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Cruise Matthew 2000063 Geophysical Surveys and Sampling Operations near Saint John, NB, 21-29 October 2000

D.R. Parrott, R. Cranston and M.B. Parsons

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Parrott, D.R., Cranston, R., and Parsons, M.B. 2010. Cruise Matthew 2000063 Geophysical Surveys and Sampling Operations near Saint John, NB, 21-29 October 2000; Geological Survey of Canada, Open File 4993, 34 p.

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Background

Survey Matthew 2000063 was conducted from 21-29 October 2000 in Saint John Harbour and Approaches in the Bay of Fundy (Figure 1). Geophysical data were collected from the CCGS Matthew (Fig. 2a), to provide information on the character and distribution of seafloor sediments, and the geological and oceanographic processes which have affected the seafloor over a marine disposal site at Black Point in the approaches to Saint John Harbour, NB. Multibeam bathymetry data were collected using the survey launch Plover (Fig. 2b) equipped with a Simrad EM3000 multibeam bathymetry system. Current velocity data were collected over the disposal site, for an entire tidal cycle, with the University of New Brunswick research vessel Mary O (Fig. 2c) equipped with an RDI acoustic doppler current meter. Geophysical equipment used during the survey consisted of a Simrad MS992 dual frequency (120 and 330 kHz) sidescan sonar system, an IKB Seistec sub-bottom profiler, and a QTCView seafloor classification system. Sediment samples were collected with a VanVeen grab sampler and a small gravity corer, and bottom photographs were taken along transects through the survey area. Cores from the survey will be analyzed to determine temporal changes in the chemical signature of modern sediments, and to determine sedimentation rates.

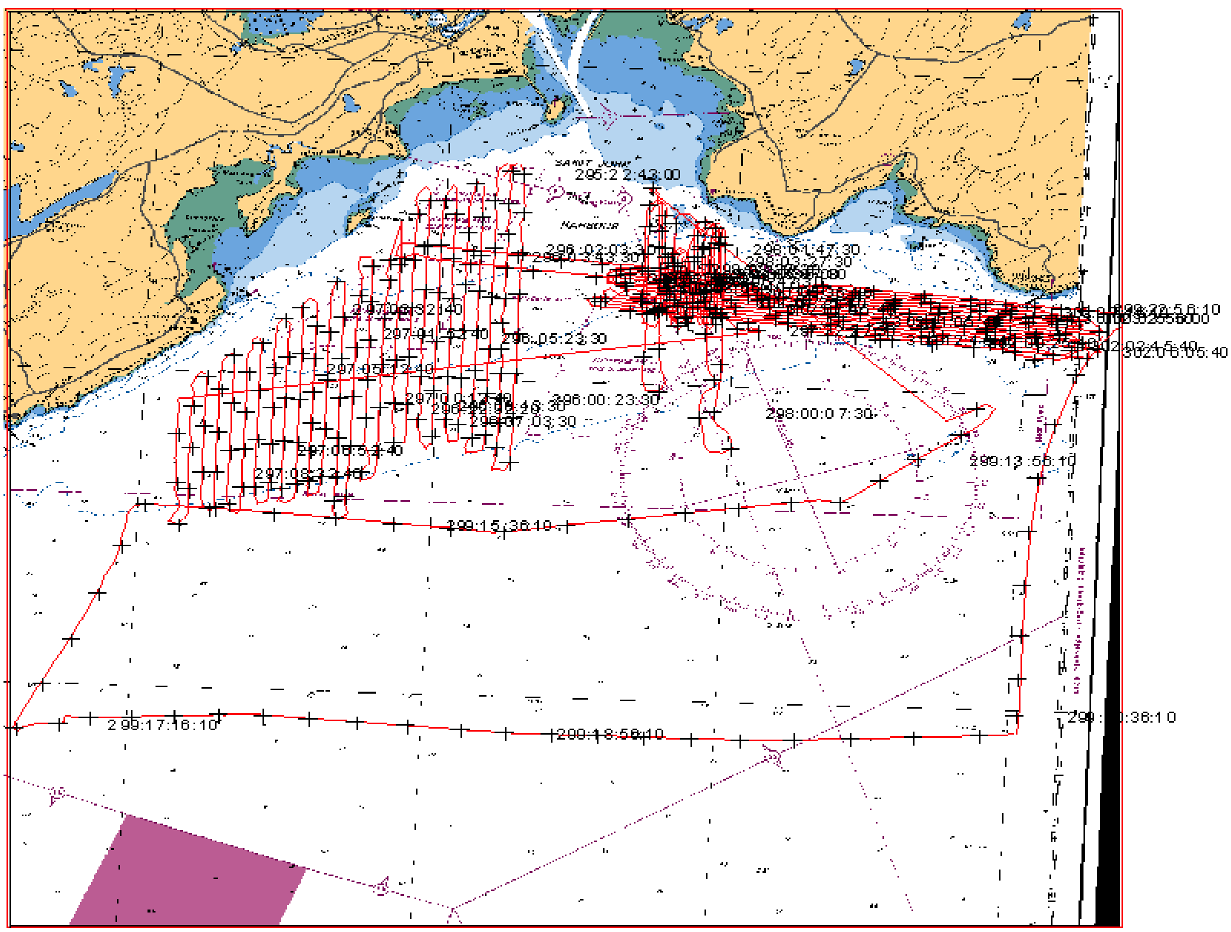
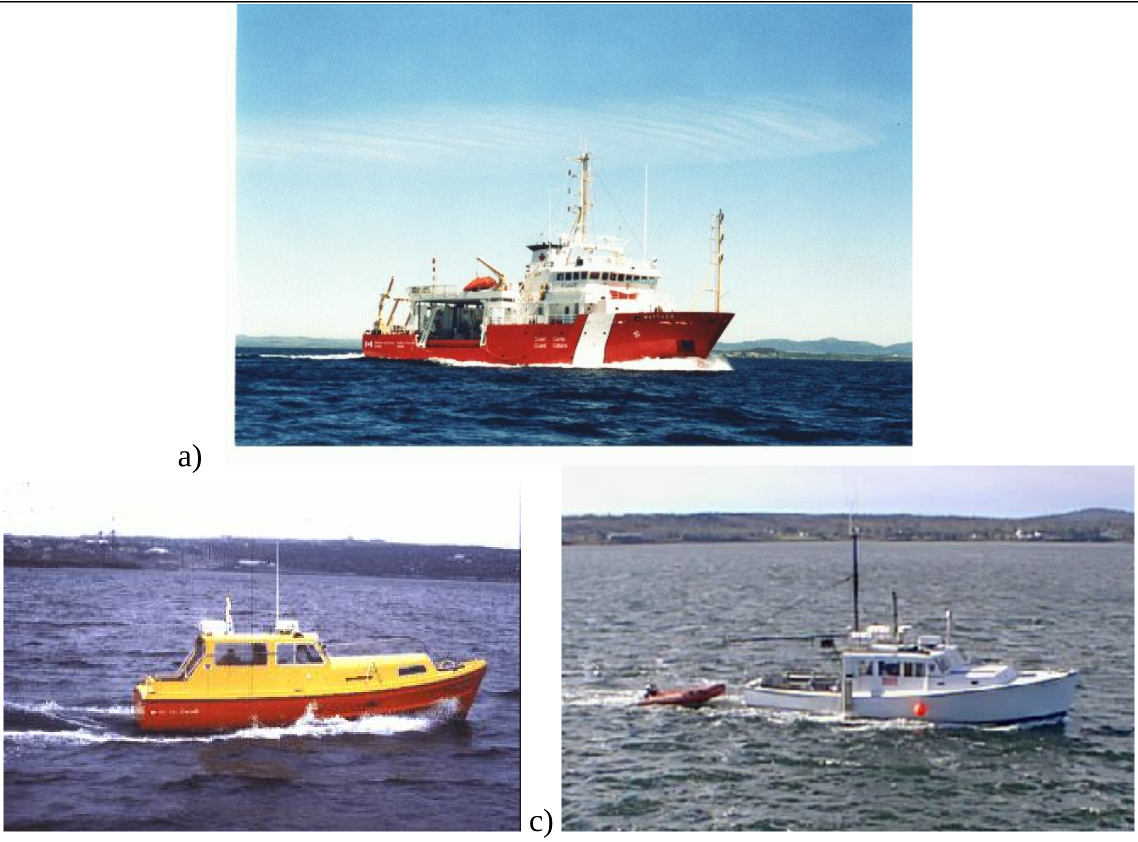


Figure 1. Trackplot showing lines where geophysical data were collected during survey Matthew 2000063.



a) b) c)

Figure 2. The geophysical survey and seafloor sampling program were performed using (a) the CCGS Matthew. Multibeam bathymetry was conducted using the survey launch Plover (b) equipped with a Simrad EM3000 multibeam bathymetry system. The University of New Brunswick research vessel Mary O (c) was used to collect current data over the disposal site through a complete tidal cycle.

The survey was performed concurrently with dredging operations in Courtney Bay. A fleet of 5 small self-unloading barges were transporting dredged materials to the Black Point disposal site and dumping at the disposal ground.

Previous Work

For over 40 years, the Black Point Ocean Disposal Site (Fig. 3), located in the Bay of Fundy in the approaches to Saint John Harbour, New Brunswick, has been used as a disposal site for material dredged from Saint John Harbour. Up to 1,000,000 m^3 of dredged sediment are deposited annually at the site. The site is located in a high-energy area affected by the outflow of the Saint John River and the Bay of Fundy tides. Although it was initially predicted that material dumped at the disposal site would be dispersed by the strong currents, disposal activities have resulted in a buildup of sediment with a distinct chemical imprint and an impoverished benthic community.

Environment Canada had previously sponsored a three year monitoring program (1992-94) at the disposal site, to define the zone of influence of the disposal activities, assess the physical, chemical and biological impacts caused by disposal activities, and evaluate the long-term use of the site for future dredging projects (Tay et al., 1997). Sidescan sonar, sub-bottom profiler, single beam bathymetry, seafloor photographs, and samples were collected over the disposal area. The study indicated that past disposal activities resulted in a significant buildup of dredged material within a one-kilometer radius of the disposal buoy.

A joint research program between Environment Canada and the Geological Survey of Canada was initiated in 1999 to determine recent changes in the disposal site and to study the possibility that material was being transported away from the disposal area and impacting nearby fisheries.

The Geological Survey of Canada has recently performed three surveys of the Black Point marine disposal site in Saint John Harbour. These surveys originally concentrated on determining conditions near the disposal site. Geophysical surveys with a sub-bottom profiler, and sidescan sonar were performed by the Geological Survey of Canada in April 1999 during survey Hart 99-002 (Parrott, 1999). A multibeam bathymetry survey was performed in April 2000 and seafloor photographs, sediment samples and free fall penetrometer measurements were taken in May 2000 during survey Hart 2000004 (Parrott, 2000) to provide information on the character of seafloor sediments. The present survey (Matthew 2000063) took place 21-29 October 2000 and concentrated on repetitive surveys of the disposal site and detailed studies of seafloor conditions of the surrounding areas.

