GEOLOGICAL SURVEY OF CANADA
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Cruise Report
Parizeau 96-003
Emerald Bank, Scotian Shelf
16-18 April 1996

D.R. Parrott

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Introduction

Mission Parizeau 96-003 was organized as a joint research project between the Ocean Mapping Group, Geological Survey of Canada (Atlantic) (GSC-A), Natural Resources Canada and the Defense Research Establishment Atlantic on an area of Emerald Bank on the Scotian Shelf. The primary objectives of the survey were to study the backscatter characteristics and locate an area free of large (greater than 1 metre) boulders. The survey was performed during 16-18 April 1996. An area of about 4 km by 4 km was surveyed to provide overlaping sidescan sonar, and closely spaced seismic coverage of the seafloor. About 200 kilometers of sidescan sonar, single channel seismic reflection and echo sounder data were collected along the tracks shown in Figure 1.

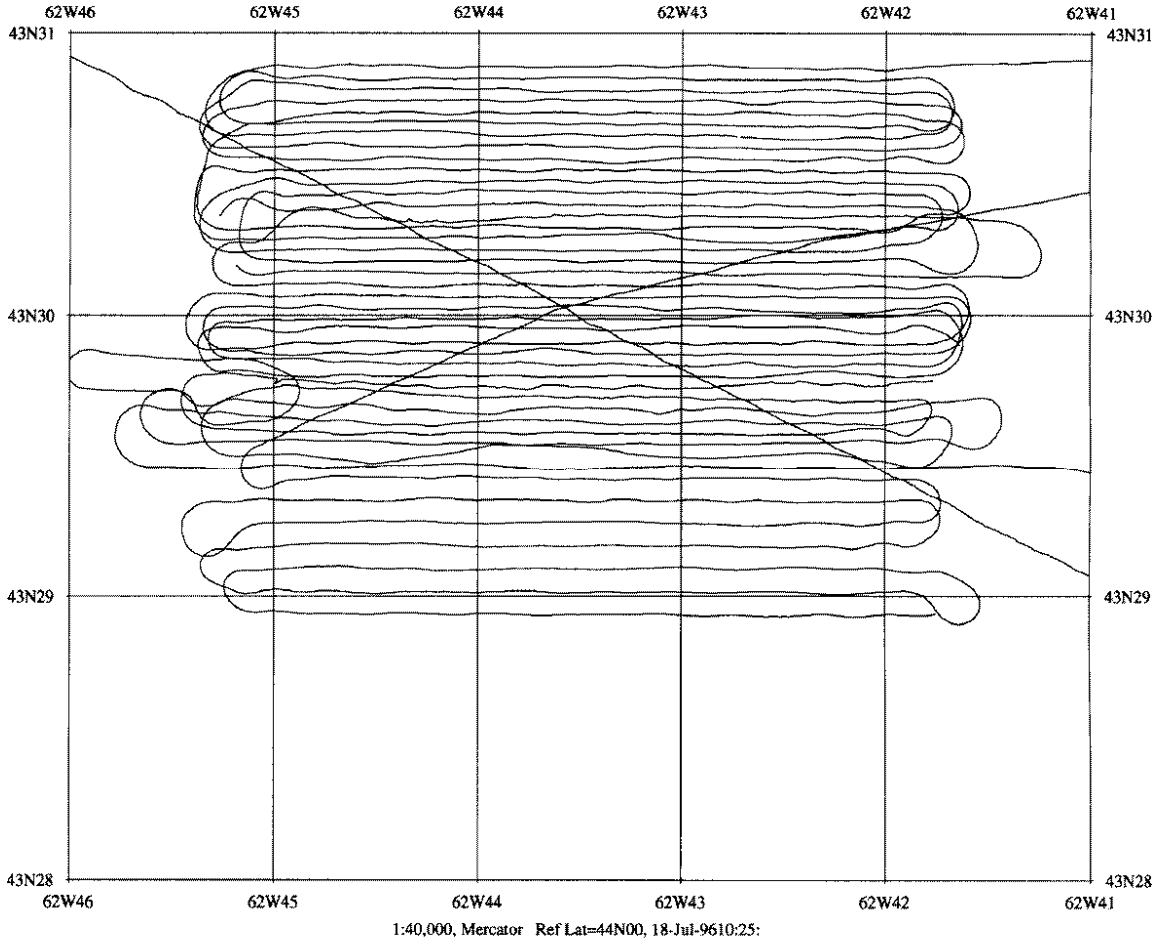

Figure 1 Ship's track for survey area on Emerald Bank

Surficial Geology

The survey area is located on the western flank of Emerald Bank, on the Scotian Shelf, about 200 km south-southeast of Halifax, N.S. Water depths in the survey area are about 100 metres. The surficial sediments on the seafloor in the survey area have been mapped as Sable Island Sand and Gravel, based on a combination of echosoundings and sediment samples (King 1970). This present survey confirms the earlier findings.

Much of the Scotian Shelf, in water depths above 115 to 120 metres, was exposed as a series of islands during a late-Pleistocene lowering of sea level (about 15,000 to 1900 years ago). Sable Island Sand and Gravel, a sand and gravel formation overlying deposits of Scotian Shelf Drift, occurs across all the bank areas and inner shelf of the Scotian Shelf at water depths above the low stand of sea level at 115 to 120 metres. The unit varies in thickness from a veneer of about 1 metre to 15-20 metres. The unit consists of medium- to coarse-grained, very well-sorted sand grading to very coarse gravel with boulders, and includes various mixtures of these lithological types. During the low stand of sea level, the sediments in the study area were exposed to subaerial weathering and erosion. The sediments were reworked by waves during a trasngression, which removed the fine components of the original sediments and further sorted and rounded the coarse fraction.

