CRUISE REPORT

R/V Farnella FA87-3

March 28 - April 25, 1987

Dennis W. O'Leary
U.S. Geological Survey
Woods Hole, Mass. 02543

Cruise number: FA 87 - 3
Vessel: R/V Farnella (fig. 1) Captain: Michael Patterson
Parent project: Atlantic EEZ GLORIA survey
Funding agency: U.S. Geological Survey
Funding amount: $750,000
Cruise start/end dates March 28 - April 25, 1987
Area of operations: (fig. 2)

1. The U.S. EEZ, from 72°10'W, 39°25'N, east along the 400-m contour of the New England Continental Slope to 66°05'W, 41°00'N, southeast and west along the outer border of the EEZ, and then along a line 316° from 69°47'W, 37°49'W.
2. The Continental Rise off Nova Scotia within an area bounded by the eastern margin of the U.S. EEZ, east to approximately 42°15'N, 62°40'W, southeast to 61°15'W, 40°30'N, southwest to 62°00'W, 40°00'N, and west along 40°N to about 64°50'W, and northwest along 316° to the U.S. EEZ.

Purpose of cruise: To obtain complete GLORIA long-range sidescan sonar image coverage within the area of operations, as well as ancillary seismic reflection profile data and magnetometer profile data, pursuant to Project Implementation Plan no. 7, Annex 8, between USGS and National Environment Research Council (NERC) of the U.K.

Scientific party: (fig. 3)

Dennis O'Leary - USGS: chief scientist
John Hughes Clarke - CGS: co-chief scientist
Eric Schmuck - USGS: cruise data curator
James Vaughan - USGS: MASSCOMP tech
Gerard Costello - Canadian Hydrographic Service

Roy Sparkes - CGS	Max Dobson - IOS
Eric Darlington - IOS	Linton Wedlock - IOS
Ross Walker - IOS	Mick Gooden - IOS
Steve Williams - IOS	David Gunn - IOS

Navigation technique:

Loran C in the hyperbolic mode was used throughout the survey area for positioning. Four receivers were operational: 2 Megapulse Accufix 500's; a Northstar 7000; and a Racal-Decca MNS2000. Time Differences (TD's) and Lat/Long from the Northstar and MNS2000 were logged on the IOS ABC system for the entire cruise.

The 2 Megapulse receivers were interfaced to separate IBM PC's where the observed TD's were converted to Lat/Long and all data logged on floppy disc and were printed out every 5 minutes. As of April 8 (JD098) data from one of the Megapulse/IBM's were logged on the ABC system, but near the end of the cruise it was discovered that a bug in the program (making the tenth of a microsecond (us) digit = 0) rendered the TD's useless.

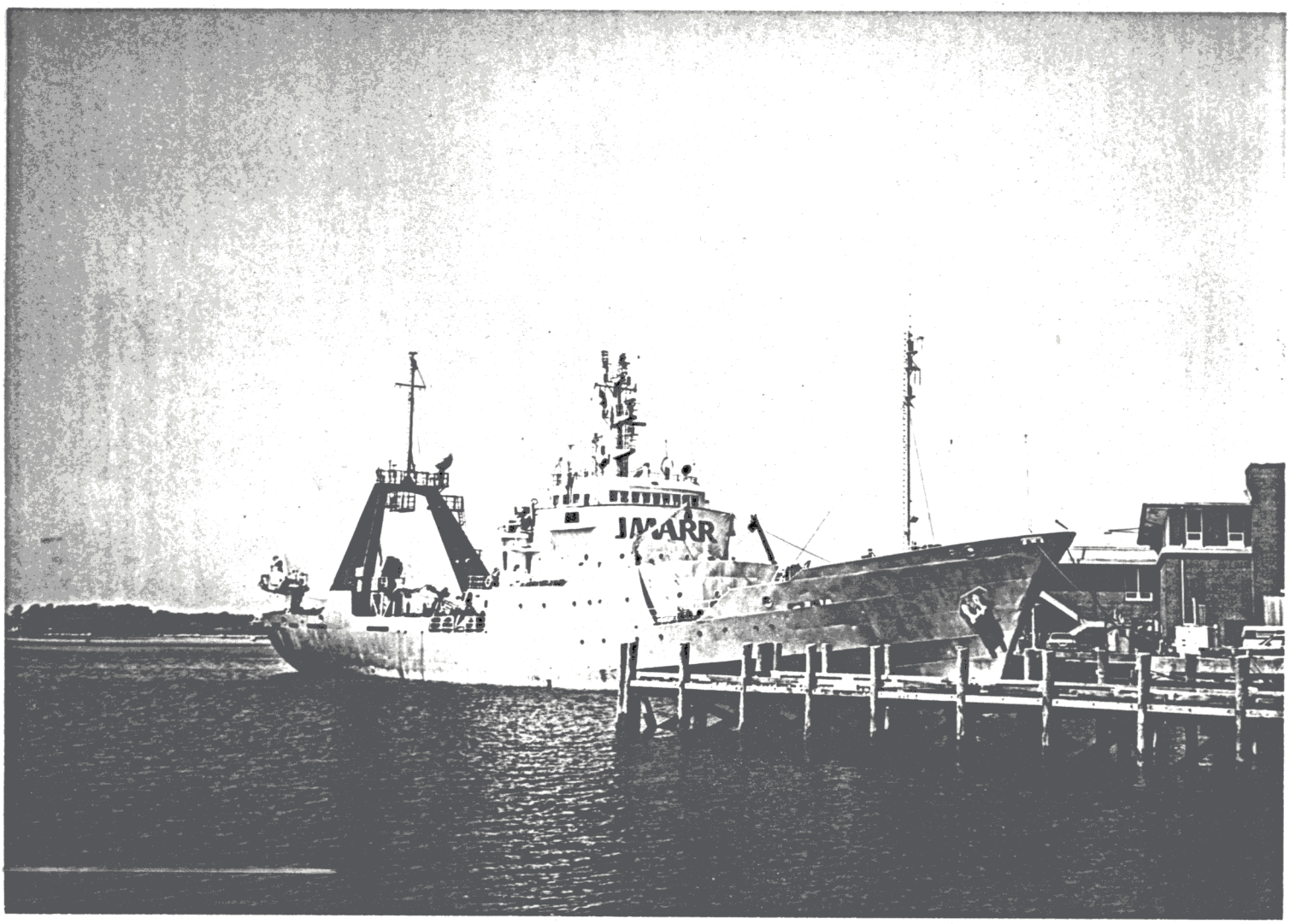


fig. 1 R/V Farnella

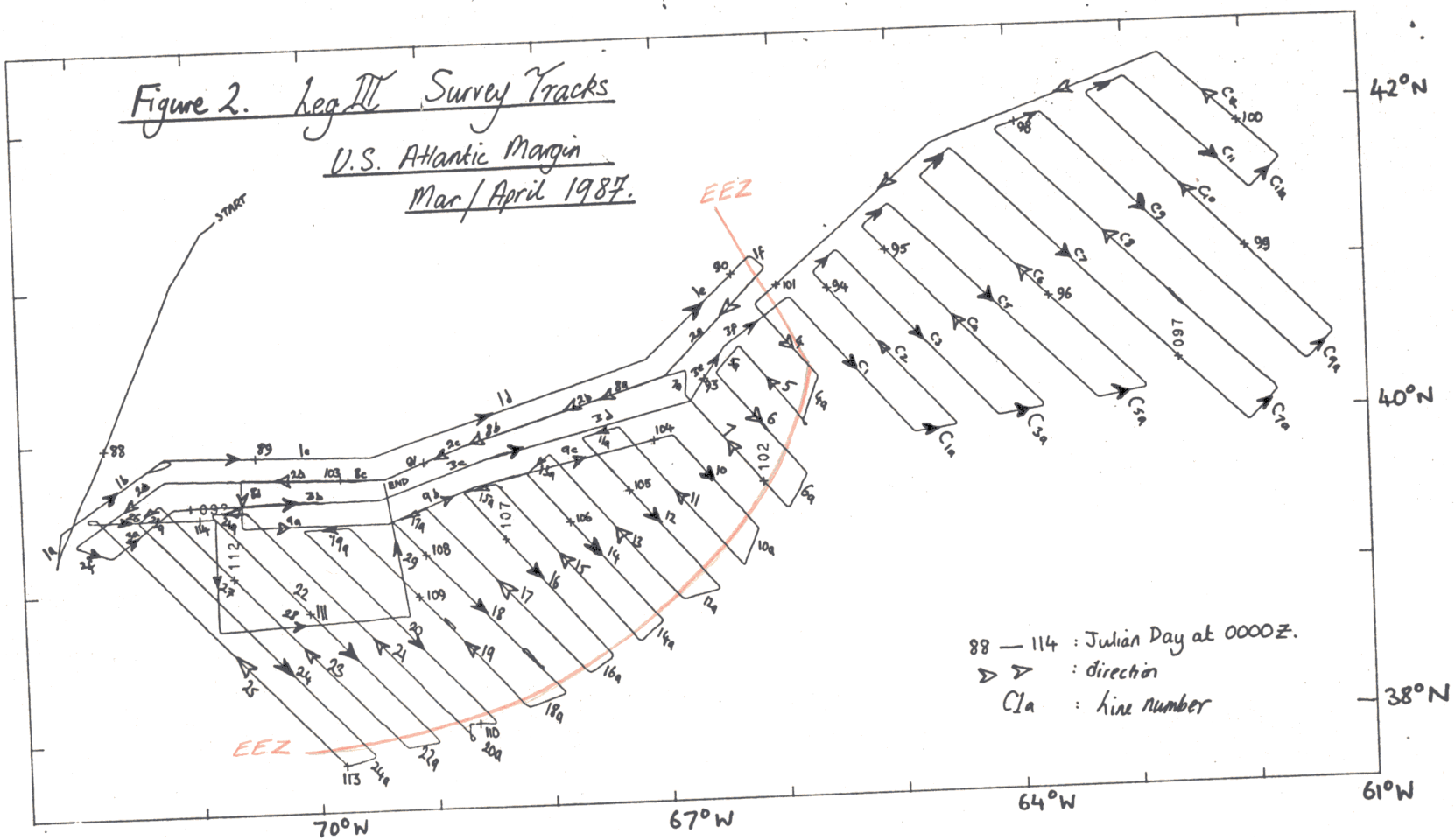
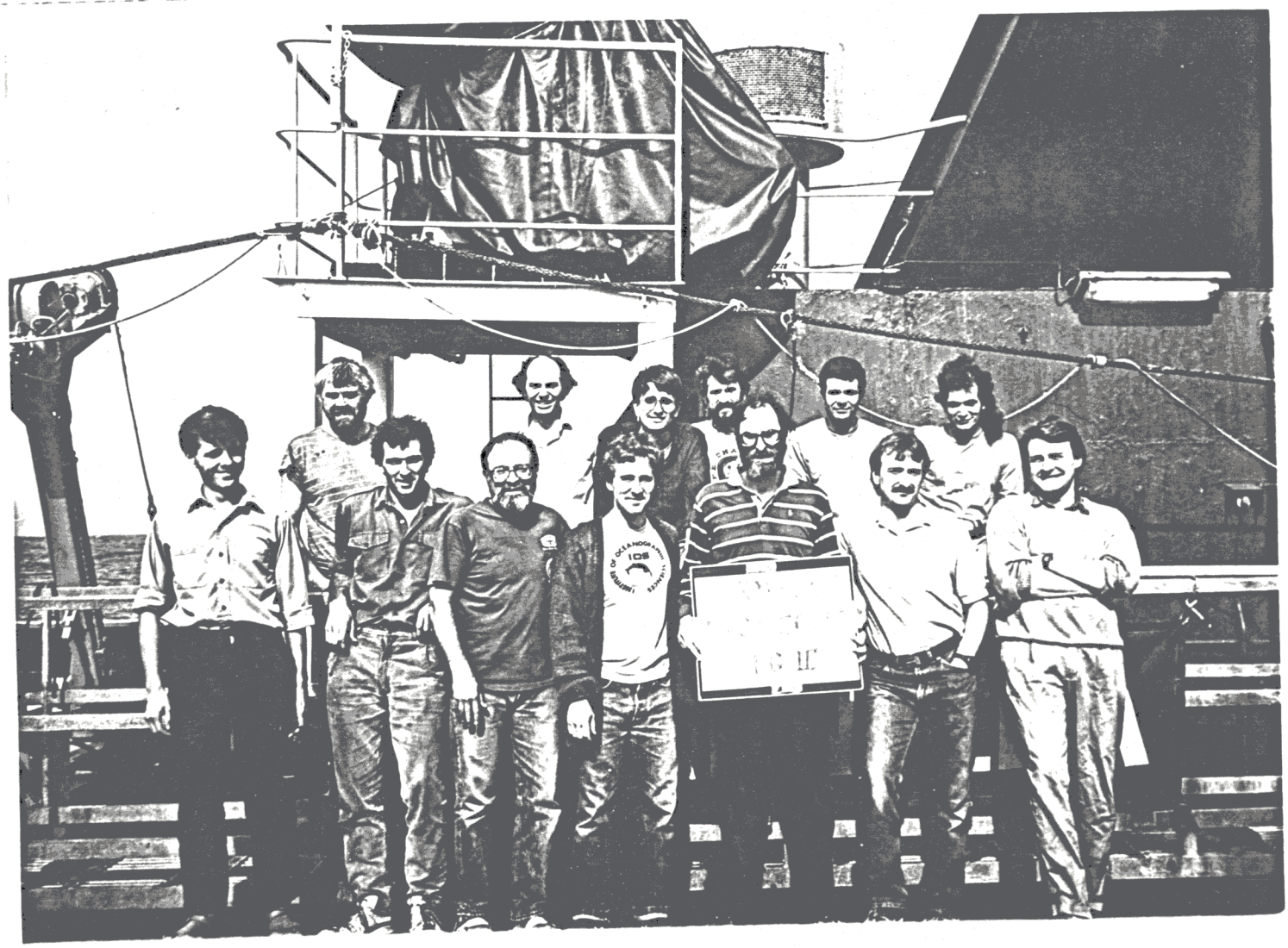


Figure 2. Leg III Survey Tracks
U.S. Atlantic Margin
Mar/April 1987.

fig. 2 FA87-3 - trackline



Back row: E. Darlington, M. Dobson, J. Hughes-Clarke, D. O'Leary, M. Gooden
E. Schmuck

Front row: L. Wedlock, R. Walker, J. Vaughan, D. Gunn, R. Sparkes,
G. Costello, S. Williams.

fig. 3 Scientific party, FA87-3

A single "mean" ASF correction for each Master/Secondary pair was determined from the available sources---DMA and CHS/BIO---and applied to the observed TD's on the Megapulse/IBM system for the entire survey, as shown below.