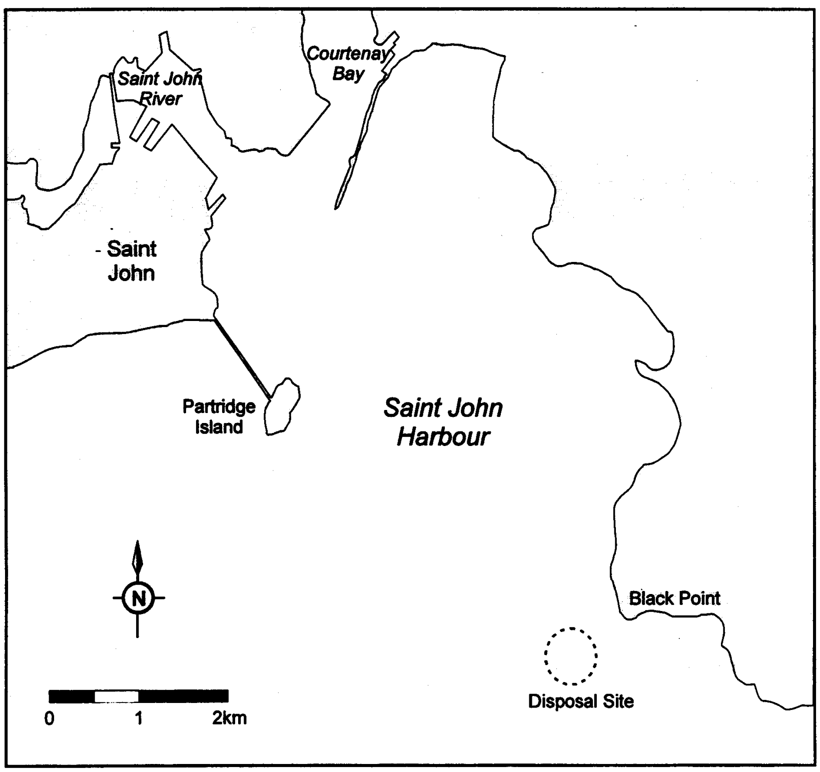


Figure 3. Location of Black Point offshore disposal site

Data Acquisition and Processing

The following geophysical and sampling equipment was used during survey Matthew 2000063:

- Simrad MS992 sidescan sonar system in a neutrally-buoyant tow configuration
- IKB Seistec high resolution sub-bottom profiler
- AGCDIG 4 channel digital geophysical data acquisition system
- ORE TrackPoint II ultra short baseline towfish positioning system
- Regulus survey navigation package with input from differential GPS
- Simrad EM3000 multibeam bathymetry system
- HP workstations running GRASS with GSCA extensions
- Linux workstations running GRASS with GSCA extensions
- Caris HIPS multibeam bathymetry data cleaning software running on Windows NT
- InterOcean S4 current meters
- Acoustic Doppler Current meters
- GSCA icehole camera
- VanVeen grab sampler
- Small gravity corer

Sidescan sonar

High-resolution, acoustic images of the seabed were produced with a Simrad MS992 dual frequency (120 and 330 kHz) sidescan sonar system equipped with a neutrally-buoyant towbody deployed 13 metres behind a dead weight depressor (a 120 kg. iron blister weight on a swivel). The towfish was deployed about 50 metres behind the vessel. This configuration was chosen to reduce artifacts seen on the sidescan sonar records due to vessel-induced heave, and thereby improve resolution. The sidescan sonar system was capable of resolving objects down to a size of about 0.15 m. An ORE TrackPoint II acoustic position system was used to position the towfish. A hardcopy graphic record of the 330 kHz portion of the sidescan sonar data was produced on an Alden 9315CTP thermal recorder set at a fixed speed of 1.7 knots. This produced records with a 2 to 1 aspect ratio at the slowest survey speeds of 3.5 knots. A hardcopy graphic record of the 120 khz portion of the sidescan sonar data was produced on an EPC Labs GSP1086-2 thermal recorder.

The sidescan sonar data were collected at 100 metre range for lines near the disposal site and at 200 metre range for lines outside the primary disposal sites. This provided swaths of 200 and 400 metres respectively. Lines run at the 100 m range were typically 75 or 100 metres apart, with a 300 metre spacing used for the 200 metre range lines.

Sidescan sonar data from survey Matthew 2000063 (both 120 and 330 kHz) were collected digitally using an AGCDIG digitizer with version 2.3 software. A sample interval of 80 microseconds was used. 3400 samples per ping were collected at 200 metre range and 1700 samples at the nominal 100 metre range setting. Digital gain settings for the sidescan sonar system and digitizers were logged on field sheets. During the survey, data were imported into a Unix workstation at a resolution of 0.35 metres (across track). The seafloor was detected and slant range and beam corrections were applied to the raw data to remove geometric distortions present in sidescan sonar data. The data were integrated with navigation and imported into the GRASS GIS system at 0.5 metre resolution for data near the disposal site and 1.0 metre resolution for regional data. The sidescan sonar data from adjacent survey lines were integrated to produce a sidescan sonar mosaic (Figure 4). A variable layback, based on towfish positions from the TrackPoint II positioning system, was applied to the sidescan sonar data.

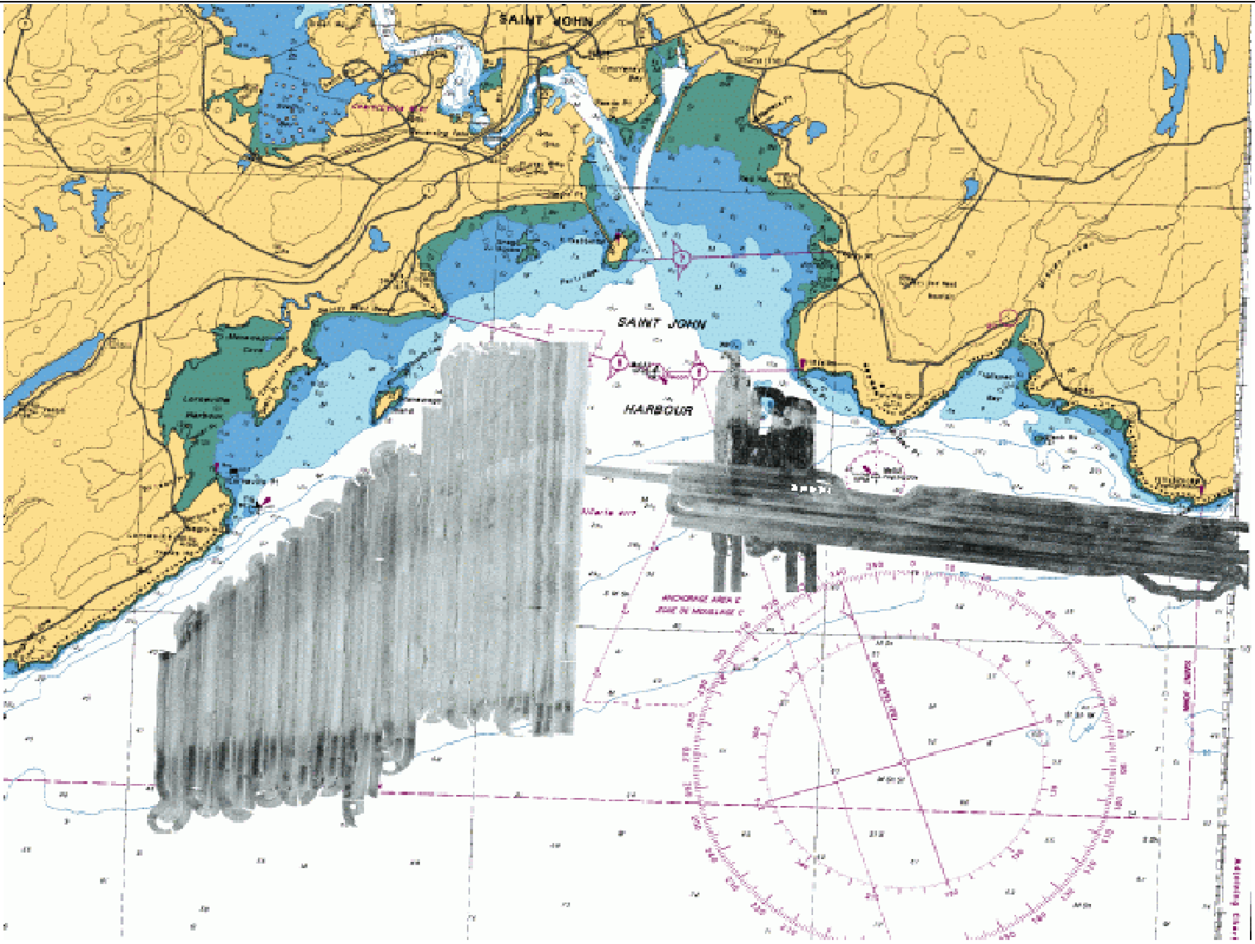


Figure 4 Mosaics created from sidescan sonar data collected during cruise Matthew 2000063. The dashed line south of Black Point shows the location of the sub-bottom profiler data shown in Figure 5.

IKB Technologies Seistec Sub-bottom profiler

An IKB Technologies Seistec high-resolution, sub-bottom profiler system was used to map the thickness and structure of materials on the sea floor and provide information on the genesis of the sediments. The system uses an electrodynamic (boomer) source to produce a repeatable impulse-like output which provides vertical resolution of 0.25 metre or better. The Seistec system was equipped with an internal line-and-cone array and an external streamer. The external streamer was attached to the front of the catamaran, so that the lead-in section of the streamer was positioned under the boomer and line-and-cone array with the receiving elements trailing behind the catamaran. The catamaran was deployed by crane on the starboard side of the vessel and towed on the port side at the surface. The system was fired 2 times per second, or faster, and graphic records were displayed on a thermal graphic recorder. The power supply to the boomer was operated at a nominal setting of 175 Joules. Graphic records were printed on an EPC9800 recorder set for 125 millisecond scans in two channel mode. Data were sampled at a 38 microsecond interval for 124 milliseconds to provide 3845 samples per channel. Bandpass filtered signals were recordered. External steamer data were filtered at 1000 to 7000 hertz. The internal hydrophone data were filtered at 1.5-3.5 kHz. Data collected on the external streamer had a pronounced noise spike on the printed signal 120 times per second.

The Holocene sediments in the upper portion of the image in Figure 5 are currently being deposited as outwash and sediments from the Saint John River. They overlay a sequence of stratified glaciomarine sediments, which in turn overlie coarser sand and gravel that have been derived from underlying glacial deposits. The dredged material presently being dumped at the Black Point Disposal Site is deposited on top of the fine-grained Holocene sediments and has formed a large slump that extends about 1.5 km from the disposal site. The location of this data is shown by the dashed line south of Black Point in Figure 4.

