Cruise Report Amundsen 2004-804: Beaufort Sea / Amundsen Gulf / Northwest Passage, June 23 – August 27, 2004

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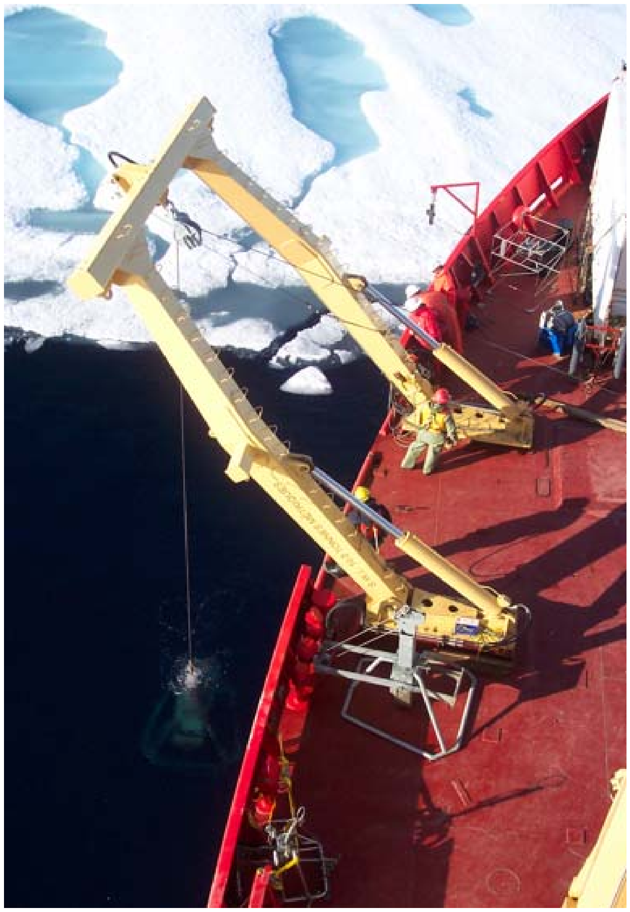

Robbie Bennett[1], André Rochon[2], Trecia Schell[3], Jason Bartlett[4], Steve Blasco[1], John Hughes-Clarke[5], David Scott[3], Adam MacDonald[1], Walli Rainey[1]

[1] Geological Survey of Canada (Atlantic)
[2] Institut des sciences de la mer de Rimouski; Université du Quebec à Rimouski
[3] Dalhousie University – Department of Earth Sciences
[4] Canadian Hydrographic Service
[5] Ocean Mapping Group – University of New Brunswick

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R. Bennett, A. Rochon, T. Schell, J. Bartlett, S. Blasco, J. Hughes-Clarke, D. Scott, A. MacDonald, W. Rainey

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1.0 INTRODUCTION

This cruise report summarizes the activities of the geological/paleoceanographic science program of CASES (Canadian Artic Shelf Exchange Study) Leg 8, 9 and ArcticNet Leg 1. A GSCA cruise number (2004-804) has been given to this project since GSCA personnel were onboard and samples from these two CASES Legs and ArcticNet will be curated at the Bedford Institute of Oceanography. The cruise number does not apply to data collected by other scientists involved in the CASES or ArcticNet programs and their activities will not be discussed in this report. Additional information on the activities of other CASES participants can be obtained from Louis Fortier (louis.fortier@bio.ulaval.ca) or at the CASES website (http://www.cases.quebec-ocean.ulaval.ca/). Additional information on the activities of other ArcticNet participants can be obtained from Martin Fortier (martin.fortier@arcticnet.ulaval.ca) or at the ArcticNet website (http://www.arcticnet-ulaval.ca/).

1.1 Scientific Staff

André Rochon	Institut des sciences de la mer de Rimouski located at the Université du Quebec à Rimouski
David Scott	Dalhousie University – Department of Earth Sciences
Trecia Schell	Dalhousie University – Department of Earth Sciences
Barry Hill	Dalhousie University – Department of Earth Sciences
Genevieve Cauchon-Voyer	Université Laval
Jason Bartlett	Canadian Hydrographic Service
Kristian Llewellyn	Ocean Mapping Group located at the University of New Brunswick (Fredericton)
Jonathan Beaudoin	Ocean Mapping Group located at the University of New Brunswick (Fredericton)
Steve Brucker	Ocean Mapping Group located at the University of New Brunswick (Fredericton)
Robbie Bennett	Geological Survey of Canada (Atlantic)
Adam MacDonald	Geological Survey of Canada (Atlantic)

1.2 Background

In March 2001, the CASES Research Network was funded by the Natural Sciences and Engineering Research Council of Canada (NSERC) to conduct the Canadian Arctic Shelf Exchange Study (CASES). This multi-disciplinary, international project was initiated to develop an understanding of the biogeochemical and ecological consequences of sea ice variability on the MacKenzie Shelf.

The Geological Survey of Canada (Atlantic) (GSCA) has been involved with the development of the CASES program since its inception in 2001. Using over 30 years of experience in marine geophysical and geotechnical data collection, the GSCA took an advisory role in the early stages of CASES. The GSCA technical and scientific staff was able to advise and assist the CASES Research Network in outfitting the CCGS Amundsen for piston coring and box coring operations.

As the CASES program progressed, the GSCA was able to take a support role in the project and provided personnel for the two final legs of CASES onboard the Amundsen. The support that the GSCA was able to provide was onboard coring and box coring technical support, geophysical interpretation of sub-bottom profiler data, core logging and MSCL (Multi-Sensor Core Logger) operations, and the curation of core samples at the completion of CASES.

Field data collection for CASES ended when the Amundsen left Coronation Gulf and began its transit of the Northwest Passage to Churchill, Manitoba. From this point forward, the vessel was working under the new ArcticNet program. ArcticNet is a Network of Centres of Excellence of Canada funded project similar to CASES but with a larger scope. This project aims to contribute to the development and dissemination of the knowledge needed to formulate adaptation strategies and national policies to help Canadians face the impacts and opportunities of climate change and globalization in the Arctic. This will encompass the study of geological, ecological, environmental, biological, chemical, and cultural processes in the Arctic, focused on the Northwest Passage. The GSCA has also been involved with this project since its inception, in a more prominent role than was assumed for the CASES program.

2.0 SCIENTIFIC OBJECTIVES

The objectives of cruise 2004-804 fall under CASES sub-projects 2.8, 2.7 and ArcticNet sub-project 1.6. Sub-project 2.8 entitled "Decadal-Millennial Variability in Sea Ice and Carbon Fluxes" aims at reconstructing the paleoceanography of the Canadian Arctic Shelf. This sub-project places emphasis on the sea ice history and the storage and transport of organic carbon from the shelf to the deep part of the basin during the Holocene.

Sub-project 2.7 entitled "Benthic Processes and Carbon Cycling" aims to examine the processes that influence benthic community structure and respiration on the Mackenzie Shelf. To accomplish the goals of sub-project 2.7 the shells of benthic invertebrates will be recovered from the Beaufort Shelf to provide suitable materials to examine the utility of biogeochemical "markers" as proxies for the sources of organic materials consumed by marine benthos. The necessary samples were collected from box cores by sub-project 2.7 researchers and the samples will be analyzed, processed, sub-sampled, and curated by the same researchers. The responsibility of the GSCA to sub-project 2.7 is to provide a geological context to the samples and to provide assistance with geophysical interpretation for benthic habitats.

The objectives of ArcticNet sub-project 1.6 entitled "Opening the Northwest Passage: Resources, Navigation, Sovereignty, & Security" include: 1) compile corridors of precise high resolution bathymetry, and seabed geomorphology; 2) improve the mapping of the surficial geological environment of the Canadian Archipelago channels; 3) obtain sediment cores and grabs of the Holocene record for paleoceanographic analyses at optimal sites in the region.

To accomplish these objectives, the original plan was to collect high-resolution sediment cores along 3 transects:

A) one transect of 3 cores in the Mackenzie Trough (western Mackenzie Shelf), from the shelf to the slope (~50 to 1100 m)
B) one transect of 3 cores from the shelf to the slope off Tuktoyaktuk
C) one east-west transect of 3 cores from the mouth of Amundsen Gulf and down the slope

Due to time constraints and schedules of other CASES scientists, these transects were not possible. As an alternative, piston core sites were selected based on sub-bottom data from geophysical data archived at the GSCA, CASES Leg 1, Leg 8, and Leg 9. Sites were selected in order to sample thick Holocene sequences on the Beaufort Shelf/Slope and the Northwest Passage.

The final objective of 2004-804 was to maximize multi-beam bathymetry and sub-bottom profiler data coverage. Geophysical data was collected by these two systems whenever the vessel was transiting between sampling stations, over most of the piston core sites, and in several areas where interesting seabed features were observed.

3.0 EQUIPMENT

Scientific operations for cruise 2004-804 were performed aboard the CCGS Amundsen (see Figure 3.1). The Amundsen (formerly the CCGS Sir John Franklin built in 1979, and renamed Amundsen in 2003) is a Class 3 icebreaker which has been refitted to accommodate arctic science research. The ship is 98m long, 19m wide with a draft of 7m and can obtain a maximum speed of about 16 knots. There is approximately 300 m^2 of lab space inside the vessel with another 110m^2 of lab space in temporary external lab containers. The Amundsen can accommodate 46 scientific staff in addition to the 31 ship's crew. The following equipment was used to accomplish the scientific objectives of this cruise.

3.1 Piston Corer

The piston corer used onboard the Amundsen was constructed based on blueprints of the AGC Long Corer, that were supplied by the GSCA. This system is comprised of a large core head used with 3m x 106mm ID core barrels that are attached with external couplings secured by set screws. Up to 5 barrels can be used with this system, yielding a 15m core sample; however the deck layout of the Amundsen only allowed for 3 core barrels to be used. The 3 barrel configuration was more than sufficient as all of the samples collected were less than 9m in length. Transparent plastic core liner was inserted into the core barrels for each sample to retain the core when it was removed from the corer. The whole round samples obtained by this system have a diameter of 99.2mm, and were cut into 1.5m lengths for ease of transportation. A 115kg trigger weight corer with a 1.5m aluminum barrel was used as the trigger weight for this system. The sample diameter of the trigger weight cores was also 99.2mm.

Since this equipment was manufactured specifically for the CASES program, the piston core system had never been assembled prior to the beginning of cruise 2004-804. The coring equipment had been onboard the Amundsen since the beginning of CASES and due to the shear number of personnel and equipment, the boxes containing the equipment had been moved and spread over the entire ship. With all of this moving of equipment unfortunately 2 boxes containing some essential parts were lost. These items included:
-Shear pins for the split piston
-Spring for the split piston
-O-rings for the split piston
-Vented screws for the split piston (orifice screws)
-Gasket for the split piston
-Backing plates, pivot and locking pin for the trip arm
-Stainless steel pin to attach the split piston to the cable
-core cutter for the trigger weight core
After an exhaustive search of the entire ship, the search was abandoned and the focus switched to the manufacturing of new replacements for the missing parts. After 2 days of

Figure 3.1: CCGS Amundsen
(Image courtesy M. Fortier)

work, the ship's engineers were able to manufacture all of the replacement parts needed. These make-shift parts were used for all of Leg 8 until actual replacement parts were brought onboard by GSCA personnel at the beginning of Leg 9.

The deployment of the piston corer was difficult due to the configuration of the Amundsen's foredeck. To deploy the corer, the system was first assembled perpendicular across the foredeck between the coring winch and the winch controls. When the piston corer was fully assembled, the nose of the corer was directed under the coring A-frame and the entire system was picked up horizontally using the two large cranes located on the foredeck. The core barrels were then rested on the edge of the ship and then the core head was slowly lifted to rotate the system to an almost vertical position and then it was slowly lowered to the water line (Figure 3.2). The trigger weight corer was then attached to the trigger arm using a separate winch and block. Retrieval of the piston corer was the reverse of deployment. This method of deployment/retrieval was cumbersome and slow; however it was the only method that could be conceived with the current configuration of the Amundsen. The deployment and retrieval processes did become easier and faster as the scientific personnel and ship's crew became more familiar with the equipment.

Once the piston corer was retrieved and back on the deck, each barrel is disassembled from the corer and the plastic liner is extracted. Each 3 meter long liner is then cut into 1.5 meter sections, which are capped at each end, labelled and stored in a refrigerated container (at about 4° C) for further analysis. All of the piston and box cores will be curated at the GSCA core repository located at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia. The cores have been labelled using two numbering systems. The first system used by Dalhousie University and ISMER consists of the GSCA cruise number, followed by the CASES station number (e.g. 2004-804-711PC). The second numbering system used for these samples is the standardized GSCA system (e.g. 2004-804-001PC) so the cores can be integrated into the Exploration Database (ED).

Since this piston core system was new and never used previous to 2004-804, there were problems encountered with the first two cores collected. These initial core samples were about 3 meters in length while the apparent penetration of the corer was as much as 7 meters. This problem was attributed to the split piston which was splitting too early and therefore limiting the sample length to about 3 meters. Copper shear pins in the split piston were used for the first two cores and it was determined that these pins were too soft and allowed the piston to split easily. For the rest of the cores during Leg 8 rigid stainless steel pins were used and they eliminated the problem of the piston splitting early. Effectively this made the piston a solid piston rather than a split piston. The corer functioned well for the rest of the core samples with obtained sample lengths as much as 6.64 meters.

See Section 4.1.1 for a discussion of the piston core samples that were collected.

Figure 3.2: Piston corer deployment
(Image courtesy T. Juul-Petersen)

3.2 Box Corer

The 50cm x 50cm x 80cm box corer (Figure 3.3) was used by many scientists onboard, with several samples taken from each core. For 2004-804, two push cores (99.2mm ID) were taken from each box core sample. Surface sediment sample at each box core location were also collected in order to develop reference databases of modern dinoflagellate cysts, diatoms and foraminifera populations in the study area. The surface samples will be curated at Dalhousie University and at the Institut des sciences de la mer de Rimouski (ISMER). The box corer functioned perfectly during 2004-804 with the only repair being a new trip cable which was adapted from a spare trip cable for the piston corer and then installed on the box corer.

See Section 4.1.2 for a discussion of the box core samples that were collected.

3.3 Multibeam Echosounder

The Kongsberg-Simrad EM 300 multibeam echosounder system was used to collect all bathymetry data during cruise 2004-804. This system was operated and maintained by the personnel of Ocean Mapping Group (OMG) at the University of New Brunswick (Fredericton). The EM 300 is designed for seabed mapping from the shoreline to beyond the continental rises and includes such features as phase detection, equidistant beam spacing, calibrated seabed acoustic imaging, and advanced signal processing technology. The EM 300's transmit and receive transducer arrays were hull-mounted and are networked to the control station on the Navigation Deck of the Amundsen. Post processing and display of the multibeam data was performed using OMG developed software.

The basic specifications of the EM 300 are:

Frequency	30 kHz
Peak Power	4.5 or 9 kW
Pulse Length	0.7, 2, or 15 ms
Number of Beams	135
Beamwidth	1x1°, 1x2°, 2x2°, or 2x4°
Coverage sector	150°
Depth range	10m to >5,000m
Maximum swath width	>5,000m

Sound velocity data for the EM 300 was acquired from the MVP-300 (Brooke Ocean Technology) that was dipping regularly in ice free waters, and the Seabird CTD on the rosette was also used to obtain the sound velocity profiles. Two hull mounted probes were also available to supply sound velocity information to the EM 300 transducer.

Figure 3.3: Box corer used during 2004-804
(Image courtesy T. Juul-Petersen)

See Section 4.2 for a discussion of the features observed in the 2004-804 geophysical data and the performance of the EM 300 multibeam system. At the time of this report, the geophysical data are archived at the University of New Brunswick and can be viewed on the internet at http://chamcook.omg.unb.ca/~arcticnet/.

3.4 Sub-bottom Profiler

The sub-bottom profiler installed onboard the Amundsen is the Knudsen 320R deep water echosounder. This system was operated by OMG and was used to collect all of the sub-bottom geophysical data during the CASES program. The Knudsen 320R is a high power bathymetry/sub-bottom imaging system capable of data collection at full ocean depths. The 320R utilizes a 3.5 kHz hull mounted transducer which is networked to the control station on the Navigation Deck of the Amundsen where the data is stored digitally.

The basic specifications of the Knudsen 320R are as follows:

Frequency	3.5 kHz
Power	4 to 8 selectable levels
Pulse Length	Automatically selected with override
Phased Ranges	Multiple 50% overlapped phases for each range, manual or automatic selection
Gain Controls	AGC, TVG, plus manual receive gain

See Section 4.2 for a discussion of the features observed in the 2004-804 geophysical data and the performance of the Knudsen 320R sub-bottom profiler. At the time of this report, the geophysical data are archived at the University of New Brunswick and can be viewed on the internet at http://chamcook.omg.unb.ca/~arcticnet/.

4.0 Geophysical and Geotechnical Data Sets

A large amount of both geophysical and geotechnical data has been collected during cruise 2004-804 aboard the CCGS Amundsen. Section 4 will discuss in further detail the amount and types of data collected over the duration of 2004-804. A narrative of the daily events of 2004-804 is provided in Appendix 1.

4.1 Geotechnical Samples

A total of 9 piston cores and 42 box cores (2 push cores from each) were collected during the course of cruise 2004-804. The positions of the geotechnical samples are displayed in Figure 4.1.

4.1.1 Piston Core Samples

Nine piston cores were attempted during cruise 2004-804. One of these attempts (sample 047PC) experienced considerable rigging problems and only a 52 cm, highly disturbed sample was obtained. Details on each of the piston core samples are available in Appendix 2. Sub-bottom profiles of each piston core site are available in Appendix 3. A detailed sediment description of each piston core is available in Appendix 4.

Because of limited survey time and the uneven distribution of Holocene sediments in the study area, it was not possible to collect cores along all of the transects that had been originally selected. However, the cores have been collected at key locations along the Mackenzie Shelf/Slope and Amundsen Gulf to fulfill the objectives of the expedition. Cores from a previous cruise in the Mackenzie Trough area (2002 JWACS cruise aboard the RV Mirai) will be used to complement the 2004-804 sampling transects.

Overall, the upper 4-5.5 metres of the cores consist of olive grey silty clay overlying massive grey clay, which, in the case of core 2004-804-015PC, was highly cohesive. This is most likely what stopped the corer from going deeper in the sediment. The upper 5.5 metres of core 2004-804-042PC are composed of the same olive grey silty clay, overlying a unit of pinkish grey clay. The time period covered by each core depends on the sediment accumulation rate at each location and will be determined at a later date using ^{14}C accelerated mass spectrometry (AMS) dating techniques.

4.1.2 Box Core Samples

A series of 42 box cores were collected at 40 different locations along the Beaufort Shelf/Slope, Amundsen Gulf, and the Northwest Passage. The high number of samples in the Beaufort Shelf/Slope and Amundsen Gulf provides an excellent surface coverage of

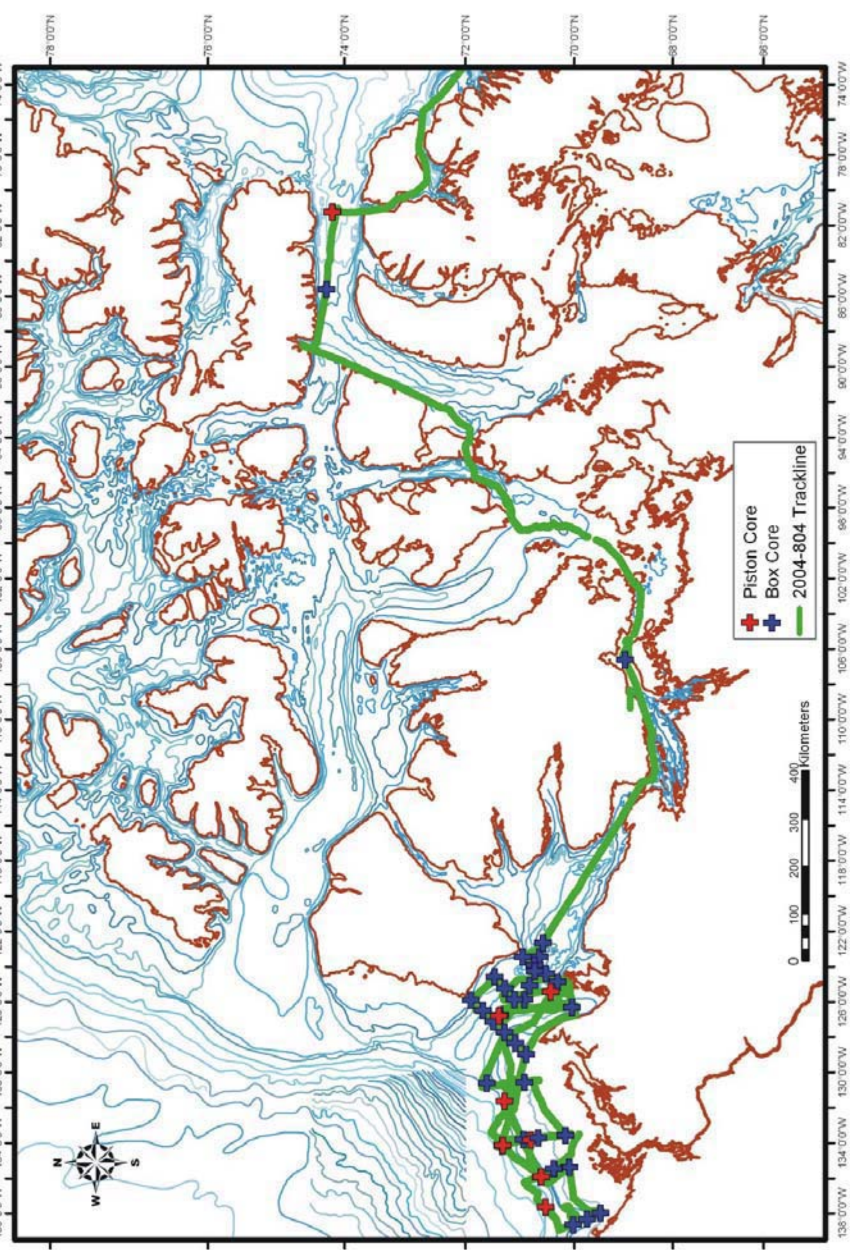

Figure 4.1: Geophysical and geotechnical data collected during 2004-804

the area. In each boxcore, 2 surface samples and push cores were collected. The surface samples will be curated at Dalhousie University and at ISMER. Box cores collected in conjunction with piston cores allowed for the recovery the surficial layer of sediment, which is usually destroyed when the piston corer enters the sediments. In general, box cored sediments from the Beaufort Shelf/Slope area are composed of silty clay, possibly of late Holocene age, with relatively abundant benthic fauna (brittle stars, polychetes, amphipods, etc.). Sediments from the Amundsen Gulf, however, are composed of a relatively thin layer of silty clay overlying a diamicton of pink or grey color with abundant pebbles and cobbles.