CHAIN	SECONDARY	ASF
9960	W Caribou	+1.0 us
	X Nantucket	+2.8 us
	Y C. Beach	+2.4 us
5930	X Nantucket	+2.1 us
	Y Cape Race	+1.4 us

The Northstar receiver had ASF corrections built in at time of manufacture. There was a Lat/Long bias available but was not used. Apparently the Northstar reciever has errors in the TD to Lat/Long conversion and is not reliable/accurate (according to USGS/WHOI).

The Northstar reciever was used for bridge navigation and line running. Although a monitor from the Megapulse/IBM was on the bridge (with waypoint navigation and line running) it was not used because it was difficult to see (numbers too small) and interpret and generally not user friendly; the navigation officers preferred the Northstar.

The Northstar reciever sometimes gave problems at dawn--bad signals, erroneous course corrections and speed---possibly because of atmospheric noise or skywave interference at long ranges from one of the transmitters. It also gave negative speed values at times. Usually during these periods, waypoint navigation would have to be restarted once good signals were acquired. Overall the receiver was reliable for navigation and good TD's were logged.

The only real problem with the Megapulse reciever occurred when, after a temporary loss of signal, the tracking gate did not necessarily lock back onto the 3rd cycle, thus giving 10us or multiples of 10us errors thereafter. This was caused by having the cycle selection disabled (status 4); the problem was prevented by enabling cycle selection (status 3).

Carolina Beach (9960 y) went off the air for a six hour period on March 31 (JD090) at a time it was needed. Alternate stations were used during this period but giving worse geometry.

In addition to all the Loran recievers, a Racal-Decca MNS2000 Transit satellite receiver was available and logged on the ABC system, but was not used for navigation; only for comparison to the Loran C.

Daily track plots were produced showing the Loran C Northstar, Megapulse, MNS2000 and the Transit/DR. Northstar and Megapulse tracks agreed well, but were offset up to 1mm (up to 375m) because of the different ASF corrections and TD-Lat/Long conversions used. The observed TD's on both receivers agreed within 0.1 us.

Best navigation can be achieved in post-processing by using the observed TD's, applying the best available ASF corrections (from a lookup table based on position) and recomputing the Latitude and Longitude.

Scientific equipment:

- GLORIA III sidescan sonar system
- Continuous seismic reflection profiler with 160 in^3 airgun, data from Geomechanique streamer fed to MASSCOMP 2-channel logger for digital tape recording; one channel fed to EPC and LSR dry paper recorders: 4 sec. sweep, 10 sec. shot rate (see Appendix A).
- Proton precession magnetometer (see Appendix A)
- 3.5 kHz bow-towed echosounder
- 10 kHz bow-towed bottom profiler
- Seas III XBT system (see Appendix A)

Tabulated information:

- days at sea: 27
- km of continuous data: 10,042 km (6882 km in US EEZ; 3160 km off Canada)
  total area covered: 208,946 km^2 (75,998 km^2 off Canada; 132,948 km^2 in US EEZ)
  total down time: 9.86 hours
  total survey time: 660 hours
  total transit time: 24 hours

Commentary: See scientific report by S.R.J. Williams, Appendix C. Obligations re Clearance Approval; Canadian Dept. of External Affairs Letter No. TPT-0433; 3/13/87. (attached memo).

Note:

- The Canadian Geological Survey has possession of data acquired during the cruise off Canada.
- Subsequent data processing will be coordinated with USGS personnel at Woods Hole during the remainder of this year.
- Further collaboration will include joint publications of scientific interest and possibly a USGS-CGS folio of seafloor image mosaics with geological interpretation.

United States Department of State

Washington, D.C. 20520

BUREAU OF OCEANS AND INTERNATIONAL
ENVIRONMENTAL AND SCIENTIFIC AFFAIRS

March 23, 1987

MEMORANDUM

TO: Dennis O'Learry
USGS
Woods Hole, MA 02543

FROM: W. Thomas Cocke WTC
Research Vessel Clearance Officer
Office of Marine Science
and Technology Affairs

SUBJECT: Clearance Approval and Post Cruise Obligations

1. A. The Government of Canada has approved the research cruise of the M/V FARNELLA during March 28 to April 23, 1987.

B. The document authorizing the research is Canadian Dept. of External Affairs Letter No. TPT-0433 dated March 13, 1987.

2. The obligations stated as a condition of research are as follows:

Provision of full data results to the Government of Canada (see Notice to Research Vessel Operators #66).

3. In the preliminary cruise report submitted 30 days after completion of the cruise, the chief scientist is required to provide a schedule (month/year) for meeting each obligation listed above, independently. Obligations already met, such as taking aboard participants, should be noted in the preliminary cruise report. All other obligations should be met according to the schedule outlined in the preliminary cruise report. Copies of all data results and reports should normally be sent to this Office for forwarding to the U.S. Embassy for transmittal to the Foreign Office. The Department will rely on the institution that operates the research vessel to implement these requirements.

4. Consult Notice to Research Vessel Operators #66 for further details or contact this office if obligations are not understood.

cc: Bob Rowland
USGS

Appendix A

F3-87-NA (FA87-3)

MAGNETOMETER

AIR GUN SEISMIC REFLECTION PROFILING SYSTEM

JAMES R. VAUGHAN
U.S.G.S. P.M.G.

25 APRIL 87

c/c DENNIS O'LEARY U.S.G.S.

JOHN HUGHES-CLARKE CAN.

STEPHEN WILLIAMS I.O.S.

FILE

MAGNETOMETER

THIS EQUIPMENT OPERATED FROM 87 088 0911 Z TO 87 114 2004 Z, A PERIOD OF APPROXIMATELY 27 DAYS 11 HOURS, WITH NO INTERNAL PROBLEMS. THE ONLY DOWN TIMES ——

87 088 1450-1821 Z 3h 31m
(GEAR PULLED IN WHILE SHIP STOPPED TO REPAIR MAIN ENGINE)

87 108 0830-0850 Z 20m
(EQUIPMENT SHUT DOWN DURING SHIFT OF SHIP'S GENERATOR LINE-UP)

—— WERE DUE TO CAUSES EXTERNAL TO THE MAGNETOMETER.

TOTAL MAGNETIC FIELD INTENSITY DATA WERE COLLECTED IN TWO WAYS:

1. DIGITAL MAGNETIC TAPE RECORDED BY THE ABC SYSTEM,
2. ANALOG PAPER TAPE RECORDED BY THE GRAPHIC RECORDER THAT IS PART OF THE MAGNETOMETER EQUIPMENT.

THE MAGNETOMETER MADE ONE MEASUREMENT EVERY THREE SECONDS, OF A FIELD TYPICALLY 52,000 TO 54000 GAMMA. SIX BINARY-CODED-DECIMAL DIGITS WERE LOGGED BY THE ABC SYSTEM, AND THE TWO LEAST-SIGNIFICANT DIGITS WERE CONVERTED,

WITHIN THE MAGNETOMETER ELECTRONICS, TO AN ANALOG VOLTAGE REPRESENTING 0 TO 100 MV/GAMMA, FOR RECORDING ON THE GRAPHIC RECORDER. THIS REQUIRED OPERATOR ATTENTION TO ANNOTATE TIME (HOURLY) AND READINGS OF THREE MOST SIGNIFICANT DIGITS. THE PAPER RECORDS INCLUDED 10 MINUTE TIME TICKS FROM THE ABC SYSTEM MASTER CLOCK. THIS TWO-RECORDER SCHEME PROVED INVALUABLE WHEN THE ABC SYSTEM CORRUPTED THE DATA, BY SETTING THE TWO MIDDLE DIGITS TO ZERO, FOR APPROXIMATELY 30 HOURS (89 095 2000 Z ± TO 89 097 0200 Z ±). DATA RECOVERED FROM PAPER RECORDS AND MANUALLY ENTERED INTO THE ABC SYSTEM ALLOWED SUCCESSFUL RECONSTRUCTION OF MAGNETIC FIELD DATA FILES, DESPITE THE FACT THAT THERE WERE OCCASIONAL GAPS IN THE PAPER RECORDS WHERE THE PEN RAN OUT OF INK AND THE WATCHSTANDER DID NOT NOTICE IT IMMEDIATELY.

AIR GUN SEISMIC REFLECTION PROFILING SYSTEM

THIS SYSTEM CONSISTED OF THE I.O.S. S.R.P. RACK (USING ONLY AIR GUN TRIGGERING CIRCUITRY AND STREAMER PREAMPLIFIERS FOR CHANNELS 1 AND 4), THE MASSCOMP COMPUTER DIGITIZING AND RECORDING SYSTEM, TWO GRAPHIC RECORDERS (RAYTHEON LSR 1807 M AND EPC 3200), A 160 IN^3 AIR GUN (PAR 1500). A VARIETY OF FILTERS AND AMPLIFIERS, PLUS THE EXTENSIVE AIR GUN SUPPORT GEAR (COMPRESSORS, TANKS, HOSE REELS, ETC.).

THE STANDARD SET-UP ON THIS CRUISE WAS:

10 SECONDS / SHOT
4 SECONDS / SWEEP (BOTH RECORDERS)
0 TO 4 SECONDS DEEP WATER DELAY
FILTER PASSING 15 TO 300 Hz (LSR)
FILTER PASSING 75 TO 150 Hz (EPC)
CHANNEL 1 TO LSR AND EPC
CHANNEL 1 AND 4 TO MASSCOMP
6 SECOND DATA RECORD PER MASSCOMP DATA FILE

THE SYSTEM COLLECTED DATA FROM
87 088 0807 Z TO 87 114 2007 Z,
A TOTAL OF 27 DAYS 12 HOURS, OR 660 HOURS;
WITH THE FOLLOWING DOWN-TIMES:

87 088 1450-1838 Z — 3 HR 48 MIN
ALL GEAR PULLED IN; SHIP STOPPED TO REPAIR MAIN ENGINE

87 093 1500-1535 Z — 35 MIN
CHANGED AIR GUN

87 098 1643-1727 Z — 44 MIN
CHANGED AIR GUN

87 099 0107-0253 Z — 1 HR 51 MIN
REPLACED AIR GUN HOSE

87 105 2100-2236 Z — 1 HR 36 MIN
CHANGED AIR GUN

87 108 0822-0841 Z — 19 MIN
FAILURE OF SHIP'S POWER

87 108 1519-1522 Z — 3 MIN
AIR GUN OFF; CKT BRKR TO STP TRIPPED

87 108 2059-2110 Z — 11 MIN
AIR GUN TURNED OFF WHILE SHIP TURNING SHARPLY

87 110 1647-1732 Z — 45 MIN
CHANGED AIR GUN

TOTAL DOWN TIME = 9 HR 52 MIN
= 9.86 HR
= 1.49 %
OF 660 HR

THERE WERE ADDITIONAL GAPS IN INDIVIDUAL RECORDS, SUCH AS PAPER CHANGES AND ROUTINE MAINTENANCE ON THE LSR AND EPC RECORDERS, AND BREAKS IN THE MASSCOMP DIGITAL TAPE RECORDINGS AT END-OF-LINE AND START-OF-LINE, WHEN THE OPERATOR WAS ENTERING TAPE, LINE, ETC. DATA. NORMAL TRANSFERS FROM ONE TAPE DRIVE TO THE OTHER DID NOT RESULT IN ANY LOSS OF DATA. THE DOWN-TIME DUE TO FAILURE OF SHIP'S POWER WAS ACTUALLY MUCH LONGER FOR THE MASSCOMP, THAN FOR OTHER UNITS OF THE AIR GUN SYSTEM: 2 HR 59 MIN VS. 19 MIN. WHILE POWER WAS BEING RESTORED, IT WENT THROUGH SEVERAL PERIODS OF LOW VOLTAGE / LOW FREQUENCY, TOO LOW FOR THE MASSCOMP POWER SUPPLY, RESULTING IN NUMEROUS "CRASHES". AS A RESULT, THE PROCESS OF REBOOTING THE OPERATING SYSTEM TOOK MUCH LONGER THAN NORMAL, SINCE IT REQUIRED MUCH CLEARING OF DISC FILES. THERE WAS ALSO ANOTHER POWER SAG THAT CRASHED ONLY THE MASSCOMP AND GLORIA (87 108 2025-2223 Z APPROX.), BUT AGAIN, IT TOOK SEVERAL TRIES TO GET A SUCCESSFUL REBOOT.