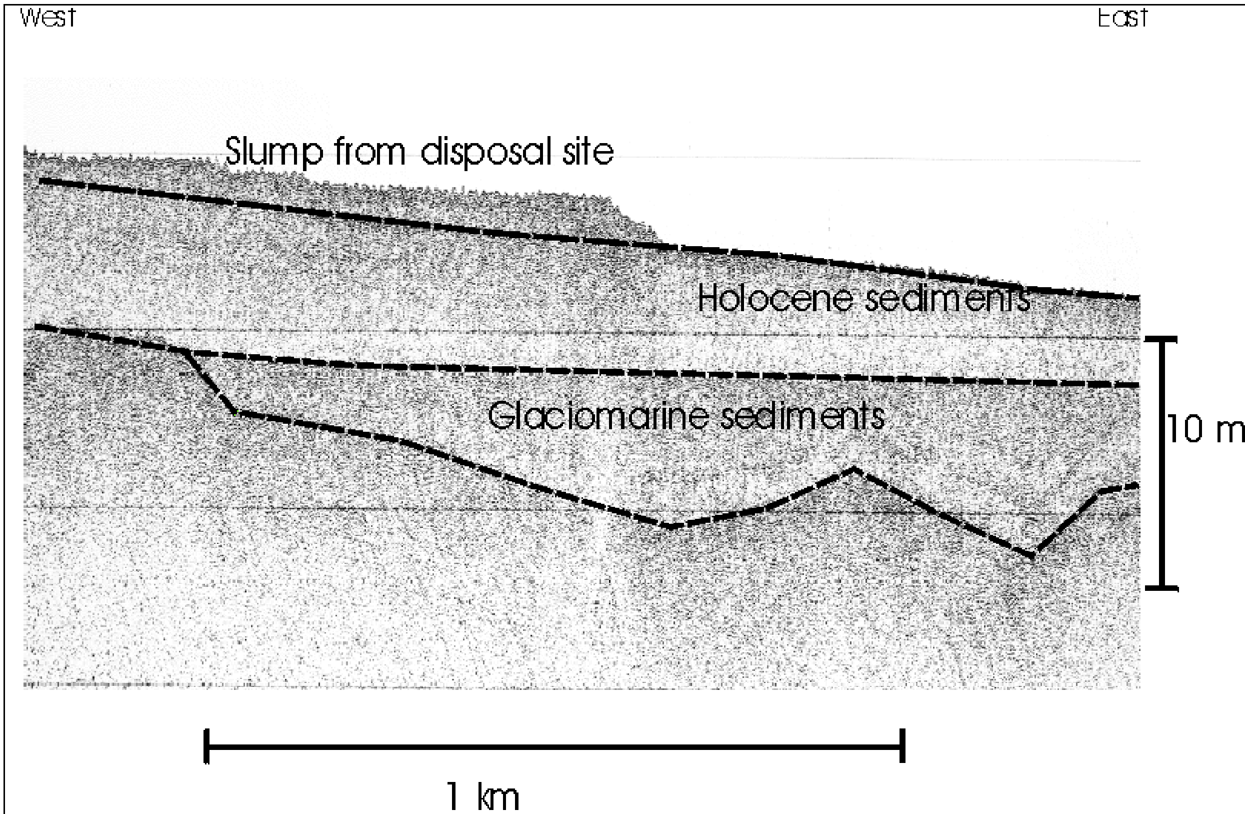


Figure 5 Sub-bottom profiler data collected during cruise Matthew 2000063. The location of this data is shown by the dashed white line in Figure 4.

Digital data acquisition

The sidescan sonar and sub-bottom profiler data were digitized and logged on an AGCDIG digital data recorder developed by the Geological Survey of Canada (Atlantic), running version 2.3 software. The clock in the AGCDIG was synchronized to the GPS time signal. No gains or corrections were applied by the digitizer to the raw logged data. Channel configurations for the logged data were:

Sidescan sonar - 80 microseconds sample interval

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

Sub-bottom profiler – IKB Seistec - 38 microseconds sample interval

Channel	Use
0	STB Seistec line cone receiver
1	STB GF10/15P streamer hydrophone

Navigation
Navigation was by a Global Positioning System utilizing differential corrections broadcast from the Coast Guard station at Western Head. Accuracy of the navigation was about 4 m. Tracks and survey lines were run with the ICAN Regulus navigation package.

Quester-Tangent Corp View System
The Quester-Tangent Corp. View System (QTCView) was used to collect seafloor classification data in the survey area. The QTCView system was connected to a Skipper GDS101- 200kHz sounder running an LSE 140 transducer with a 10 degree beam width. No attenuators were used between the sounder and QTCView system. The output power of the Skipper sounder was set to 50% power or 500 watts. The "reference depth" in the QTCView software was selected as 30 meters. Many files were successfully recorded in the full 166 parameter mode to be processed at a later date.

The file naming convention was " YY MA DDD A . ffv or . cal " or 2k for year 2000 ; MA for Matthew vessel; Julian Day; and A, or B, or C, etc. depending on the number of file started that particular Julian day. For example file 2kMA301B.ffv is the second file of day 301. The *.ffv files contain the binary QTCView numbers describing the wave shape and the *.cal file created simultaneously is the ASCII file with the classification QTCview string followed by the GPGGA nav data strings.

Note that the QTCView system requires provision of navigation strings that contain only the GPGGA information. Inclusion of any other information in the navigation string will cause the system to crash. A laptop computer running the program "GPS2QTC.exe" was used to extract the GPGGA data from the navigation strings provided by the Regulus and TrackPoint II systems in order for the QTCView to work properly.

The QTCView system generally worked well, but the system did hang several times. The Skipper sounder locked up once.

Multibeam Bathymetry
Multibeam bathymetric data were collected using a Simrad EM3000 multibeam bathymetry system mounted in the hydrographic survey launch Plover (Figure 2b). The EM3000 system uses 300kHz transducer with 127 beams with a beamwidth of 1.5^o x 1.5^o. The system provides a depth resolution of 1 cm with an accuracy of 5 cm RMS. Each beam insonifies an area of approximately 1.35 m^2 at 50 metres water depth.

An Applied Analytics Corporation POS-MV 320 attitude sensing system with integrated differential GPS navigation system was used to both position the vessel and determine the attitude. The system integrates data from an inertial measurement unit and differential GPS signals. A positional accuracy of 2-10 mm can be obtained using phase differential of the GPS carrier frequency. A heading aiding accuracy of 0.1^o - 0.5^o can be obtained from the raw GPS data. A Kalman filter is used to improve the heading estimate to 0.05^o - 0.1^o. Vessel attitude is measures using an inertial measurement unit to provide an accuracy of 0.0003^o for pitch, roll and true heading.

Survey lines were run at a various spacing throughout the survey area to provide 200 percent coverage of the seafloor in water depths greater than about 20 metres. During the survey, data were processed using version 5.0 of the HIPS data cleaning program (CARIS by Universal Systems Limited, Fredericton, NB) on a Windows NT workstation to remove spurious soundings and navigation data and to correct for tidal variations. Data were also imported into a Linux based workstation and processed using the MBTools software developed by the Lamont-Doherty Institute. The processed data were imported into the GRASS GIS system where shaded-colour relief images were generated and overlaid on scanned bathymetry maps of the area as shown in Figure 6. After the survey, the data were reprocessed by the Ocean Mapping Group of the University of New Brunswick to remove residual tidal and refraction errors.

Tidal corrections were made using predicted tides for Partridge Island and measured tides from the tide gauge in Saint John NB provided by the Canadian Hydrographic service.

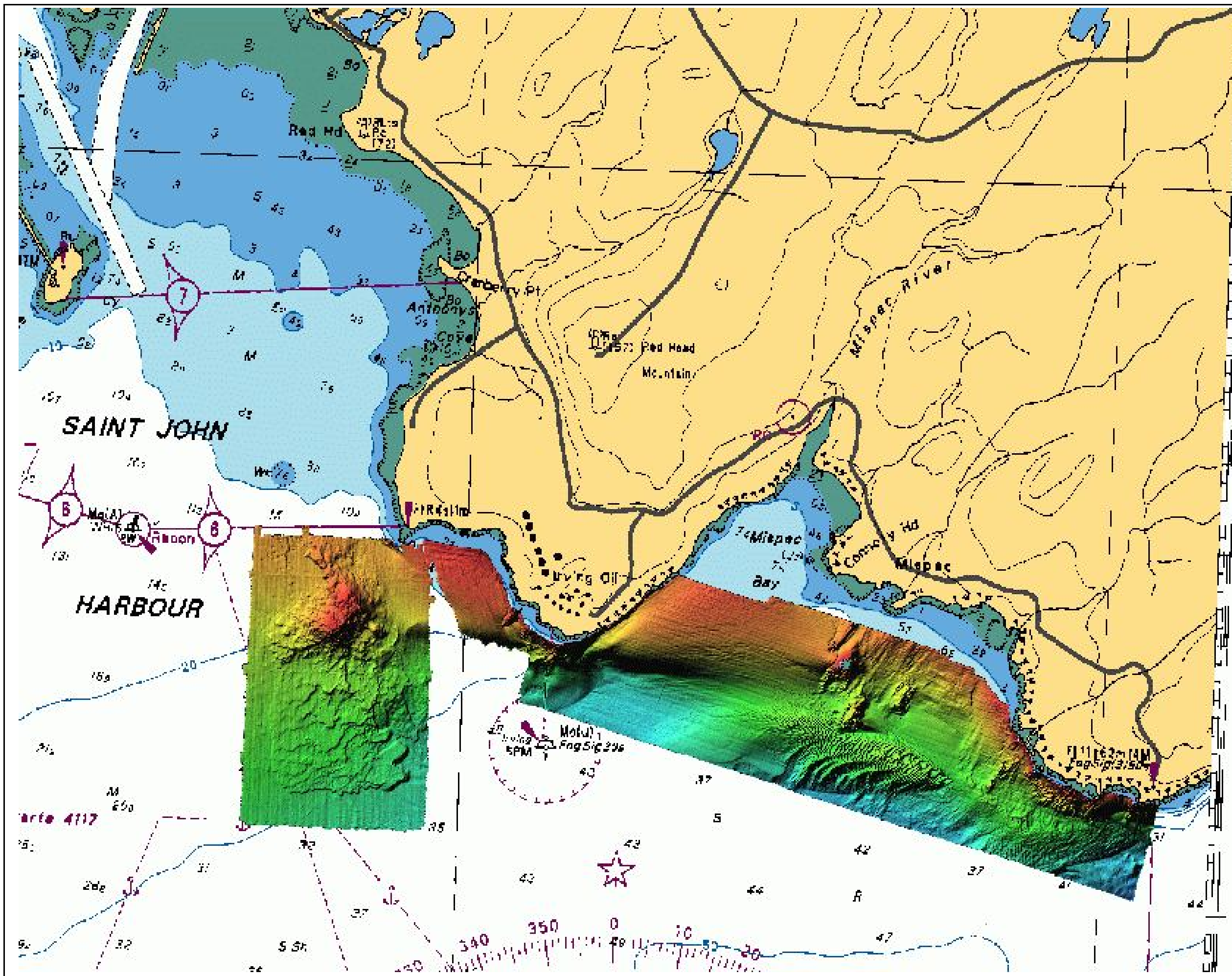


Figure 6. Shaded colour-relief image of the study area generated from Simrad EM3000 multibeam bathymetry data collected in October 2000. The data was processed at a cell resolution of 2.5 metres.