Details on each of the box core samples are available in Appendix 2.

4.1.3 Other Collected Samples

Phytoplankton (collected with a diatom net; 50μm mesh) and drifting sediment trap samples were collected in order to document dinoflagellate (motile and cyst stage) populations in the water column. These samples will also help to establish relationships between dinoflagellates in the water column versus those found in surface sediments. Details on each of these samples are available in Appendix 2. These water column samples will be curated at ISMER.

4.1.4 Onboard Sample Processing and Sub-sampling

The 6 piston cores and 5 Trigger weight cores collected during Leg 8, and 48 pushcores from the 36 box cores were analyzed with the onboard MSCL (Multi Sensor Core Logger). Two piston cores, 2 trigger weight cores, and 11 pushcores from 6 box cores collected on Leg 9 were also analyzed with the MSCL. Piston core 047PC was not analyzed by MSCL due to the significant disturbance of the sample. A total of 6713 cm of core material was logged onboard the Amundsen for gamma density, p-wave velocity, core thickness, magnetic susceptibility and temperature.

Seven of the 9 piston cores obtained on Legs 8 and 9 were split into a Working and Archive half, a sediment description compiled, and then digitally color photographed. The last piston core collected (050PC and 050TWC) and the failed core attempt (047PC) were not split or processed. In total 3996 cm of core material was processed in this manner.

Sub-samples were taken every 10 cm from the Working core half. The sub-samples included:
-micropaleontology (foraminifera and thecamoebians, 10 cc's for T. Schell, Dalhousie)
-diatoms (5 cc's for T. Schell, Dalhousie)
-marine palynomorphs (dinoflagellates and pollen, 10 cc's for A. Rochon, ISMER)

-u-tube (or mini-core) was taken from the entire core length for paleomagnetic study (for G. St. Onge, ISMER)

In total, 1191 sub-samples and 3996 cm of U-channel/mini-cores for paleomagnetism were collected. These sub-samples will be curated at Dalhousie University and ISMER.

Both the Working and Archive core halves are stored in plastic D-tubes and held in cold storage (~ 4^{o}C) along with the unsplit pushcores and one unsplit piston core. The refrigerated unit that contains the cores remained on board the CCGS Amundsen until her return to Quebec City in October 2004. At this time, the cores were taken off the ship and trucked to the Bedford Institute of Oceanography in Dartmouth where they were placed into storage in the GSC Core Repository.

4.2 Geophysical Data

Geophysical survey blocks were conducted in the following areas in order to image core sites or interesting seabed features.

Table 4.1: Geophysical survey blocks

Block#	Date	CASES Station	Feature /Core #	Latitude	Longitude	Dimensions (km)	WD(m)
1	06/30/04	711	005PC	70°48.27	-133°43.97	1.2 x 4	75
2	07/03/04	850	008PC	70°33.83	-137°35.67	8 x 7	1100
3	07/18/04	118		70°57.10	-125°51.63	5 x 8	375
4	07/18/04	309		71°06.94	-125°51.33	9 x 4.5	400
5	07/20/04	415	Sachs Feat.	71°54.05	-125°52.30	4.5 x 2.2	45
6	07/22/04	409	Deep Water Scours	71°30.38	-127°00.42	6 x 9	375
7	07/26/04	803	Slump	70°36.04	-136°04.41	3 x 11	250
8	07/26/04		Mud Volcano	70°23.37	-135°25.04	0.6 x 3	60
9	07/29/04	112		70°50.83	-125°02.23	3 x 4	350
10	08/01/04	209		70°32.24	-124°22.04	3 x 5.5	250
11	08/02/04	250	042PC	70°26.98	-125°24.06	8.5 x 1.6	150
12	08/02/04	309	Glacial Sole Marks	71°18.05	-125°39.01	10 x 9.5	400

Multibeam and sub-bottom profiler data was also collected while the ship was transiting between stations, when ice conditions permitted. Figure 4.1 shows the complete track of the Amundsen where geophysical data was collected and figure 4.2 displays the locations of the survey blocks shown in Table 4.1 (map projection: Mercator). Images of the multibeam and sub-bottom profiler data can be viewed at the University of New Brunswick Ocean Mapping Group's website http://chamcook.omg.unb.ca/~arcticnet/.

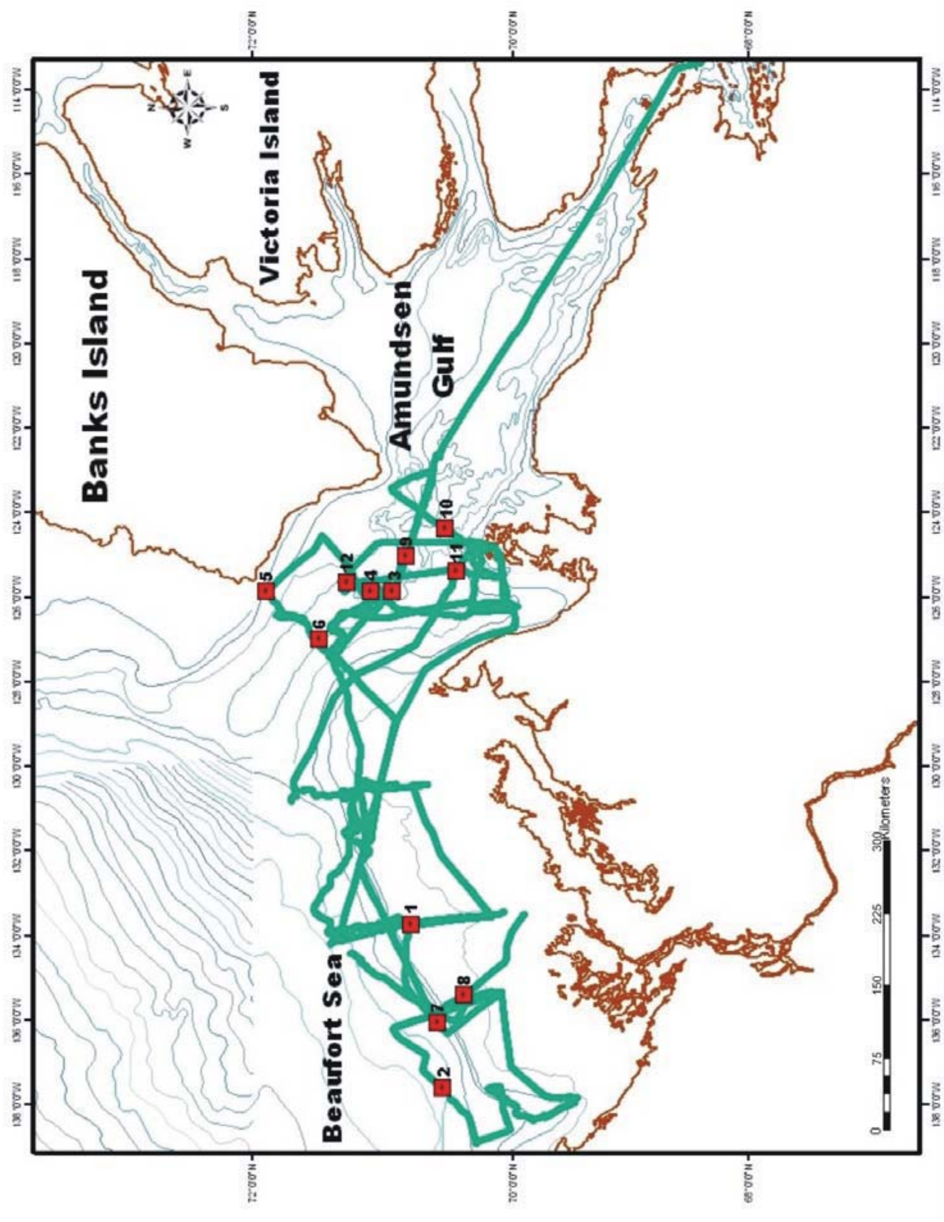

Figure 4.2: 2004-804 Geophysical survey blocks

The performance of the EM 300 multibeam system was excellent in ice free waters; however sea ice did adversely affect the quality of the bathymetry data. An evaluation of the geophysical equipment's performance in ice is presented in Section 5.3.

5.0 SCIENTIFIC ACCOMPLISHMENTS

The 2004-804 scientific program was successful in acquiring useful geophysical and geotechnical data to address the objectives of the CASES sub-project 2.8. This section will discuss the scientific accomplishments of this expedition.

5.1 Geophysical Data Acquisition over Seabed Features

Several seabed features were observed in the geophysical data collected onboard the Amundsen. These features are discussed in the following sections.

5.1.1 Slope Failure Feature

During the course of 2004-804, a large slope failure feature was imaged by multibeam echosounder and 3.5 kHz sub-bottom profiler (figure 5.1). Due to its large scale, the entire feature could not be imaged during the allotted time set aside to survey the area during CASES leg 8. This same slope failure feature has been imaged and reported on at least two prior occasions by O'Connor Associates (1981) (figure 5.2) and Hill, Moran, and Blasco (1982).

The O'Connor report attributes this feature to recent and possibly ongoing slope instability mainly due to the assumption that the failed sediments on the slope are recent Holocene sediments. Hill et al. attributes the feature to creep deformation of undefined age. Both of these studies were based on a model which assumed that the Beaufort Shelf and Slope were areas which had high sedimentation rates and therefore thick Holocene accumulation.

However, sedimentation is not consistent across the Beaufort Shelf. The MacKenzie River sediment plume provides more sediment to the inner shelf than it does to the outer shelf and shelf break. Re-suspension and sediment transport by bottom currents and storm action can be quite dynamic, causing sediment to be swept from the shelf (Carmack and MacDonald, 2002). Therefore, high sedimentation rates may not be present in the area of the slump which could mean that the slumped sediments are pre-Holocene in age. Low sedimentation rates would also preserve the sharp morphology and "fresh" appearance of the slump. Additional data is required to date the slumped material and calculate the sedimentation rate in the area of the feature.

When the failure feature in figure 5.1 was first observed onboard the Amundsen, some scientists thought it was the result of melting permafrost which caused the slope to become unstable and fail. In 1982, O'Connor Associates compiled a report entitled "Shallow Acoustic Permafrost in the Southern Beaufort Sea" which examined the available seismic reflection data in the Beaufort Sea for the presence of acoustic permafrost (APF). No shallow APF has been observed beyond the shelf edge in this report and considering the historical geology of the shelf, none is expected to occur

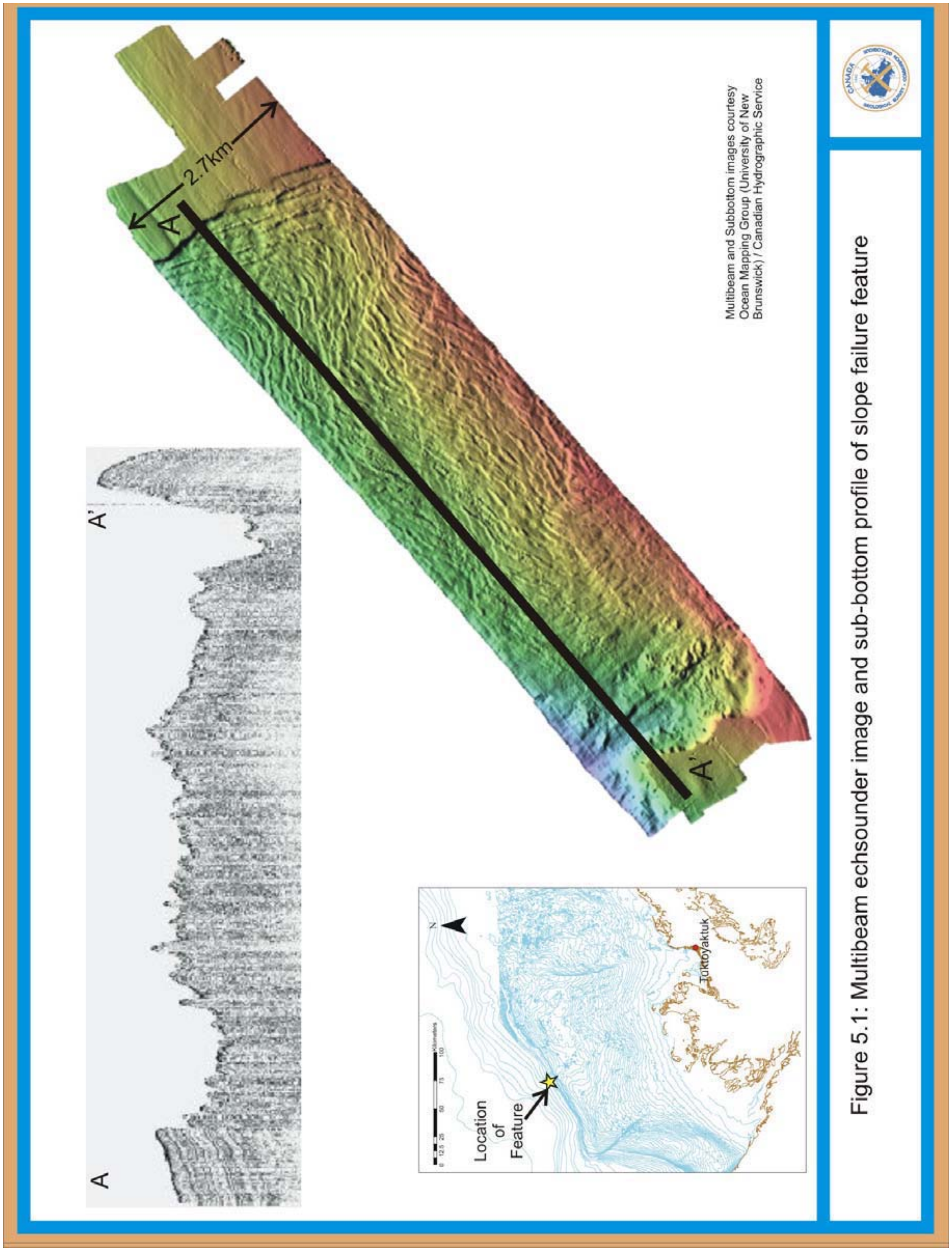

Figure 5.1: Multibeam echsounder image and sub-bottom profile of slope failure feature

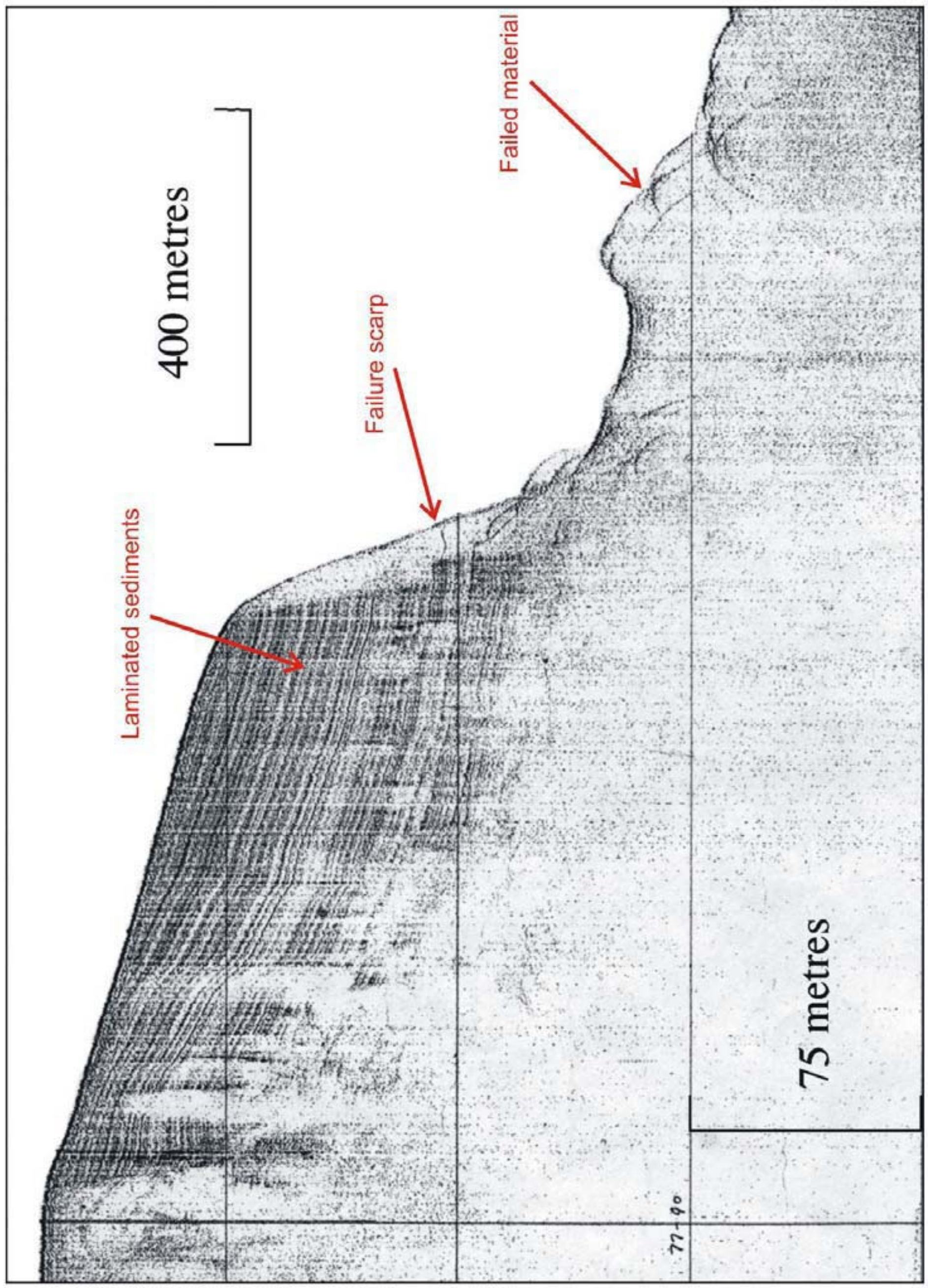

Figure 5.2: Sub-bottom profile of slope failure feature (from O'Connor, 1981)

(O'Connor, 1982). All APF that was observed on the shelf occurred below the top of Unit C. This unit is consists of sands and silts that are interpreted to originate from deposition by glacial outwash onto the shelf which was at that time above sea level. No APF reflectors were observed within Unit A (recent marine sediments) or Unit B (transgressive sequence). All of these observations made in the O'Connor report suggest that permafrost does not occur in the area of the failure feature and therefore permafrost was probably not a factor in the initiation of the slope instability.

The age of this failure feature is also not certain. Initial observations onboard the Amundsen lead several scientists to theorize that the feature has occurred only recently due to the sharp sides and scarps along the margin of the failure (figure 5.3). The failed material at the base of the failure is also sharply folded which supports the theory that this is a recent feature. However if the sedimentation rate is low in this area (i.e. from regionally variable MacKenzie River sediment plume; and from current and storm re-suspension and transport) then there would be a low sediment supply in this area which would cause most seafloor features to appear as if they were recent, regardless of their true age. Sharp sides and scarps on par with those of the failure are also observed along the margins of dredged sediment borrow sites used for the construction of artificial islands during hydrocarbon exploration. These borrow sites are located in areas of dynamic sediment transport and ice scouring, however the pits still appear fresh and have almost vertical walls after 30 years.