TWO MASSCOMP COMPUTER CRASHES (87 094 0423-0511 Z AND 87 104 095?-0951Z) ARE PROBABLY ATTRIBUTABLE TO OPERATOR ERROR, SUCH AS INADVERTENTLY BUMPING CERTAIN KEYS ON THE SYSTEM CONSOLE.

THE GRAPHIC RECORDERS IN THE SEISMIC REFLECTION SYSTEM SHOWED A MINOR, THOUGH PERSISTENT, PROBLEM: A SMALL TIME-JITTER IN THE DISPLAYED DATA. USUALLY, THIS INVOLVED AN ENTIRE DATA SWEEP (1 DISPLAY SWEEP ON THE EPC, 5 DISPLAY SWEEPS ON THE LSR) BEING SHIFTED SLIGHTLY TO THE LEFT, APPROXIMATELY 0.5 MM., JUST PERCEPTABLE ENOUGH TO BE IRRITATING. SOMETIMES THIS PROBLEM WOULD BE ABSENT, BUT USUALLY NOT FOR LONG. QUITE A VARIETY OF POSSIBLE CAUSES HAVE BEEN CONSIDERED, INCLUDING:

— TIME JITTER IN TRIGGER SIGNAL FROM AIR GUN FIRING MODULE,
— JITTER IN THE TIME DELAY FROM THE DEEP WATER DELAY UNIT,
— JITTER IN THE TIME DELAY IN THE AIR GUN SOLENOID,
— JITTER IN THE SENSOR CIRCUIT FOR STYLUS TIME-ZERO IN THE RECORDERS,

— MISADDRESSING OF DATA IN MEMORY OF LSR,
— MISADJUSTMENTS OF TRIGGER SENSITIVITY OF THE RECORDERS,
— INTERMITTENT PROBLEMS IN "GRAY SHOT BOX" (WHICH DOES APPEAR TO BE VERY SENSITIVE TO VIBRATION, MOTION, AND IMPACT),
— SEA SWELL OR INTERNAL WAVES MOVING THE STREAMER UP AND DOWN,
— SHIP ROLL AND PITCH MOVING THE AIR GUN UP AND DOWN.

MOST OF THESE POSSIBILITIES HAVE BEEN ELIMINATED BY CHANGING CIRCUIT CARDS, RECONFIGURING TRIGGER CABLING, SHIFTING TRIGGER LEVELS, ETC. IT IS ALSO POSSIBLE THAT THIS JITTER IS A REAL FEATURE IN THE DATA, BUT HAS BEEN AGGRAVATED BY THE DIGITIZING AND MEMORY PROCESSES IN THE RECORDERS.

IN SUMMARY, THE RELIABILITY OF THE AIR GUN SEISMIC SYSTEM HAS BEEN BETTER THAN TYPICAL FOR A COMPLEX MULTI-RECORDER SYSTEM. LESS THAN 1.5 % DOWN-TIME, NONE DUE TO INTERNAL SYSTEM FAILURES, OTHER THAN AIR GUN MAINTENANCE REQUIREMENTS, IS A VERY SATISFACTORY RECORD.

Appendix B

XBT

Water column temperature profiles were collected throughout the survey area using XBT's and the Sippican MK9 Oceanographic Data System. Temperature vs depth profiles were logged on the SEAS III system and subsequently transmitted via the GEOS satellite to NOAA.

Once an XBT was launched, a thermistor measured the varying temperature as the probe fell to the bottom at an assumed velocity. This temperature vs depth profile was logged on the SEAS III microcomputer. Erroneous temperature spikes at the bottom of the profile could be edited prior to transmission to GEOS.

Each profile was logged on floppy disc and hard copy profiles were obtained on a printer. For each drop three profiles were usually plotted: one of the full profile; one to depths of 200-400m where the surface layer and seasonal thermocline occur; and one to a depth of 60m , just below the depth of GLORIA. See the Appendices for detailed launch procedures and listing of XBT deployments.

During the survey this data was not used quantitatively---i.e. to correct GLORIA images for refraction---but as a planning aid and to confirm the existence of warm core rings. Reduced sonar ranges were observed in areas of high thermal gradients near the fish depth and in areas of warm core rings.

XBT's were dropped once per day and attempted to give good coverage of the work area. Six model T6's (max. depth 460m) and twenty-one T5's (max. depth 1830m at 6 knots ship speed) were dropped. Maximum depth reached with the T5's was 1650m due to the 8 knot ship speed.

About 90% of the drops were successful; only a few had to be repeated due to snags in the streaming cables or in rough seas.

The port quarter proved to be the optimum launch position, regardless of wind direction or sea state. The deck-mounted launcher would probably work as well as the present "pole" system.

The general trend of the profiles was varying gradients in the surface and seasonal layers (temperature variations up to 8 degrees) to depths of 200-300m; then the main negative thermocline to about 1000m; then a relatively constant temperature near 4 degrees C to the bottom (1650m).

An exception was drop #62 which showed a positive thermocline to depth 700m and then a negative thermocline to 1600m; also the temperature below 1000m was much higher at 9-7 degrees. Other interesting profiles were #56 and #63 (11 miles apart) which showed a cold layer at depth 75-100m between two warm layers.

Appendix C

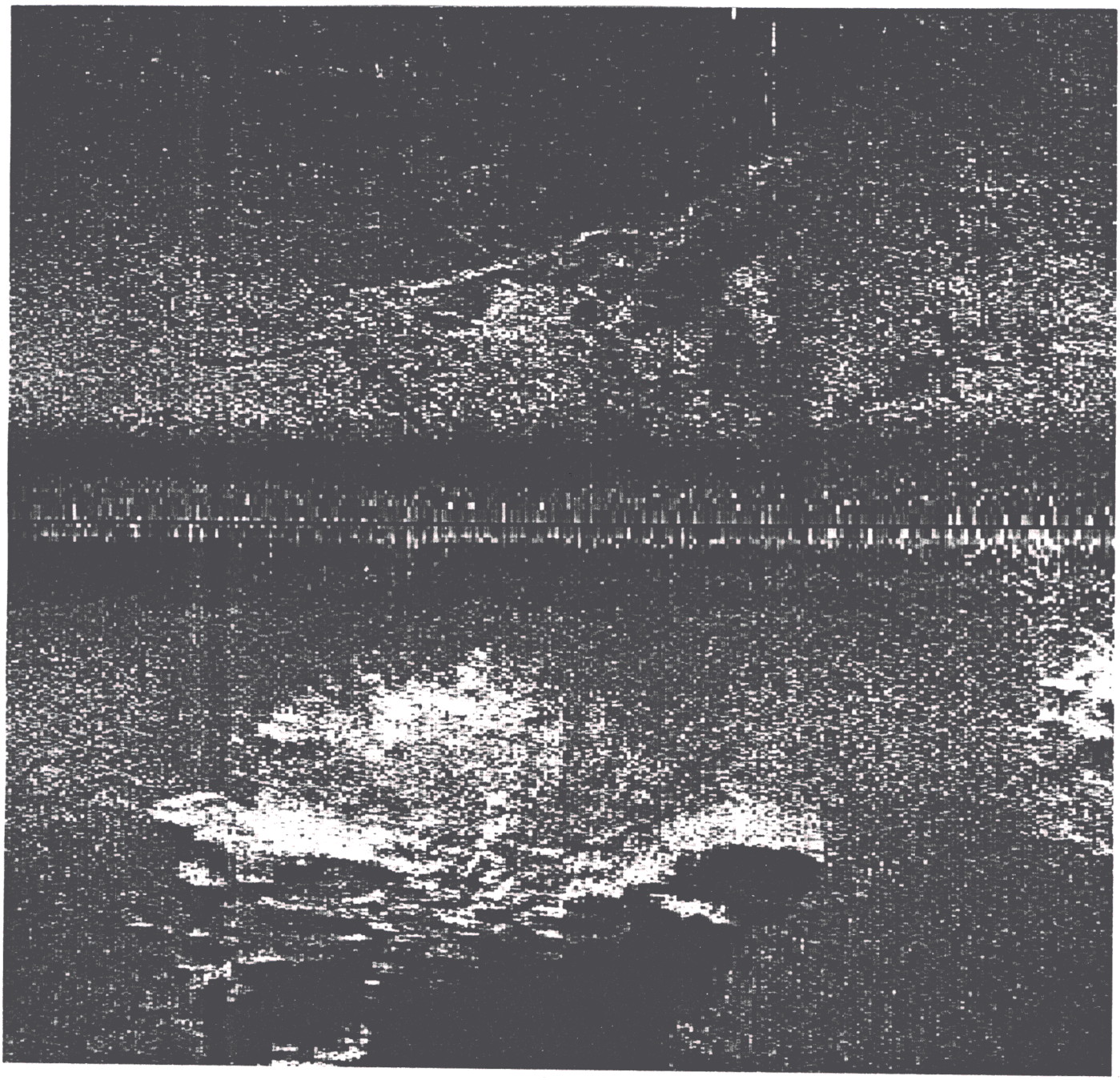
D.O'L.

FARNELLA III 1987

USA Atlantic EEZ
+ Canadian Rise

Scientific Report

by S.R.J. Williams



SCIENTIFIC PERSONNEL

BACK ROW L-R: E.D., M.D., J.H-C., D.O'L., M.G., E.S.,
FRONT ROW L-R: L.W., R.W., J.V., D.G., R.S., G.C., S.W.

Farnella N. Atlantic US EEZ Leg III
Mar-APR, 1987
Report by SRJ Williams.
(Saved as L387REP on disk)

CONTENTS

5. Navigation

NARRATIVE

The Farnella sailed from Woods Hole on day 087 and arrived in the survey area west of Hudson Canyon at 0200/088. The gear was streamed by 0800/088 and Line 1 commenced in shallow depths along the Slope running East. Lines 2 & 3 were completed in a parallel orientation by 0456/093 although much of Line 2 was dogged by bad weather. The seperate Canadian survey commenced at 0456/093 and continued, with good ranges and no major interruptions, until 0003/101 although weather conditions were sometimes marginal in the later stages.

The USGS survey then recommenced with principal lines in a NW-SE or E-W orientation. The lines were run parallel with a seperation of approximately 12 NM. Range was restricted by Gulf Stream warm core rings with associated currents of up to 4 kts (see Figure 4). The allotted area was completely surveyed byDay 113 whereupon 4 short lines were run to repeat coverage of areas of special interest.

The gear was retrieved on Day 114 at 1600 and the ship docked at Woods Hole, early morning on Saturday 25 April at the end of a highly successful cruise.

SCIENTIFIC PERSONNEL

IOS

E. Darlington.	GLORIA Engineer
S. Williams	Geologist
R. Walker	GLORIA Engineer
D. Gunn	Photographer
M. Gooden	Workshop
L. Wedlock (RVS)	Computing
M. Dobson (Aberystwyth Univ.)	

USGS(Woods Hole)

D. O'Leary	Geologist
J. Hughes-Clarke (Dalhousie U.)	Geologist
E. Schmuck (USGS)	Watchstander/ Collator
R. Sparkes (GSC)	Watchstander/ Collator
G. Costello (GSC)	Watchstander/ XBT
J. Vaughan (Menlo Park)	ET

SHIP'S CREW

M. Patterson	Master
J. Cannon	Mate
I. Newsome	2nd Officer
M. Baldwin	Chief Eng.
G. McCain	2nd Eng.
C. Cook	3rd Eng.
G. McFadden	Cook
E. Merrin	2nd Cook

R. Valiente	Steward
A. Thompson	Bosun
J. Springal	Seaman
T. Sayers	Seaman
M. Brooks	Seaman

CRUISE SUMMARY
(all times GMT).

Day 087: Sailed from Woods Hole at 1500. Steamed towards Hudson Canyon. Emergency drill after dropping pilot.

Day 088: 0230 Deployed PES fish. 3.5 kHz fish damage found and case replaced after reaming bolt holes. Ship power off for cooling pipe repair. 3.5 kHz fish deployed. After 30 min wait to check repair OK Gloria, Magnetometer & SRP deployed. All equipment OK at SoL 1B at 0900. 1445 Recovered gear for further engine repairs. 1806 Gear redeployed and logging restarted.

Day 090: 0100 Weather deteriorating progressively, data quality.also. 0200 EoL 1, Sol 2. 1900 30 mins of Gloria data lost due to 240V power failure to portacabin. Problems with Loran navigation due to failure of Carolina Beach station on US chain (see Figure 2). Northstar retuned to Nantucket for several hours.