Multibeam backscatter

The strength of an echo from the seafloor is known as the acoustic backscatter intensity. Acoustic backscatter intensity values are controlled by the physical properties of the seafloor sediments such as the velocity of sound, the density and roughness of the sediment. Backscatter generally increases as the sediments on the seafloor become denser and less porous, and increase in grain size. Mapping the distribution of backscatter provides valuable information on the character and distribution of sediments within an area. After the survey, the multibeam bathymetry data were processed by the Ocean Mapping Group at the University of New Brunswick to extract backscatter information and to determine the resolution limits of the data.

A mosaic of the backscatter data from the Simrad EM3000 multibeam was produced at 2 metre resolution and a mosaic of the sidescan sonar data was produced at 2.5 metre resolution. The backscatter intensity values measured from the Simrad EM3000 multibeam system (Figure 7) compared well with the backscatter information shown in the sidescan sonar mosaic (Figure 4). The mosaic of backscatter data produced from the multibeam system enables interpretation of the distribution of sediments and large-scale bedforms within the area, and has resolution comparable to the mosaic of sidescan sonar data. The resolution of the mosaics, produced from both the multibeam and sidescan sonar systems, is much lower than the resolution of the raw sidescan sonograms. The mosaics do not resolve small scale features evident on the raw sidescan sonograms or multibeam bathymetry data.

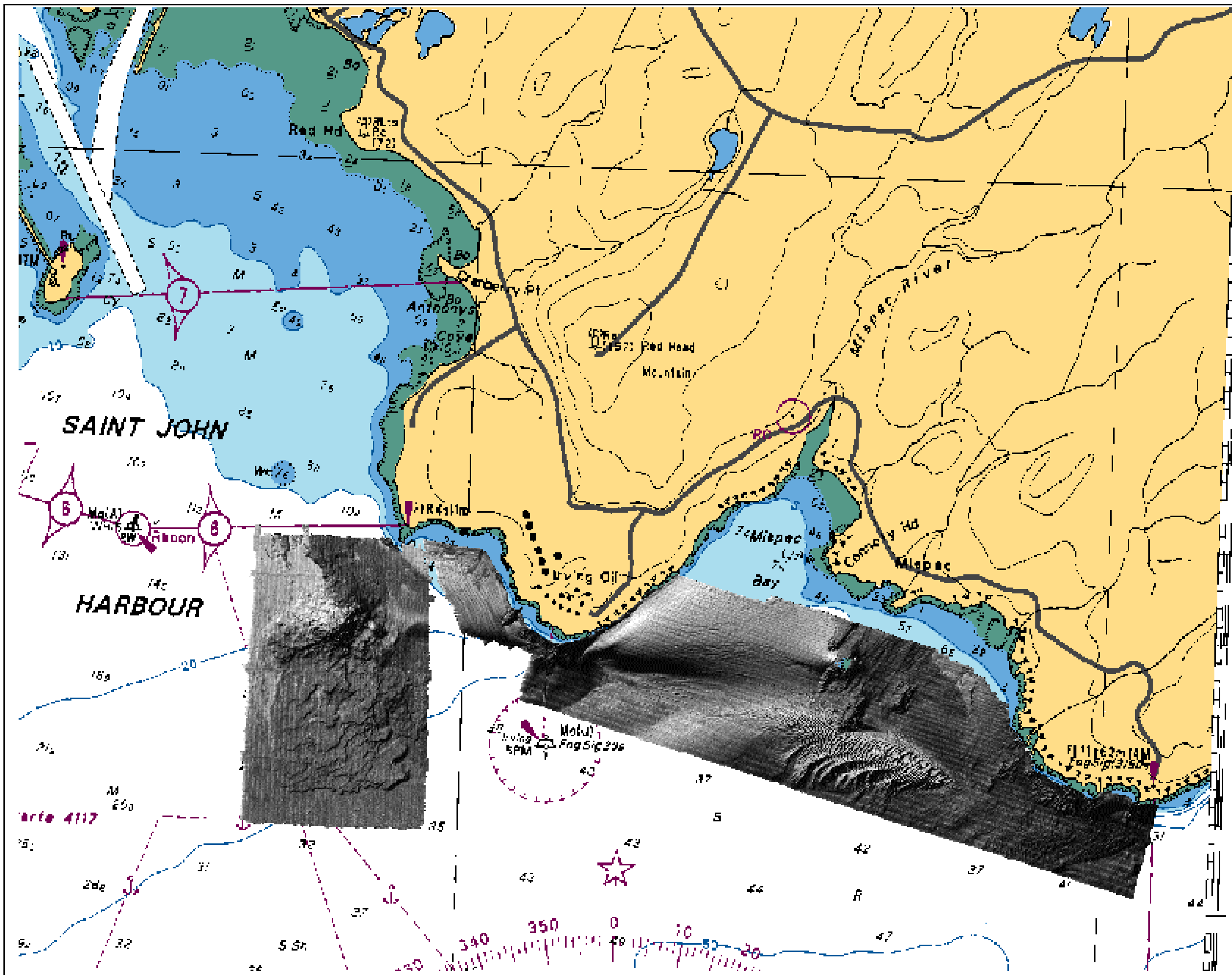


Figure 7. Multibeam backscatter data collected during cruise Matthew 2000063. The backscatter data have been draped over the bathymetry and are shown as a shaded-relief image.

Current meters

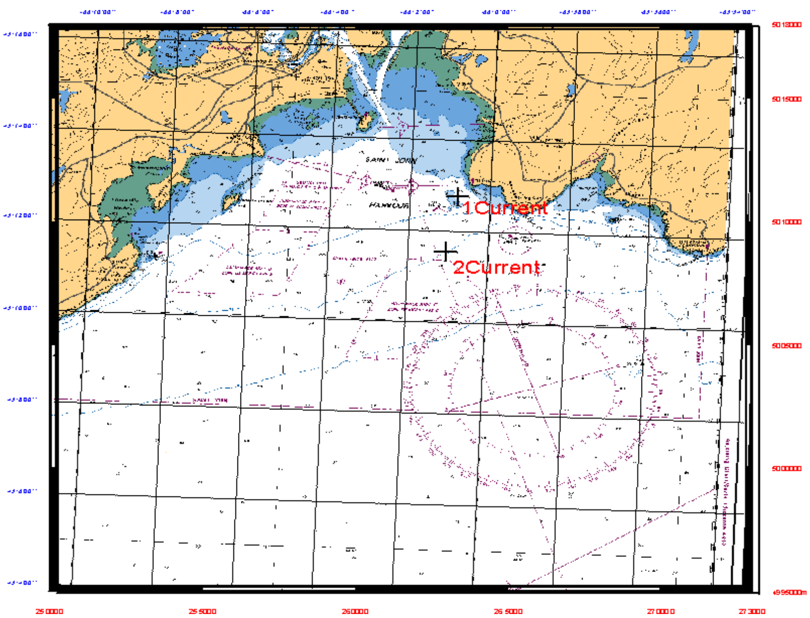


Figure 8. Location of current meters deployed in October 2000.

Two InterOcean S4 current meters were deployed in the area to monitor tidally and storm-induced currents. The current meters were deployed on 21 October 2000 and recovered on 8 November 2000. The positions of the meters and acoustic releases were determined with D-GPS navigation. The locations are shown in Figure 8, and given in Appendix I.

The current meter was setup to record a burst sample of current and pressure, for 10 minutes every hour at 1 Hz. Data were successfully collected with current meter at location 2 shown as "2Current" in Figure 8.

Seafloor Photographs

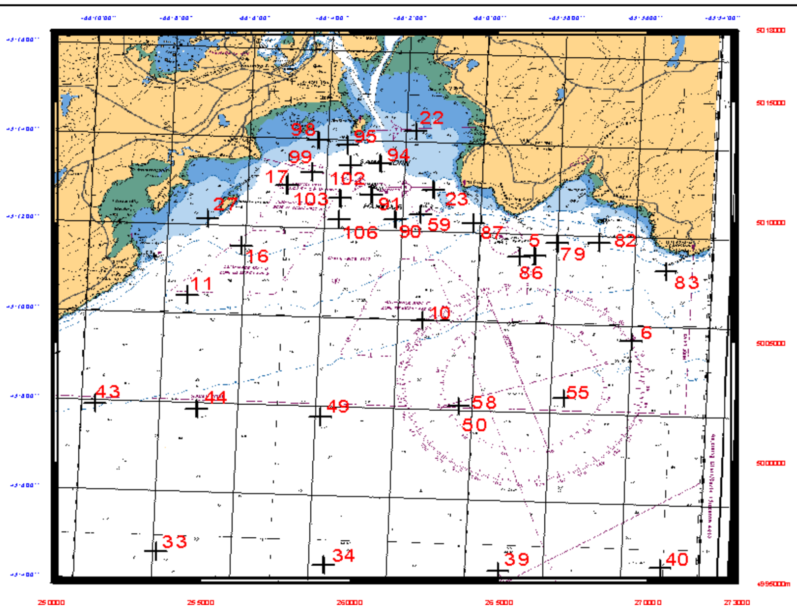


Figure 9. Location of seafloor photographs taken during survey Matthew 2000063 in October 2000

Photographs were taken at 34 camera stations off Saint John Harbour (about 200 photographs in total) with the "Icehole" camera developed by GSCA. Images were obtained on transects through the disposal site and surrounding area. Locations for all camera stations are shown in Figure 9, and provided in Appendix IV. The photographs were processed and stored on CD-ROM in "PCD" format.

Seafloor Samples

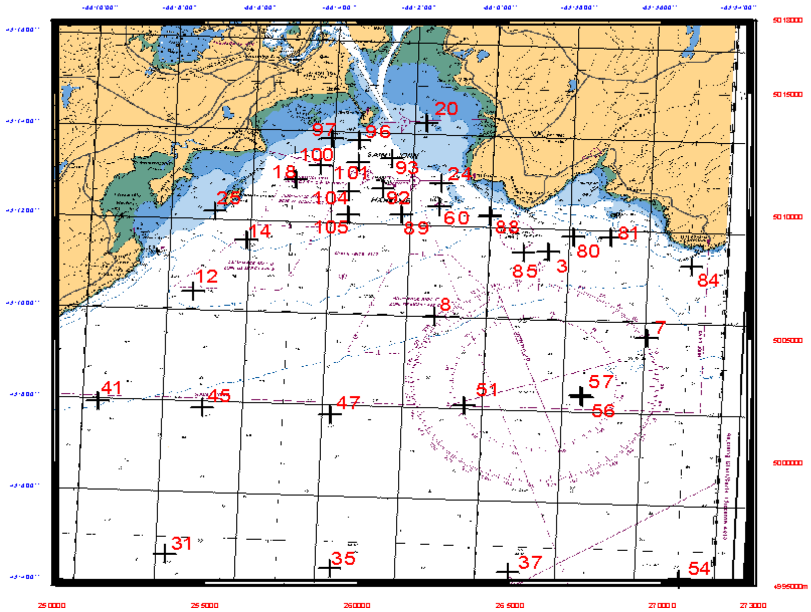


Figure 10. Location of grab samples taken during survey Matthew 2000063 in October 2000.

A 0.1 cubic metre VanVeen grab sampler was used to collect 35 sediment samples in Saint John Harbour and approaches to provide groundtruth for interpretation of the sidescan sonar and sub-bottom profiler data. The sample locations are shown in Figure 10. The sample positions are provided in Appendix IV.

