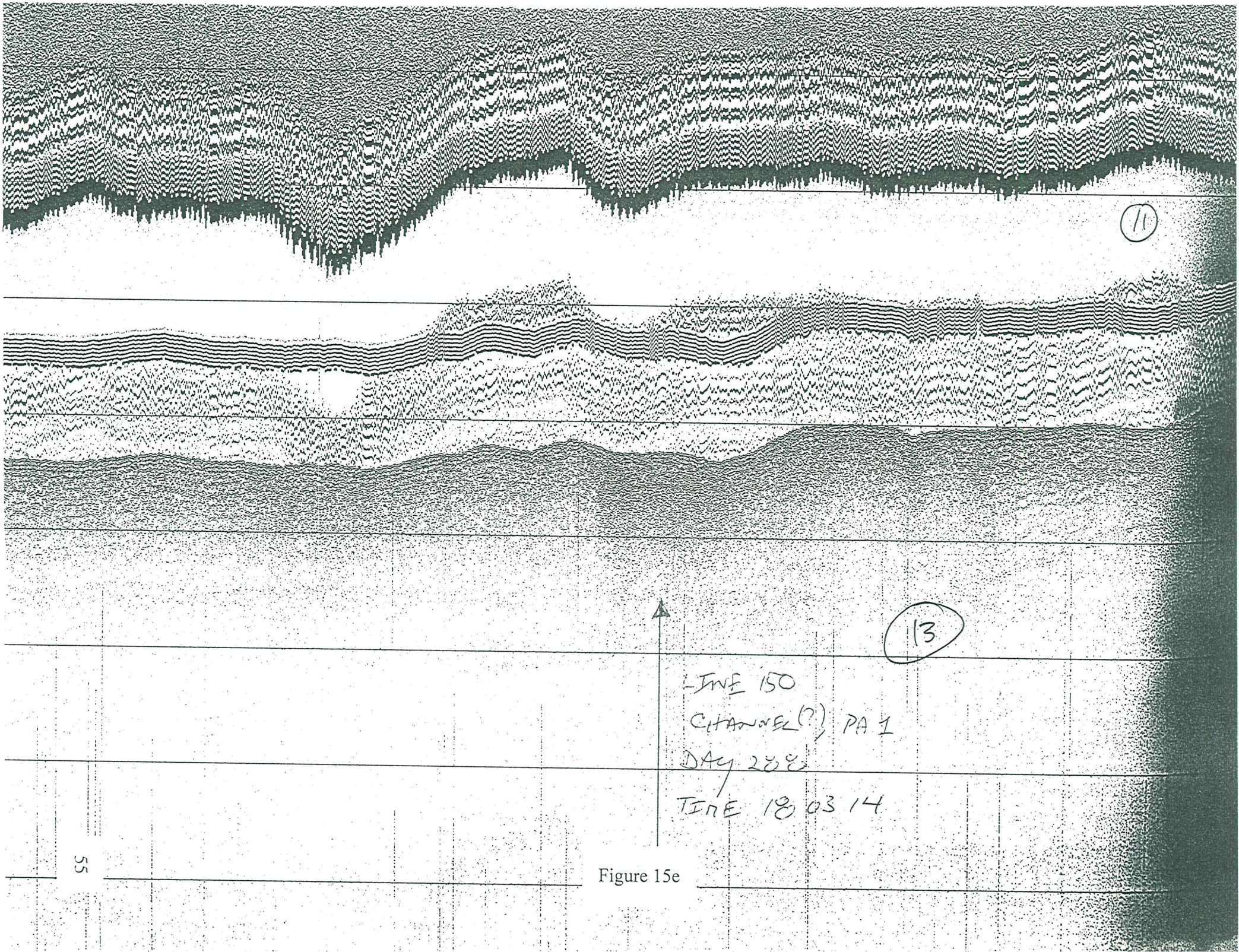

Figure 15e

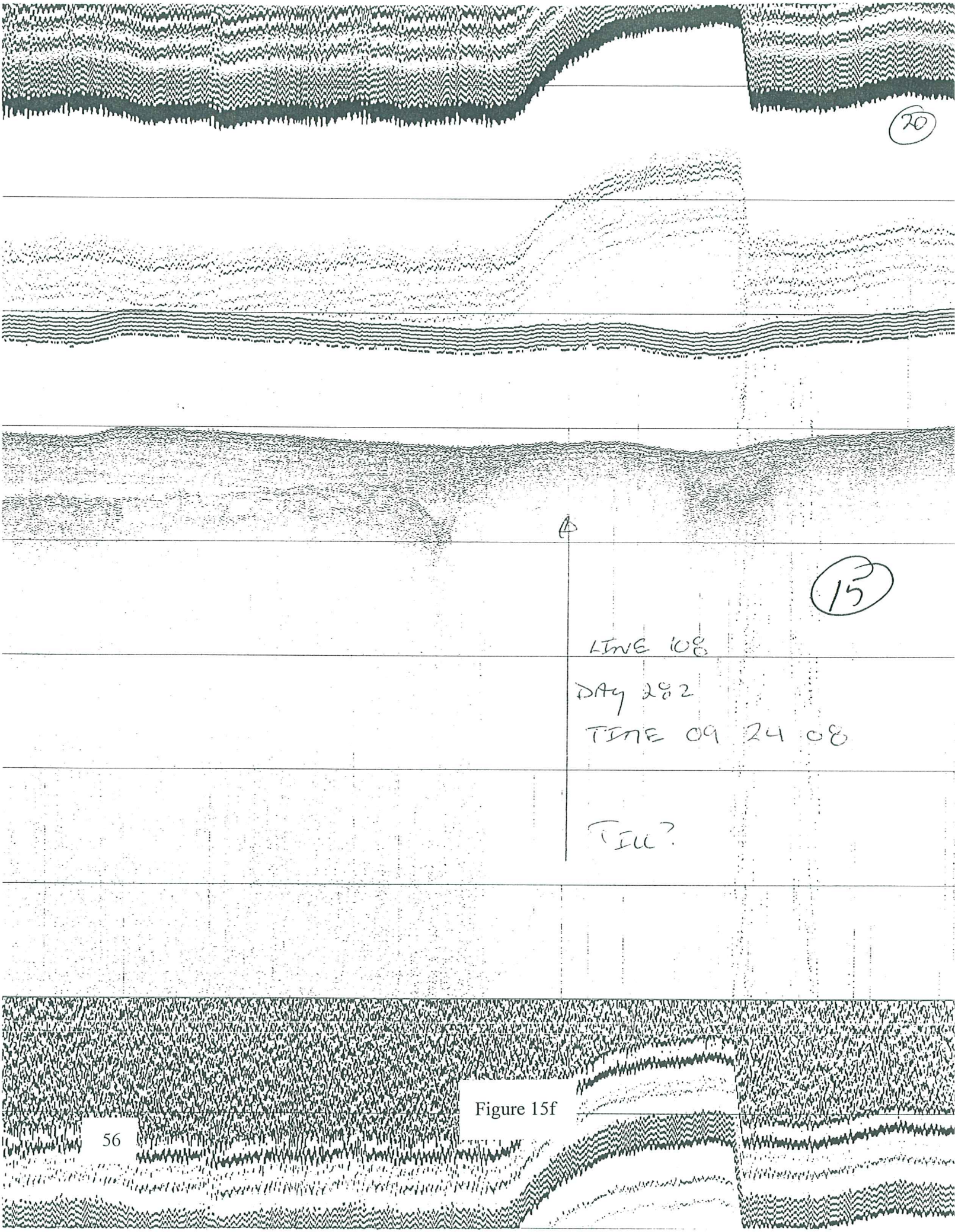