Preliminary observations from the 2002 research cruise aboard the M/V Mirai suggest that sediment failures at the Beaufort Shelf break are pre-Holocene in age. 3.5 kHz sub-bottom profiler records have imaged opaque deformed sediments overlain by a veneer of soft, recent (probably Holocene) marine sediment (figure 5.4). A thin layer of probable Holocene sediment has also been observed on sub-bottom profiles of the shelf break collected during 2004-804 (figure 5.5). If the same Holocene veneer could be recognized at the site of the slope failure feature observed on the 2004 Amundsen cruise then an estimate of the feature's age could be made. Additional high-resolution sub-bottom profiler data and sediment cores are required to adequately determine an age for this feature.

The historical geology of the Beaufort Margin would also tend to suggest that slope failure features in the Beaufort Sea would be pre-Holocene. The Beaufort Slope was a much more dynamic environment in the past, when the relative seal level (RSL) was as much as 140m lower than the current sea level about 27,000 years ago. The shallow water depths and glacial influences (i.e. increased sedimentation leading to sediment loading etc.) would have created an environment that would be more likely to cause slope failure than the current slope environment. There is no record of relict slope failures in seismic data collected over the Beaufort Slope. The failure-conducive environment and apparent lack of relict features suggest that this feature is likely pre-Holocene in age, however additional work is required to constrain the age of the failure.

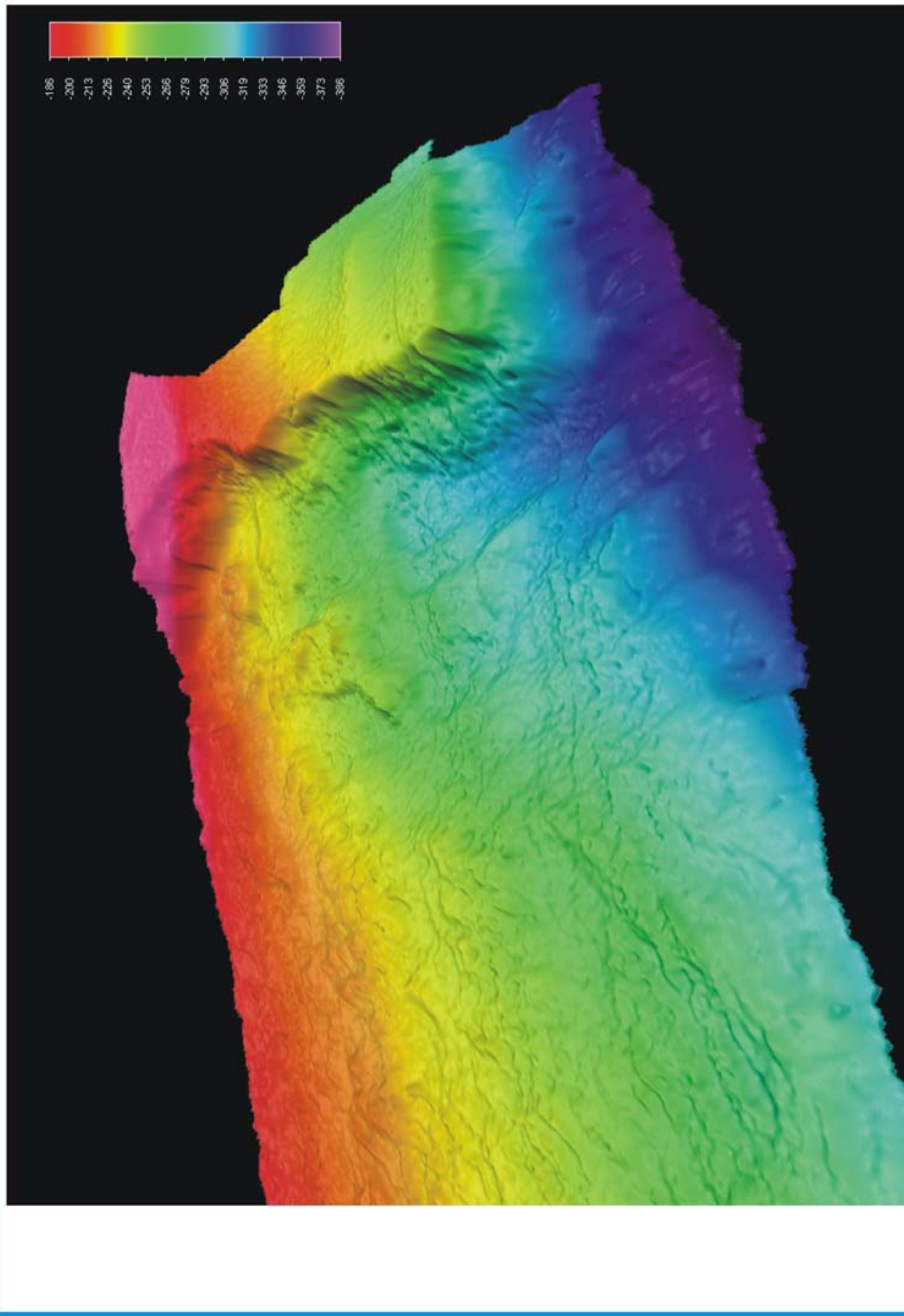

Figure 5.3: 3D multibeam image of steep sides of the slope failure feature (viewed from the north)
(Image courtesy Jason Bartlett, CHS)

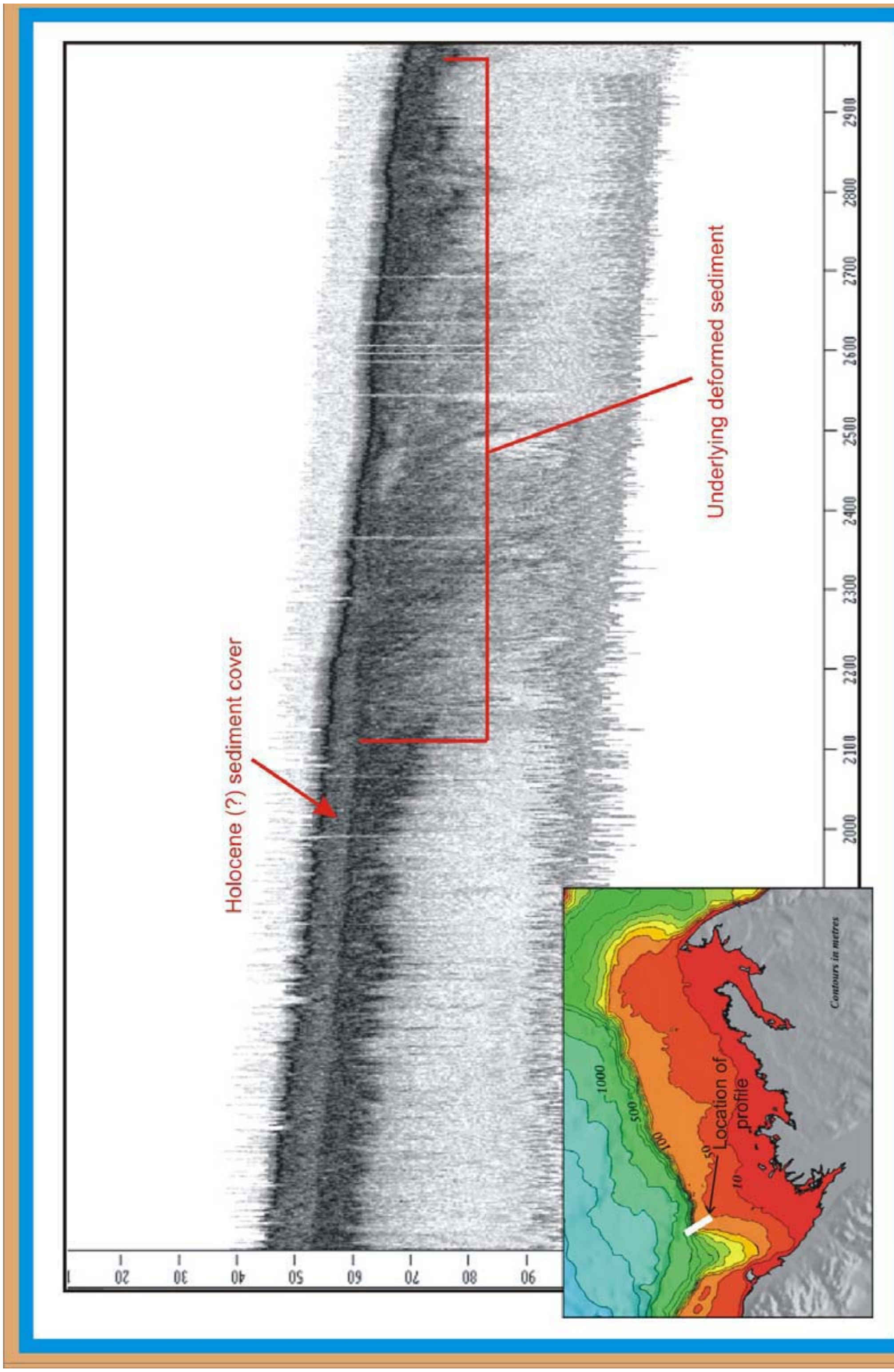

Figure 5.4: 2002 Mirai sub-bottom profile showing presumed Holocene sediment overlying older disturbed sediments

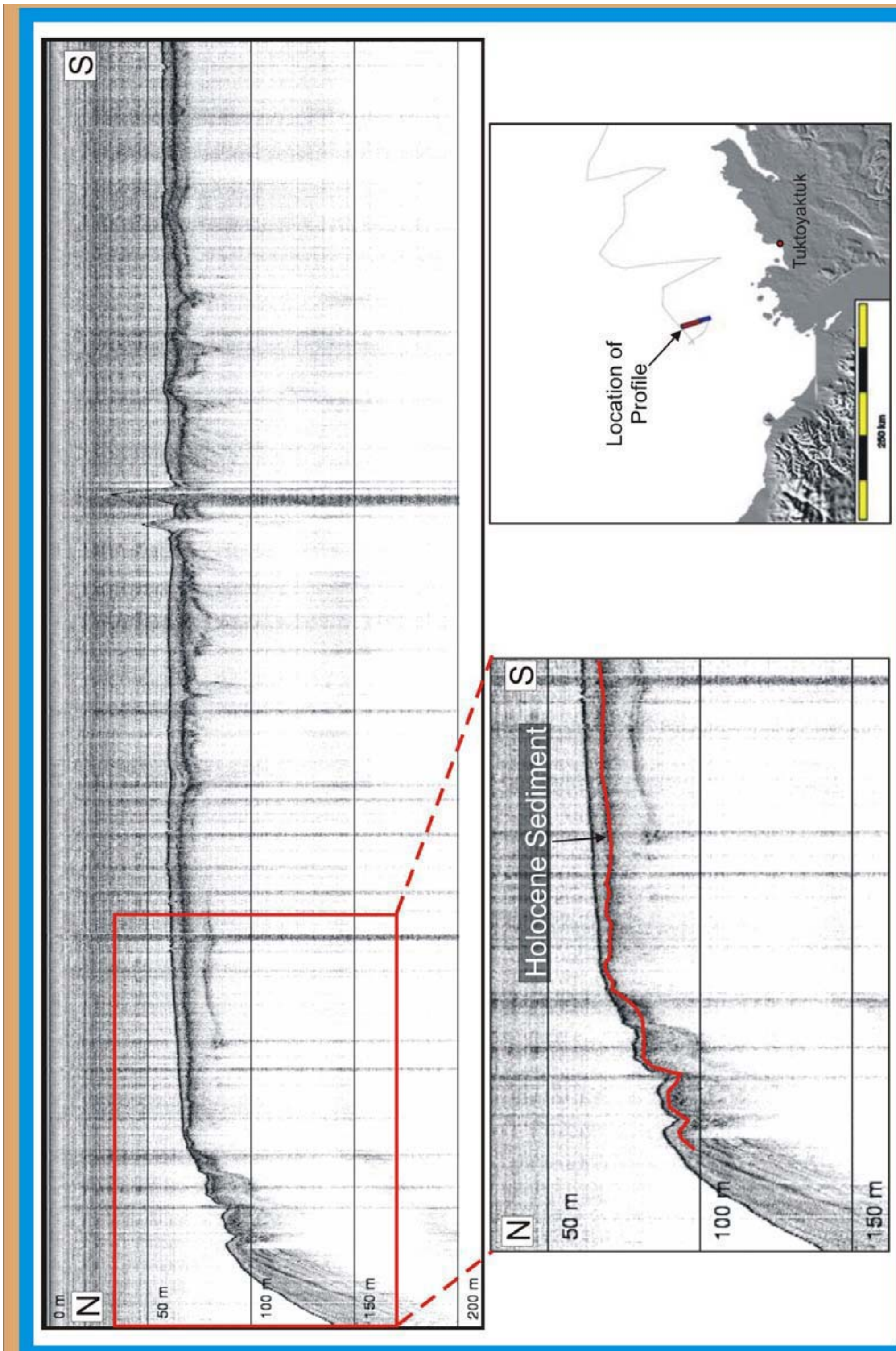

Figure 5.5: Holocene Sediment at the Beaufort Shelf Break

5.1.2 Kopanoar Mud Volcano

The Kopanoar Mud Volcano is located on the Beaufort Shelf in approximately 60 meters water depth (Figure 5.6). This feature was first identified in the 1970's and has been imaged several times with geophysical instruments. Recently the mud volcano has been surveyed with multibeam echosounder in 2002 (R/V Mirai), 2004 (CCGS Amundsen and CCGS Nahidik) and with shallow seismic reflection systems in 2004 (CCGS Amundsen and CCGS Nahidik).

Mud volcanoes can be formed by several different processes including: rising volcanic gases through fine sediment; when mud and sand are squeezed upward by compressive forces created by sediment overburden; and in areas of high hydrocarbon concentration when gas and/or fluids migrate upwards through soft sediment. The origin of the Kopanoar mud volcano is still undetermined, but it is likely that this feature is related to migrating hydrocarbons (gas and/or associated fluids) from deep underlying reservoirs, shallow gas deposits, or gas hydrates.

The Kopanoar feature is slightly elongated and measures about 318m x 407m at its base with a height of about 20m above the seabed.

5.1.3 Ice Sheet Related Seabed Features

Seabed features interpreted to be related to glacier ice and/or meltwater movement have been identified at several multibeam survey sites. The sites that appear to have been affected by glacial actions are located in Amundsen Gulf and Dolphin and Union Strait (Figure 5.7), which were glaciated during the Late Wisconsinan by the Laurentide Ice Sheet (Dyke et al., 2003).

The most dramatic and abundant features observed in the Amundsen Gulf are glacial sole marks (Figure 5.8). These features have been observed at three different multibeam sites each located in about 400 meters of water at the western end of Amundsen Gulf. The sole marks are linear, parallel ridges and troughs that are orientated in a NW – SE direction. Each individual ridge is wider and higher above the seabed at their SE end and then decreases in size (both in width and height) to the NW. The ridges are approximately 40 to 300m wide, up to 30m high, and as long as 5km. Erosion is visible at the SE end of some of the ridges. The orientation and morphology of the sole marks suggests an ice movement direction to the Northwest. Similar features are observed on nearby Wollaston Peninsula, Victoria Island (Sharpe, 1992). It is not certain if these features originated from the movement of a large ice sheet or created by glacial meltwater processes.

A second type of seabed feature interpreted to be created by glacial / ice sheet processes were observed offshore Sachs Harbour in the Amundsen Gulf. These features occur in

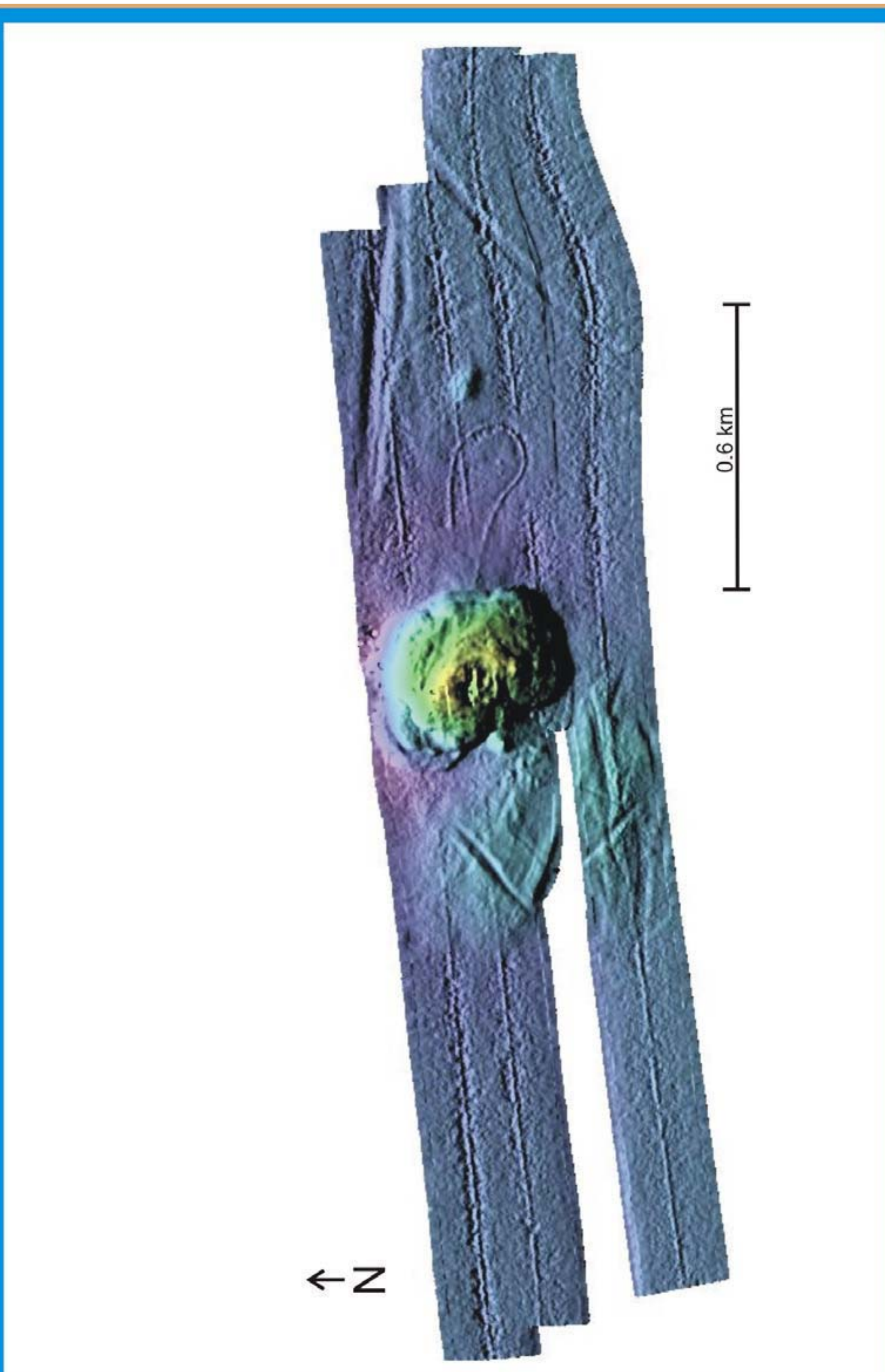

Figure 5.6: Kopanoar Mud Volcano (water depth = 60 m)
(Iamge courtesy Jason Bartlett, CHS)