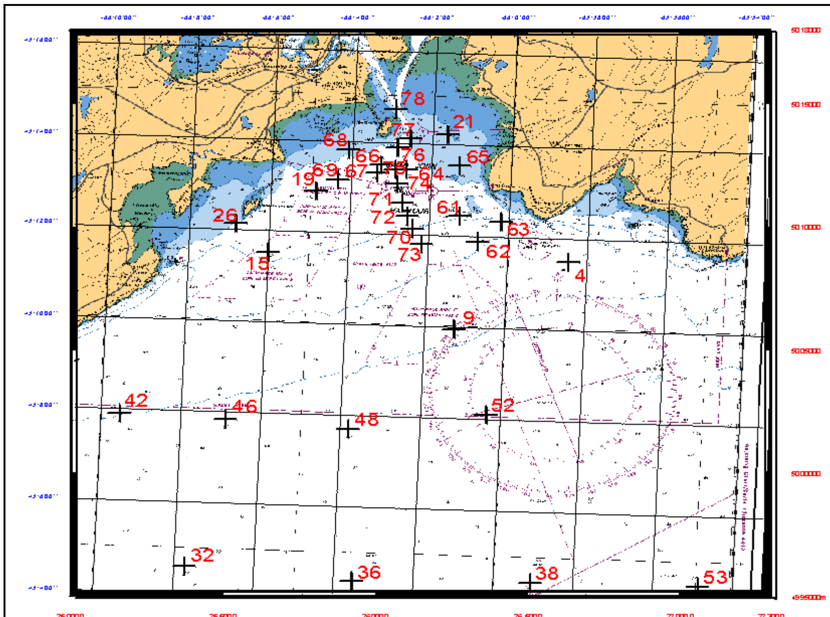


Figure 11. Location of gravity cores and grab samples taken in Saint John Harbour and approaches during survey Matthew 2000063 in October 2000.

A small gravity corer was used to collect 34 cores near the Black Point disposal site, and approaches to Saint John Harbour. The cores from near the disposal site were extruded, split, and subsampled in the field. Pore water extracted from the sediments will be used to determine sediment accumulation rates in the area. The sample locations are shown in Figure 11. The sample positions are provided in Appendix IV.

Tides and Currents

The Bay of Fundy boasts the highest recorded tides in the world. A peak tidal range of about 7.4 metres was experienced in Saint John, NB, during the survey. Tidal data was downloaded from the Canadian Hydrographic Service (CHS) tide gauge in Saint John NB. Predicted tides were also obtained from CHS for a location near Partridge Island in Saint John Harbour. These data, shown in Figure 12, were used to correct the multibeam bathymetry data.

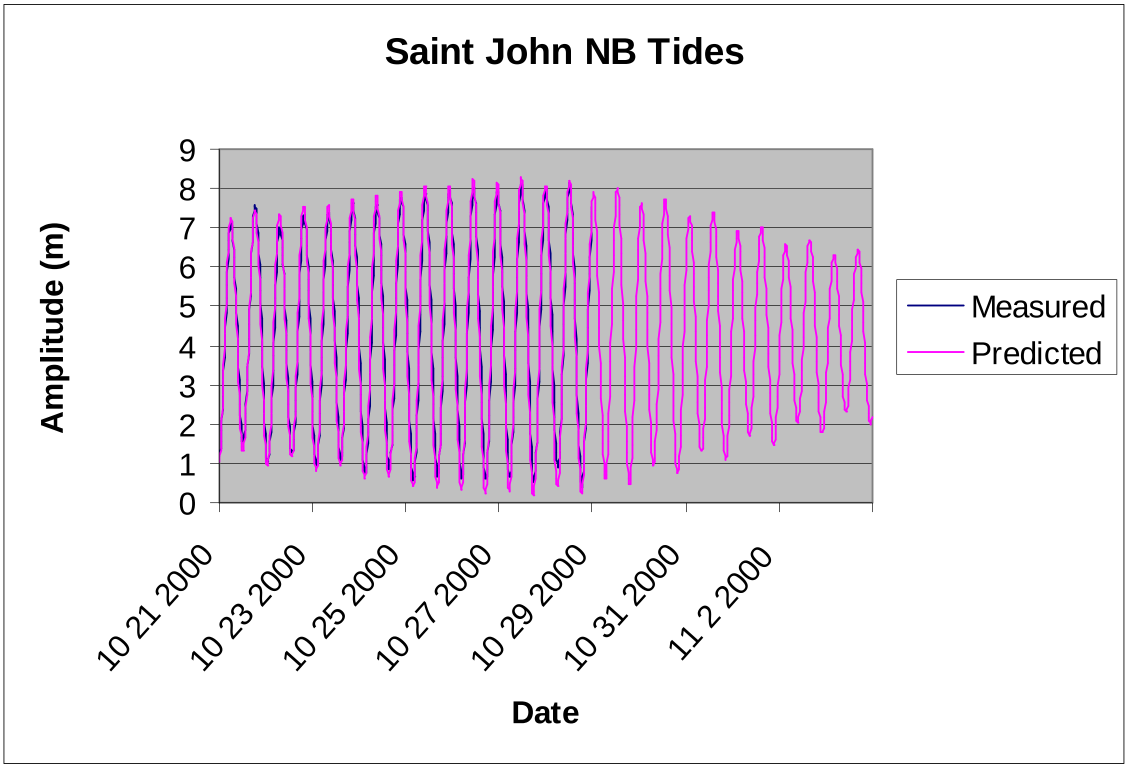


Figure 12. Measured and predicted tides for Saint John NB during October 2000.

The high tidal range induces high current velocities throughout the Bay. During the survey, tides and currents for the survey area were calculated using the program Tides and Currents Pro by Nautical Software Inc. As shown in Figures 13 and 14, a tidal range of 7.4 metres was predicted for Saint John during the survey, with currents of about 1.7 knots predicted for an area 20 km south of Cape Spencer. Note that during the October 2000 geophysical surveys, currents in excess of 4 knots were experienced closer to shore, about 1 kilometer off Cape Spencer.

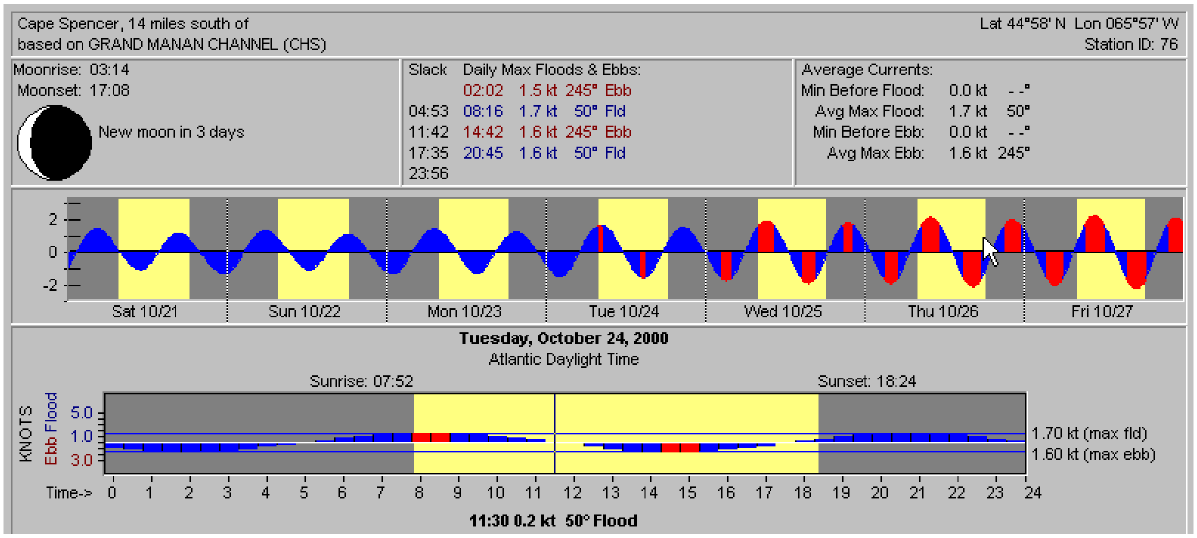


Figure 13. Predicted currents for an area 20 km south of Cape Spencer area during the Matthew 2000063 survey. Currents of about 4 knots were encountered closer to Cape Spencer.

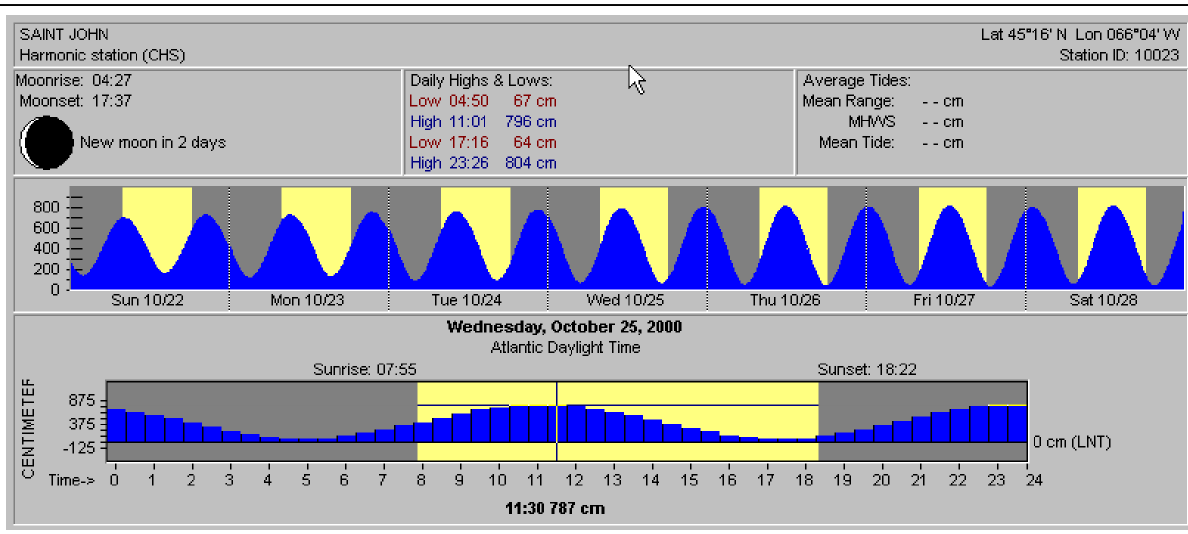


Figure 14. Predicted tides for Saint John NB during survey Matthew 2000063.

Geochemistry Program

Lab Mobilization

A pore water geochemistry laboratory was set up on October 22, 2000 by Ray Cranston and Mike Parsons, MEG-GSCA, in a double-bay garage facility at the Canadian Coast Guard base in Saint John. The facility consisted of a core extruder, a table for subsampling cores, a 1965 Volkswagon police cruiser and a table to conduct pore water analyses for ammonium, sulfate and salinity (Figure 15).

Figure 15 – Geochemistry laboratory

Sampling Operation

On average, 5 gravity cores were collected in the study area each day during daylight hours and delivered to the Coast Guard site. Details of the location and water depth are listed in Appendix V. Gravity core locations are shown in Figure 10.