Figure 15f

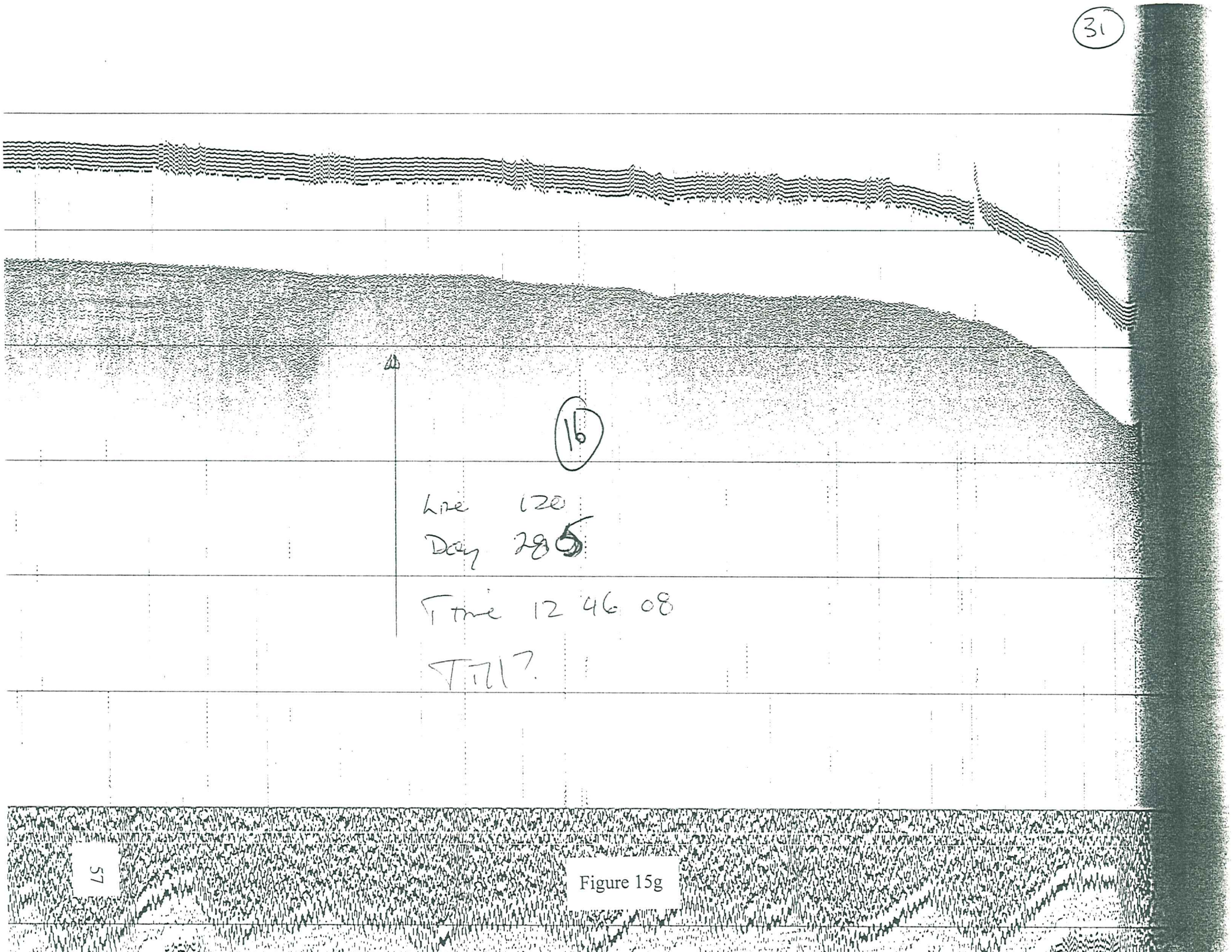

Figure 15g