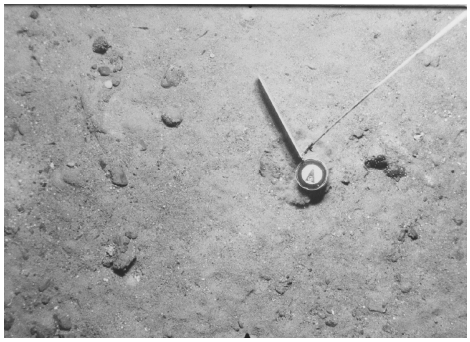

Figure 2a Seafloor photograph in a area of the sand facies of the Sable Island Sand and Gravel unit.

A sequence of seafloor photographs taken at a single camera station where the ship was allowed to drift between successive photographs (Fader 1983), shows the character and variability of the Sable Island Sand and Gravel unit in this area (Figure 2a-c). The grain size of the material on the seafloor can be estimated by comparing with the current vane used as the trigger weight for the camera, which is about 30 cm (12 inches) long.

Figure 2b - gravel facies of the Sable Island Sand and Gravel unit.

The photograph in Figure 2a shows a predominately sandy seafloor with occasional cobble sized material of the sand facies of the Sable Island Sand and Gravel unit.

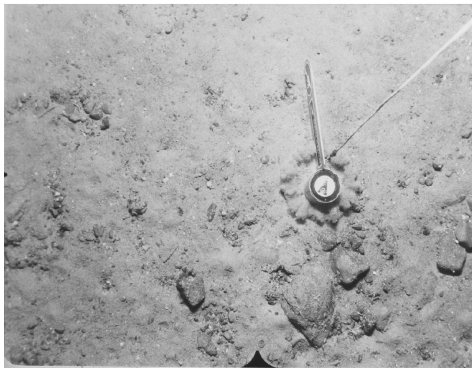

Figure 2c - transition between the sand and gravel facies of the Sable Island Sand and Gravel unit.

Figure 2b shows the gravel facies of the Sable Island Sand and Gravel unit. The presence of the well-rounded gravel is a result of the marine transgression across the bank as a series of high energy beaches. The largest boulder in this photograph is about 30 cm long.

Figure 2c shows an area composed predominately of sand adjacent to the gravel facies of the Sable Island Sand and Gravel unit.

Survey Results

A sidescan sonar survey was performed by the Geological Survey of Canada using a Simrad MS992 dual frequency (120 and 330 kHz) sidescan sonar system and recorded on a 4-channel digital data acquisition and display system. Data were displayed on Alden thermal recorders. Hardcopy records were annotated with time and location for later use in target identification, and calculation of boulder distribution. Sidescan sonar data were recovered from digital tape, imported into a Geographic Information System (GIS), slant-range corrected, integrated with navigation and combined to produce a mosaic of the survey area. Selected records were also replayed from digital tapes for inclusion in this report and to provide a hardcopy record of seafloor conditions at the site.