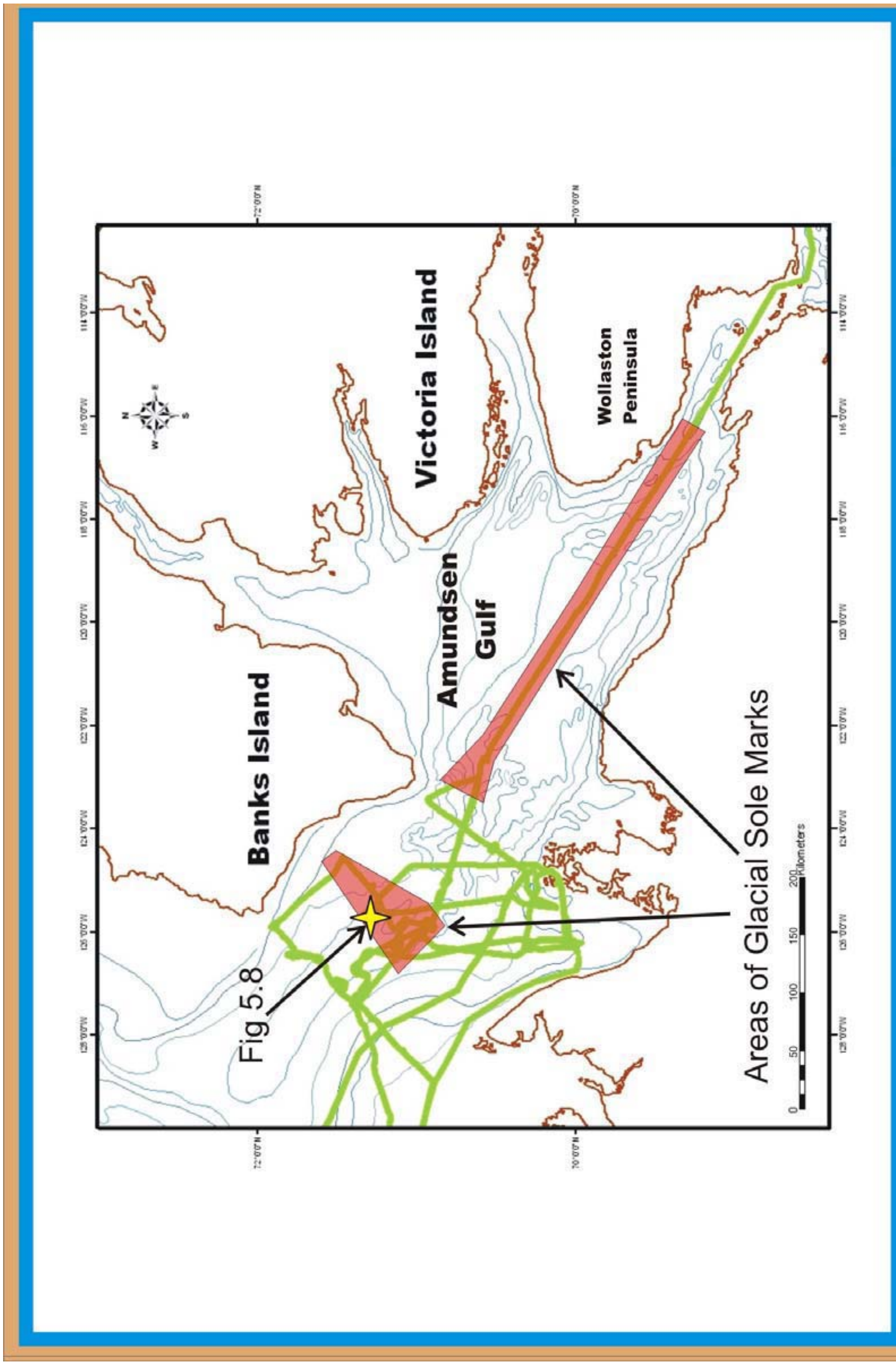

Figure 5.7: Areas of glacial sole marks

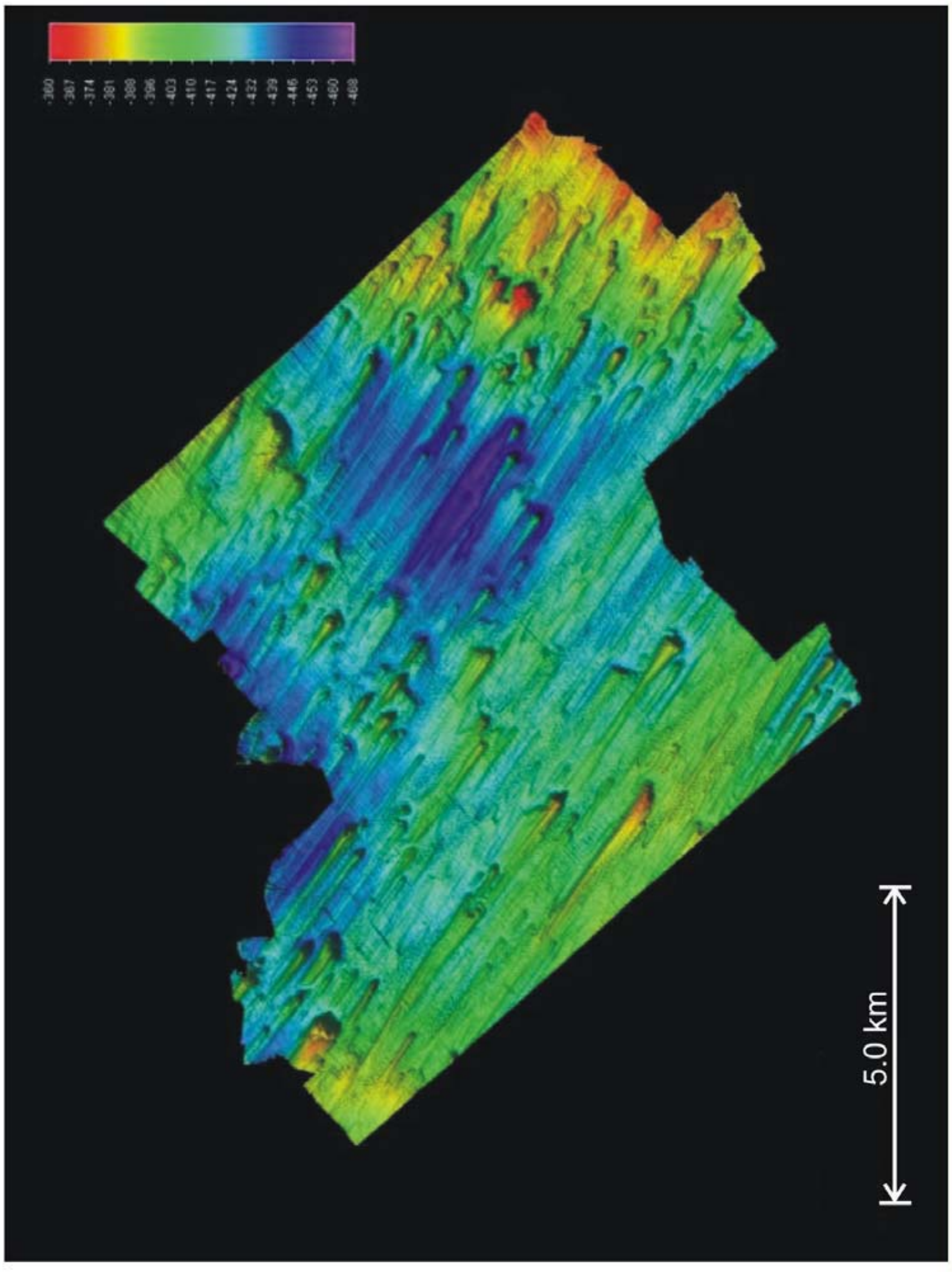

Figure 5.8: Multibeam echosounder image of glacial sole marks in the Amundsen Gulf.
(Image courtesy Jason Bartlett, CHS)

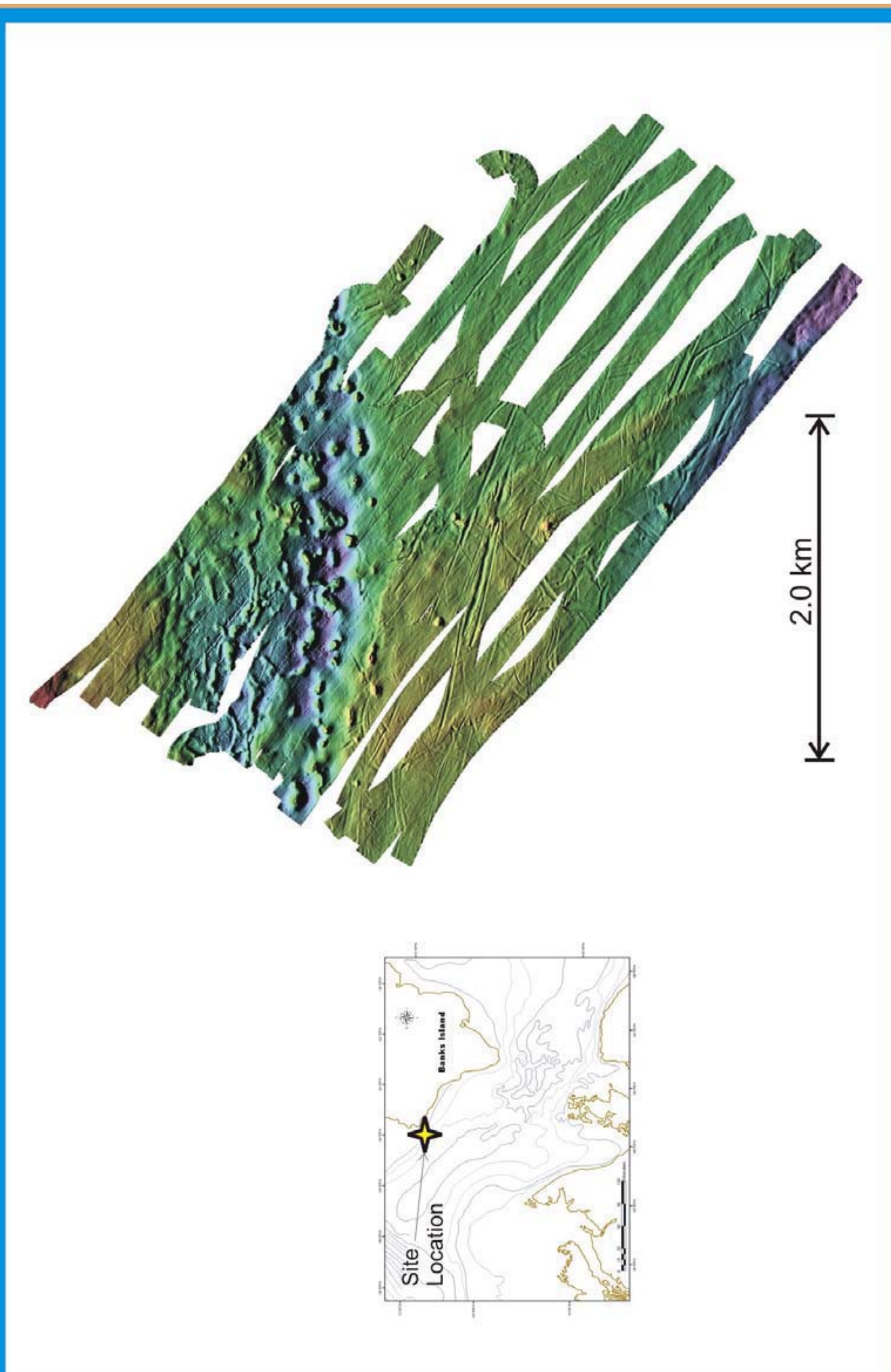

Figure 5.9: Multibeam echosounder image of drumlin-like features in the Amundsen Gulf near Sachs Harbour. (Image courtesy Jason Bartlett, CHS)

about 46m water depth and appear on the multibeam image as seafloor mounds (Figure 5.9). Most of the features are concentrated in an East –West trending band across the top of the multibeam site. There are also several E – W trending non-linear ridges observed just to the North of the main band of mounds. It is interpreted that these features originated from the deposition of sediment caused by glacial run-off, or they could be the result of post-depositional erosion of glacial moraines.

5.1.4 Deep Water Ice Scours

Ice scours with irregular paths have been observed to water depths of 400 m (Figure 5.10). Present day sea-ice pressure ridge keels scour to water depths of 55 m on the Beaufort Shelf. Low stand late Pleistocene sea level would have allowed pressure ridge keels to generate ice scours to approximately 175 m. This low sea level cannot account for the ice scours observed from 175 m to 400 m water depth. These deep water events may be the product of iceberg calving from the retreating Amundsen Gulf ice stream/sheet.

5.2 Deep Water Geotechnical and Geophysical Data

The use of the CCGS Amundsen for 2004-804 allowed for the collection of both geotechnical and geophysical data in much deeper water depths than are possible with other vessels in the Arctic Region. The Amundsen proved to be an excellent research platform, capable of working in rough weather and sea ice.

Piston cores and box cores were collected in various water depths in the Beaufort Sea, Amundsen Gulf, and the Northwest Passage ranging from 36m to 1154m water depth. Geophysical data was collected in water depths as deep as 1460m on the Beaufort Slope. This deep water geophysical and geotechnical data compliments the extensive dataset collected in shallower water on the Beaufort Shelf onboard the CCGS Nahidik.

5.3 Evaluation of the Performance of Geophysical Equipment in Ice

As discussed in Section 4.2, sea ice adversely affected the quality of the geophysical data collected by the Amundsen. OMG personnel observed that the vessel's speed has a direct effect on how well the system can track the sea floor while moving through thin to moderate sea ice. A slower survey speed decreases the amount of noise generated as the ship's hull strikes sea ice. OMG has also observed that keeping tight tracking gates and narrowing the angular coverage sector will slightly improve the bottom tracking as well. The Knudsen 320R sub-bottom profiler proved to be a bit more robust that the EM 300 as it was able to collect usable data in most ice conditions.

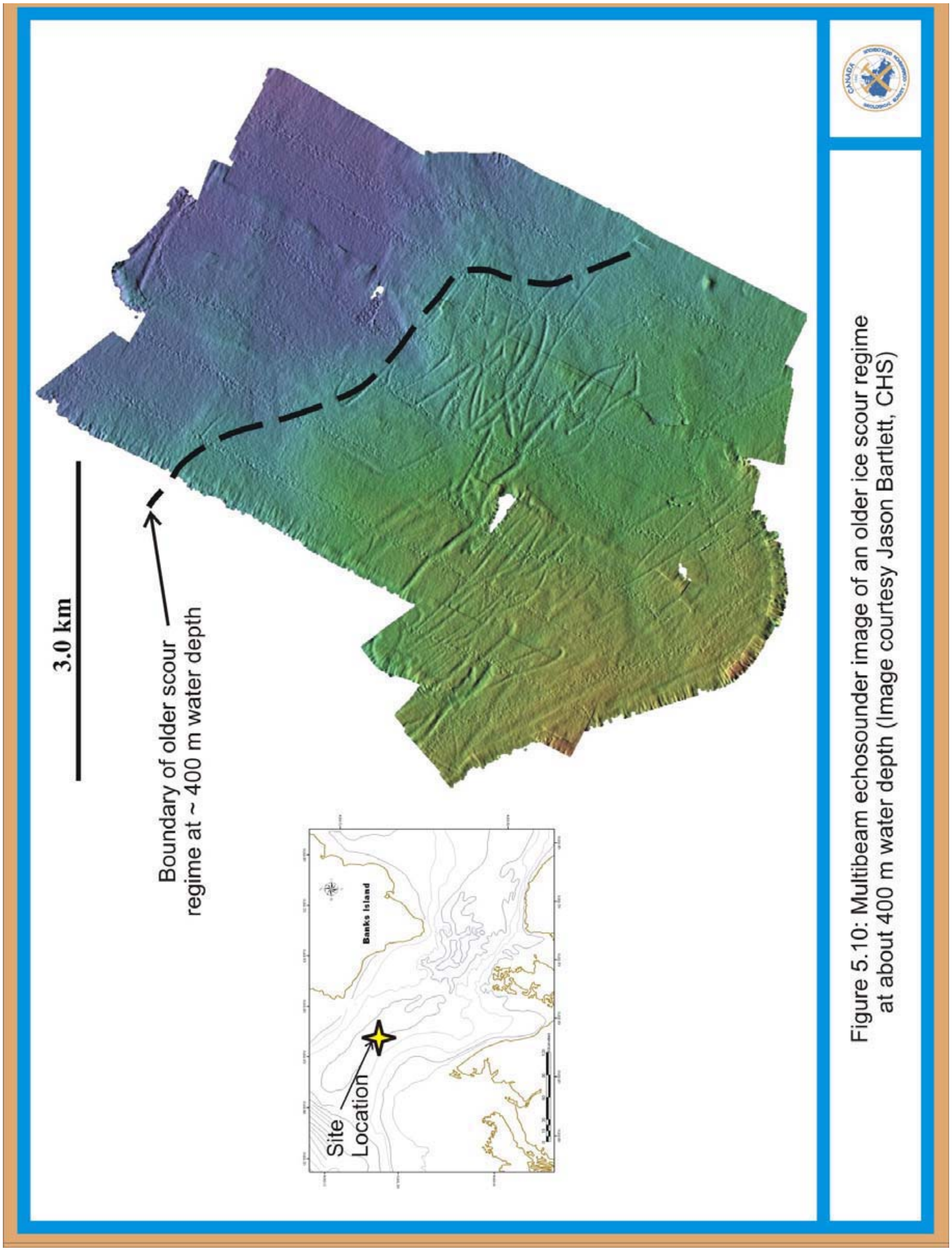

Figure 5.10: Multibeam echosounder image of an older ice scour regime at about 400 m water depth (Image courtesy Jason Bartlett, CHS)

Very thick sea ice causes the vessel to ride up onto the ice in order to break it, which brings the EM 300 and Knudsen 320R transducers to come in contact with the ice and/or highly aerated water. This situation led to unusable geophysical data from both the sub-bottom profiler and the multibeam echosounder. It is not an option to decrease the speed of the vessel in these ice conditions as the ship requires momentum to break the ice.

6.0 RECOMMENDATIONS

- Acquire more multibeam data in the Amundsen Gulf to determine the extent of ice sheet related features
- Acquire sediment cores from the slope failure feature. Also acquire additional multibeam and sub-bottom profiler data in order to identify the failure mechanism and the age of the feature
- Complete multibeam and sub-bottom profiler coverage over piston core sites
- Complete multibeam and sub-bottom profiler coverage over seabed features imaged during 2004-804

Tables 6.1 and 6.2 summarize the data that was collected over seabed features and core sites. These tables are to assist the planning of future field work.

Table 6.1 - Multibeam / Sub-bottom and Core Data at Seabed Features

Feature	Multibeam/SBP	Box Core	Piston Core	Comments
Glacial Sole Marks	Yes	Yes (021BC and 022BC)	No	
Ice Scours (400m)	Yes	Yes (027BC)	No	
Sachs Harbor Mounds	Yes, but incomplete	Yes (025BC)	No	
Slope Failure Feature (Slump)	Yes (feature not completely mapped)	Nearby (006BC)	Nearby (013PC)	013PC and 006BC about 4.5km east of slump
Kopanoar Mud Volcano	Yes	Yes (032BC, 033BC)	No	Two BC's, one on crest, one on adjacent seabed

Table 6.2 - Multibeam / Sub-bottom Data at Piston Core Sites

Piston Core	Multibeam/SBP Survey Block	Comments
050PC / 9	No	Lancaster Sound (attempted survey; 1.5 lines)
044PC / 124	No	Regional survey line over site
042PC / 250	Yes	Complete Survey
019PC / 650	No	Regional survey line over site
005PC / 711	Nearby	Near multibeam block of deep scour (71 m WD)
015PC / 750	No	Regional survey line over site
013PC / 803	No	Near slump multibeam block (4.5 km)
008PC / 850	Yes	Complete Survey

7.0 References

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Sharpe, D.R., 1992. Glacial Sediments and Landforms, Southern Victoria Island, N.W.T., Canada. Ph.D. Thesis, University of Ottawa.

APPENDIX 1 - 2004-804 NARRATIVE

2004-804 NARRATIVE

CASES Leg 8
Robbie Bennett- GSC Coring Technician onboard June 23rd to August 4th

All times Mountain Daylight Time (MDT)

Monday, June 21, 2004
- Leave Halifax, load van and travel from Halifax to Rimouski

Tuesday, June 22, 2004
- travel from Rimouski to Quebec City
- drop off equipment to be loaded onto charter flight to Inuvik

Wednesday, June 23, 2004
- travel from Quebec City to CCGS Amundsen

Thursday, June 24, 2004
- attended meeting with all scientific staff (Chief Scientist- Louis Fortier)
- searched the Amundsen for coring equipment
- unloaded helicopter
- went over potential core sites with André Rochon

Friday, June 25, 2004
- tried to isolate missing core equipment

Saturday, June 26, 2004
- searched for missing core equipment
- met with ship's engineers on the construction of replacement parts
- disabled tilt switch on pinger
- box core 2004-804-001BC

Sunday, June 27, 2004
- tried to isolate missing core equipment
- cleaned couplings and core cutter
- partially assembled the trigger weight core
- box core 2004-804-002BC

Monday, June 28, 2004
- lifted core barrels out of the hold with help from the crew
- cleaned inside and outside of core barrels
- cleaned inside and outside of core head
- surface samples collected at CASES station 703
- 50ml drifting sediment trap sample collected at CASES station 708

Tuesday, June 29, 2004
- tested replacement parts made by the ship's engineer
- prepared some of the rigging for the piston corer and trigger weight corer
- meeting with André Rochon, Dave Scott and Jacques Claveau (Bosun) on how to launch the corer

Wednesday, June 30, 2004
- continued preparation for the first piston core which is planned for tomorrow morning (July 1st)

Thursday, July 01, 2004
- box core 2004-804-003BC
- collected the first piston core 2004-804 005PC
    - apparent penetration 7m
    - core length 3m
    - no trigger weight core, may have landed on its side
    - piston appears to have jammed about 3m up the barrel, could be due to the gasket which may have been too tight and caused the jam
    - system worked well except for the trigger weight core and the piston

Friday, July 02, 2004
- box core 2004-804-006BC
- cleaned up piston
- got equipment ready for the next core

Saturday, July 3, 2004
- collected second piston core 2004-804 008PC
    - apparent penetration 7m
    - core length 3m
    - trigger weight core about 40cm
    - piston stopped about 3m up the barrel, maybe due to weak shear pins which caused the piston to split early
    - system worked well except for the trigger weight core and the piston
    - tried to use the pinger on this core but was unable to see the bottom and the numbers (ms) from the software did not agree with the cable out readings on the winch, will probably just use this system for box coring from now on.