Day 091: Continued poor weather and poor Gloria data (15 degrees of yaw). 1000 Weather moderating. 1945 Eol 2F, Sol 3A at S.W. survey boundary. 1805 an extra layer of GLORIA cable was let out to spread wear.

Day 092: GLORIA signal attenuation due to Gulf Stream Gyre (Warm Core Ring -WCR).

Day 093: 0456 Commence survey of Canadian area with line C1. 1900 Increased gain on starboard GLORIA channel from 12 to 18 dB. Marked improvement in range.

Day 094: Seas calm to force 1. No swell. Good data. 2300 Strong biological interference at dusk.

Day 095: 1200 Force 3 increasing.

Day 096: 0516 Disabled the MNS2000L as it was playing up. Force 4-5.

Day 097: 1315-1412 PES fish cable fouled by fishing floats, slowed to clear.

Day 099: Megapulse interfaced to ABC and logging. 0100-0300 Airgun pressure hose problems. 0652-0926 Problems with Gloria PPA's tripping causing stripy records. c 2300 weather deteriorating, dropouts.

Day 100: Weather ameliorating. 1900 rapid sea temperature changes. Gloria short circuits 3 times.

Day 101: 0003 End Canadian survey. Restart USGS survey. Close encounters with submarine, whale and light table. Nice views of seamount.

Day 102: Lifeboat muster. Poor ranges, dropouts.

Day 103: 0547 Northstar jittery. Thunderstorm. Wake-like interference on Gloria. Swell building.

Day 104: Heavy rolling but data OK on NW-SE tracks.

Day 105: Swell decreases

Day 106: Lots of GLORIA dropouts.

Day 107: Sea state worsening steadily.

Day 108: 0736 (Line 18) Waxy fuel from Woods Hole causes engine problems, causing generator problems, causing electronic mayhem in the lab. GLORIA and ABC disabled. 1111 back on line after loop for . reshooting.
2021 (Line 19) Another generator crash with similar results. 2219 back on line for reshoot.

Day 109: Mysterious disappearance of several hours of magnetometer data from ABC.

Day 110: 0030 Line 20A waypoint mix-up. Dog leg required.

Day 111: 0200-0300 Significant bio-interference on GLORIA. Continued problems with GLORIA range and ship velocity.

Day 113: 1759 Completed coverage of allotted area. Commenced turn for 4 short extra lines to the east for repeat coverage and extra profiles.

Day 114: 2000 Terminated data collection. 2130 All gear retrieved and ship underway for Woods Hole.

Day 115: Arrived Woods Hole early morning (Local time).

SURVEY PATTERN

The Leg II area remained uncompleted for Leg IV to fill in at a later date. In a special arrangement 7/8 days of survey had been allocated to Canadian researchers although the detailed allocation of ship time was not formalised prior to sailing. The original planned survey grids are shown in Figure 1. The survey started with WSW to ENE lines 1,2 & 3 in US waters along the Continental Slope.The quality of Gloria data and lateral range obtained varied with sea conditions. Much of Line 2 being of poor quality.

At the end of Line 3 we turned onto Line C1 at the start of the Canadian survey. The original Canadian survey area (Figure 1) was not rigidly defined. The eventual tracks are shown in Figure 2. The survey was restricted to areas with depths greater than 2000 m for two reasons: a) in order to maximise areal coverage and b) because the Rise was of more interest than the Slope. Main track lines were run in a NW-SE direction, slope perpendicular in the west, becoming more oblique to the slope eastwards. This resulted in better imaging of slope-perpendicular channel topography. Correlation of Gloria images with 3.5 kHz and SRP is less efficient when running near-parallel to the grain but this was considered acceptable in view of existing 3.5 kHz coverage.

The US survey recommenced with NW-SE tracks in the east of the EEZ. Some lines were extended slightly to cover local seamounts. Part of Line 2 was reshot as Line 8 from E-W and Line 9 was run W-E before continuing the general NW-SE grid. This contour-oblique track-line orientation, although less efficient than contour-parallel lines produced better data in the strong southwesterly swells and facilitated adjustment to local variations in Gloria range induced by water temperature anomalies (Warm Core Rings shed by the Gulf Stream). The variation in range with water depth was not great in this part of the survey and so no fanning-out of the lines was required.

A 1:750,000 scale transverse Mercator chart was used which showed bathymetric contours (200, 1000, 2000, 3000 & 4000m) and the EEZ boundary. A 30' grid and 1' ticks on the grid lines made plotting much easier than previously. On this chart were plotted the hourly ship positions and GLORIA ranges for planning survey lines on a day to day basis. By mistake a projection latitude other than 28N (as used for the Leg II plotting) was used which complicated accurate meshing with the Leg II area. For simplicity a straight line boundary was drawn within the area of complete Leg II coverage and it was to this line that Leg III coverage extended.

EQUIPMENT

GLORIA

On starting the Canadian survey it was noticed that signal amplitude on the starboard channel was relatively low. (Previously this had been obscured by topographic effects on contour parallel lines). The gain was increased from 12 to 18 dB with a marked improvement in record quality.

Problems with the PPA's at times resulted in stripy gain variations in the data but it should be possible to remove this with the MIPS.

The system crashed twice on Day 108 due to the generator problem.

Between 2100 and 2330 Day 106 a new and unexplained type of data loss was noticed on the records.

SRP (by J.V.)

The system comprised the IOS SRP rack (using only airgun triggering circuitry and streamer preamplifiers for channels 1 & 4); the MASSCOMP computer digitising and recording system; 2 graphic recorders (Raytheon LSR 1807M & EPC 3200); a 160 cu in PAR 1500 airgun; various filters, amplifiers and the extensive support gear for the airgun; a Geomechanique 2 element hydrophone.

The standard set-up on this cruise was:
10 secs shot interval
4 s recorder sweep
0-4 s deep water delay
Either 15-300 Hz BP (LSR) or 75-150 HZ (EPC)
Channel 1 to LSR & EPC
Channels 1 & 4 to Masscomp
6 sec data record per MASSCOMP data file.

The system collected data from 0807/088 to 2007/114: a total of 660 hours/ 27.5 days, with the following downtimes:
088 1450-1838 Ship engine failure
093 1500-1535 Air gun swap
098 1643-1727 Air gun swap
099 0102-0253 Replaced airgun hose
105 2100-2236 Air gun swap
108 0822-0841 Ship engine failure
108 1519-1522 Circuit breaker tripped
108 2059-2110 Turned off for sharp turn
110 1647-1732 Air gun swap.

Total downtime 9.9 hours (1.5%)

Problems with the Masscomp occurred due to variable line voltages following the 2 mid-cruise engine failures.

An unexplained small time jitter occurred intermittently on the graphic recorders.

Further detail is provide in J.V.'s report. All in all very reliable.

3.5 kHz PROFILER

Damage to the fish body during Leg II caused a delay in deployment whilst the upper casing was replaced and the bolt holes reamed out.

The data were replayed at 1 s sweep on a Raytheon LSR. This has only got a facility for L-R sweep. It would greatly ease interpretation if the sweep direction could be reversed as with the EPC. Again it is worth stating that a heave compensator would do wonders for data quality in all but the calmest of seas.

10 kHz PRECISION ECHOSOUNDER (PES)

This system performed throughout the cruise. Depths were measured every 6 minutes, entered in a log, annotated on the records, typed into the ABC computer logging program and then used for slant range correction of GLORIA data.
Bathymetric soundings were plotted along track at 1:375000 scale at the end of the survey but were not particularly clear.

It was noticed at one stage that depth readings given by the PES and 3.5 kHz were up to 100 m different. This was attributed to steeply sloping seabed.

MAGNETOMETER (by J.V.)

The Geometrics G-801 Proton Free precession magnetometer performed well.
Data was collected between 088/0911 and 114/2004 (27.5 days). The only downtime was due to ship power supply failures.

Data were displayed on a pen chart recordand logged by the ABC. Sampling rate was 1 per 3 sec. The ABC logged 6 BCD for each sample, the recorder displayed the 2 least significant digits. Between 095 2000 and 097 0200 the ABC registered the 2 middle digits as zero and so data had to be transferred manually from the pen records for this period. Values and profiles were plotted along track at the end of the cruise.

XBT

See Appendix 1.

NAVIGATION

The Northstar unit utilising Loran C was used throughout and considered satisfactory except when Loran signals were disrupted on rare occasions for up to 20 mins. Slight jumps also occurred when the unit was automatically jumping between stations.

MNS2000 loran fixes were generally inferior for prolonged periods this gave wildly inaccurate positions.

MNS2000 transit satellite/dead reckoning fixes were often very bad due to bunching of satellites and extreme current drift velocities.

Megapulse Loran C data were logged on floppy disk but could not initially be supplied to the Level C logging system. LW devised an interface and Megapulse data were logged continuously early in the cruise except when the ABC crashed. Its results were generally comparable to those of the Northstar system now that suitable asf correction factors were available. Prior to the cruise the Canadians were anxious about using Northstar because of some previous bad experiences.

The Trimble GPS system was unfortunately unavailable.

Daily plots were produced showing Northstar, MNS2000 and satellite/DR tracks with hourly annotation, 10 minute ticks and 2 minute sampling. Early in the cruise plots of Megapulse data were produced on a micro computer at similar scale but no significant differences from the Northstar tracks were noted. It has yet to be decided which nav system will be used for the MIPS work although the general feeling is that Northstar is best, with Megapulse filling the gaps.

See also Appendix 5.

EXTERNAL FACTORS

The Gulf stream influence was expected to be greatest in the South of the area (See Figure 4) but warm core rings (WCR) drifting further North were expected to cause additional problems. Indeed at certain times up to 25-30 d of helm were required to maintain course on Line 2. Severe loss of GLORIA range was caused by refraction. Loss of ground speed control also occurred (up to kts depending on track direction). Ship speed variations and water temperature (Gloria, XBT and compressor cooling intake) indicated when we were in the Stream or a WCR. The position of the Stream and WCR's varies fairly slowly according to the weekly charts (Figure 4).

Figure 7 shows the compressor seawater inlet temperaturesmeasured in the Canadian survey.

It is expected that major problems will be experienced on Leg ~~4~~ 5 west of Florida.

Plankton and fish were seen frequently in the water column on Gloria LSR and PES, sometimes degrading Gloria data, especially during the upward plankton migration at dusk. There were frequent bursts of ship noise from passing vessels. Correct phasing of the SRP prevented interference on GLORIA records.

Strong multiple hyperbolic signals were recorded at certain times and attributed to a submarine or transponder.

GEOLOGY

For more detailed descriptions please see the summaries by D. O'L. and by J. H-C.

US EEZ

The survey area continues to the North of the Leg II area with no immediate change in geological style.

The Slope is intensely canyoned. In the west of the area the distribution of major features such as canyons and large mass flow deposits was much as indicated by the echotype character map of Vassallo, Jacobi and Shor in the Ocean Margin Drilling Project Atlas but the detailed morphology was better resolved. On the Slope the

surficial geology was much as described by O'Leary's Open File report. There was good correlation of topographic features with published bathymetry.

Large mass flow pathways up to 10's of km wide extend 10's of km across the Rise from the base of the Slope. These are imaged in great detail. Reflectivity variations on sonographs in the vicinity of mass flow deposits can sometimes be correlated with the 3.5 kHz echo character.

Elsewhere smaller incised channels run from individual canyons across the Rise with varying degrees of sinuosity. Evidence of slumping is seen on margins of the channels which extend across the rise.

Canyons run largely perpendicular to the Slope, especially the smaller ones.
Patchy or wave-like variations in reflectivity which border many mass flows and channels may have been formed during overbank depositon or by subsequent reworking by local benthic currents.

Large areas of layered, parallel laminated (hemipelagic/contourite) sediments extending down to 40 m subbottom occur between the major mass flow pathways. The bedding varies from flat to gently undulating (hemipelagic drape) to regularly undulating (sediment waves with a c. 1 km wavelength). Intermediate styles are common and minor low-angle unconformities are occasionally visible. In general the evidence for along-slope sediment movement is greater than in the Leg II area.

Isolated 'massifs' occur, surrounded by debris flows and capped by hemipelagic laminated sequences. These are probably upstanding erosive remnants (rather than olistostromes). Their margins are frequently onlapped by mass flow deposits.

The airgun records are of fair to good quality. The long bubble pulse obscures much stratigraphic detail. Perhaps post-cruise digital deconvolution can do something for this?

SRP data revealed major (X, Au and A*) and minor unconformities, the effect of salt swells and shallow igneous bodies and the erosional nature of the canyons. Identification of epidermal mass movement decollement zones was more speculative. Minor faulting was detected but correlation with surface scarps was only speculative.

Seamounts are imaged well and rugged basement reflectors can be traced several kilometers from their margins.

On the Slope canyons are seen to be incised into a sequence resting on a locally prominent unconformity. A prominent BSR seen in parts of the area at c. 0.6 s TWT subbottom may be attributed to a clathrate/free gas interface.

Some buried channels were seen on the Rise but the general situation there is a laterally-variable one of low-angle unconformities seperating local sediment lenses. Major channels such as the Hudson

are incised as deep as 300 m into older rocks with little evidence of levees or older, underlying channel base facies. The channel sides are as steep as 1 in 5.