Positions were determined with a Global Position System with real time Differential corrections (D-GPS) and displayed using AGCNav, a navigation display and logging program specifically developed for marine geoscientific surveying. AGCNav accepts input from a range of navigation devices, most notably a GPS or Differential GPS receiver and produces a display of the ship and towed bodies in real time.

The quality of the sidescan sonar data collected during this surveyed suffered due to weather conditions at the time of the survey. Wind speeds of 60-70 km/hr generated waves of 4-5 m. The sidescan sonar attitude sensor package recorded the pitch of the towfish at about $+30^{o}$ to -15^{o}. The sidescan sonar data quality was reduced as a result of the poor weather conditions.

A representative sample of the original geophyscial records from the survey have been included in this report to provide an overview of the character of the seafloor in the survey area, but cannot duplicate the detail present in the original records. The original records have been archived at the Geological Survey of Canada (Atlantic) offices in Dartmouth, Nova Scotia.

The overall sediment distribution in the survey area is shown in the mosaic in Figure 3. (An enlargement was enclosed with the master copy of this report.) The dark areas of the mosaic represent predominately gravel sediments; the large light patch represents a deposit of sand within the gravel. Isolated bright (dark coloured) areas in the sidescan sonar image with small shadows (light areas) immediately behind indicate the presence of boulders on the seafloor. Other features such as fishing trawl marks are present, and can be seen in the original records and the enlargement of this figure.