Sunday, July 04, 2004
- cleaned up some equipment and prepared for the next piston core
- enabled tilt switch on pinger
- box core2004-804-009BC

- tested pinger again, worked better and was able to see the bottom, however this was intermittent and the problem has not been isolated yet, will continue to test.
- 50m deep plankton tow and 50ml drifting sediment trap samples collected at CASES station 906

Monday, July 05, 2004
- prepared for the next piston core
- box core 2004-804-010BC

Tuesday, July 06, 2004
- 50m deep plankton tow sample collected at CASES station 912
- box core 2004-804-011BC
- wrote up piston coring procedures for personnel on Leg 9, gave the file to Andre

Wednesday, July 7, 2004
- box core 2004-804-012BC
- discussed potential sites with André Rochon, Dave Scott, and Jason Bartlett

Thursday, July 8, 2004
- collected piston core 2004-804 013PC
    - 256m water depth
    - apparent penetration 7 meters
    - sample length 6 meters
    - corer worked well

Friday, July 9, 2004
- box core 2004-804-014BC
- tested pinger with short BNC cable, same intermittent problem with only seeing the bottom some of the time
- collected piston core 2004-804 015PC
    - 1100m water depth
    - apparent penetration 8 meters
    - sample length 6 meters
    - corer worked well

Saturday, July 10, 2004
- box core 2004-804-016BC

Sunday, July 11, 2004
- box core 2004-804-017BC

Monday, July 12, 2004
- box core 2004-804-018BC
- collected piston core 2004-804 019PC
    - 250m water depth
    - apparent penetration 8 meters
    - sample length 6.2 meters
    - corer worked well

Tuesday, July 13, 2004
- cleaned up piston core equipment
- built rack to store cores vertically
- 50m deep plankton tow sample collected at CASES station 650
- spoke with Bosun about better ways to launch the corer
- moved core head and barrels and strapped them down

Wednesday, July 14, 2004
- transited to fuel barge, no coring activity
- unloaded garbage onto barge

Thursday, July 15, 2004
Crew change- no coring activity. New Chief Scientist- Dave Scott

Friday, July 16, 2004
- grind piston to make larger opening to be used with cable termination
- clean up lab

Saturday, July 17, 2004
- 50m deep plankton tow and 50ml drifting sediment trap samples collected at CASES station 200
- box core 2004-804-020BC
- grind piston

Sunday, July 18, 2004
- box core 2004-804-021BC
- box core 2004-804-022BC
- cleaned up lab
- started the assembly of MSCL

Monday, July 19, 2004
- continued assembly of the MSCL
- box core 2004-804-023BC
- 50m deep plankton tow sample collected at CASES station 309
- safety drill

Tuesday, July 20, 2004
- 50ml drifting sediment trap sample collected at CASES station 312
- box core 2004-804-024BC
- continued assembly of the MSCL

Wednesday, July 21, 2004
- 40ml drifting sediment trap sample collected at CASES station 312
- box core 2004-804-025BC
- continued assembly of MSCL

Thursday, July 22, 2004
- box core 2004-804-026BC
- continued assembly of MSCL

Friday, July 23, 2004
- continued calibrating MSCL
- 50ml drifting sediment trap sample collected at CASES station 415
- box core 2004-804-027BC
- box core 2004-804-028BC
- box core 2004-804-029BC

Saturday, July 24, 2004
- box core 2004-804-030BC

Sunday, July 25, 2004
- box core 2004-804-031BC

Monday, July 26, 2004
- box core 2004-804-032BC on Kopanoar Mud Volcano crest
- box core 2004-804-033BC on Kopanoar Mud Volcano seafloor

Tuesday, July 27, 2004
- Ship transited to Tuk, no coring operations

Wednesday, July 28, 2004
- organized sample data and created sample database for all cores/water samples etc. collected during CASES Leg 8
- box core 2004-804-034BC

Thursday, July 29, 2004
- box core 2004-804-035BC

Friday, July 30, 2004
- box core 2004-804-036BC
- calculated distances between core sites for Leg 9 with André Rochon

Saturday, July 31, 2004
- box core 2004-804-037BC
- box core 2004-804-038BC
- box core 2004-804-039BC

Sunday, August 1, 2004
- setup piston corer
- box core 2004-804-040BC
- box core 2004-804-041BC
- collected piston core 2004-804 042PC
    - 193m water depth
    - apparent penetration 9 meters
    - sample length 7 meters
    - corer worked well

Monday, August 2, 2004
- CASES leg 8 scientific work complete, clean up lab and cabin

Tuesday, August 3, 2004
- clean up lab and cabin
- check and label all core samples

Wednesday, August 4, 2004
- Crew Change- GSC personnel, Robbie Bennett, departs CCGS Amundsen
- GSC personnel, Adam MacDonald, arrives on CCGS Amundsen

CASES Leg 9
Adam MacDonald- GSC Coring Technician onboard August 4th to August 27th

Thursday, August 5, 2004
- attended meeting with all scientific staff (Chief Scientist- André Rochon)
- unloaded helicopter

Friday, August 6, 2004
- prepare for piston coring and box coring

Saturday, August 7, 2004
- box core 2004-804-043BC

Sunday, August 8, 2004

- collected piston core 2004-804 044PC
    - 426m water depth
    - apparent penetration 9 meters
    - sample length 4.4 meters

Monday, August 9, 2004

- box core 2004-804-045BC
- calibrate and run tests on MSCL

Tuesday, August 10, 2004

- box core 2004-804-046BC
- further calibration and trial measurements on MSCL

Wednesday, August 11, 2004

- MSCL analysis of core samples begins

Thursday, August 12, 2004

- box core 2004-804-047BC
- collected piston core 2004-804 047PC
    - 115m water depth
    - apparent penetration 9 meters
    - sample length 0.5 meters
    - cable caught on core head shackle and did not allow piston to travel

Friday, August 13, 2004

- MSCL analysis of core samples

Saturday, August 13, 2004

- MSCL analysis of core samples

Sunday, August 14, 2004

- MSCL analysis of core samples

Monday, August 15, 2004

- MSCL analysis of core samples

Tuesday, August 16, 2004

- MSCL analysis of core samples

Wednesday, August 17, 2004

- MSCL analysis of core samples

Thursday, August 18, 2004
- box core 2004-804-048BC
- MSCL analysis of core samples

Friday, August 19, 2004
- box core 2004-804-049BC
- collected piston core 2004-804 049PC
    - 772m water depth
    - apparent penetration 950 meters
    - sample length 6 meters
    - corer worked well

Saturday, August 20, 2004
- MSCL analysis of core samples

Sunday, August 21, 2004
- MSCL analysis of core samples
- sub-sample core sediments
- check for core not run through MSCL

Monday, August 22, 2004
- sub-sample core sediments
- organize sample database and back-up MSCL data to CD ROM

Tuesday, August 23, 2004
- sub-sample core sediments
- disassembled and packed MSCL

Wednesday, August 24, 2004
- cleaned lab area and equipment
- secured core samples in refrigerated container

Thursday, August 25, 2004
- CCGS Amundsen arrives in Churchill, Manitoba
- cleaned lab in preparation for inspection by the Captain
- packed equipment in preparation for shipment
- loaded equipment to be shipped

Friday, August 26, 2004
- cleaned lab and cabin
- prepared for departure

Saturday, August 27, 2004
- GSC personnel, Adam MacDonald, departs CCGS Amundsen
- Fly from Churchill to Quebec City

Sunday, August 28, 2004
- Fly from Quebec City to Halifax

APPENDIX 2 - 2004-804 SAMPLE INFORMATION

2004-804 - CASES 2004 Leg 8 and 9 (June 23rd to August 24)

Calendar Date	Time MTN	Station No.	GSC #	CASES Sample #	Latitude	Longitude	Water Depth (m)	Sampling Device	Sample Type	Length (cm)	Apparent Penetration
26-Jun-04	0:43	600	1A	2004-804-600A	71,37.48N	130, 34.24W	330	boxcore	Push core	38	
"	"	"	1B	2004-804-600B	"	"	"	"	"	31.5	
"	"	"		2004-804-600	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
27-Jun-04	18:09	609	2A	2004-804-609A	70, 56.58N	130, 31.38W	44	boxcore	Push core	34	
"	"	"	2B	2004-804-609B	"	"	"	"	"	34.5	
"	"	"		2004-804-609	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
"	"	"		"	"	"	"	"	Loose shell	~30	
28-Jun-04	8:17	703		2004-804-703	70, 56.58N	130, 31.38W	1154	boxcore	~surface (forams)	0-1	
28-Jun-04	8:17	708		2004-804-708	70, 56.58N	130, 31.38W	1154	-	Drifting sediment trap	~50 ml	
1-Jul-04	8:00	709	3A	2004-804-709	70, 57.811N	133, 47.025W	87	boxcore	Push core	31	
"	"	"		"	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
1-Jul-04	19:45	711	4A	2004-804-711A	70, 49.427N	133, 48.199W	77	boxcore	Push core	32	
"	"	"	4B	2004-804-711B	"	"	"	"	"	32	
"	"	"	4C	2004-804-711C	"	"	"	"	"	29	
"	"	"		2004-804-711	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
1-Jul-04	19:45	711	-	2004-804-711TWC	70, 49.427N	133, 48.199W	77	TWC	EMPTY	-	-
"	"	"	5PC	2004-804-711PC	"	"	"	Piston	section C-D	0-9	~700 cm
"	"	"	5PC	"	"	"	"	"	section B-C	9-159	
"	"	"	5PC	"	"	"	"	"	section A-B	159-309	

"	"	"	5TWC	"	"	"	"	"	core cutter	-	
2-Jul-04	14:13	803	6A	2004-804-803A	70, 38.169N	135, 55.041W	237	boxcore	Push core	39	
"	"	"	6B	2004-804-803B	"	"	"	"	"	40	
"	"	"	6C	2004-804-803C	"	"	"	"	"	40	
"	"	"		2004-804-803	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
3-Jul-04	4:55	850	7A	2004-804-850A	70, 32.889N	137, 36.00W	1071	boxcore	Push core	38	
"	"	"	7B	2004-804-850B	"	"	"	"	"	38	
"	"	"		2004-804-850	"	"	"	"	Surface (Forams)	0-1	
"	"	"		2004-804-850	"	"	"	"	Surface (Dinos)	0-0.5	
3-Jul-04	7:45	850	8TWC	2004-804-850TWC	70, 32.922N	137, 35.95W	1054	Gravity	section 1	72	
"	"	"	8PC	2004-804-850PC	"	"	"	Piston	section B-C	0-150	600 cm
"	"	"	8PC	"	"	"	"	"	section A-B	150-300	
"	"	"	8PC	"	"	"	"	"	core catcher	-	
4-Jul-04	16:12	906		2004-804-906	70, 01.2N	138, 35.58W	281	-	Plankton tow	50m deep	
4-Jul-04	13:31	906		2004-804-906	70, 01.2N	138, 35.58W	281	-	Drifting sediment trap	~50 ml	
4-Jul-04	17:00	906	9A	2004-804-906A	70, 01.145N	138, 35.817W	272	boxcore	Push core	39	
"	"	"	9B		"	"	"	"	"	39.5	
"	"	"		2004-804-906	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
5-Jul-04	9:45	909	10A	2004-804-909A	69, 45.16N	138, 16.296W	169	boxcore	Push core	40	
"	"	"	10B	2004-804-909B	"	"	"	"	"	41	
"	"	"		2004-804-909	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
6-Jul-04	16:12	912		2004-804-912	69, 29.29N	137, 56.43W	54	-	Plankton tow	50m deep	
6-Jul-04	4:40	912	11A	2004-804-912A	69, 29.25N	137, 56.43W	54	boxcore	Push core	43	

"	"	"	11B	2004-804-912B	"	"	"		"	40	
"	"	"		2004-804-912	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
7-Jul-04	19:25	809	12A	2004-804-809A	70. 05.7N	135, 20.48W	42	boxcore	Push core	39	
"	"	"	12B	2004-804-809B	"	"	"	"	"	39	
"	"	"		2004-804-809	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
8-Jul-04	22:44	803		2004-804-803	70, 38.615N	135, 52.437W	251	-	Plankton tow	50m deep	
8-Jul-04	10:50	803	13TWC	2004-804-803TWC	70, 37.976N	135, 52.815W	218	Gravity	section 1	114	
"	"	"	13PC	2004-804-803PC	"	"	"	Piston	section E-F	0-17	650 cm
"	"	"	13PC	"	"	"	"	"	section D-E	17-167	
"	"	"	13PC	"	"	"	"	"	section C-D	167-317	
"	"	"	13PC	"	"	"	"	"	section B-C	317-467	
"	"	"	13PC	"	"	"	"	"	section A-B	467-617	
9-Jul-04	8:17	906		2004-804-906	70, 37.976N	135, 52.815W	218	-	Drifting sediment trap	~50 ml	
9-Jul-04	14:40	750	14A	2004-804-750A	71, 20.753N	134, 08.609W	1087	boxcore	Push core	39	
"	"	"	14B	2004-804-750B	"	"	"	"	"	39	
"	"	"		2004-804-750	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
9-Jul-04	16:10	750	15TWC	2004-804-750TWC	71, 20.45N	134, 06.20W	1087	Gravity	section 1	39	
"	"	"	15PC	2004-804-750PC	"	"	"	Piston	section D-E	0-136	900 cm
"	"	"	15PC	"	"	"	"	"	section C-D	136-286	
"	"	"	15PC	"	"	"	"	"	section B-C	286-436	
"	"	"	15PC	"	"	"	"	"	section A-B	436-586	
"	"	"	15PC	"	"	"	"	"	core catcher	-	
"	"	"	15PC	"	"	"	"	"	core cutter	-	
10-Jul-04	10:00	712	16A	2004-804-712A	70, 41.37N	133, 40.84W	70	boxcore	Push core	38	
"	"	"	16B	2004-804-712B	"	"	"	"	"	36	

"	"	"		2004-804-712	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
11-Jul-04	13:45	718		2004-804-718	70, 10.37N	133, 32.54W	45	-	Plankton tow	40m deep	
11-Jul-04	14:12	718	17A	2004-804-718A	70, 10.196N	133, 32.047W	45	boxcore	Push core	44	
"	"	"	17B	2004-804-718B	"	"	"	"	"	43	
"	"	"		2004-804-718	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
12-Jul-04	18:06	650	18A	2004-804-650A	71, 18.558N	131, 37.148W	241	boxcore	Push core	38	
"	"	"	18B	2004-804-650B	"	"	"	"	"	38	
"	"	"		2004-804-650	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
12-Jul-04	19:10	650	19TWC	2004-804-650TWC	71, 18.52N	131, 36.98W	246	Gravity	section 1	83	
"	"	"	19PC	2004-804-650PC	"	"	"	Piston	section E-F	0-15	800 cm
"	"	"	19PC	"	"	"	"	"	E*	-	
"	"	"	19PC	"	"	"	"	"	section D-E	15-165	
"	"	"	19PC	"	"	"	"	"	section C-D	165-315	
"	"	"	19PC	"	"	"	"	"	section B-C	315-465	
"	"	"	19PC	"	"	"	"	"	Section A-B	465-615	
13-Jul-04	7:50	650		2004-804-650	71, 19.05N	131, 36.98W	255	-	Plankton tow	50m deep	
17-Jul-04	5:07	200		2004-804-200	70, 02.75N	126, 17.81W	228	-	Drifting sediment trap	~50 ml	
17-Jul-04	0:07	200		2004-804-200	70, 02.75N	126, 17.81W	228	-	Plankton tow	50m deep	
17-Jul-04	6:55	200	20A	2004-804-200A	70, 02.7N	126, 17.8W	236	boxcore	Push core	43.5	
"	"	"	20B	2004-804-200B	"	"	"	"	"	42	
"	"	"		2004-804-200	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
18-Jul-04	6:39	118	21A	2004-804-118A	70, 56.64N	125,51.02W	388	boxcore	Push core	34	

"	"	"	21B	2004-804-118B	"	"	"	"	"	32	
"	"	"		2004-804-118	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
18-Jul-04	12:33	309	22A	2004-804-309A	71, 07.52N	125, 50.01W	397	boxcore	Push core	41	
"	"	"	22B	2004-804-309B	"	"	"	"	"	44	
"	"	"		2004-804-309	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
19-Jul-04	8:25	309		2004-804-309	71, 07.52N	125, 49.75W	314	-	Plankton tow	50m deep	
19-Jul-04	22:00	312	23A	2004-804-312A	71, 18.115N	125, 11.534W	307	boxcore	Push core	31	
"	"	"	23B	2004-804-312B	"	"	"	"	"	30	
"	"	"		2004-804-312	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
20-Jul-04	5:07	312		2004-804-312	71, 18.115N	125, 11.534W	307	-	Drifting sediment trap	~50 ml	
20-Jul-04	8:28	315	24A	2004-804-315A	71, 29.155N	124, 32.583W	224	boxcore	Push core	33	
"	"	"	24B	2004-804-315B	"	"	"	"	"	31	
"	"	"		2004-804-315	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
21-Jul-04	4:50	415		2004-804-415	71, 53.90N	125, 52.21W	46	-	Plankton tow	40m deep	
21-Jul-04	12:15	415	25A	2004-804-415A	71, 54.455N	125, 52.092W	56	boxcore	Push core	24	
"	"	"	25B	2004-804-415B	"	"	"	"	"	27	
"	"	"		2004-804-415	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
22-Jul-04	2:15	412	26A	2004-804-412A	71, 41.992N	126, 28.649W	390	boxcore	Push core	24	
"	"	"	26B	2004-804-412B	"	"	"	"	"	27	
"	"	"		2004-804-412	"	"	"	"	Surface (Forams)	0-1	

"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
23-Jul-04	4:50	415		2004-804-409	71, 30.53N	127, 03.62W	383	-	Plankton tow	50m deep	
23-Jul-04	17:40	409	27A	2004-804-409A	71, 30.70N	127, 05.53W	387	boxcore	Push core	35	
"	"	"	27B	2004-804-409B	"	"	"	"	"	37	
"	"	"		2004-804-409	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
23-Jul-04	17:40	406	28A	2004-804-406A	71, 18.66N	127, 41.91W	179	boxcore	Push core	35	
"	"	"	29A	2004-804-406B	71, 18.68N	127, 41.87W	178	"	"	35	
"	"	"		2004-804-406	71, 18.66N	127, 41.91W	179	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
24-Jul-04	23:09	403	30A	2004-804-403A	71, 06.777N	128, 18.302W	59	boxcore	Push core	31	
"	"	"	30B	2004-804-403B	"	"	"	"	"	31	
"	"	"		2004-804-403	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
25-Jul-04	10:54	400	31A	2004-804-400A	70, 54.991N	128, 55.987W	36	boxcore	Push core	28	
"	"	"	31B	2004-804-400B	"	"	"	"	"	30	
"	"	"		2004-804-400	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
26-Jul-04	11:34	805	32A	2004-804-805A	70, 23.405N	135, 25.178W	36	boxcore	Push core	28	
"	"	"	32B	2004-804-805B	"	"	"	"	"	30	
"	"	"		2004-804-805-1	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
26-Jul-04	11:57	805	33A	2004-804-805C	70, 23.571N	135, 25.214W	66	boxcore	Push core	28	
"	"	"	33B	2004-804-805D	"	"	"	"	"	30	
"	"	"		2004-804-805-2	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	

28-Jul-04	19:50	124	34A	2004-804-124A	71, 23.368N	126, 43.112W	442	boxcore	Push core	38	
"	"	"	34B	2004-804-124B	"	"	"	"	"	37	
"	"	"		2004-804-124	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-0.5	
29-Jul-04	13:23	115	35A	2004-804-115A	70, 50.910N	125, 03.010W	352	boxcore	Push core	17	
"	"	"	35B	2004-804-115B	"	"	"	"	"	17	
"	"	"		2004-804-115	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
30-Jul-04	9:41	109	36A	2004-804-109A	70, 39.600N	123, 25.824W	569	boxcore	Push core	38	
"		"	36B	2004-804-109B	"	"	"	"	"	39	
"	"	"		2004-804-109	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
31-Jul-04	2:59	215	37A	2004-804-215A	70, 58.450N	123, 24.900W	297	boxcore	Push core	21	
"		"	37B	2004-804-215B	"	"	"	"	"	26	
"	"	"		2004-804-215	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
31-Jul-04	14:14	212	38A	2004-804-212A	70, 45.429N	123, 53.429W	430	boxcore	Push core	35	
"		"	38B	2004-804-212B	"	"	"	"	"	32	
"	"	"		2004-804-212	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
31-Jul-04	22:32	209	39A	2004-804-209A	70, 32.319N	124, 21.95W	241	boxcore	Push core	16	
"		"	39B	2004-804-209B	"	"	"	"	"	13	
"	"	"		2004-804-209	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
1-Aug-04	6:17	206		2004-804-206	70, 19.28N	124, 50.69W	93	-	Plankton tow	50m deep	