Analytical Procedures and Methods

Gravity cores were extruded and subsampled within 24 hours of being collected. Each core was manually extruded into a split core liner. A second split liner was placed on the exposed core half and a piano wire was drawn longitudinally through the core. The two split liners were turned 90 degrees and given an abrupt impact on the floor, which generally caused the two core halves to split apart and to be contained by the two split liner pieces.

A working core half was placed on the subsample table, and 20 ml volumes of wet sediment from selected depths down the core were placed into 25 ml snap-cap plastic vials. The base of each vial had been pre-drilled with 4 holes, 1 mm in diameter and fitted with a 25 mm filter paper. The wet sediment was placed on the filter paper in the vial, then each vial was inserted into a 50 ml centrifuge tube and centrifuged in a table-top centrifuge for 10 minutes. Pore water was expelled through the filter paper, through the holes in the vials, and collected in the centrifuge tube. The sediment vial was removed from the centrifuge tubes, and the pore water (varying from 0.5 to 5 ml) was poured into pre-labelled 7 ml scintillation vials.

Dissolved ammonium in each pore water sample was determined using a colourimetric method. Five ml of deionized water was placed in a 25 ml test tube, along with 50 or 100 µl of pore water or ammonium standard. A 500 µl addition of phenol-ethanol solution (0.8 g phenol dissolved in 100 ml of ethanol) was made along with 500 µl of sodium nitroprusside solution (0.075 g of sodium nitroprusside in 50 ml of deionized water). Finally, 1 ml of oxidizing solution (1 ml of sodium hypochlorite, 0.75 g trisodium citrate and 0.04 g sodium hydroxide in 50 ml of deionized water) was added to each test tube. The tubes were shaken and allowed to stand for at least 2 hours in order for the blue colour, indicative of ammonium content, to fully develop. The colour absorbance was measured at 640 nm with a Brinkmann PC900 colourimeter. A calibration curve was acquired by measuring the absorbance of various ammonium chloride solutions. Precision and accuracy were determined to be ± 0.2 mM.

Dissolved sulfate was measured in the pore water samples using a turbidimetric method. A 50 µL volume of sample or standard was placed in a cylindrical glass cuvette. Barium chloride (100 µL of 300 mM solution) was added to precipitate the available sulfate. Four ml of deionized water were added to dilute the mixture in the cuvette. The turbidity of the resulting solution and barium sulfate precipitate was measured using a Milton Roy Spectronic Mini-20 fitted with a turbidity attachment. A calibration curve was established by measuring the turbidity of various dilutions of magnesium sulfate solution. Precision and accuracy limits were estimated to be ± 2 mM.

Geochemical Results

Analytical results are presented in Appendix V. A total of 183 pore water samples from 12 gravity cores were analyzed for ammonium, sulfate and salinity. An additional 56 pore water samples from 8 short gravity cores were collected and stored for subsequent analyses.

From the preliminary sample analyses, the pore water distributions suggest that in the inner portion of the study area, sediment accumulation rates are estimated to be 1 to 10 mm per year. In the outer portion of the study area, sediment accumulation rates are estimated to be on the order of 0.1 mm per year. Further details of these estimates will be made when organic carbon analyses are completed on the sediment samples.

Access to Data and Samples

The sidescan sonar, sub-bottom profiler and grab samples collected during this survey are archived at the Geological Survey of Canada - Atlantic, in Dartmouth Nova Scotia. For access to the geophysical data and samples contact the senior scientist for the survey, Russell Parrott (902-426-7059) or Susan Merchant of the GSCA Curation group (902-426-3410). Graphical records for the sidescan sonar and subbottom profiler, digitally processed sidescan sonar mosaics, ExaByte tapes containing the sidescan sonar data in SEG-Y format, CD-ROMs containing the sidescan sonar and sub-bottom profiler data in SEG-Y format, and ExaBytes tapes of the raw data are available for viewing.

Acknowledgements

We would like to thank the officers, crew onboard the CCGS Matthew for their assistance in the various surveys and in collecting and delivering the sediment samples. Staff at the Saint John Coast Guard site were very supportive throughout the laboratory operation; we appreciate all of their efforts. The image of the CCGS Matthew shown on the report cover and in Figure 1a was taken by Fergus Francey, chief officer, CCGS Matthew.

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Appendices

Appendix I Survey Particulars

Name of Vessel:	CCGS Matthew
Vessel captain:	Anthony Potts
Dates of Survey:	21-31 October 2000
Area of Operation:	Saint John, New Brunswick
Senior Scientist:	Russell Parrott, GSC

Appendix II Survey Personnel

<u>Geological Survey of Canada Atlantic</u>

Russell Parrott	Senior Scientist
Austin Boyce	Electronics Technologist
Bruce Wile	Electronics Technologist
Robert Murphy	Sampling/photography
Darrel Beaver	Multibeam bathymetry data collection
Paul Girouard	Navigation/multibeam data cleaning/database entry/computers
Jason Silliker	Navigation/multibeam data cleaning
Ray Cranston	Geochemistry – CCG base Saint John
Michael Parsons	Geochemistry – CCG base Saint John

<u>University of New Brunswick</u>

John Hughes Clarke	Professor Ocean Mapping Group/ADCP operations
Robert Bosine	Captain, UNB Research Vessel 'Mary O'

Appendix III - Summary of Activities (all times in GMT)

Day 294 – Friday 20 October 2000 – Transit to survey site

09:00 CCGS Matthew departs BIO en route to Saint John NB.

Day 295 – Saturday 21 October 2000 – Mobilization and test equipment

11:00 GSC personnel depart BIO en route to Saint John NB.
13:00 CCGS Matthew arrives CCG Base Saint John
16:00 GSC personnel arrive CCG Base Saint John and join CCGS Matthew
- current meter bases on far side of jetty – boom truck called in to load bases on ship

19:00 sidescan connected and S4 current meters installed
21:30 CCGS Matthew departs Saint John for survey site
22:00 near Black point disposal site – 20-25 knot winds – too rough to deploy current meters
22:20 deploy sidescan sonar and run a series of regional lines on west side of Saint John Harbour. 200 metre range (each side), 300 metre line spacing

Day 296 – Sunday 22 October 2000 – Survey and sampling

00:01 Continuing with sidescan sonar survey
10:00 Recover sidescan sonar
11:00 Deploy S4 current meters
11:45 Deploy multibeam launch for survey of Black Point disposal site
12:00 Prepare camera, grab and corer
13:00 Commence sampling program consisting of a grab sample, core and seafloor photograph at each site

20:30 Recover multibeam launch
21:30 Deploy sidescan sonar and TrackPoint II acoustic positioning system for continuation of survey on west side of harbour

Day 297 – Monday 23 October 2000 – Survey and sampling
00:01 Continuing with sidescan sonar survey
10:00 Recover sidescan sonar and TrackPoint II
Mary O running ADCP survey of Balck Point disposal site
11:00 Deploy multibeam launch for survey of Mispec Bay sand waves
- transit to CCG base Saint John to offload cores and take on water

12:40 Depart CCG base Saint John
13:00 Commence sampling program consisting of a grab sample, core and seafloor photograph at each site
19:45 End sampling program and transit to Black point to recover survey launch
20:30 Recover multibeam launch
22:15 Deploy sidescan sonar, Seistec and TrackPoint II acoustic positioning system for survey of disposal site

Day 298 – Tuesday 24 October 2000 – Survey and sampling
00:01 Continuing with sidescan sonar survey
09:39 Recover sidescan sonar, Seistec and TrackPoint
10:00 Continue sampling program over regional sites
19:45 End sampling program – transit to CCG base Saint John to offload cores and take on water

Day 299 – Wednesday 25 October 2000 – Survey and sampling
09:40 Depart CCG base Saint John
11:00 Deploy multibeam launch for survey Mispec Bay sand waves
11:15 Continue sampling program over regional sites
13:30 Commence sidescan sonar, Seistec and QTC survey of deep water sample sites.
20:28 Bring gear to surface to recover survey launch
20:40 Continue survey on E-W lines through Mispec Bay and disposal site

Day 300 – Thursday 26 October 2000 – Survey and sampling
00:01 Continuing with sidescan sonar survey
09:00 Recover sidescan sonar, Seistec and TrackPoint
11:00 Deploy multibeam launch for survey
- transit to CCG base Saint John to offload cores and take on water
- Mike Parsons joins vessel

13:00 Depart CCG base Saint John
13:20 Commence sampling program consisting of a core at each site to be used to determine sediment accumulation rates
15:20 weather deteriorating – recover multibeam launch
19:30 Finish sampling program
- transit to CCG base Saint John to offload cores and take on water

Day 301 - Friday 27 October 2000 – Survey and sampling
09:30 Depart CCG base Saint John
11:00 2-3 metre waves at survey location. Cannot deploy survey launch
11:20 Commence sampling program over regional sites
18:30 End sample program

- transit to CCG base Saint John to exchange ship's personnel

22:40 Continue survey on E-W lines through Mispec Bay and disposal site with sidescan sonar, Seistec, TrackPoint and QTC

Day 302 – Saturday 28 October 2000 – Survey

00:01 Continuing with sidescan sonar survey
11:00 Deploy multibeam launch for survey
13:00 Recover multibeam launch – problems with generator
winds increase to 40 knots – recover all gear and return to CCG base Saint John
14:00 Secure at CCG base Saint John – continue with data processing

Day 303 - Sunday 29 October 2000 – Data processing and report

09:00 Strong northeasterly winds at survey site with strong winds forecast for next several days - remain at CCG base Saint John

- perform data backups and survey report

16:00 Secure survey equipment in after-lab. Depart vessel and drive to BIO.