CANADIAN AREA

The survey only extended to the lower part of the slope where canyons are fairly broad and shallow. The area was dominated by a complex of lenticular mass-flow deposits with a sheet-like or braided surface expression. Channels were relatively shallow but fairly extensive. Oblique crossings by 3.5 kHz did not provide optimum definition. Margins of deposits were not well-defined.

Extensive areas of hummocky topography are caused by slides and/or sediment waves. Some slide scars are evident on the Rise.

MOSAICS

See the section in the Leg II report.
For future reference the following production schedule was implemented except for Days when logging interruptions occurred.

GMT	LOCAL	
0700	0200	2nd Gloria cartridge full.
1300	0800	Produce 24 hr track plot and SPDL values on ABC computer.
1400	0900	Start laser printing (after EXACTLY 2 hours warm-up).
1600	1100	Start developing film.
1730	1230	Produce contrast test prints.
1745	1245	Print photos (64 copies)
2100	1600	Prints dry. Start mosaicking (data from 0700-0700Z, delay 28 to 14 hrs).

The minimum time from ending a Pass to having dry prints is about 4 hours.

8 copies of each print were produced: 1,2 & 3 for IOS for mosaic, spare and archive; 4,5 and 6 similarly for either USGS OR GSC, 7 & 8 for M.Dobson (apprentice mosaicker).

PHOTOGRAPHY

A Test Pass (No. 29 from Leg II) was used for quality control between films with favourable results, the grey scales are not very helpful.

Continued problems with enlarger luminosity cropped up intermittently, eventually it was thought to be due to using paper from different boxes, despite equivalent purchase dates. BEWARE of this!

The Laser printer will give variable intensity negatives unless the warm-up period is standardised !!!

See comments in Leg II report re paper size.

MG expertly plumbed-in the large water filter canister beneath the darkroom sink.

3.5 kHz and some SRP analogue records were photographed for onboard interpretation purposes. 2 days data can be photographed and developed in an hour and later printed in an hour. The laser printer technical film gave good results using an Olympus OM-20 SLR at 4 feet with a single dedicated flashgun attached (with diffuser). Four rechargeable AA-size NiCd batteries were sufficient for at least 72 shots.

Attempts were made to photograph the mosaics using 2 angled floodlights with moderate success.

MISCELLANEOUS

An old problem: in bad weather water enters the forward hold from somewhere and sloshes about, sometimes getting into the electrics of the airgun compressors.

The hazard of slippery metal decks was reduced temporarilly by painting with sand-mixed paint but a better solution is required.

Air gun retrieval was complicated by the sticky hydraulics of the cable winch. A gate cut in the gunwhale and/or a special davit would make deployment less hazardous.

Problems with the hydraulics of the Gloria cable winch persisted.

Insertion of brass bushes to match the brass liners on the airguns instead of polythene ones solved the seating problem.

There seems to be incomplete communication at Leg changeovers regarding the serviceability of survey equipment (e.g. 3.5 kHz fish damage) and this could subsequently lead to avoidable down-time. This should be avoided by compiling a written log or fault list instead of relying, as at present, on oral communication.

The ships crew were, as always, helpful and friendly and this is much appreciated.

A list of suggested improvements has been posted in the wet darkroom (shelves, light etc.)

CONSUMMABLES

Lists of photographic and general consummables and rate have been produced. These lists are found on the GLORIA disk for the BBC. Please update as required.

There appear to be no firm guidelines as to who is responsible for restocking what but please check stocks and reorder for the next leg

either from IOS or USGS (bulky or heavy materials).

Present and ordered supplies should be sufficient for the 12 day Gap-filling Leg from Woods Hole to Norfolk.

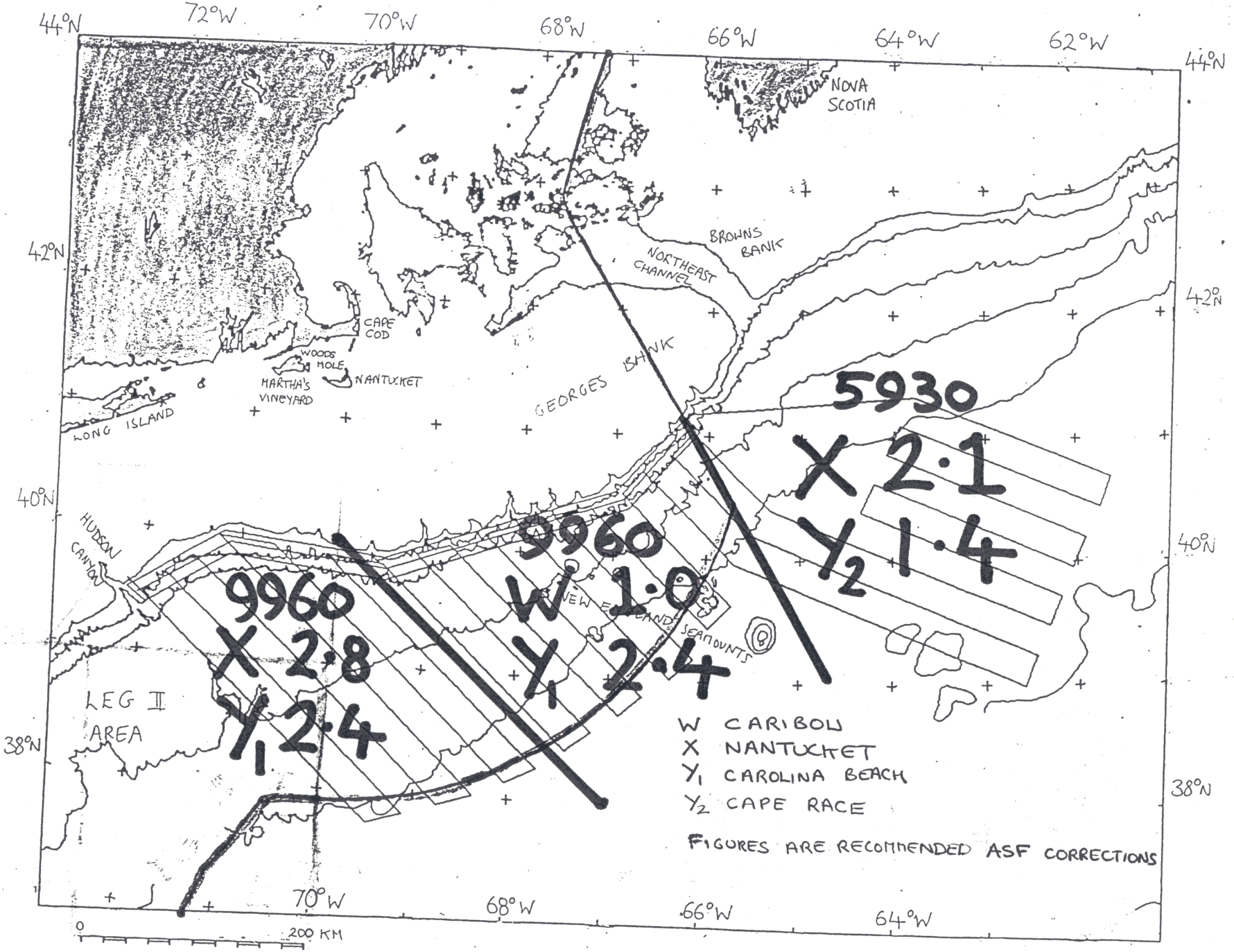


FIGURE 3 LORAN C STATION COVERAGE

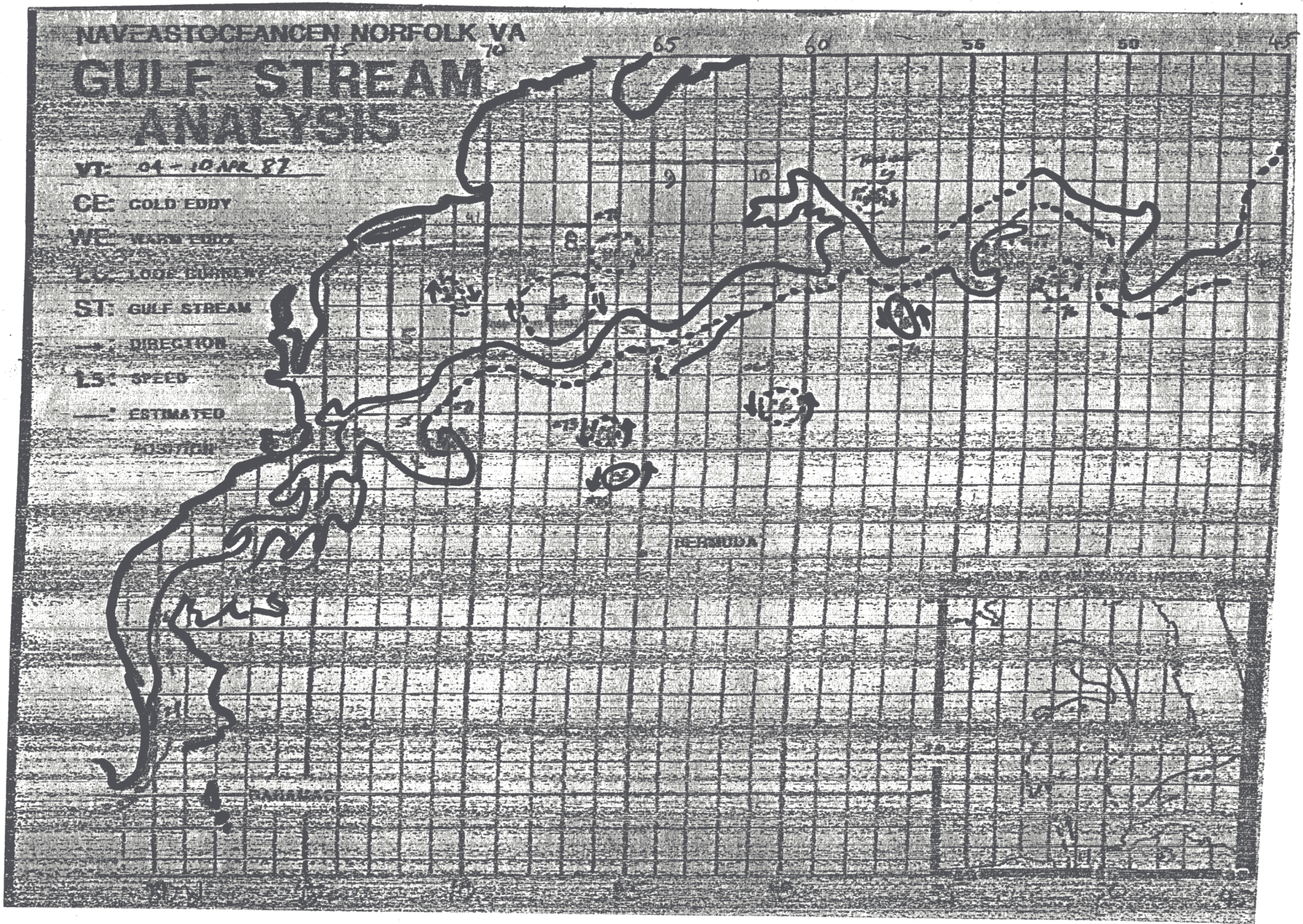
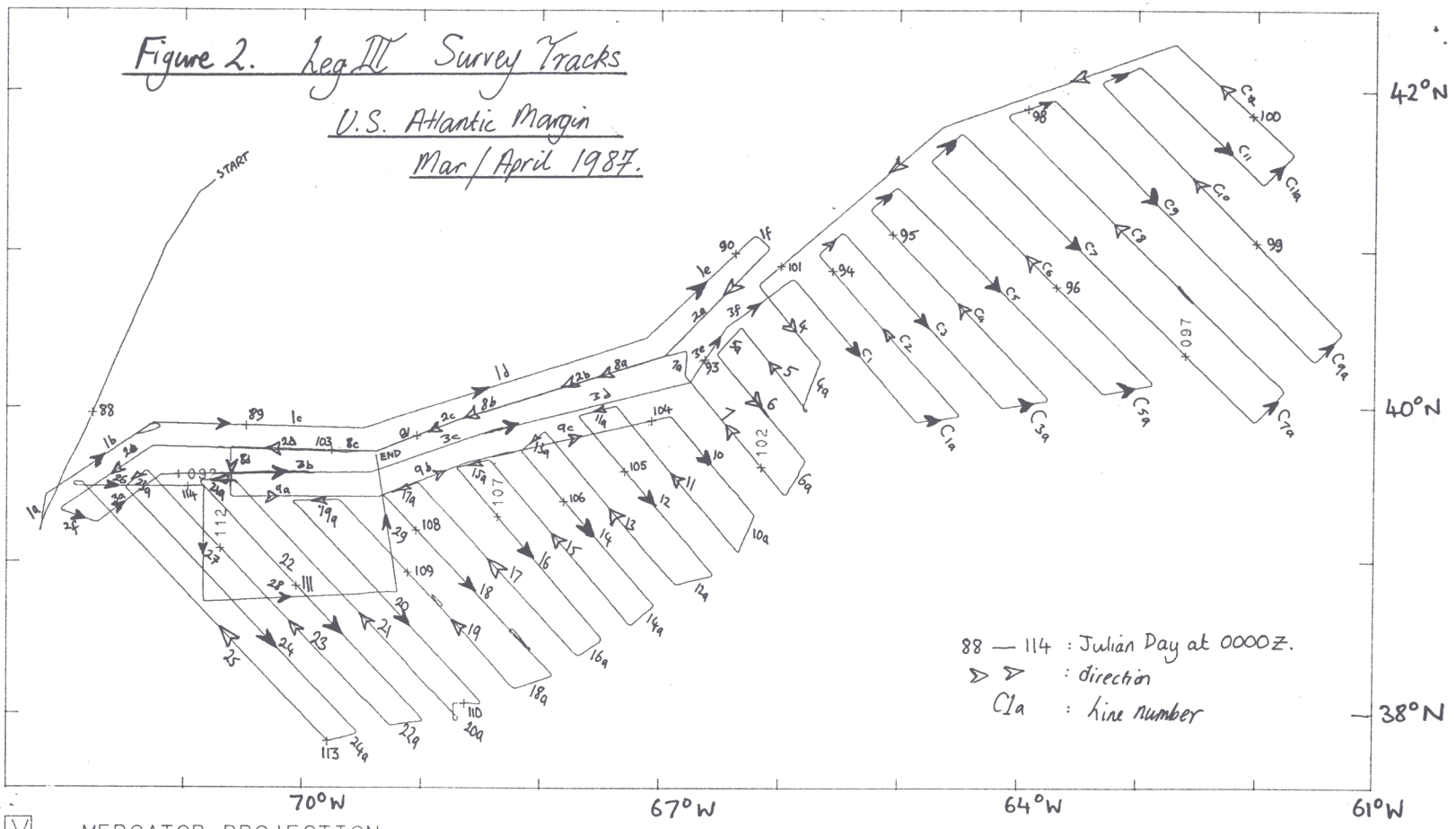