1-Aug-04	14:49	206	40A	2004-804-206A	70, 19.248N	124, 50.320W	95	boxcore	Push core	35	
"		"	40B	2004-804-206B	"	"	"	"	"	36	
"	"	"		2004-804-206	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
1-Aug-04	0:08	250	41A	2004-804-250A	70, 27.095N	125, 25.386W	193	boxcore	Push core	37	
"		"	41B	2004-804-250B	"	"	"	"	"	35	
"	"	"		2004-804-250	"	"	"	"	Surface (Forams)	0-1	
"	"	"			"	"	"	"	Surface (Dinos)	0-0.5	
1-Aug-04	1:28	250	42TWC	2004-804-250TWC	70, 27.079N	125, 23.562W	193	TWC	section 1	108	150 cm
"	"	"	42PC	2004-804-250PC	"	"	"	Piston	section E-F	0-64	900 cm
"	"	"	42PC	"	"	"	"	"	section D-E	64-214	
"	"	"	42PC	"	"	"	"	"	section C-D	214-364	
"	"	"	42PC	"	"	"	"	"	section B-C	364-514	
"	"	"	42PC	"	"	"	"	"	Section A-B	514-664	
"	"	"	42PC	"	"	"	"	"	core catcher	-	
"	"	"	42PC	"	"	"	"	"	core cutter	-	
7-Aug-04	6:45	200	43A	2004-804-200	70, 02.70N	126, 17.14W	236	boxcore	pushcore	38	
"	"	"	43B	"	"	"	"	"	"	38	
									Surface sample	20cc's	
8-Aug-04	6:45	124	44PC	2004-804-124	71, 24.8N	126, 46.1W	426	Piston	section C-D	0-144	900
"	"	"	44PC	"	"	"	"	"	section B-C	144-295	
"	"	"	44PC	"	"	"	"	"	Section A-B	295-442	
"	"	"	44PC	"	"	"	"	"	core catcher		
"	"	"	44PC	"	"	"	"	"	core cutter		
"	"	"	44TWC	"	"	"	"	TWC	Section A-B	0-47	150
9-Aug-04	10:17	112	45A	2004-804-112	70, 45.2N	124, 13.9W	511	boxcore	Pushcore	37	
"	"	"	45B	"	"	"	"	"	"	38	
"	"	"		"	"	"	"	"	Surface (Forams)	0-1	
"	"	"		"	"	"	"	"	Surface (Dinos)	0-1	

10-Aug-04	16:30	106	46A	2004-804-106	70, 36.0N	122, 37.8W	544	boxcore	pushcore	39	
"	"	"	46B	"	"	"	"	"	pushcore	39	
"	"	"		"	"	"	"	"	surface (forams)	0-1	
"	"	"		"	"	"	"	“	surface (dinos)	0-1	
12-Aug-04	9:56	2	47PC	2004-804-002	68, 59.9N	106, 35.1W	115	Piston	section A-B	0-52	
"	"	"	47TWC	"	"	"	"	TWC		0-71	
"	"	"	48A	"	"	"	"	boxcore	pushcore	42	
"	"	"	48B	"	"	"	"	“	pushcore	42	
"	"	"		"	"	"	"	“	surface (forams)		
"	"	"		"	"	"	"	“	surface (dinos)		
18-Aug-04	10:15	7	49A	2004-804-007	74, 16.9N	085, 36.1W	534	boxcore	pushcore	42	
"	"	"	49B	"	"	"	"	"	pushcore	44	
"	"	"		"	"	"	"	“	surface (forams)		
"	"	"		"	"	"	"	“	surface (dinos)		
19-Aug-04	7:48	9	50PC	2004-804-009	74, 11.2N	81, 11.7W	772	Piston	section D-E	0-150	
"	"	"	50PC	"	"	"	"	"	section C-D	150-300	
"	"	"	50PC	"	"	"	"	"	section B-C	300-447	
"	"	"	50PC	"	"	"	"	"	section A-B	447-597	
"	"	"	50TWC	"	"	"	"	TWC	section A-B	0	
"	"	"	51A	"	"	"	"	boxcore	pushcore	38	
"	"	"	51B	"	"	"	"	"	pushcore	38	
"	"	"		"	"	"	"	“	surface (forams)		
"	"	"		"	"	"	"	“	surface (dinos)		

APPENDIX 3 – 2004-804 SUB-BOTTOM PROFILES OVER PISTON CORE SITES

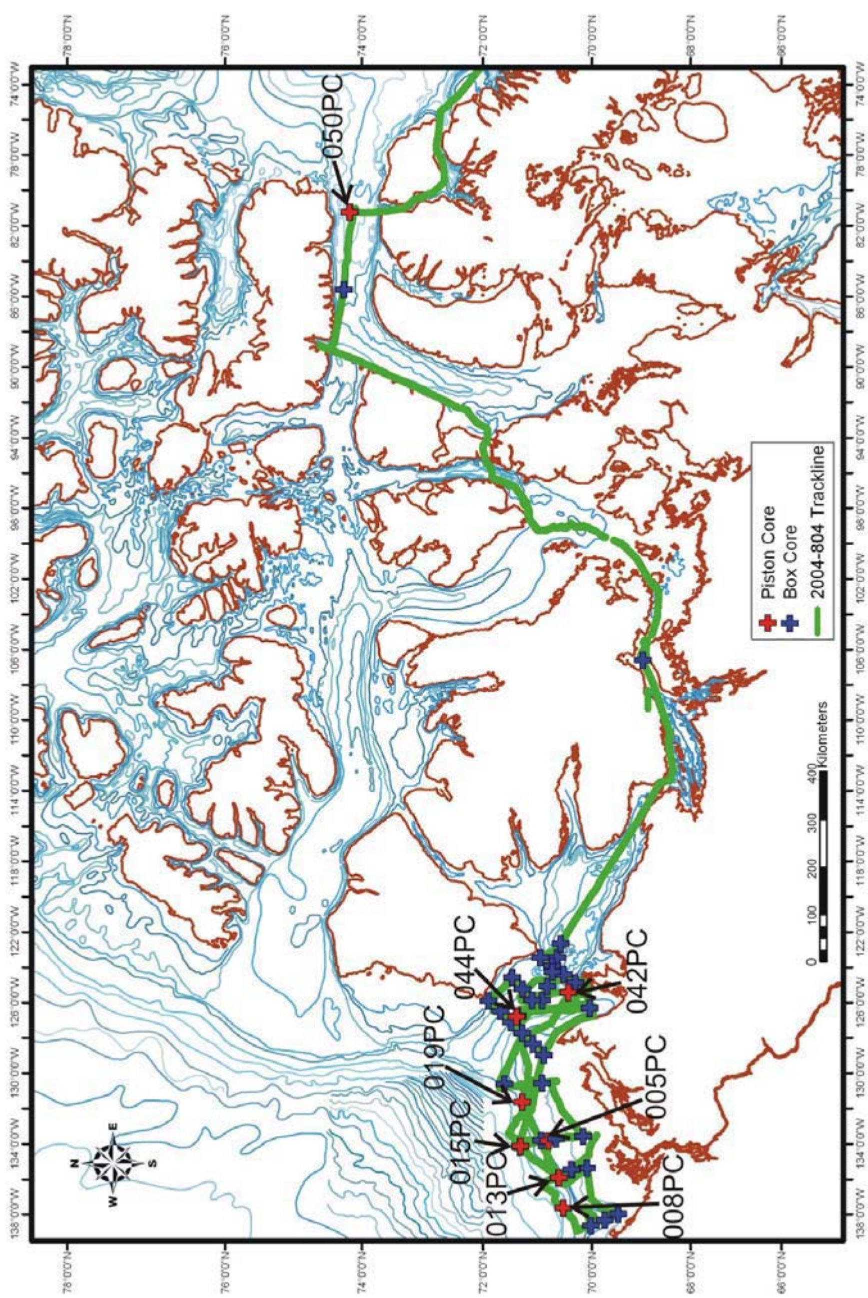

Figure A3.1: 2004-804 piston core locations

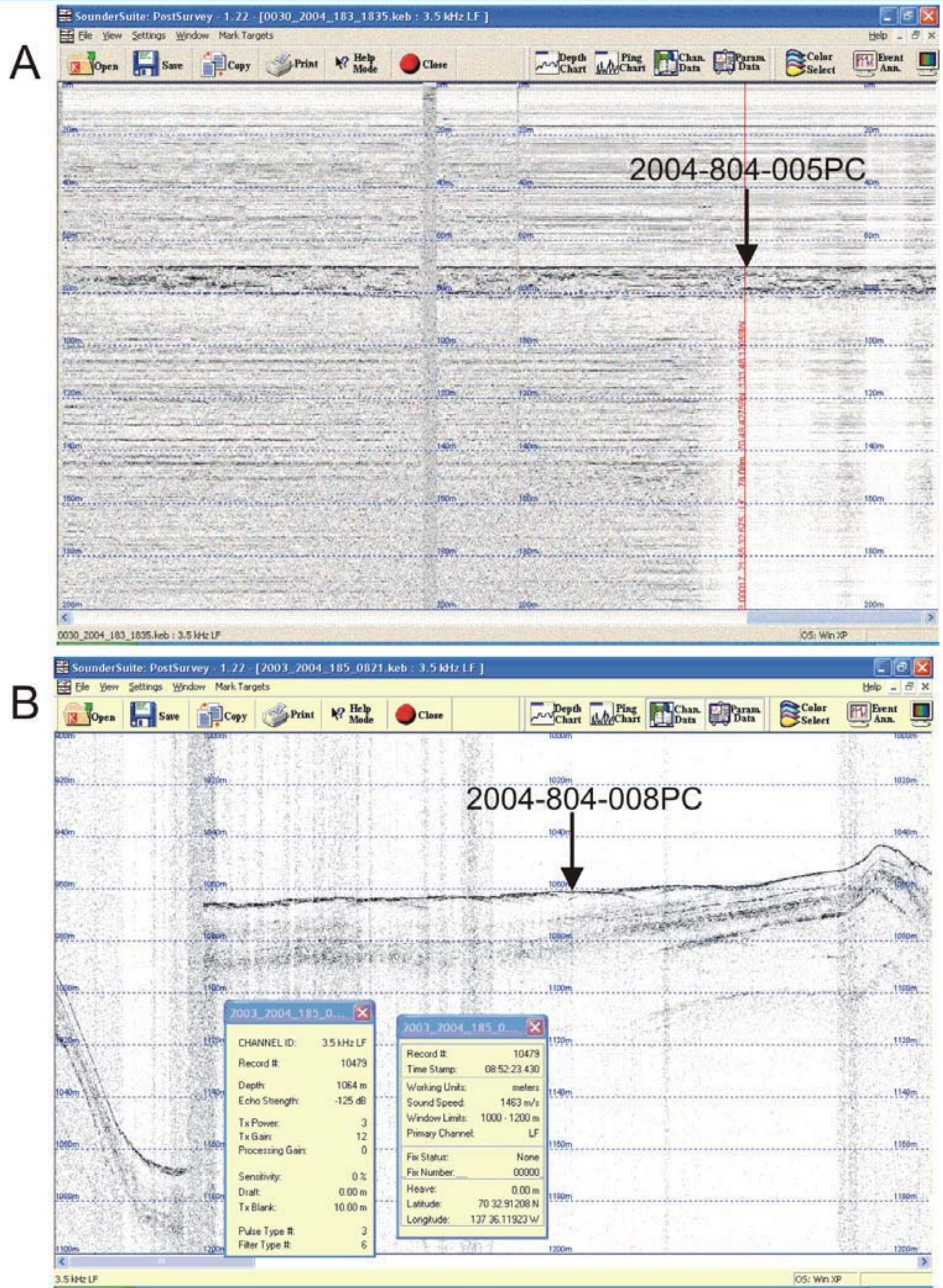

Figure A3.2: Sub-bottom profiler records of piston core sites:
A) site 005PC; B) site 008PC

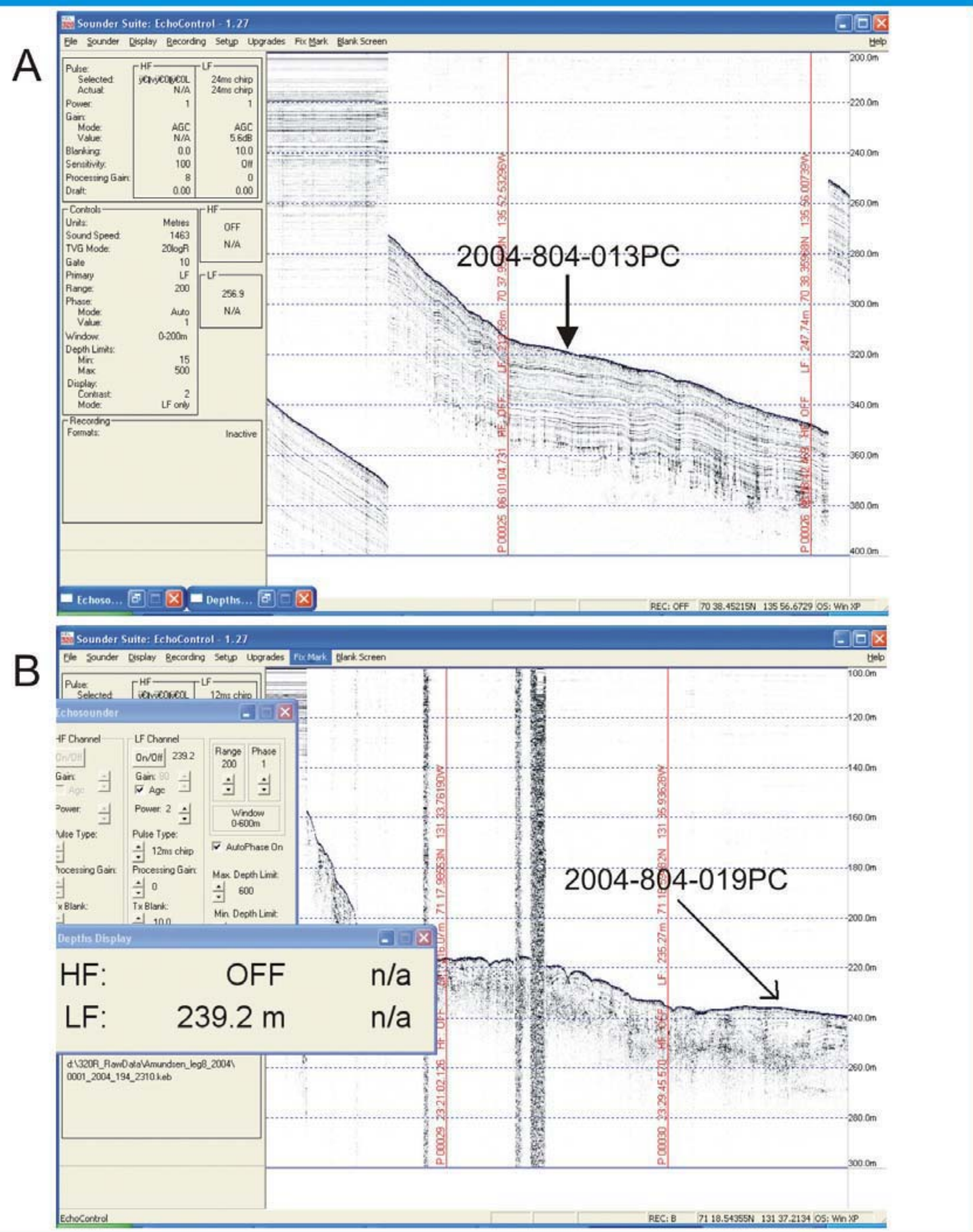

Figure A3.3: Sub-bottom profiler records of piston core sites:
A) site 013PC; B) site 019PC

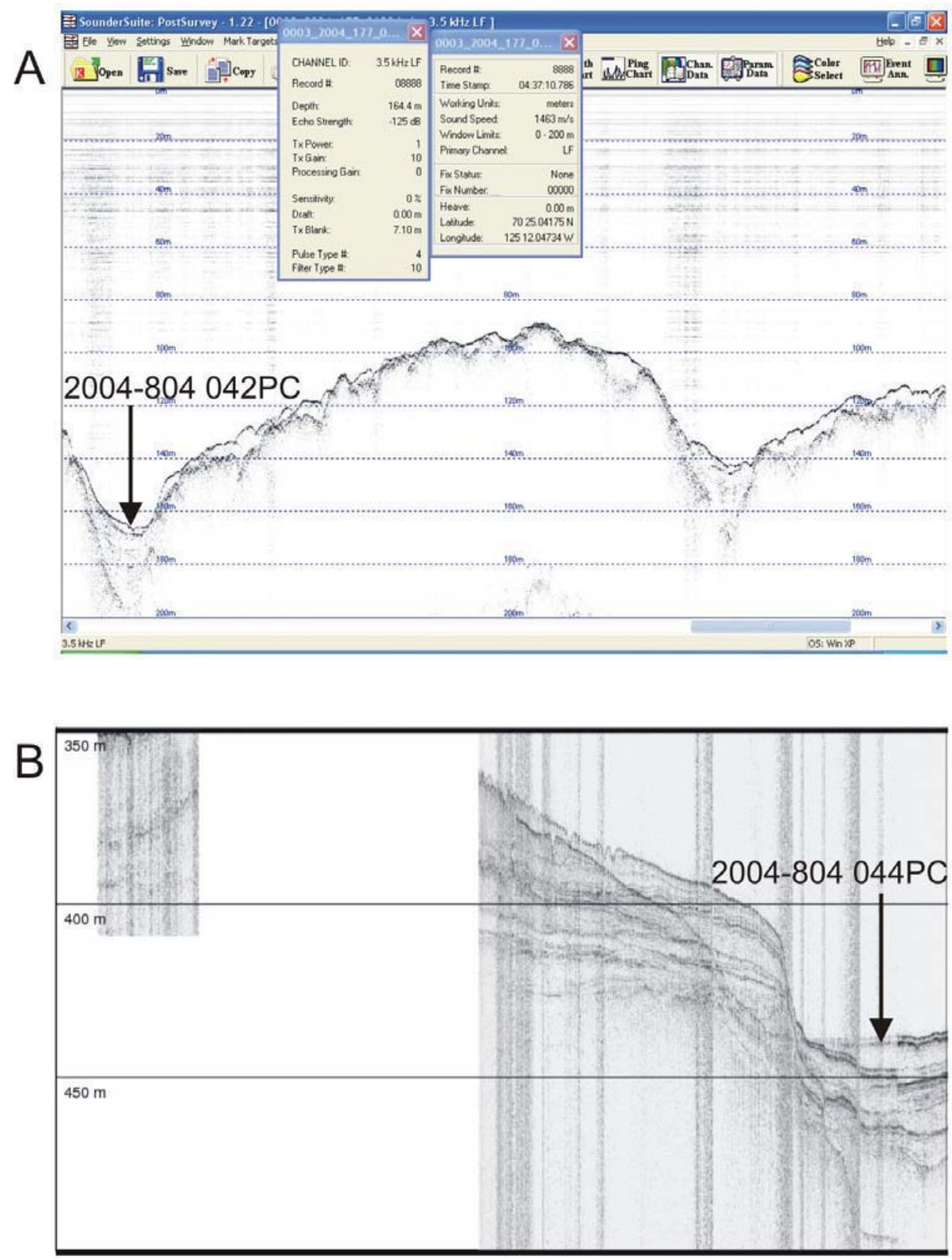

Figure A3.4: Sub-bottom profiler records of piston core sites:
A) site 042PC; B) site 044PC

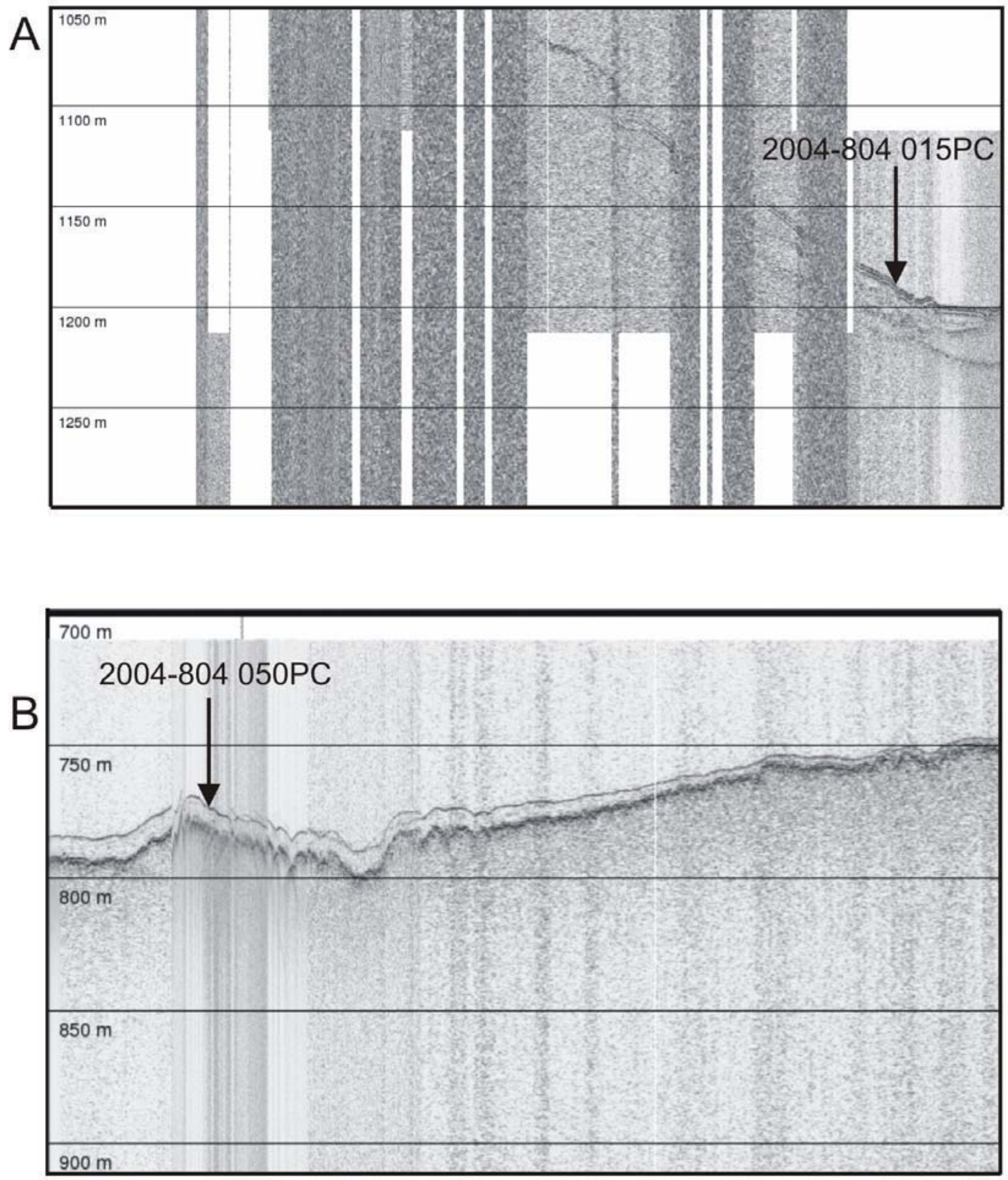

Figure A3.5: Sub-bottom profiler records of piston core sites:
A) site 015PC; B) site 050PC

APPENDIX 4 – 2004-804 PISTON CORE DESCRIPTION SHEETS

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 711	Geographic Location: Kugmallit Beaufort Sea, Channel	Water Depth: 77 m Total Length: 299 cm
Core Barrel Type: 1005 PC Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 49, 427 N Longitude: 133° 48, 199 W	SYMBOL LEGEND	
Described by: T Schell	Page 1 of 3	

SYMBOL LEGEND: mottling bioturb. ; laminae ; layer with mottl ; mud clasts ; shell frag.