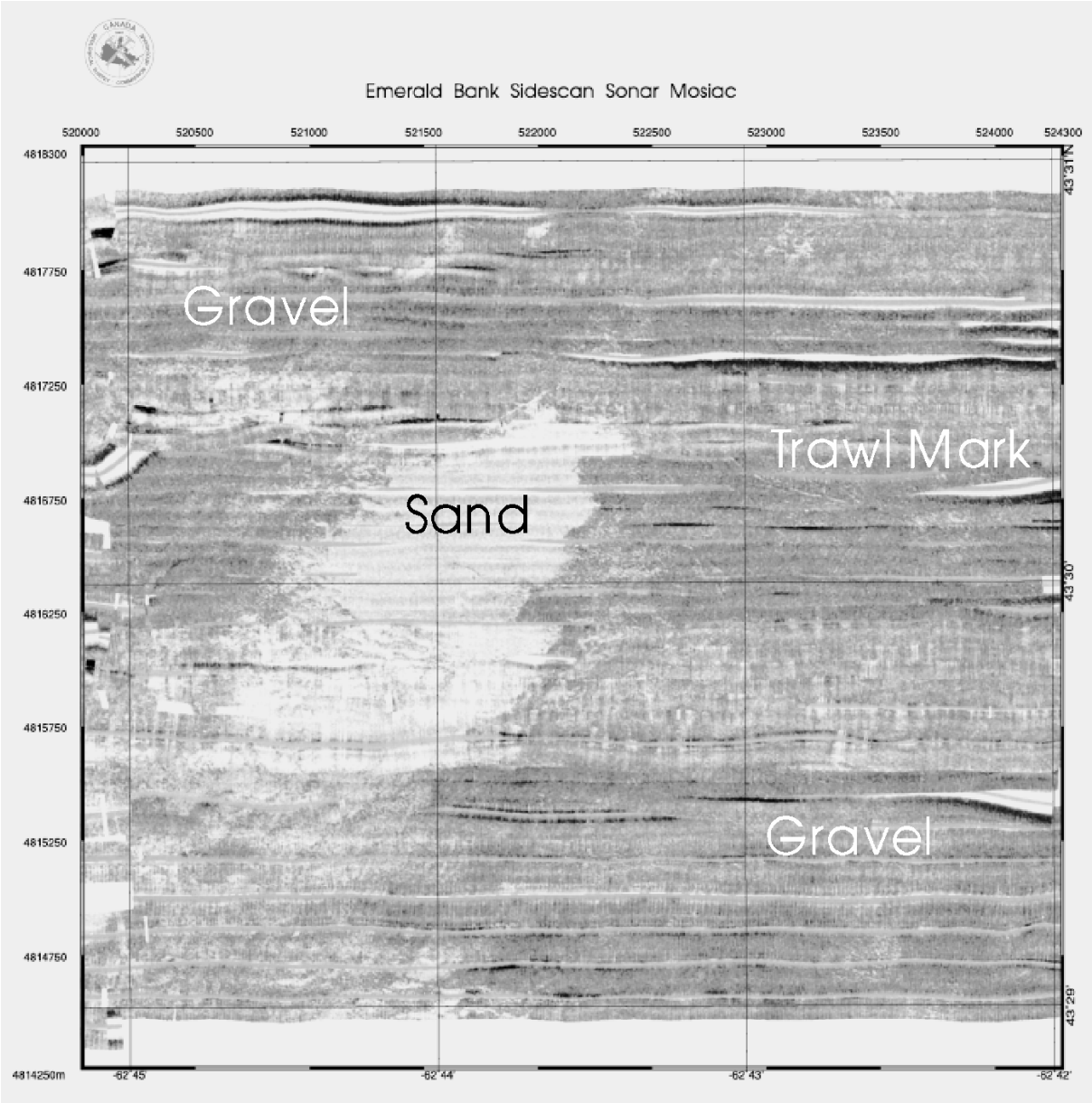

Figure 3 Sidescan sonar mosaic of the survey area on Emerald Bank.