NAVEASTOCEANCEN NORFOLK VA
GULF STREAM
ANALYSIS
VT: 04 - 10 APR 87
CE: COLD EDDY
WE: WARM EDDY
LC: LOOP CURRENT
ST: GULF STREAM
DIRECTION
SPEED
ESTIMATED
POSITION
BERMUDA
75
70
65
60
55
50
45

Figure 4.

Figure 2. Leg III Survey Tracks

U.S. Atlantic Margin

Mar / April 1987.



MERCATOR PROJECTION

SCALE 1 TO 4000000 (NATURAL SCALE AT LAT. 36)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

FARNELLA 3/87

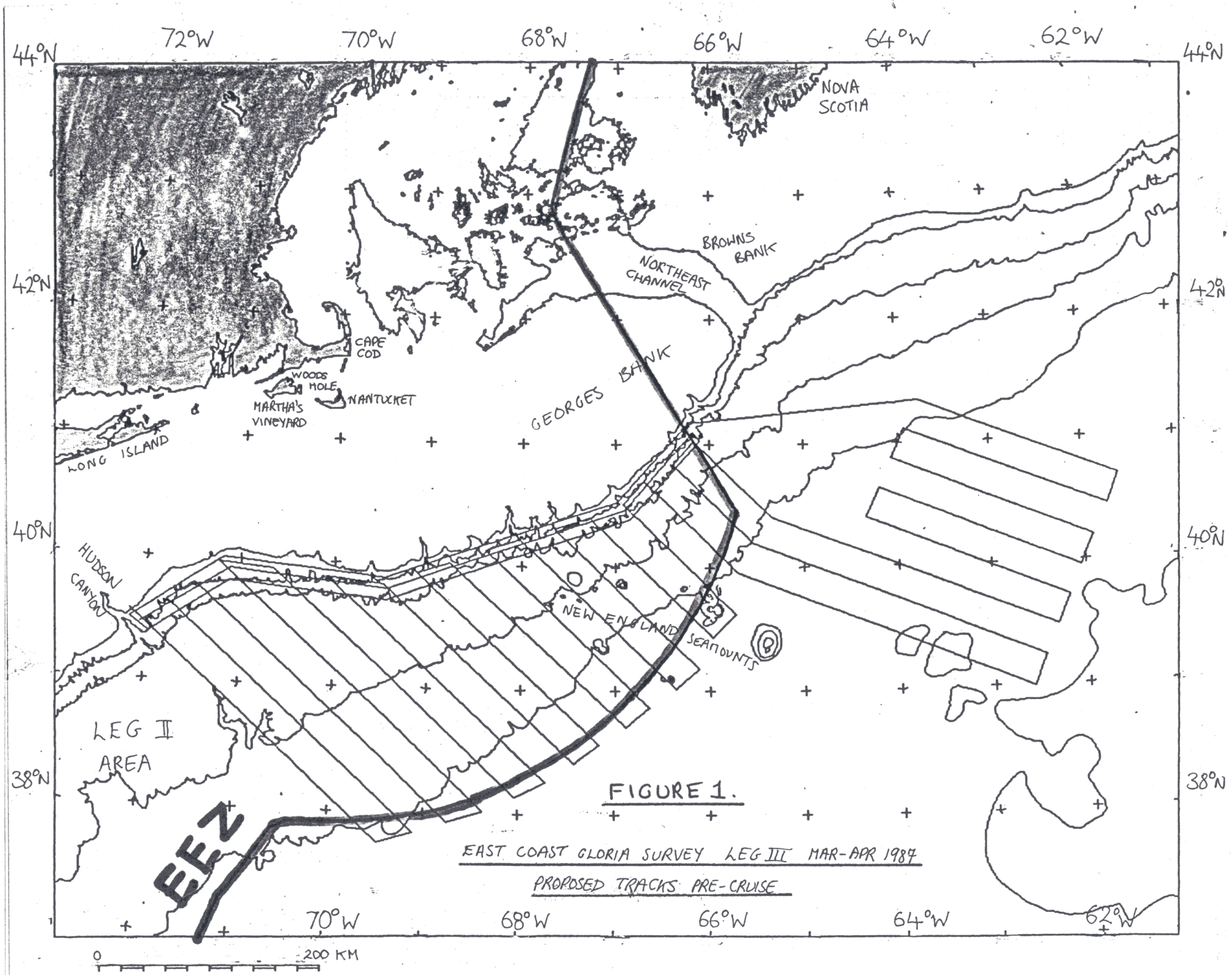
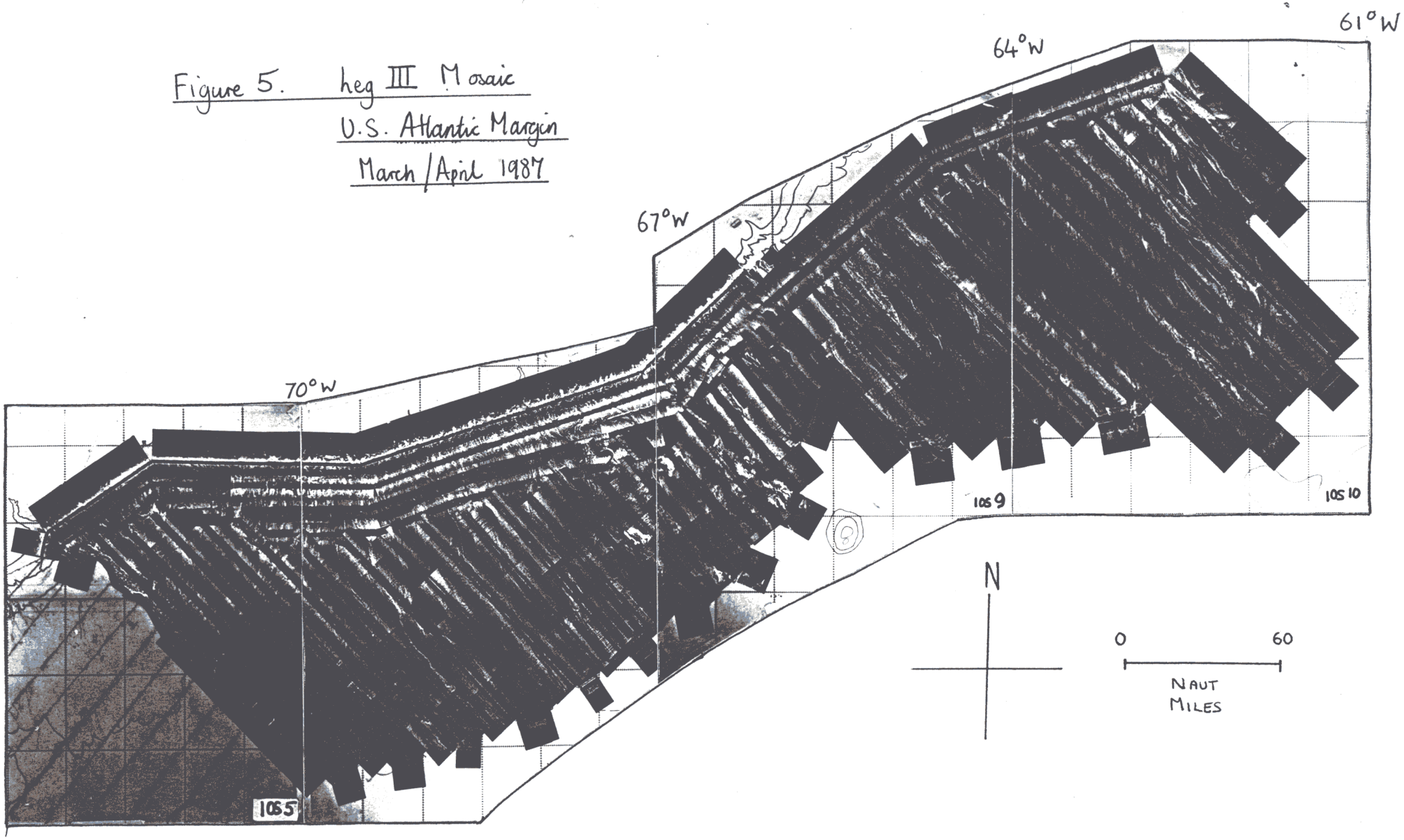


FIGURE 1.