Appendix IV Sample and Camera Station Locations

Current meters

Station_Num	Julian_Day	GMT	Lat	Long	Water_Depth
1	296	1104	45.21359	-66.0167	18
2	296	1125	45.1933	-66.0207	36

Camera stations

Station_Num	Julian_Day	GMT	Lat	Long	Water_Depth
5	296	1429	45.19225	-65.9767	44
6	296	1543	45.16138	-65.9338	59
10	296	1655	45.16697	-66.0234	46
11	296	1734	45.17389	-66.1243	30
16	296	1856	45.19291	-66.1022	21
17	296	1925	45.21602	-66.0839	16
22	297	1305	45.23782	-66.0299	13
23	297	1327	45.216	-66.0213	19
27	297	1438	45.20275	-66.1172	13
28	297	1549	45.07479	-66.1996	83
33	297	1720	45.07755	-66.1324	83
34	297	1754	45.07446	-66.0608	87
39	297	1911	45.07401	-65.9864	89
40	297	1937	45.07686	-65.9173	85
43	298	1551	45.13235	-66.1614	54
44	298	1613	45.13132	-66.1181	64
49	298	1735	45.12974	-66.0651	69
50	298	1745	45.13532	-66.0064	70
55	299	1130	45.13941	-65.9616	73
58	299	1236	45.13532	-66.0064	74
59	300	1350	45.20661	-66.0263	28
79	301	1120	45.19741	-65.9673	37
82	301	1153	45.19793	-65.9495	32
83	301	1209	45.18784	-65.9202	38
86	301	1300	45.19185	-65.9833	45
87	301	1328	45.20401	-66.0035	33
90	301	1523	45.20451	-66.0371	28
91	301	1538	45.21335	-66.0476	21
94	301	1606	45.22524	-66.0445	20
95	301	1618	45.23162	-66.0588	19
98	301	1645	45.23315	-66.0715	15
99	301	1707	45.22121	-66.0735	18
102	301	1737	45.22425	-66.0573	18
103	301	1751	45.2117	-66.061	20
106	301	1815	45.20383	-66.0611	21

Grabs

Station_Num	Julian_Day	GMT	Lat	Long	Water_Depth
3	296	1345	45.19193	-65.9767	44.5
7	296	1600	45.16139	-65.9339	58
8	296	1630	45.16702	-66.0231	47
12	296	1747	45.1737	-66.1242	30
14	296	1837	45.193	-66.1029	22
18	296	1936	45.21576	-66.0835	16
20	296	2012	45.23786	-66.03	13
24	297	1345	45.21599	-66.0227	19
25	297	1415	45.20322	-66.1168	13
29	297	1559	45.07483	-66.1996	83
31	297	1643	45.07734	-66.1308	84
35	297	1807	45.07379	-66.0619	86
37	297	1845	45.07439	-65.9876	89
41	298	1522	45.13253	-66.1618	54
45	298	1627	45.13133	-66.1181	63
47	298	1659	45.13015	-66.0646	71
51	298	1757	45.13478	-66.0089	70
54	298	1917	45.07357	-65.9161	85
56	299	1201	45.1397	-65.9606	73
57	299	1216	45.13927	-65.9598	73
60	300	1538	45.20731	-66.023	26
80	301	1125	45.19764	-65.9664	37
81	301	1141	45.19789	-65.9509	30
84	301	1233	45.18802	-65.9167	43
85	301	1250	45.19156	-65.9871	46
88	301	1341	45.20444	-66.0018	34
89	301	1402	45.20404	-66.0387	28
92	301	1548	45.21322	-66.047	21
93	301	1556	45.22435	-66.0438	20
96	301	1629	45.23072	-66.0579	19
97	301	1635	45.23106	-66.0692	19
100	301	1723	45.2211	-66.0736	19
101	301	1730	45.22278	-66.0577	19
104	301	1759	45.21178	-66.0611	20
105	301	1806	45.2033	-66.061	21

Gravity Core

Station_Num	Julian_Day	GMT	Lat	Long	Water_Depth
4	296	1401	45.19249	-65.9768	44
9	296	1643	45.16692	-66.0233	47
13	296	1803	45.17361	-55.1238	30
15	296	1847	45.193	-66.1024	22
19	296	1946	45.21579	-66.0835	16
21	296	2022	45.23782	-66.0296	13
26	297	1425	45.20317	-66.1165	13
30	297	1610	45.07495	-66.1997	83
32	297	1655	45.07736	-66.1312	83
36	297	1818	45.07393	-66.0612	86
38	297	1857	45.07518	-65.9867	89
42	298	1535	45.13258	-66.1613	54
46	298	1637	45.13142	-66.117	62
48	298	1709	45.12932	-66.0655	69
52	298	1826	45.13605	-66.0082	69
53	298	1905	45.07554	-65.9168	81
61	300	1550	45.20823	-66.023	24
62	300	1600	45.19904	-66.0151	35
63	300	1605	45.20657	-66.0056	35
64	300	1633	45.22474	-66.0463	19
65	300	1648	45.22665	-66.024	16
66	300	1708	45.22605	-66.057	18
67	300	1718	45.22305	-66.0583	17
68	300	1726	45.23127	-66.0708	15
69	300	1737	45.22026	-66.0746	16
70	300	1804	45.2031	-66.0426	17
71	300	1814	45.21243	-66.0472	17
72	300	1833	45.20756	-66.0449	20
73	300	1846	45.19751	-66.0386	28
74	300	1858	45.21934	-66.0499	15
75	300	1910	45.22466	-66.0509	15
76	300	1915	45.23262	-66.0503	15
77	300	1928	45.23611	-66.045	15
78	300	1941	45.24669	-66.0517	10

Appendix V Preliminary Geochemical Results

Cruise	id	core	z	Salinity	NH4	S04
			cm	ppt	mM	mM
2000063	20001600	13	0	32.0	0.06	26
2000063	20001601	13	2	31.2	0.09	30
2000063	20001602	13	4	31.2	0.11	25
2000063	20001603	13	6	30.8	0.14	26
2000063	20001604	13	8	31.0	0.13	24
2000063	20001605	13	10	30.8	0.15	29
2000063	20001606	13	12	31.0	0.16	25
2000063	20001607	13	14	31.4	0.18	26
2000063	20001608	13	16	31.4	0.21	31
2000063	20001609	13	18	31.4	0.21	29
2000063	20001610	13	20	30.8	0.21	28
2000063	20001611	13	22	31.3	0.23	27
2000063	20001612	13	24	31.3	0.23	28
2000063	20001613	13	26	31.3	0.22	27
2000063	20001614	13	28	31.5	0.24	30
2000063	20001615	13	30	31.5	0.26	27
2000063	20001616	13	32	31.3	0.29	29
2000063	20001617	4	50	31.2	0.35	27
2000063	20001618	4	45	31.6	0.38	27
2000063	20001619	4	40	31.2	0.33	26
2000063	20001620	4	35	31.2	0.33	28
2000063	20001621	4	30	31.6	0.22	28
2000063	20001622	4	25	31.3	0.27	29
2000063	20001623	4	20	31.3	0.29	26
2000063	20001624	4	15	32.0	0.24	29
2000063	20001625	4	10	31.6	0.24	29
2000063	20001626	4	7.5	31.3	0.17	30
2000063	20001627	4	5	31.9	0.15	28
2000063	20001628	4	2.5	31.9	0.17	31
2000063	20001629	4	0	32.1	0.11	29
2000063	20001630	30	0	32.2	0.18	28
2000063	20001631	30	2.5	32.6	0.15	24
2000063	20001632	30	5	32.1	0.16	25
2000063	20001633	30	7.5	32.9	0.18	24
2000063	20001634	30	10	32.8	0.18	24
2000063	20001635	30	20	32.0	0.17	24
2000063	20001636	30	30	31.7	0.18	29
2000063	20001637	30	40	32.1	0.19	28
2000063	20001638	30	50	32.2	0.18	25
2000063	20001639	30	60	32.2	0.20	29
2000063	20001640	30	70	31.6	0.21	28
2000063	20001641	30	80	32.3	0.21	26
2000063	20001642	30	90	32.0	0.24	26
2000063	20001643	30	100	32.7	0.22	26
2000063	20001644	32	0	33.4	0.17	27

Cruise	id	core	z	Salinity	NH4	S04
			cm	ppt	mM	mM
2000063	20001645	32	2.5	32.4	0.18	25
2000063	20001646	32	5	32.1	0.19	24
2000063	20001647	32	7.5	32.4	0.17	25
2000063	20001648	32	10	32.1	0.17	27
2000063	20001649	32	20	32.3	0.13	26
2000063	20001650	32	30	32.7	0.13	24
2000063	20001651	32	40	32.0	0.13	26
2000063	20001658	32	50	32.1	0.19	27
2000063	20001652	32	60	32.4	0.21	25
2000063	20001653	32	70	31.8	0.19	25
2000063	20001654	32	80	32.6	0.21	29
2000063	20001655	32	90	32.6	0.24	26
2000063	20001656	32	100	32.8	0.21	26
2000063	20001657	32	110	33.1	0.22	32
2000063	20001659	36	0	32.1	0.11	25
2000063	20001660	36	2.5	32.4	0.18	28
2000063	20001661	36	5	32.7	0.17	26
2000063	20001662	36	7.5	32.6	0.13	24
2000063	20001663	36	10	32.5	0.15	25
2000063	20001664	36	20	32.5	0.15	26
2000063	20001665	36	30	32.4	0.16	25
2000063	20001666	36	40	31.9	0.18	26
2000063	20001667	36	50	32.6	0.20	28
2000063	20001668	36	60	32.9	0.20	25
2000063	20001669	36	70	32.7	0.15	29
2000063	20001670	36	80	33.1	0.19	28
2000063	20001671	36	90	32.4	0.23	30
2000063	20001672	38	0	32.7	0.12	24
2000063	20001673	38	2.5	32.7	0.10	25
2000063	20001674	38	5	32.7	0.10	24
2000063	20001675	38	7.5	32.6	0.14	25
2000063	20001676	38	10	32.8	0.14	25
2000063	20001677	38	20	32.7	0.18	25
2000063	20001678	38	30	32.3	0.22	25
2000063	20001679	38	40	32.7	0.20	25
2000063	20001680	38	50	32.2	0.26	29
2000063	20001681	38	60	32.5	0.25	27
2000063	20001682	42	0	32.9	0.10	25
2000063	20001683	42	2.5	31.8	0.17	23
2000063	20001684	42	5	31.6	0.16	23
2000063	20001685	42	7.5	31.5	0.16	23
2000063	20001686	42	10	32.1	0.15	24
2000063	20001687	42	15	31.5	0.13	24
2000063	20001688	42	20	31.4	0.15	22
2000063	20001689	42	25	30.8	0.15	23
2000063	20001690	42	30	31.5	0.14	24
2000063	20001691	42	35	31.5	0.13	22

Cruise	id	core	z	Salinity	NH4	S04
			cm	ppt	mM	mM
2000063	20001692	42	40	31.7	0.17	24
2000063	20001693	46	0	32.1	0.24	24
2000063	20001694	46	2.5	31.8	0.22	23
2000063	20001695	46	5	32.0	0.20	26
2000063	20001696	46	7.5	32.3	0.19	25
2000063	20001697	46	10	31.8	0.13	24
2000063	20001698	46	20	32.1	0.19	26
2000063	20001699	46	30	31.6	0.18	26
2000063	20001700	46	40	31.8	0.18	24
2000063	20001701	46	50	31.6	0.18	24
2000063	20001702	46	60	31.7	0.23	29
2000063	20001703	46	70	31.8	0.28	27
2000063	20001704	46	80	32.1	0.32	25
2000063	20001705	46	90	31.9	0.31	28
2000063	20001706	48	0	32.3	0.21	24
2000063	20001707	48	2.5	32.6	0.29	24
2000063	20001708	48	5	32.7	0.30	23
2000063	20001709	48	7.5	32.5	0.29	25
2000063	20001710	48	10	31.7	0.31	24
2000063	20001711	48	15	32.0	0.34	25
2000063	20001712	48	20	32.3	0.34	25
2000063	20001713	48	25	32.2	0.27	24
2000063	20001714	48	30	32.2	0.25	25
2000063	20001715	48	35	32.3	0.22	24
2000063	20001716	48	40	32.8	0.18	24
2000063	20001717	48	45	32.3	0.24	25
2000063	20001718	48	50	32.2	0.25	27
2000063	20001720	52	0	32.1	0.17	28
2000063	20001721	52	2.5	32.3	0.22	28
2000063	20001722	52	5	32.0	0.21	27
2000063	20001723	52	7.5	32.3	0.20	25
2000063	20001724	52	10	32.2	0.22	32
2000063	20001725	52	20	31.9	0.22	26
2000063	20001726	52	30	32.3	0.34	30
2000063	20001727	52	40	31.7	0.32	26
2000063	20001728	52	50	32.0	0.36	29
2000063	20001729	52	60	31.9	0.34	27
2000063	20001730	52	70	31.9	0.36	25
2000063	20001731	71	0	30.8	0.36	27
2000063	20001732	71	2.5	30.5	0.74	27
2000063	20001733	71	5	30.7	0.76	25
2000063	20001734	71	7.5	30.7	0.87	25
2000063	20001735	71	10	30.2	1.23	24
2000063	20001736	71	20	30.0	2.08	19
2000063	20001737	71	30	30.0	2.36	18
2000063	20001738	71	40	30.2	2.30	17
2000063	20001739	71	50	29.7	2.13	22