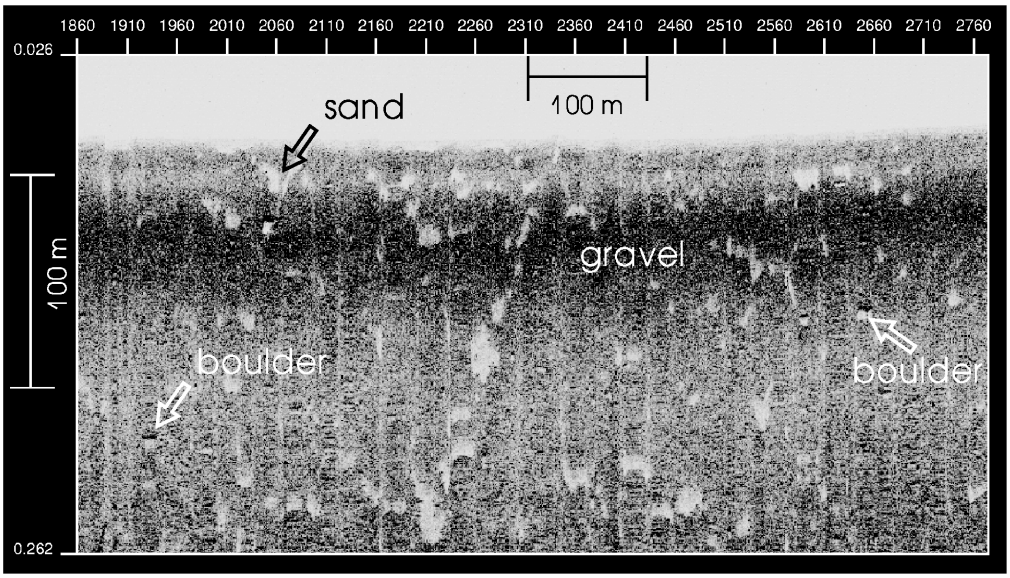

Figure 4a Sidescan sonar data from Line Ln_14

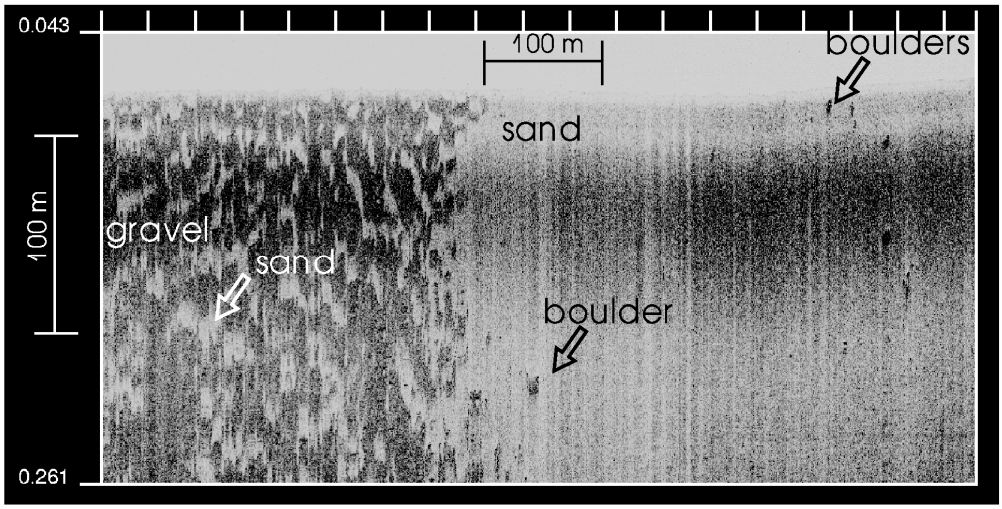

Figure 4b Sidescan sonar data from Line Ln_14

A more detailed description of the seafloor can be obtained from sections of an individual survey line from the centre of the mosaic shown in Figure 4a-c. Figure 4a shows a predominately gravel (dark) seafloor with small patches of sand (light areas) from the western side of the mosaic. The photographs in Figure 2b and 2c show a typical seafloor for this sediment type. In the sidescan sonar records shown in Figure 4a to 4c, the presence of boulders is indicated by isolated bright (dark coloured) areas in the sidescan sonar image with small shadows (light areas) immediately behind.

Figure 4b shows a transition from a predominately gravel (dark) seafloor with sand (light areas) in the form of starved megaripples (Amos and King 1984) present on the western portion of the mosaic to the large sand deposit seen in the centre of the mosaic. The photographs in Figure 2b and 2c show the nature of a typical seafloor for the gravel and the photograph in Figure 2a shows the character of the sand.

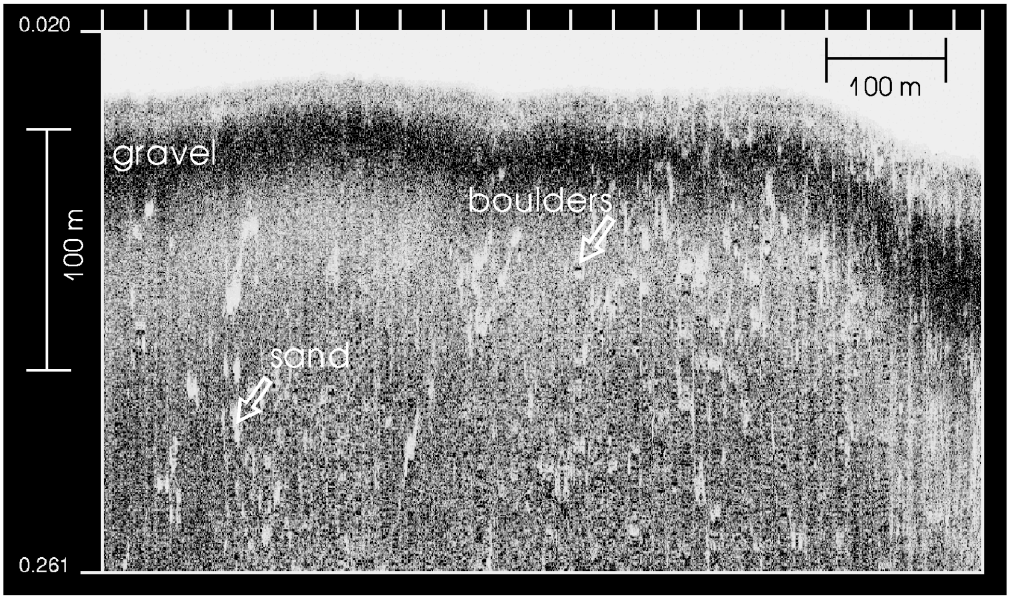

Figure 4c Sidescan sonar data from Line Ln_14

Figure 4c shows a sidescan sonar record from the eastern portion of the mosaic. The photographs in Figure 2b and 2c show the nature of a typical seafloor for this sediment type.

An interpretation of all the sidescan data from the survey area, failed to define a zone on the seafloor that could be guaranteed to be free of large boulders. Boulders are widespread across the survey area.