EAST COAST GLORIA SURVEY LEG III MAR-APR 1987

PROPOSED TRACKS PRE-CRUISE

Figure 5. heg III Mosaic
U.S. Atlantic Margin
March/April 1987



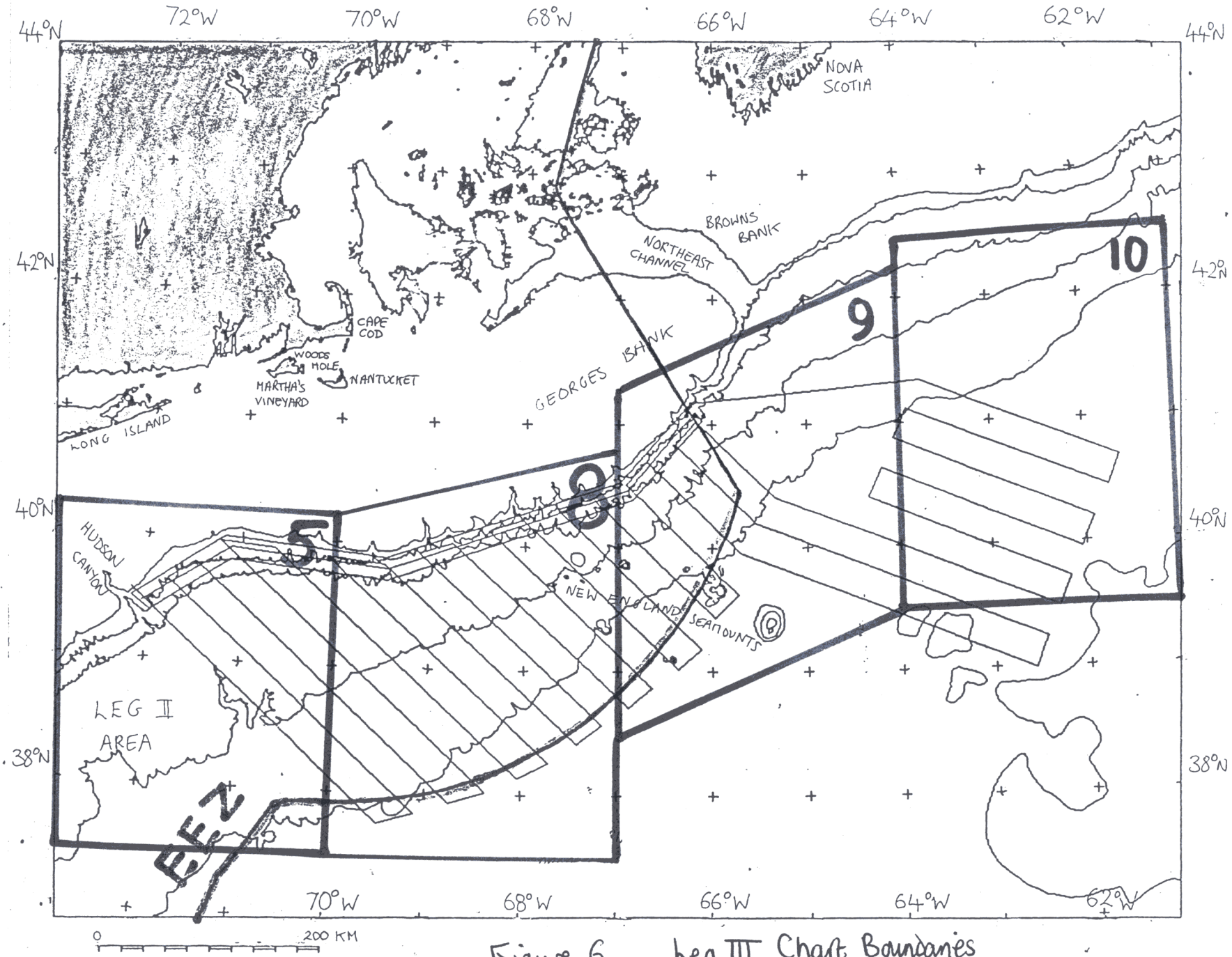


Figure 6. Leg III Chart Boundaries

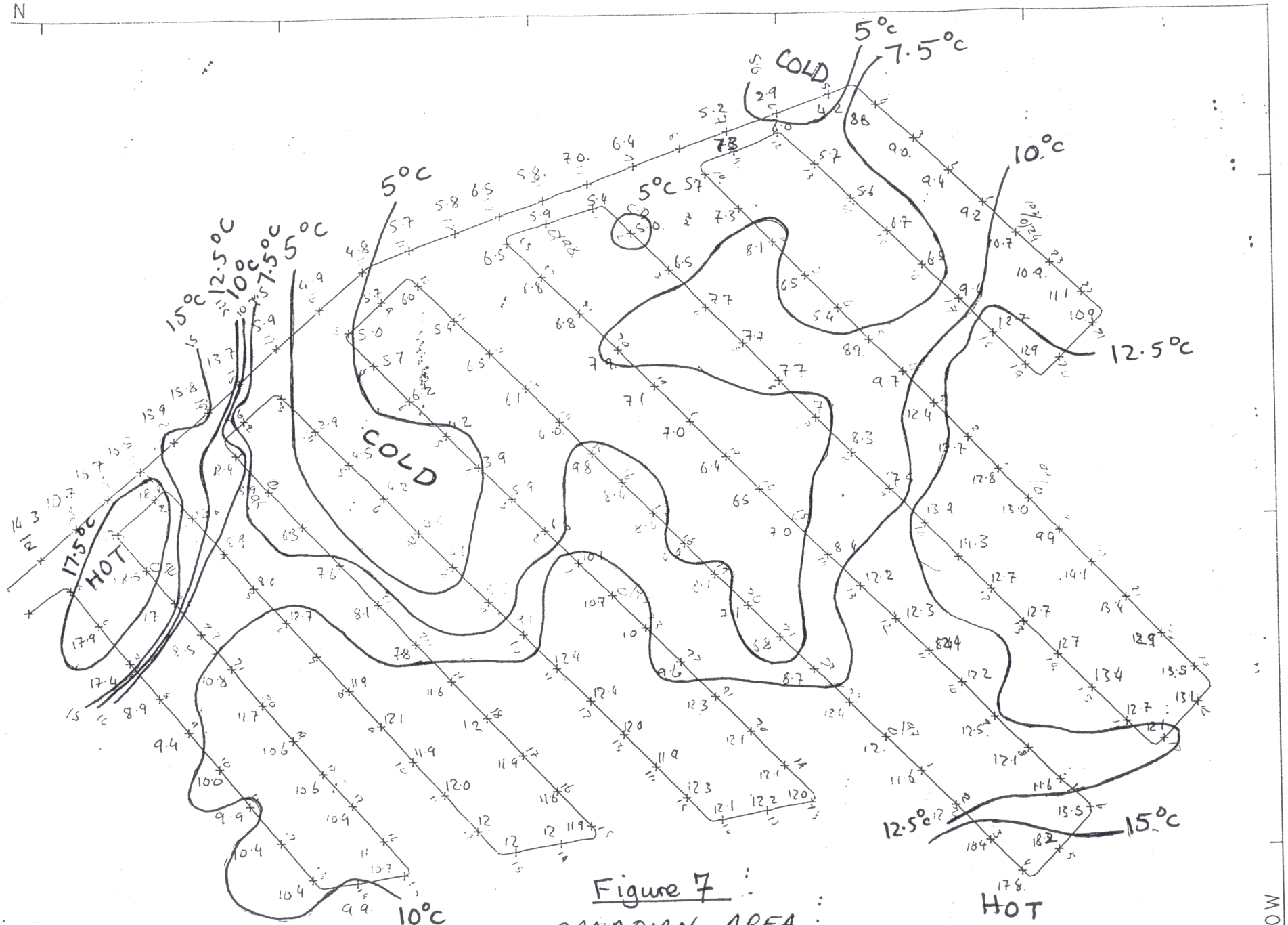


Figure 7

CANADIAN AREA

GLORIA: TEMPERATURE DISTRIBUTION

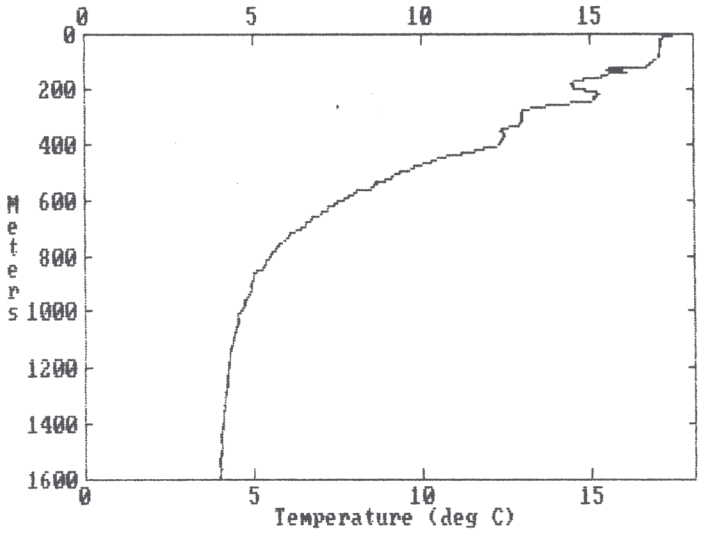
(ASYNCHRONOUS)

by J.H-C

Figure 8. XBT Profile Examples

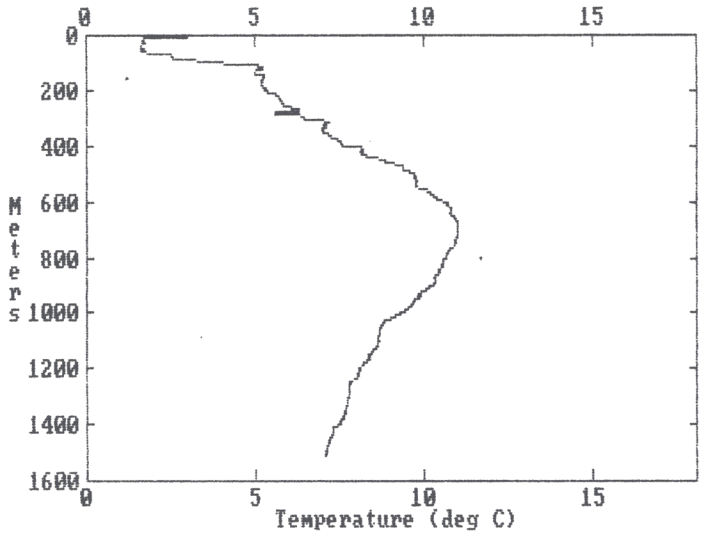
NOAA
National
Ocean
Service

Drop 067
Latitude : 38 46.5 N
Longitude: 67 07.0 W
Probe T-05
Date 87/04/16
Time 04:37 GMT
Bottom depth: 4400 m
Cruise: F87-3



NOAA
National
Ocean
Service

Drop 062
Latitude : 41 42.5 N
Longitude: 64 44.5 W
Probe T-05
Date 87/04/10
Time 15:19 GMT
Bottom depth: 2600 m
Cruise: F87-3



NOAA
National
Ocean
Service

Drop 063
Latitude : 41 15.5 N
Longitude: 65 26.0 W
Probe T-05
Date 87/04/10
Time 19:50 GMT
Bottom depth: 2600 m
Cruise: F87-3

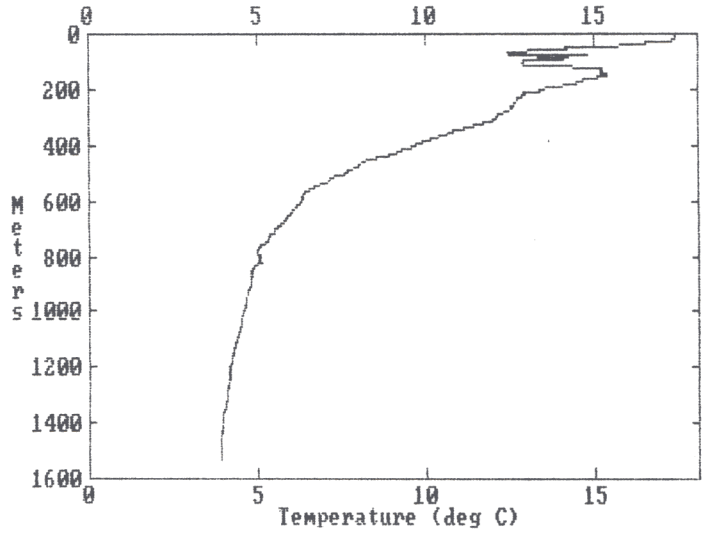


FIGURE 9. XBT DATASHEET EXAMPLE

Cruise: F87-3

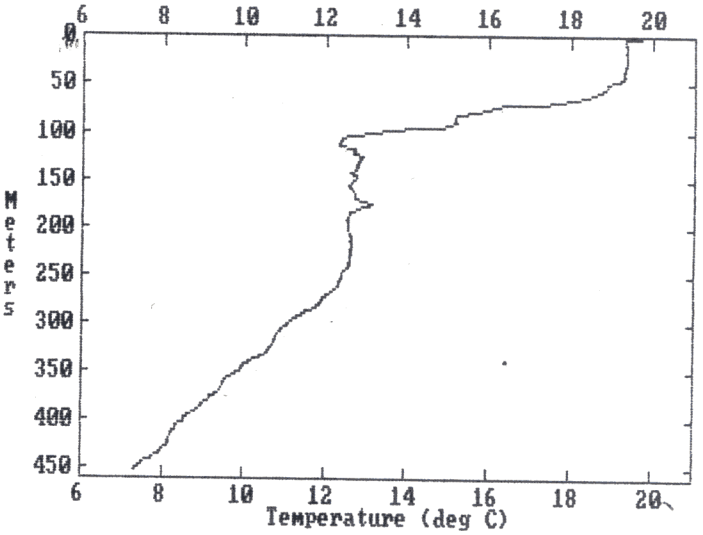
Ship: R/V FARNELLA

Bottom depth: 2200 m

Point	Depth (m)	Temp. (C)
46	29.7	19.33
47	30.4	19.34
48	31.0	19.32
49	31.7	19.32
50	32.3	19.31
51	33.0	19.30
52	33.6	19.29
53	34.2	19.30
54	34.9	19.30
55	35.5	19.30
56	36.2	19.30
57	36.8	19.29
58	37.5	19.27
59	38.1	19.28
60	38.8	19.29
61	39.4	19.29
62	40.0	19.29
63	40.7	19.30
64	41.3	19.30
65	42.0	19.28
66	42.6	19.28
67	43.3	19.25
68	43.9	19.21
69	44.6	19.20
70	45.2	19.18
71	45.8	19.14
72	46.5	19.06
73	47.1	19.00
74	47.8	18.97
75	48.4	18.93
76	49.1	18.91
77	49.7	18.89
78	50.4	18.89
79	51.0	18.87
80	51.6	18.88
81	52.3	18.86
82	52.9	18.84
83	53.6	18.82
84	54.2	18.79
85	54.9	18.79
86	55.5	18.75
87	56.1	18.75
88	56.8	18.74
89	57.4	18.72
90	58.1	18.67
91	58.7	18.61
92	59.4	18.60
93	60.0	18.55
94	60.6	18.51
95	61.3	18.45
96	61.9	18.40
97	62.6	18.37
98	63.2	18.33
99	63.9	18.27
100	64.5	18.19
101	65.1	18.11
102	65.8	18.01

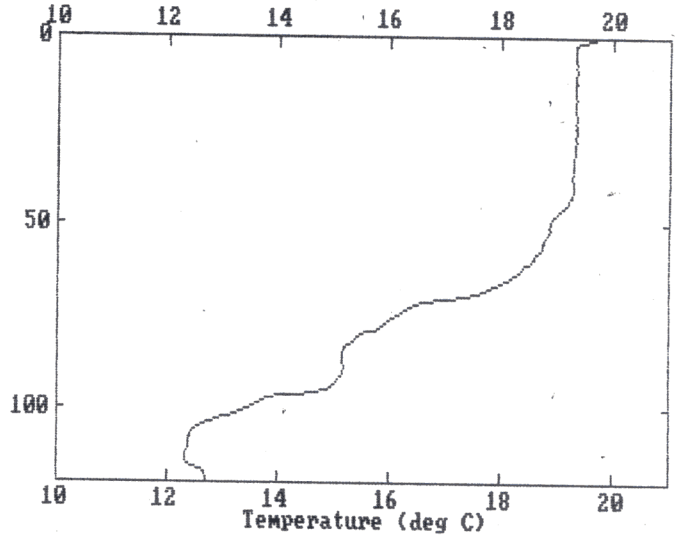
NOAA
National
Ocean
Service

Drop 050
Latitude : 40 54.0 N
Longitude: 66 14.0 W
Probe T-06
Date 87/03/31
Time 03:17 GMT
Bottom depth: 2200 m
Cruise: F87-3



NOAA
National
Ocean
Service

Drop 050
Latitude : 40 54.0 N
Longitude: 66 14.0 W
Probe T-06
Date 87/03/31
Time 03:17 GMT
Bottom depth: 2200 m
Cruise: F87-3



APPENDIX 2.