Cruise	id	core	z	Salinity	NH4	S04
			cm	ppt	mM	mM
2000063	20001740	71	60	30.6	1.61	24
2000063	20001741	71	70	30.8	0.83	25
2000063	20001742	71	80	30.4	1.13	25
2000063	20001743	71	90	30.3	1.53	26
2000063	20001744	71	100	30.4	1.52	24
2000063	20001745	75	0	30.6	0.64	24
2000063	20001746	75	2.5	30.5	0.85	24
2000063	20001747	75	5	30.4	1.66	24
2000063	20001748	75	7.5	30.0	1.96	19
2000063	20001749	75	10	29.8	2.18	18
2000063	20001750	75	20	30.2	2.30	17
2000063	20001751	75	30	30.0	2.12	20
2000063	20001752	75	40	30.0	2.02	22
2000063	20001753	75	50	30.1	1.84	26
2000063	20001754	75	60	30.0	1.98	24
2000063	20001755	75	70	29.9	2.04	24
2000063	20001756	75	80	29.7	2.02	23
2000063	20001757	75	90	30.5	2.27	22
2000063	20001758	78	0	30.2	2.14	14
2000063	20001759	78	2.5	29.9	2.66	11
2000063	20001760	78	5	30.2	2.80	10
2000063	20001761	78	7.5	29.8	3.05	7
2000063	20001762	78	10	30.0	3.31	3
2000063	20001763	78	20	30.0	4.13	0
2000063	20001764	78	30	30.0	4.70	0
2000063	20001765	78	40	30.1	5.13	0
2000063	20001766	78	50	29.9	4.83	0
2000063	20001767	78	60	30.3	5.45	0
2000063	20001768	78	70	30.3	5.62	0
2000063	20001769	78	80	30.3	5.75	0
2000063	20001770	78	90	30.5	5.82	0
2000063	20001771	70	0	31.3	0.39	29
2000063	20001772	70	2.5	31.0	0.57	29
2000063	20001773	70	5	30.4	0.61	27
2000063	20001774	70	7.5	30.6	0.61	26
2000063	20001775	70	10	30.7	0.63	25
2000063	20001776	70	15	30.7	0.57	25
2000063	20001777	70	20	30.7	0.52	27
2000063	20001778	70	25	30.9	0.49	26
2000063	20001779	70	30	30.8	0.44	27
2000063	20001780	70	35	30.6	0.50	27
2000063	20001781	70	40	30.4	0.42	28
2000063	20001782	70	45	30.8	0.43	29
2000063	20001783	62	0			
2000063	20001784	62	2.5			
2000063	20001785	62	5			
2000063	20001786	62	7.5			

Cruise	id	core	z	Salinity	NH4	S04
			cm	ppt	mM	mM
2000063	20001787	62	10			
2000063	20001788	62	15			
2000063	20001789	62	20			
2000063	20001790	62	25			
2000063	20001791	62	30			
2000063	20001792	66	0			
2000063	20001793	66	2.5			
2000063	20001794	66	5			
2000063	20001795	66	7.5			
2000063	20001796	66	10			
2000063	20001797	66	15			
2000063	20001798	69	0			
2000063	20001799	69	2.5			
2000063	20001800	69	5			
2000063	20001801	69	7.5			
2000063	20001802	69	10			
2000063	20001803	69	15			
2000063	20001804	76	0			
2000063	20001805	76	2.5			
2000063	20001806	76	5			
2000063	20001807	76	7.5			
2000063	20001808	76	10			
2000063	20001809	76	15			
2000063	20001810	76	20			
2000063	20001811	76	25			
2000063	20001812	77	0			
2000063	20001813	77	2.5			
2000063	20001814	77	5			
2000063	20001815	77	7.5			
2000063	20001816	77	10			
2000063	20001817	77	15			
2000063	20001818	77	20			
2000063	20001819	77	25			
2000063	20001820	72	0			
2000063	20001821	72	2.5			
2000063	20001822	72	5			
2000063	20001823	72	7.5			
2000063	20001824	72	10			
2000063	20001825	72	15			
2000063	20001826	72	20			
2000063	20001827	74	0			
2000063	20001828	74	2.5			
2000063	20001829	74	5			
2000063	20001830	74	7.5			
2000063	20001831	74	10			
2000063	20001832	74	15			
2000063	20001833	61	0			

Cruise	id	core	z	Salinity	NH4	S04
			cm	ppt	mM	mM
2000063	20001834	61	2.5			
2000063	20001835	61	5			
2000063	20001836	61	7.5			
2000063	20001837	61	10			
2000063	20001838	61	12.5			

Appendix VI Graphic Records and Digital Tapes

120 kHz Sidescan Analog Records							
Record #	Start Time	End Time	Line #	Record #	Start Time	End Time	Line #
1	295/2223	295/0156	1 to 3	2	296/0000	296/0943	3 to 10
3	296/2152	297/1000	11 to 26	4	297/2215	298/0431	27 to 39
5	298/0432	298/0626	39 to 44	6	298/0629	298/0940	44 to 49
7	299/1329	299/1609	201	8	299/1610	299/2210	201, 202
9	299/2212	300/0354	101, 102	10	300/0358	300/0956	103 to 106
11	301/2247	302/0410	107 to 109	12	302/0411	302/0939	110 to 113
13	302/0941	302/1303	113 to 115				
330 kHz Sidescan Analog Records							
Record #	Start Time	End Time	Line #	Record #	Start Time	End Time	Line #
1	295/2220	295/0942	1 to 10	2	296/2151	297/1000	11 to 26
3	297/2220	298/0104	27 to 30	4	298/0106	298/0930	30 to 49
5	299/1335	299/1525	201	6	299/1528	299/2218	201, 202
7	299/2219	300/0143	101	8	300/0145	300/0956	102 to 106
9	301/2249	302/0855	107 to 112	10	302/0858	302/1302	113 to 115
Seistec Analog Records							
Record #	Start Time	End Time	Line #	Record #	Start Time	End Time	Line #
1	297/2220	298/0935	27 to 49	2	299/1344	300/0956	101 to 106 201, 202
3	301/2250	302/1303	107 to 115				
Digital Tapes							
Sidescan				Seistec			
Tape #	Start Time	End Time	Line #	Tape #	Start Time	End Time	Line #
1	295/2152	296/0941	1 to 10	1	297/2307	298/0940	28 to 49
2	296/2151	297/1000	11 to 26	2	299/1344	299/2210	201, 202
3	297/2230	298/0939	27 to 49	3	299/2218	300/0956	101 to 106
4	299/1344	299/2215	201, 202	4	301/2250	302/0355	107 to 109
5	299/2215	300/0955	101 to 106	5	302/0358	302/1301	109 to 115
6	301/2252	302/1300	107 to 115				

Appendix VII Start and end times for survey lines

Line No.	Start Time	End Time	Sidescan			Seistec	
			Record #		Tape #	Record #	Tape #
			120 kHz	330 kHz			
1	295/2341	295/2353	1	1	1		
2	296/0000	296/0143	1	1	1		
3	296/0147	296/0246	1, 2	1	1		
4	296/0248	296/0402	2	1	1		
5	296/0404	296/0456	2	1	1		
6	296/0500	296/0600	2	1	1		
7	296/0603	296/0655	2	1	1		
8	296/0658	296/0755	2	1	1		
9	296/0758	296/0851	2	1	1		
10	296/0855	296/0941	2	1	1		
11	296/2151	296/2250	3	2	2		
12	296/2253	296/2344	3	2	2		
13	296/2348	297/0034	3	2	2		
14	297/0041	297/0141	3	2	2		
15	297/0145	297/0226	3	2	2		
16	297/0230	297/0330	3	2	2		
17	297/0333	297/0416	3	2	2		
18	297/0421	297/0502	3	2	2		
19	297/0504	297/0548	3	2	2		
20	297/0551	297/0624	3	2	2		
21	297/0628	297/0708	3	2	2		
22	297/0712	297/0741	3	2	2		
23	297/0746	297/0823	3	2	2		
24	297/0827	297/0853	3	2	2		
25	297/0858	297/0931	3	2	2		
26	297/0942	297/1000	3	2	2		
27	297/2236	297/2302	4	3	3	1	
28	297/2308	297/2334	4	3	3	1	1
29	298/0017	298/0050	4	3	3	1	1
30	298/00552	298/0114	4	3, 4	3	1	1
31	298/0118	298/0140	4	4	3	1	1
32	298/0146	298/0203	4	4	3	1	1
33	298/0208	298/0228	4	4	3	1	1
34	298/0233	298/0252	4	4	3	1	1
35	298/0256	298/0316	4	4	3	1	1
36	298/0322	298/0340	4	4	3	1	1
37	298/0346	298/0401	4	4	3	1	1
38	298/0404	298/0414	4	4	3	1	1
39	298/0423	298/0450	4, 5	4	3	1	1
40	298/0502	298/0518	5	4	3	1	1
41	298/0521	298/0538	5	4	3	1	1
42	298/0541	298/0556	5	4	3	1	1
Line No.	Start Time	End Time	Sidescan			Seistec	

			Record #		Tape #	Record #	Tape #
			120 kHz	330 kHz			
43	298/0601	298/0618	5	4	3	1	1
44	298/0621	298/0633	5, 6	4	3	1	1
45	298/0638	298/0710	6	4	3	1	1
46	298/0712	298/0754	6	4	3	1	1
47	298/0800	298/0846	6	4	3	1	1
48	298/0848	298/0916	6	4	3	1	1
49	298/0919	298/0934	6	4	3	1	1
101	299/2250	300/0141	9	7	5	2	3
102	300/0147	300/0351	9	8	5	2	3
103	300/0356	300/0507	10	8	5	2	3
104	300/0512	300/0701	10	8	5	2	3
105	300/0707	300/0849	10	8	5	2	3
106	300/0855	300/0956	10	8	5	2	3
107	301/2300	302/0106	11	9	6	3	4
108	302/0111	302/0218	11	9	6	3	4
109	302/0237	302/0405	11	9	6	3	4, 5
110	302/0412	302/0603	12	9	6	3	5
111	302/0608	302/0713	12	9	6	3	5
112	302/0721	302/0853	12	9	6	3	5
113	302/0906	302/1020	12, 13	10	6	3	5
114	302/1027	302/1128	13	10	6	3	5
115	302/1137	302/1302	13	10	6	3	5
201	299/1344	299/2028	7, 8		4	2	2
202	299/2046	299/2250	8	6	4	2	2