List of references

Amos, C.L. and King, E.L. 1984. Bedforms of the Canadian eastern seaboard: a comparison with global occurences, Marine Geology, 57, pp 167-208.

Fader, G.B., 1983 Cruise report No. 83-019 C.S.S. Hudson, July 8-15, 1983. Geological Survey of Canada, unpublished manuscript.

King, L.H. 1970, Surficial geology of the Halifax-Sable Island map area, Marine sciences Branch, Department of Energy, Mines and Resources, Canada. paper 1

APPENDIX I

I. Cruise Summary

Cruise Parizeau 96-003 was organized as a joint research project between the Ocean Mapping Group of the Geological Survey of Canada Atlantic and the Defense Research Establishment Atlantic to study the backscatter characteristics of an area of Emerald Bank on the Scotian Shelf. The survey was performed during 16-18 April 1996. About 200 kilometers of sidescan sonar, single channel seismic reflection and echo sounder data were collected.

An area of about 2 km by 4 km was surveyed to provide overlaping sidescan sonar coverage of the seafloor. The data were processed to produce a mosaic of the seafloor, to study the backscatter intensity of the area, and to determine the concentrations of large boulders in the area.

The following acoustic equipment were used on the survey: a Simrad MS992 dual frequency sidescan sonar system; a GeoAcoustics 300 joule multi-tip sparker; and a 12 kHz hull-mounted echo sounder. Navigation was provided by the Global Positioning System with differential corrections provided by the Canadian Coast Guard through the Western Head site. Lines were run and navigation recorded using the AGCnav program.

Seafloor samples were taken with a medium-sized vanVeen grab sampler.

II. Cruise Particulars

Name of Vessel:	CSS Parizeau
Name of Master:	Capt. W. English
Dates of Cruise:	16-18 April 1996
Areas of Operation:	Emerald Bank, Scotian Shelf
Responsible Agency:	Geological Survey of Canada (Atlantic)
Senior Scientist:	Russell Parrott, GSCA

Personnel	Russell Parrott, GSCA
	Austin Boyce
	Larry Johnston
	Jesse Neilsen
	Doug Dwyer
	Shawna Bowser
	Paul Kidney

III. Cruise Objectives

1. Collect sidescan sonar data in an area of Emerald Bank for use in backscatter intensity studies and for the detection of an area free of boulders greater than 1 metre.
2. Collect siesmic reflection data to determine the thickness of nearsurface unconsolidated sediments and determine the liklihood of buried boulders.
3. Obtain grab samples to provide information on sediment grain-size distribution and to confirm the interpretation of the geophysical data.

IV. Operational Summary

Tuesday 16 April 1996 Mobilization and transit to site.

11:00 GMT Trials were run with the Innovative Technologies 24-channel streamer to determine the effectiveness of recent repairs. The 24-channel streamer was removed from the vessel at the end of the trials.

21:00 GMT Fire and boat drill. Vessel departs BIO for Emerald Bank.

Wednesday 17 April 1996 Survey

04:00 GMT Stream gear to survey cross line. 35-40 kn winds 4-5 m seas. Towfish motion shows pitch of about $+30^{o}$ to -15^{o}. Data quality marginal

12:00 GMT Winds reduced. Data quality improved. Continue survey of E-W lines.

Thursday 18 April 1996 Survey, sample and transit

09:00 GMT Complete survey of E-W lines with sidescan sonar and seismic. Recover gear.

09:30 GMT Start sampling of area with vanVeen grab

14:00 GMT End of sampling. Steam for BIO

18:30 GMT Arrive BIO.

V. Equipment Specifications and Performance

The geophysical survey equipment was positioned on the afterdeck of the CSS Parizeau. The geophysical recording equipment was placed in the upper deck laboratory. Navigation was provided by differential GPS system.

REFLECTION SEISMICS

Single channel seismic reflection data were produced with a 300 joule multi-tip sparker. Data were received on an NSRF-Type LT-18 element 25 foot streamer. The sparker source was deployed from the port side of the gantry on the stern of the vessel. The single channel streamer was deployed from the starboard side using a boom to move the streamer away from the vessel.