XBT DROPS

DATAFILES ON DISK

###	TYPE	DATE	TIME	LAT			LON			FILE	JJXX
		YY/MM/DD	HH:MM	DD	MM.M		DDD	MM.M			
048	T-06	87/03/30	02:13	39	52.7	N	70	04.0	W	06870330.048	Y
049	T-06	87/03/30	13:13	40	14.0	N	68	03.5	W	06870330.049	Y
050	T-06	87/03/31	03:17	40	54.0	N	66	14.0	W	06870331.050	Y
051	T-06	87/03/31	15:55	40	05.0	N	68	00.0	W	06870331.051	Y
052	T-06	87/04/01	13:25	39	44.0	N	71	18.0	W	06870401.052	Y
053	T-06	87/04/02	14:05	39	50.0	N	68	27.0	W	06870402.053	Y
054	T-05	87/04/03	15:19	39	59.0	N	64	32.0	W	05870403.054	Y
055	T-05	87/04/03	14:20	40	03.0	N	63	49.0	W	05870403.055	Y
056	T-05	87/04/05	01:04	41	13.8	N	65	13.0	W	05870405.056	Y
057	T-05	87/04/05	02:00	40	59.0	N	63	57.5	W	05870405.057	Y
058	T-05	87/04/07	00:34	40	16.0	N	62	30.0	W	05870407.058	Y
059	T-05	87/04/08	04:03	41	37.0	N	63	15.5	W	05870408.059	Y
060	T-05	87/04/08	17:37	40	23.5	N	61	22.5	W	05870408.060	Y
061	T-05	87/04/09	00:48	41	56.0	N	62	09.5	W	05870409.061	Y
062	T-05	87/04/10	15:19	41	42.5	N	64	44.5	W	05870410.062	Y
063	T-05	87/04/10	19:50	41	15.5	N	65	26.0	W	05870410.063	Y
064	T-05	87/04/11	17:54	39	56.5	N	66	05.5	W	05870411.064	Y
065	T-05	87/04/12	22:52	39	43.0	N	69	33.0	W	05870412.065	Y
066	T-05	87/04/12	23:51	39	55.0	N	67	04.5	W	05870412.066	Y
067	T-05	87/04/16	04:37	38	46.5	N	67	07.0	W	05870416.067	Y
068	T-05	87/04/17	02:18	39	00.0	N	68	02.0	W	05870417.068	Y
069	T-05	87/04/17	23:05	39	16.0	N	69	07.0	W	05870417.069	Y
070	T-05	87/04/18	22:05	38	42.0	N	68	49.0	W	05870418.070	Y
071	T-05	87/04/20	02:52	38	07.0	N	68	52.5	W	05870420.071	Y
072	T-05	87/04/20	22:41	38	57.5	N	70	11.0	W	05870420.072	Y
073	T-05	87/04/22	18:49	38	09.0	N	69	51.5	W	05870422.073	Y
074	T-05	87/04/23	17:38	39	28.0	N	71	49.0	W	05870423.074	Y

222208 bytes left on disk

APPENDIX 3

(File PhoCons on GLORIA disk, SW 1987)

PHOTOGRAPHIC CONSUMABLES ON 24/4/87 END OF LEG III.

	USED	REMAINING	ORDERED
B/W 35 mm films (36 exp)	38	128	
Patterson ACUTEC developer pkts	5	13	
Kodak Unifix FIXER cans	5	16	
ILFOPRINT IA-11 activator (5 l)	3	51	
ILFORD IS-21 stabiliser (5 l)	4	42	
PAPER ILFOPRINT YR, Glossy single weight 2.1P B&W paper. Beware expiry date!	[illegible]		
(20"x 16", 50 sheets)	—	—	
(16"x 12", 50 sheets)	14	11	
(N.B. Print size 6x8")			
PHOTOFLO solution (500 cc)	50cc	4x500cc	
DISPOSABLE GLOVES (Box 100 large)	50	150	
(Box 50 medium)	10	40	
Water filter element large	—	6	
small	N/A		
Philips 150W Photocrescenta bulbs (6).			
15W bayonet bulbs for exposure timer.			
Transparent A4 paper negative holders.	12	75	
Lens fluid			

APPENDIX 4.

SEISMIC ANALOG RECORD INVENTORY

CRUISE I.D.. & LEG F3-87-NA
CHIEF SCI. O'LEARY
SYSTEM TYPE GLORIA LSR

TIME ZONE ZULU
i.e., EST, EDT, Zulu-DO NOT USE A.M.-P.M.

FOLDER #	LINE #	START DATE YYDDMM 80JAN01	START TIME	END DATE YYDDMM 80JAN02	END TIME	REMARKS
GLORIA LSR						
1	1-21	87MAR29	0730	87APR20	1500	INCLUDES: BREAK FOR CANADIAN SURVEY
2	22-29	87APR20	1700	87APR24	2000	
PES - 10 kHz						
1	1	87MAR29	0648	87MAR31	0200	TWO PIECES
2	2	87MAR31	0202	87APR01	1918	TWO PIECES
3	3	87APR01	1948	87APR03	0448	BREAK FOR CANADIAN
4	4,5,6,7,8	87APR11	0102	87APR13	0636	
5	9,10,11,12	87APR13	0644	87APR15	0725	
6	13,14,15,16	87APR15	0726	87APR17	0732	
7	17,18,19,20	87APR17	0730	87APR19	1342	
8	20,21,22,23	87APR19	1348	87APR21	2331	
9	24 - 29	87APR21	0236	87APR24	2000	LINES 24 thru 29
3.5 kHz						
1	1	87MAR29	0748	87MAR31	0200	
2	2	87MAR31	0215	87APR01	1943	
3	3	87APR01	1948	87APR03	0446	
4	4,5,6,7,8	87APR11	0100	87APR13	0636	BREAK FOR CANADIAN S.
5	9,10,11,12,13	87APR13	0644	87APR15	2100	
6	14,15,16,17,18	87APR15	2125	87APR18	1604	
7	19,20,21,22	87APR18	1610	87APR21	0430	
8	22,23	87APR21	0500	87APR22	0617	
9	24 - 29	87APR22	0625	87APR24	2000	LINES 24 THRU 29 (TWO (2 PIECES)
SRP - TCAG 160 cu in LSR						
1	1	87MAR29	0807	87MAR31	0200	
2	2	87MAR31	0205	87APR01	1943	
3	3	87APR01	1950	87APR03	0446	
4	4,5,6,7,8	87APR11	0100	87APR13	0636	BREAK FOR CANADIAN S.
5	9,10,11,12,13	87APR13	0644	87APR15	2100	FILES 9 THRU 13
6	14 - 20	87APR15	2230	87APR20	0032	FILES 14 THRU 20
7	21,22,23,24	87APR20	0130	87APR22	2350	FILES 21 THRU 24
8	25-29	87APR23	0012	87APR24	2000	FILES 25 THRU 29
SRP - TCAG + EPC						
1	1,2,3	87MAR29	0828	87APR03	0447	
2	4,5,6,7,8	87APR11	0112	87APR13	0636	BREAK FOR CANADIAN S.
3	9-17	87APR13	0646	87APR17	1415	LINES 9 thru 17
4	17-29	87APR13	0021	87APR24	2000	LINES 17 thru 29 (3 PIECES)

Appendix 5.

NAVIGATION by G.C.

Loran C in the hyperbolic mode was used throughout the survey area for positioning. Four recievers were operational: 2 Megapulse Accufix 500's; a Northstar 7000; and a Racal-Decca MNS2000. Time Differences (TD's) and Lat/Long from the Northstar and MNS2000 were logged on the IOS ABC system for the entire cruise.

The 2 Megapulse recievers were interfaced to separate IBM PC's, where the observed TD's were converted to Lat/Long and all data logged on floppy disc and were printed out every 5 minutes. As of April 8 (JD098) data from one of the Megapulse/IBM's were logged on the ABC system, but near the end of the cruise it was discovered that a bug in the program (making the tenth of a microsecond (us) digit = 0) rendered the TD's useless.

A single "mean" ASF correction for each Master/Secondary pair was determined from the available sources---DMA and CHS/BIO---and applied to the observed TD's on the Megapulse/IBM system for the entire survey, as shown below.

CHAIN	SECONDARY	ASF
9960	W Caribou	+1.0 us
	X Nantucket	+2.8 us
	Y C. Beach	+2.4 us
5930	X Nantucket	+2.1 us
	Y Cape Race	+1.4 us

The Northstar reciever had ASF corrections built in at time of manufacture. There was a Lat/Long bias available but was not used. Apparently the Northstar reciever has errors in the TD to Lat/Long conversion and is not reliable/accurate (according to USGS/WHOI).

The Northstar reciever was used for bridge navigation and line running. Although a monitor from the Megapulse/IBM was on the bridge (with waypoint navigation and line running) it was not used because it was difficult to see (numbers too small) and interpret and generally not user friendly; the navigation officers preferred the Northstar.

The Northstar reciever sometimes gave problems at dawn---bad signals, erroneous course corrections and speed---possibly because of atmospheric noise or skywave interference at long ranges from one of the transmitters. It also gave negative speed values at times. Usually during these periods, waypoint navigation would have to be restarted once good signals were acquired. Overall, the reciever was reliable for navigation and good TD's were logged.

The only real problem with the Megapulse reciever occurred when, after a temporary loss of signal, the tracking gate did not necessarily lock back onto the 3rd cycle, thus giving 10us or multiples of 10us errors thereafter. This was caused by having the cycle selection disabled (status 4); the problem was prevented by enabling cycle selection (status 3).

Carolina Beach (9960 y) went off the air for a six hour period on March 31 (JD090) at a time it was needed. Alternate stations were used during this period but giving worse geometry.

In addition to all the Loran recievers, a Racal-Decca MNS2000

Appendix 1.

XBT's by G.C.

Water column temperature profiles were collected throughout the survey area using XBT's and the Sippican MK9 Oceanographic Data System. Temperature vs depth profiles were logged on the SEAS III system and subsequently transmitted via the GEOS satellite to NOAA.

Once an XBT was launched, a thermistor measured the varying temperature as the probe fell to the bottom at an assumed velocity. This temperature vs depth profile was logged on the SEAS III microcomputer. Erroneous temperature spikes at the bottom of the profile could be edited prior to transmission to GEOS.

Each profile was logged on floppy disc and hard copy profiles were obtained on a printer. For each drop three profiles were usually plotted: one of the full profile; one to depths of 200-400m where the surface layer and seasonal thermocline occur; and one to a depth of 60m , just below the depth of GLORIA. See the Appendices for detailed launch procedures and listing of XBT deployments.

During the survey this data was not used quantitatively---i.e. to correct GLORIA images for refraction---but as a planning aid and to confirm the existence of warm core rings. Reduced sonar ranges were observed in areas of high thermal gradients near the fish depth and in areas of warm core rings.

XBT's were dropped once per day and attempted to give good coverage of the work area. Six model T6's (max. depth 460m) and twenty-one T5's (max. depth 1830m at 6 knots ship speed) were dropped. Maximum depth reached with the T5's was 1650m due to the 8 knot ship speed.

About 90% of the drops were successful; only a few had to be repeated due to snags in the streaming cables or in rough seas.

The port quarter proved to be the optimum launch position, regardless of wind direction or sea state. The deck-mounted launcher would probably work as well as the present "pole" system.

The general trend of the profiles was varying gradients in the surface and seasonal layers (temperature variations up to 8 degrees) to depths of 200-300m; then the main negative thermocline to about 1000m; then a relatively constant temperature near 4 degrees C to the bottom (1650m).

An exception was drop #62 which showed a positive thermocline to depth 700m and then a negative thermocline to 1600m; also the temperature below 1000m was much higher at 9-7 degrees. Other interesting profiles were #56 and #63 (11 miles apart) which showed a cold layer at depth 75-100m between two warm layers.

Transit satellite reciever was available and logged on the ABC system, but was not used for navigation; only for comparison to the Loran C.

Daily track plots were produced showing the Loran C Northstar, Megapulse, MNS2000 and the Transit/DR. Northstar and Megapulse tracks agreed well, but were offset up to 1mm (up to 375m) because of the different ASF corrections and TD-Lat/Long conversions used. The observed TD's on both recievers agreed within 0.1 us.

Best navigation can be achieved in post-processing by using the observed TD's, applying the best available ASF corrections (from a lookup table based on position) and recomputing the Latitude and Longitude.