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0		v. soupy					0-1 f, d, D
				5Y 4/1	Olive grey mud Abundant bioturbation mottling		10-11 f, d, D
							20-21 f, d, D
							30-31 f, d, D
38					black horizon/laminae		40-41 f, d, D
50							50-51 f, d, D
54					black laminae		
57					black laminae		
60					swirled, disturbed laminae mudclasts of light beige mud. shell fragment, crushed.		60-61 f, d, D
69							70-71 f, d, D
74							
					faintly laminated, mottled - black specks		80-81 f, d, D
							90-91 f, d, D
100							100-101 f, d, D

NOTES:
* entire core was subsampled for paleomag. by u-channel minicore
* f = forams, d = dinos, D = Diatoms subsamples

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 711 PC	Geographic Location: Amundsen Gulf	Water Depth: 77 m Total Length: 299 cm
Core Barrel Type: GOSPC Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 49. 427 N Longitude: 133° 48. 199 W	SYMBOL LEGEND: faint lamina; shell frg.; U-shaped burrow	
Described by: A. Schell	Page 2 of 3	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100				5YR 4/1	Olive grey mud faintly laminated, with black specs		100-101 δ,d,D
							110-111 δ,d,D
119					large sand laminae		120-121 δ,d,D
130					shell frgs. ~130cm!		130-131 δ,d,D
139 / 140 / 142					black 1-cm bed		140-141 δ,d,D
				4/4	olive brown mud		
150							150-151 δ,d,D
153				4/1	olive grey mud.		
155				3/2	dark black/grey mud		
157					end of Section B-C		
				4/4	Olive Brown mud		160-161 δ,d,D
167							
				5YR 4/1	Olive grey mud faintly laminated, black specks		170-171 δ,d,D
							180-181 δ,d,D
							190-191 δ,d,D
200							200-201 δ,d,D

NOTES:

end of Section B-C (155cm)

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 711 PC	Geographic Location: Beaufort Sea	Water Depth: 77 m Total Length: 299 cm
Core Barrel Type: 1005PC Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 49.427N Longitude: 133° 48.109W	SYMBOL LEGEND	
Described by: A. Schell	Page 3 of 3	faintly laminated; bioturbated; shell frags

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200				5YR 4/1	Olive grey mud. faintly laminated, black specks		200-201 S,d,D; 210-211 S,d,D; 220-221 S,d,D; 230-231 S,d,D
234					olive grey mud. some bioturbation		240-241 S,d,D; 250-251 S,d,D; 260-261 S,d,D
270-271					shell fragments faintly laminated.		270-271 S,d,D; 280-281 S,d,D; 290-291 S,d,D
299					end of section A-B		
300							

NOTES:
end of section A-B and core ~ 299cm.

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 850 PC	Geographic Location: Beaufort Sea	Water Depth: 1054 m Total Length: 285 cm
Core Barrel Type: 008 PC Piston	Date: 20 August 2004	Project Number: CASES - Log 8
Latitude: 70° 32.922N Longitude: 137° 35.95W	SYMBOL LEGEND: laminae; mottled bioturbat.	
Described by: T. Schell	Page 1 of 3	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
1		v. soft		10YR 3/2	Brown mud		0-1 f, d, D
					Olive grey mud		
4					Brown laminae		
7				5YR 4/1		laminae	
10					Brown laminae	laminae	10-11 f, d, D
12					Brown laminae	laminae	
15					Brown laminae.	laminae	
20							20-21 f, d, D
							30-31 f, d, D
39					black mottling, organics	mottled	
42							40-41 f, d, D
				5YR 4/1	Olive grey mud.		
							50-51 f, d, D
							60-61 f, d, D
							70-71 f, d, D
							80-81 f, d, D
							90-91 f, d, D
100							100-101 f, d, D

NOTES:
* entire core was subsampled for paleomag. by u-channel minicore.
* f = forams, d = dinos, D = Diatoms subsample

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004 - 804 Sample Number: 850	Geographic Location: Beaufort Sea	Water Depth: 1054 m Total Length: 286 cm
Core Barrel Type: Piston 008PC	Date: 20 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 32.922 N Longitude: 137° 35.95 W	SYMBOL LEGEND	
Described by: T. Schell	Page 2 of 3	

SYMBOL LEGEND: black spots = organics; laminae

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100				5YR 4/1	Olive grey mud		100-101 S,d,D
							110-111 S,d,D
							120-121 S,d,D
							130-131 S,d,D
136					end of Section B-C		
					Olive grey mud, with black specks (organics)		140-141 S,d,D
							150-151 S,d,D
							160-161 S,d,D
166							
				5YR 4/1	Olive grey mud		170-171 S,d,D
							180-181
							190-191
200							200-201

NOTES: end of Section B-C ~136 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 850 PC	Geographic Location: Beaufort Sea	Water Depth: 1054 m Total Length: 286 cm
Core Barrel Type: (008 PC) Piston	Date: 20 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 32.922 N Longitude: 137° 35.95 W	SYMBOL LEGEND: shell frag.	
Described by: T. Schell	Page 3 of 3	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200							200-201 8,9,D
				5YR 4/1	Olive grey mud		210-211 8,9,D
							220-221 8,9,D
225					shell frag.		
							230-231 8,9,D
							240-241 8,9,D
							250-251 8,9,D
							260-261 8,9,D
							270-271 8,9,D
					faint black laminae.		280-281 8,9,D
285					end of Section A-B		
							290-291 8,9,D
300							300-301 8,9,D

NOTES:

end of core 286 cm + Section A-B

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 850 twc	Geographic Location: Beaufort Sea	Water Depth: 1054 m Total Length: 71 cm
Core Barrel Type: LOOK TWC twc	Date: 20 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 32.922N Longitude: 137° 35.95W	SYMBOL LEGEND: laminae	
Described by: K. Scholl	Page 1 of 1	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
4				10YR 3/2	Brown Mud		0-1 f,d,D
		V. soft			Olive grey mud		10-11 f,d,D
13					Red Brown Laminae	laminae	
							20-21 f,d,D
				5YR 4/1	Olive grey mud		30-31 f,d,D
							40-41 f,d,D
							50-51 f,d,D
							60-61 f,d,D
70-71					end of twc		70-71 f,d,D.

NOTES: end of Section ① = core @ 71cm
* entire core subsampled for paleomag. by U-channel minicore.
* f = forams, d = dinos, D = Diatom subsamples

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 803	Geographic Location: Beaufort Sea - Trough	Water Depth: 218 m Total Length: 598 cm
Core Barrel Type: Piston	Date: 10 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 37,976N Longitude: 135° 52,815 W	SYMBOL LEGEND: SS bioturb.	
Described by: A. Schell	Page 1 of 6	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0–30				5YR 4/1	olive grey mud. very little mottling or bioturbation	ς	0-1 f,d,D; 10-11 f,d,D; 20-21 f,d,D
30–45				3/2	Slightly blacker in colour		30-31 f,d,D; 40-41 f,d,D
45–49				4/1	Olive grey mud		
49/50–55				3/2	slightly blacker in colour.		50-51 f,d,D small
55–100				4/1	olive grey mud	ς	60-61 f,d,D; 70-71 f,d,D; 80-81 f,D,d; 90-91 f,d,D; 100-101 f,d,D

NOTES: * entire core was subsampled for paleomag. by u-channel mini-core.
* f = forams, d = dinos, D = Diatoms subsamples

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004 - 804 Sample Number: 803	Geographic Location: Amundsen Gulf	Water Depth: 218 m Total Length: 578 cm
Core Barrel Type: 013PC Piston	Date: 10 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 37.976 N Longitude: 135° 52.815 W	SYMBOL LEGEND	
Described by: T. Schell	Page 2 of 6	

SYMBOL LEGEND: mottled bioturb; U-shaped burrows

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100				5YR 4/1	olive grey mud.		100-101 8, d, D
							110-111 8, d, D
							120-121 8, d, D
					U-shaped burrows the last 20 cm's		130-131 8, d, D
							140-141 8, d, D
150					end of Section D-E		150-151 8, d, D
				5YR 4/1	olive grey mud abundant bioturbation		160-161 8, d, D
							170-171 8, d, D
							180-181 8, d, D
							190-191 8, d, D
200							200-201 8, d, D

NOTES: end of Section D-E ~ 150 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004 - 804 Sample Number: 803	Geographic Location: Amundsen Gulf	Water Depth: 218 m Total Length: 578 cm
Core Barrel Type: 1013PC Piston	Date: 10 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 37. 976 N Longitude: 135° 52. 815 W	SYMBOL LEGEND	
Described by: T. Schell	Page 3 of 6	

SYMBOL LEGEND: mottled / bioturb.; u-shaped / burrows; laminae

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200							200-201 S,d,D
				5YR 4/1	olive grey mud.		210-211 S,d,D
221					blacker horizon		220-221 S,d,D
							230-231 S,d,D
							240-241 S,d,D
							250-251 S,d,D
261					black laminae		260-261 S,d,D
					abundant bioturbation		270-271 S,d,D
273							shell
275							
276							
							280-281 S,d,D
286							
							290-291 S,d,D
					faint black laminae.		
298					end of section C-D		
300							300-301 S,d,D

NOTES: end of section ~298cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 803	Geographic Location: Amundsen Gulf	Water Depth: 218 m Total Length: 598 cm
Core Barrel Type: 013PC Piston	Date: 10 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 37.976 N Longitude: 135° 52.815 W		
Described by: A. Schell	Page 4 of 6	

SYMBOL LEGEND

Symbol	Meaning	Symbol	Meaning
ʃ ʃ	bioturb	gastropod	gastropod shell
C	curved burrows	•	shell frags
═	lamina	✗	wood frag.

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
300				5YR 4/1	olive grey mud, abundant mottling, organics & bioturbation		300-301 δ,α,D; 310-311 δ,α,D
318					less bioturbation		320-321 δ,α,D
328					abundant bioturbation & curved burrows		330-331 δ,α,D
335					No Bioturbation, faint black lamina		340-341 δ,α,D
344					some bioturbation,		
348					* wood fragment ?		
349					No bioturbation		350-351 δ,α,D
					black specks		
356 / 354							
360 / 361 / 363					No burrows small shell fragments		360-361 δ,α,D; 362-363 shell
366					No bioturbation Black lamina (faint)		
370							370-371 δ,α,D
381					faint black lamina		380-381 δ,α,D
							390-391 δ,α,D
400							400-401 δ,α,D

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 803	Geographic Location: Amundsen Gulf	Water Depth: 218 m Total Length: 598 cm
Core Barrel Type: 013PC Piston	Date: 10 August 2004	Project Number: CASES - Leg 8

Latitude: 70° 37.976 N
Longitude: 135° 52.815 W

Described by: T. Schell

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SYMBOL LEGEND: biotub ; curved burrow

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Subsamples
400				5Y 4/1	olive grey mud	400-401 δ, d, D
						410-411 δ, d, D
416-418					hard black laminae	
					v. little bioturbation	420-421 δ, d, D
430						430-431 δ, d, D
					abundant bioturbation	440-441 δ, d, D
					curved burrows	
452					end of Section B/C	450-451 δ, d, D
					Olive grey mud abundant bioturbation	460-461 δ, d, D
						470-471 δ, d, D
						480-481 δ, d, D
						490-491 δ, d, D
500						500-501 δ, d, D

NOTES: end of Section B-C ~452cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 803	Geographic Location: Amundsen Gulf	Water Depth: 218 m Total Length: 598 cm
Core Barrel Type: 103PC Piston	Date: 10 August 2004	Project Number: CASES - Leg 8
Latitude: 70° 27.976 N Longitude: 135° 52.815 W	SYMBOL LEGEND mottled bioturb laminae	
Described by: A. Schell	Page 6 of 6	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
500					olive grey mud		500-501 X, d, D
503				5YR 4/1	black laminae		
							510-511 X, d, D
							520-521 X, d, D
					Slightly lesser bioturbation		
							530-531 X, d, D
							540-541 X, d, D
551					black horizon		550-551 X, d, D → shell (551)
					Slightly more bioturbation		560-561 X, d, D
							570-571 X, d, D
581 / 583					faint black laminae		580-581 X, d, D
					lesser bioturbation		
							590-591 X, d, D
598 / 600					end of Section A-B		

NOTES: end of section A-D ~598 cm
+ core

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004 Sample Number: 803	Geographic Location: Ikit Beaufort Sea - Trough	Water Depth: 210 m Total Length: 106 cm
Core Barrel Type: 0013TWC twc	Date: 10 August 2004	Project Number: CASES Leg 8

Latitude: 70 37.976 N
Longitude: 125 52.815 W

Described by:
T. Schell

Page 1 of 1

SYMBOL LEGEND

—	burrow
ᶓ	bioturb
shell symbol	shell

Depth (cm)	Deformation	Consistency	CaCo3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
				5YR 4/1	olive grey mud		
13	soupy				reddish orange lamina		
28							
				5YR 4/1	olive grey mud, mottled, bioturbated		
56					tiny shell		
100							
106							

NOTES:

end of core 106 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 750	Geographic Location: Continental Beaufort Sea - Slope	Water Depth: 1087 m Total Length: 598 cm
Core Barrel Type: PC015 Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 20.45' N Longitude: 134° 06.20' W	SYMBOL LEGEND laminae	
Described by: T. Schell	Page 1 of 6	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
		liquid?		10YR 5/3	Brown mud		0-1 f,d,D
10				10YR 3/3	Brown to Olive grey laminated mud		10-11 f,d,D
15, 16, 17, 18, 19				3/		laminae	
21				5YR 4/1	Black laminae (silt)	laminae	20-21 f,d,D
30, 31					black laminae (silt) black laminae (silt)	laminae	30-31 f,d,D
34, 35, 36					black laminae (silt) Brown mud	laminae	
					Olive grey		
40, 42					Brown mud		40-41 f,d,D
44, 45					Olive grey mud Brown mud		
				5Y 3/2	Olive Brown mud		
50				5YR 4/1	Olive grey mud with hints of brown mud		50-51 f,d,D
							60-61 f,d,D
							70-71 f,d,D
							80-81 f,d,D
							90-91 f,d,D
100							100-101 f,d,D

NOTES:
* entire core was subsampled for paleo-mag. by a U-channel mini core
* f = forams, d = dinos, D = Diatoms subsamples

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 750	Geographic Location: Beaufort Sea - Slope	Water Depth: 1087 m Total Length: 598 cm
Core Barrel Type: 1015PC Piston	Date: 13 August 2004	Project Number: CASES - Logs
Latitude: 71° 20.45 N Longitude: 134° 06.20 W	SYMBOL LEGEND	
Described by: T. Schell	Page 2 of 6	

SYMBOL LEGEND: mud clast; silt; Pebble; faintly laminated

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100				5YR 4/1	Olive grey mud, with hints of brown.		100-101 S,d,D
				10YR 7/3			110-111 S,d,D
							120-121 S,d,D
							130-131 S,d,D
136					end of Section D-E		
				5YR 3/2	Olive grey-brown mud		140-141 S,d,D
							150-151 S,d,D
							160-161 S,d,D
							170-171 S,d,D
174 / 175				10YR 3/2	light brown/beige mud; mud clasts lt. brown in Olive grey mud ± siltier!!		180-181 S,d,D
183				5YR 4/1	Olive grey mud with hints of orange staining.		
189							190-191 S,d,D
194							
196					Pebble!		
200					Olive grey mud/ brown staining		200-201 S,d,D

NOTES: end of Section D-E ~136cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 750	Geographic Location: Amundsen Gulf	Water Depth: 1087 m Total Length: 598 cm
Core Barrel Type: Piston 015PC	Date: 12 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 20.45 N Longitude: 124° 06.20 W	SYMBOL LEGEND	
Described by: T. Schell	Page 3 of 6	

SYMBOL LEGEND: sandy laminat. ; pebble

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200 / 201							200-201 X, d, D
211					pebble		210-211 X, d, D
				5YR 4/1			220-221 X, d, D
					Olive grey mud.		230-231 X, d, D
							240-241 X, d, D
							250-251 X, d, D
256							rock (256cm)
							260-261 X, d, D
							270-271 X, d, D
							280-281 X, d, D
285					end of section C-D		
				5YR 4/1	Olive grey mud		290-291 X, d, D
300							300-301 X, d, D

NOTES: end of section C-D ~ 285 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 750PC	Geographic Location: Amundsen Gulf	Water Depth: 1087 m Total Length: 598 cm
Core Barrel Type: 015PC Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 20.45 N Longitude: 134° 06.20 W	SYMBOL LEGEND	
Described by: A. Schell	Page 4 of 6	

SYMBOL LEGEND: lamina; mud clast

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
300							300-301 δ, d, D
							310-311 δ, d, D
				5Y 4/1	Olive grey mud		
							320-321 δ, d, D
							330-331 δ, d, D
							340-341 δ, d, D
					mud clast (4 cm) beige mud.		
							350-351 δ, d, D
							360-361 δ, d, D
365							
				5Y 4/1	Olive grey mud with "black laminae" + small mud clasts (beige)		370-371 δ, d, D
							380-381 δ, d, D
385							
388					angular pebble! orangish stain to the olive grey mud		rock (3 cm)
				5Y 5/6			390-391 δ, d, D
395							
				5Y 4/1	Olive grey mud.		
400							400-401 δ, d, D

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 750PC	Geographic Location: Amundsen Gulf	Water Depth: 1087 m Total Length: 598 cm
Core Barrel Type: 015PC Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 20.45 N Longitude: 134° 06.20 W	SYMBOL LEGEND	
Described by: A. Schell	Page 5 of 6	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
400							400-401 8,d,D
407					black speck		
					Olive grey mud		410-411 8,d,D
				5YR 4/1			420-421 8,d,D
							430-431 8,d,D
437					end of section B-C		
							440-441 8,d,D
					Olive grey mud		450-451 8,d,D
				5YR 4/1			460-461 8,d,D
							470-471 8,d,D
							480-481 8,d,D
							490-491 8,d,D
500							500-501 8,d,D

NOTES: end of section B-C ~ 437cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 750 PC	Geographic Location: Amundsen Gulf	Water Depth: 1087 m Total Length: 598 cm
Core Barrel Type: 015PC Piston	Date: 13 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 20.45 N Longitude: 134° 06.20 W	SYMBOL LEGEND	
Described by: T. Schell	Page 6 of 6	pebble

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
500							500-501 8,d,D
							510-511 8,d,D
							520-521 8,d,D
				5 YR 4/1	Olive grey mud		530-531 8,d,D
							540-541 8,d,D
							550-551 8,d,D
							560-561 8,d,D
568							rock (560)
							570-571 8,d,D
577					pebble		rock (580)
580					End of Section A-B		
600							

NOTES:

end of core 580 cm - Section A-B.