Labratory equipment consisted of an NSRF pre-amplifier, and an O.R.E. Geopulse Amp/ Filter/Gain (TVG) unit and band pass filter. Data were filtered at 100-1500 Hz and output to an EPC 8700 Thermal Graphic Recorder. Firing of the source was synchronized by the Airgun Firing Unit, Amp/TVG, and graphic recorder. The TSS 312B annotator was to write "day/time, event number and course/speed" on the seismic records.

SIMRAD MS992 SIDESCAN SONAR

The Simrad MS992 digitally controlled Sidescan Sonar was used to generate high resolution acoustic images of the seabed at 100 and 200 metre ranges each side of the survey track (200 and 400 metre swaths). Lines run at the 100 m range were typically 75 metres apart for most of the E-W lines in the survey site. A 200 metre range with was used for the sidescan sonar survey of the crossline. About 210 metres of towcable were deployed for survey, however, it was necessary to winch in cable during turns to prevent the towfish from colliding with the seafloor. Data (both 120 and 330 kHz) were digitized and stored on an AGCDig digital data recorder developed at the Geological Survey of Canada (Atlantic). Sidescan sonar data were acquired at a sample interval of 122 microseconds. No gains or geometric corrections were applied to the raw logged data. The digital gain settings for the system were logged on field sheets.

Channel configurations for the logged data were:

Channel	Use
0	120 kHz port
1	120 kHz starboard
2	330 kHz port
3	330 kHz starboard.

A hardcopy graphic record of the sidescan sonar data was produced on an Alden 9315CTP thermal recorder. The sidescan sonar system was capable of resolving 25 cm objects. The Simrad sidescan sonar was deployed from the starboard side of the gantry.

DIGITAL DATA ACQUISITION
The sidescan sonar and seismic reflection data were digitized and logged on an AGCDig digital data recorder developed at the Geological Survey of Canada (Atlantic). The clock in the AGCDig was synchronized to the GPS clock.

SAMPLING EQUIPMENT
Samples of the surficial sediment in the area were obtained using a small van Veen grab sampler deployed from the starboard foredeck gantry of the Parizeau.

NAVIGATION
Navigation was by a differential Global Positioning System owned and operated by GSCA, utilizing a Canadian Coast Guard signal transmitted from the shore station at Western Head, NS. Accuracy of the navigation was about 4 m.

Data processing
The sidescan sonar and sub-bottom profiler records were interpreted in the field to provide an overview of the surficial geology of the survey area, and sites were selected for sample coverage. Proposed positions for grab samples were identified from navigation information printed on the sidescan sonar records.

Digital sidescan sonar data were recovered from the ExaByte tapes recorded on the AGCDig recorder and imported into a HP715 UNIX workstation. The data were processed to remove geometric distortions present in sidescan sonar data. The geometrically corrected data were then integrated with navigation and processed to remove the effects of varying sensor gain with angle. The sidescan sonar data from adjacent survey lines were then integrated to produce a sidescan sonar mosaic of the area using software developed by the Geological Survey of Canada.

The sub-bottom profiler and processed sidescan sonar data collected during the survey were used to prepare a geological interpretation of the area.

BATHYMETRY
Bathymetry data were collected with a Raytheon UGR graphic recorder which controlled a Raytheon PTR, 2000 watt, 12 kHz transmitter using a hull mounted transducer.

VI. Acknowledgements
We thank Captain W. English and the crew of CSS Parizeau for their assistance and comraderie during the data collection.

Appendix II

KILOMETRES RUN:

SIMRAD SIDESCAN	200
SPARKER	200
12 KHZ BATHYMETRY	200

Grab Sample Locations

Sample	Latitude	Longitude
001	43.50545	62.73147
002	43.50537	62.71881
003	43.50917	62.74078
004	43.50468	62.73305
005	43.49667	62.70727
006	43.49633	62.74742
007	43.49270	62.74176
008	43.49362	62.72297
009	43.49543	62.73819
010	43.49497	62.75591
011	43.49290	62.73878
012	43.49397	62.73232
013	43.49428	62.75806
014	43.50069	62.72744
015	43.50908	62.74906
020	43.48222	62.71469
021	43.48169	62.72258
022	43.48243	62.74332
023	43.48469	62.72825
025	43.48918	62.73923