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650 PC	Geographic Location: Beaufort Sea	Water Depth: 246 m Total Length: 608 cm
Core Barrel Type: 019 PC Piston	Date: 11 August 2004	Project Number: CASES - 1008
Latitude: 71° 18.521 N Longitude: 131° 36.981 W		
Described by: T. Scholl	Page 1 of 6	

SYMBOL LEGEND

- big burrow
- bioturb

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0		soupy			v. soupy + disturbed, olive grey mud		0-1 f,d,D
10							10-11 f,d,D
20				5Y 4/1	olive grey mud		20-21 f,d,D
30							30-31 f,d,D
40							40-41 f,d,D
50							50-51 f,d,D
58					burrow (big!)		
60							60-61 f,d,D
70							70-71 f,d,D
73					73→136 cm increasing bioturbation (mottling) with depth		
80							80-81 f,d,D
90							90-91 f,d,D
100							100-101 f,d,D

NOTES:

* f = forams, d = dinos, D = diatom subsamples
* the entire core was subsampled for paleomag with a U-tube mini-core (6-8cm. empty 20-25cm ... 270-380 ... during sampling - 3 sections ... 78 ...

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650 PC	Geographic Location: Amundsen Gulf	Water Depth: 246 m Total Length: 608 cm
Core Barrel Type: 019 PC Piston	Date: 11 August 2004	Project Number: CASES - Leg 9

Latitude: 71° 18.521 N
Longitude: 131° 36.96 W

Described by: T. Scholl

Page 2 of 6

SYMBOL LEGEND

- biotorb.
- shell

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100							100-101 8,d,D
				5Y 4/1			110-111 8,d,D
118					olive grey mud * small shell, with a valve in each half of the core		120-121 8,d,D
							130-131 8,d,D
135 136					shell shell		135 shell 136 shell
142					black horizon with abundant organic material, + worm tubes.		140-141 8,d,D
							150-151 8,d,D
156					end of section D-E		
							160-161 8,d,D
				5Y 4/1	olive grey mud abundant mottling + bioturbation		170-171 8,d,D
							180-181 8,d,D
							190-191 8,d,D
200							200-201 8,d,D

NOTES: end of section D-E ~ 156cm
* 2 shells removed @ 135, 136 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650PC	Geographic Location: Amundsen Gulf	Water Depth: 246 m Total Length: 609 cm
Core Barrel Type: Piston 019PC	Date: 11 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 18.521 N Longitude: 131° 36.96 W	SYMBOL LEGEND	shell frag.; bioturb.
Described by: A. Schell	Page 3 of 6	

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200					black horizon		200-201 G,d,D
				5YR 4/1	olive grey mud,		
210							210-211 G,d,D
220					decreasing amounts of bioturbation		220-221 G,d,D
230							230-231 G,d,D
240							240-241 G,d,D
250							250-251 G,d,D
260					black laminae		260-261 G,d,D
270							270-271 G,d,D
280							280-281 G,d,D
290							290-291 G,d,D
300							300-301 G,d,D

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650PC	Geographic Location: Amundsen Gulf	Water Depth: 246 m Total Length: 608 cm
Core Barrel Type: 104PC Piston	Date: 11 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 18.521 N Longitude: 131° 36.96 W	SYMBOL LEGEND	ss biotirb
Described by: T. Schell	Page 4 of 6	

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
300				5Y 4/2	Olive grey mud.	ss	300-301 δ, d, D
305				4/1	end of section 6-D		
							310-311 δ, d, D
					olive grey mud abundant bioturbation (mottled)		320-321 δ, d, D
							330-331 δ, d, D
							340-341 δ, d, D
							350-351 δ, d, D
							360-361 δ, d, D
							370-371 δ, d, D
375					black horizon / laminae		
							380-381 δ, d, D
							390-391 δ, d, D
400							400-401 δ, d, D

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650 PC	Geographic Location: Amundsen Gulf	Water Depth: 246 m Total Length: 608 cm
Core Barrel Type: 019PC Piston	Date: 11 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 18.521 N Longitude: 131° 36.96 W	SYMBOL LEGEND SS biotrb.	
Described by: T. Schell	Page 5 of 6	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
400							400-401 δ, d, D
				5Y/R 4/1	Olive grey mud, mottled, abundant bioturbation		
							410-411 δ, d, D
415					black lamina/horizon		
421					black lamina/horizon		420-421 δ, d, D
							430-431 δ, d, D
							440-441 δ, d, D
							450-451 δ, d, D
459					end of Section B-C		460-461 δ, d, D
				5Y/R 4/1	Olive grey mud abundant bioturbation & mottling		
							470-471 δ, d, D
							480-481 δ, d, D
							490-491 δ, d, D
500							500-501 δ, d, D

NOTES: end of Section B-C ~459 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650 PC	Geographic Location: Amundsen Gulf	Water Depth: 246 m Total Length: 608 cm
Core Barrel Type: L019PC Piston	Date: 11 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 18.521 N Longitude: 131° 36.96 W	SYMBOL LEGEND bioturb.	
Described by: T. Schell	Page 6 of 6	

Depth (cm)	Deformation	Consistency	CaCo3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
500				5YR 4/1	Olive grey mud		500-501 S,d,D
509-510					No bioturbation		510-511 S,d,D
							520-521 S,d,D
							530-531 S,d,D
							540-541 S,d,D
543-545					No bioturbation		
561-562					No bioturbation		550-551 S,d,D
570-571					No bioturbation		560-561 S,d,D
578-580					No bioturbation		570-571 S,d,D
				5YR 4/1			580-581 S,d,D
							590-591 S,d,D
600							600-601 S,d,D

NOTES:

608 — end of Section A-B

end of core 608cm (end Section A-B)

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 650PC	Geographic Location: Beaufort Sea	Water Depth: 246 m Total Length: 75 cm
Core Barrel Type: LONG TWC TWC	Date: 11 August 2004	Project Number: CASES - Lag 8
Latitude: 71° 18.52' N Longitude: 131° 36.98' W	SYMBOL LEGEND SS biotub.	
Described by: T. Schell	Page 1 of 1	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0–10		v. soft		5YR 4/1	olive grey mud		
10–20		soft					
40						SS	
75					end of core 75cm		

NOTES: end of Section ① 1 core @ 75cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 670 cm (664cm)
Core Barrel Type: Piston 042PC	Date: 08 August 2004	Project Number: CASES (Leg 9)
Latitude: 70° 27.079 N Longitude: 125° 23.562 W	SYMBOL LEGEND: bioturbated; worm tubes	
Described by: T. Schell	Page 1 of 7	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0				10YR	reddish tinge upper 3cm. olive grey mud. (very soupy 0-10cm!) • worm tubes.	worm tubes	0-1 f,d,D
				5YR 4/1			
10					10-28cm disturbed, not split easily.		10-11 f,d,D
							20-21 f,d,D
28					still olive grey mud, abundant black spots or mottled, ∴ bioturbation, and high organic content.	bioturbated	30-31 f,d,D
							40-41 f,d,D
							50-51 f,d,D
					end of Section E-F		60-61 f,d,D
63				5YR 4/1	olive grey mud. bioturbated, mottled with black spots ∴ abundant organic content.	bioturbated	70-71 f,d,D
							80-81 f,d,D
							90-91 f,d,D
100							100-101 f,d,D

NOTES: end of Section E-F ~63cm
last core collected on leg 8. PC 041
* entire core subsampled for paleo mag. with a u-channel mini core
* f = forams, d = dinos, D = Diatoms subsamples

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 670 cm
Core Barrel Type: 042PC Piston	Date: 08 August 2004	Project Number: CASES (Leg a)
Latitude: 70° 27.079 N Longitude: 125° 23.582 W	SYMBOL LEGEND: bioturbat	
Described by: A. Schell	Page 2 of 7	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100							100-101 S,d,D
							110-111 S,d,D
							120-121 S,d,D
				5YR 4/1	olive grey mud, mottled with black spots (bioturbated)		130-131 S,d,D
							140-141 S,d,D
							150-151 S,d,D
							160-161 S,d,D
							170-171 S,d,D
							180-181 S,d,D
							190-191 S,d,D
200							200-201 S,d,D

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 670 cm
Core Barrel Type: 104PC Piston	Date: 09 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 27.079 N Longitude: 125° 23.562 W	SYMBOL LEGEND § bioturbated	
Described by: J Schell	Page 3 of 7	

Depth (cm) | Deformation | Consistency | $CaCo_3$ | Munsell Colour | Sedimentologic Description | Lithology & Sedimentary Structure | Subsamples

200

end of section D-E

218

5YR 4/1

olive grey mud, mottled, bioturbated (easier to split, more consolidated)

Subsamples: 200-201 δ, d, D; 210-211 δ, d, D; 220-221 δ, d, D; 230-231 δ, d, D; 240-241 δ, d, D; 250-251 δ, d, D; 260-261 δ, d, D; 270-271 δ, d, D; 280-281 δ, d, D; 290-291 δ, d, D; 300-301 δ, d, D

300

NOTES: end of section D-E ~ 218 cm.

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 470 cm
Core Barrel Type: 042PC Piston	Date: 08 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 27.079 N Longitude: 125° 23.562 W	SYMBOL LEGEND	§§ biolurbal
Described by: T. Schell	Page 4 of 7	

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
300							300-301 S,d,D
							310-311 S,d,D
				5YR 4/1	olive grey mud mottled, biolurbations		320-321 S,d,D
							330-331 S,d,D
							340-341 S,d,D
							350-351 S,d,D
							360-361 S,d,D
370					end of section C-D		370-371 S,d,D
				5YR 4/1	Olive grey mud		380-381 S,d,D
							390-391 S,d,D
400							400-401 S,d,D

NOTES: end of Section C-D ~ 370cm.

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 670 cm
Core Barrel Type: 0042PC Piston	Date: 08 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 27, 075 N Longitude: 125° 23.562 W	SYMBOL LEGEND § bioturbated	
Described by: T. Schell	Page 5 of 7	

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
400							400-401 δ, d, D
						§	410-411 δ, d, D
						§	420-421 δ, d, D
				5YR 4/1	olive grey mud, mottled, bioturbated	§	430-431 δ, d, D
						§	440-441 δ, d, D
						§	450-451 δ, d, D
						§	460-461 δ, d, D
						§	470-471 δ, d, D
						§	480-481 δ, d, D
						§	490-491 δ, d, D
500							500-501 δ, d, D

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: ~70 cm
Core Barrel Type: (04) PC Piston	Date: 08 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 27.079 N Longitude: 125° 23.562 W	SYMBOL LEGEND bioturb.	
Described by: T Schell	Page 6 of 7	

Depth (cm)	Munsell Colour	Sedimentologic Description	Subsamples
500			500-501 8,9,D
			510-511 8,9,D
521		end of Section B-C	520-521 8,9,D
	5YR 4/1	olive grey mud mottled, bioturbated	530-531 8,9,D
			540-541 8,9,D
			550-551 8,9,D
554	5YR 4/6	gradual color change to reddish mud.	560-561 8,9,D
562	5YR 4/6	red mud	570-571 8,9,D
			580-581 8,9,D
			590-591 8,9,D
600			600-601 8,9,D

NOTES: end of Section B-C ~521.0

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 670 cm
Core Barrel Type: 104PC Piston	Date: 08 August 2004	Project Number: CASES - Leg 9
Latitude: 70° 27.679 N Longitude: 125° 23.562 W	SYMBOL LEGEND mm laminae	
Described by: T. Schell	Page 7 of 7	

Depth (cm)	Deformation	Consistency	CaCo3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
600							600-601 δ, d, D
602					faint black laminations mm - thick		
							610-611 δ, d, D
				5Y2 4/6	red mud.		620-621 δ, d, D
							630-631 δ, d, D
							640-641 δ, d, D
							650-651 δ, d, D
							660-661 δ, d, D
670					end of Core	670cm	
700							

NOTES: end of Section A-B + core ~ 670cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 250	Geographic Location: Amundsen Gulf	Water Depth: 193 m Total Length: 102 cm
Core Barrel Type: TWC (AH2TWC)	Date: 09 August 2004	Project Number: CASES (Leg 9)
Latitude: 71° 27.079 N Longitude: 125° 23.562 W	SYMBOL LEGEND: biotubated	
Described by: K. Schell	Page 1 of 1	

Depth (cm)	Deformation	Consistency	CaCo3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0–20					very soupy ∴ disturbed 0-20cm		
20–102				5Y 4/1	olive grey mud, mottled with black spots - bioturbation and abundant organics.		

NOTES: 102 - end of core (section 01)
last core collected on leg 8

041 PC

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 124 PC	Geographic Location: Beaufort Sea	Water Depth: 426 m Total Length: 442 cm
Core Barrel Type: 044PC Piston	Date: 10 August 2004	Project Number: CASES
Latitude: 71° 24.8 N Longitude: 126° 46.1 W	SYMBOL LEGEND	
Described by: A Schell	Page 1 of 5	

SYMBOL LEGEND: "mottling" bioturb.; U-shaped black mottle - burrow; worm/m... tubes; laminae; silt/sand

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0-2				10YR 2/2	dark brown mud (f.w., soupy) worm tubes 0-2		0-1 f,d,D
2-16				5YR 3/1	2-16 olive brown mud		10-11 f,d,D
16					reddish sand/silt laminae in clumps		20-21 f,d,D
30				5Y 3/2 2.5Y	dark olive grey mud; faint dark grey mottle at 30		30-31 f,d,D
36-37				10YR 3/3	brown mud		
40				5YR 3/2	dark olive grey mud mottled		40-41 f,d,D
48				5YR 4/1	olive grey mud		50-51 f,d,D
60							60-61 f,d,D
72				5YR 4/1	olive grey mud mottled bioturbated.		70-71 f,d,D 80-81 f,d,D
85					orangish colour		
					olive grey mud		90-91 f,d,D
96-100					olive grey mud with faint black laminations		100-101 f,d,D

NOTES:
* f = forams, d = dinos, D = Diatoms Subsamples
* Paleomag U-channel mini-core taken of the entire core.

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 124 PC	Geographic Location: Beaufort Sea	Water Depth: 426 m Total Length: 442 cm
Core Barrel Type: Piston 1044PC	Date: 10 August 2004	Project Number: CASES - Leg 8
Latitude: 71° 24.8 N Longitude: 125° 46.1 W		
Described by: T. Schell	Page 2 of 5	

SYMBOL LEGEND

	lamina				
	mottling bioturb		silt		
	shell		pebble		

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100				5Y 4/1	olive grey mud with faint black laminae - transgressional laminae; * possible shell fragment; subangular black pebble		100-101 S,d,D
109				10YR 5/2	light brown/beige mud		110-111 S,d,D
112					olive grey - brownish mud; blackish hue, darkening towards the bottom, mottling + bioturbation		120-121 S,d,D
125							
129				10YR 5/3	light brown/beige mud; mottling + black specks decrease towards bottom		130-131 S,d,D
141 / 142					Black silty laminae		140-141 S,d,D
144					end of Section C-D		
				5Y 4/1	olive grey mud, faint black laminae		150-151 S,d,D
							160-161 S,d,D
165 / 167				10YR 5/3	black silty laminae; light brown mud		
				5YR 4/3	olive brown mud		170-171 S,d,D
				4/2	brownish olive mud (slightly black)		180-181 S,d,D
				4/2	brownish olive mud		190-191 S,d,D
200							200-201 S,d,D

NOTES: end of Section C-D ~ 144 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004 - 804 Sample Number: 124 PC	Geographic Location: Beaufort Sea	Water Depth: 425 m Total Length: 447 cm
Core Barrel Type: 044 PC Piston	Date: 10 August 2004	Project Number: CASES – Leg 9
Latitude: 71° 24.8 N Longitude: 126° 46.1 W		
Described by: T. Schell	Page 3 of 5	

SYMBOL LEGEND

faint laminae	mud clast
"bed"	

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200				5YR 4/2	Brownish olive mud		200-201 S, d, D
210					faint black laminae		210-211 S, d, D
220							220-221 S, d, D
230				5YR 5/2	brownish grey mud		230-231 S, D, d
240					mud clast @240		240-241 S, d, D
250				5YR 5/2	brownish grey mud faint black laminations		250-251 S, d, D
260				5YR 4/3	olive brown mud faint laminae, becoming horizontal gradually towards the bottom		260-261 S, d, D
270							270-271 S, d, D
280							280-281 S, d, D
290							290-291 S, d, D
295					end of Section B-C		
300				4/2	brownish olive black mud		300-301 S, d, D

NOTES: end of Section B-C ~ 295 cm

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004 - 804 Sample Number: 124 PC	Geographic Location: Beaufort Sea	Water Depth: 426 m Total Length: 442 cm
Core Barrel Type: 1044PC Piston	Date: 10 August 2004	Project Number: CASES - Leg 9
Latitude: 71° 34.8 N Longitude: 126° 46.1 W		
Described by: T. Schell	Page 4 of 5	

SYMBOL LEGEND

- "bed"
- swirls.

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
300				5YR 4/2	brownish olive black mud - faint bands of black "beds"	"bed"	300-301 S,d,D; 310-311 S,d,D; 320-321 S,d,D; 330-331 S,d,D; 340-341 S,d,D; 350-351 S,d,D; 360-361 S,d,D
365				5YR 5/3	brownish olive mud with slightly lighter brown mud, swirls.	swirls	370-371 S,d,D; 380-381 S,d,D; 390-391 S,d,D; 400-401 S,d,D
400							

NOTES:

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 124 PC	Geographic Location: Beaufort Sea	Water Depth: 426 m Total Length: 442 cm
Core Barrel Type: Piston	Date: 10 August 2004	Project Number: CASES - Leg 9
Latitude: 71° 24.8 N Longitude: 126° 46.1 W	SYMBOL LEGEND: swirl; "bed"	
Described by: A. Schell	Page 5 of 5	

Depth (cm)	Deformation	Consistency	CaCo3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
400							400-401 S,d,D
405				5YR 2/2	brownish black mud		410-411 S,d,D 420-421 S,d,D 430-431 S,d,D 440-441 S,d,D
442					end of Section A-B		
500							

NOTES:

end of core ~442 cm (end Section A-B)

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 124	Geographic Location: Beaufort Sea	Water Depth: 426 m Total Length: 47 cm
Core Barrel Type: 044TWC TWC	Date: 11 August 2004	Project Number: CASES - Leg 7
Latitude: 71° 24.8N Longitude: 126° 46.1W		
Described by: T. Schell	Page 1 of 1	

SYMBOL LEGEND

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0		very soupy		10YR	dark brown mud		
				5Y 4/2	light olive grey mud		
47					end of core		

NOTES:

end of core 47cm

* very soupy ∴ probably very disturbed

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 002	Geographic Location: Dease Strait	Water Depth: 115 m Total Length: 120 cm	
Core Barrel Type: 047TWC TWC	Date: 21 August 2004	Project Number: Arctic Net	
Latitude: 69° 00.1N Longitude: 106° 35.1 W	SYMBOL LEGEND: S_s bioturb., mottled		
Described by: T. Schell	Page 1 of 2		

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0							0-1 S, d, D
10					Red Brown mud,		10-11 S, d, D
				5YR 4/6	black mottles +		
20					Bioturbated		20-21 S, d, D
30							30-31 S, d, D
40							40-41 S, d, D
50							50-51 S, d, D
60							60-61 S, d, D
70							70-71 S, d, D
80							80-81 S, d, D
90							90-91 S, d, D
100							100-101 S, d, D

NOTES:
* entire core was subsampled for paleomag. by U-channel minicore.
* S = forams, d = dinos, D = Diatom subsamples

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: 2004-804 Sample Number: 002	Geographic Location: Dease Strait	Water Depth: 115 m Total Length: 120 cm
Core Barrel Type: 047 TWC twc	Date: 21 August 2004	Project Number: Arctic, Net
Latitude: 67° 00.1 N Longitude: 106° 35.1 W	SYMBOL LEGEND mottled biotub.	
Described by: T. Schell	Page 2 of 2	

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100				5YR 4/6	Red-brown mud		100-101 8,d,D
							110-111 8,d,D
120					end of section ①		120-121 8,d,D

NOTES:

end of core - 120cm.

GEOLOGICAL SURVEY OF CANADA (Atlantic) CORE DESCRIPTION

Cruise Number: **2004804** Sample Number: **009 (GSCA 050)**	Geographic Location: **Lancaster Sound**	Water Depth: **781 m** Total Length: 597 **cm**
Core Barrel Type: **Piston Core**	Date: **March 4, 2005**	Project Number: **X-30**
Latitude: **74° 11.1** Longitude: **81° 12.6**		
Described by: **K.A. Jenner**	Page 1 of 6	

SYMBOL LEGEND

- clay
- silt
- mottles

Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
0–100	Brkn. (0–10); none	soft		5Y 4/3; 5Y 4/2 (from ~92)	0-55cm Massive, olive silty clay. Rare, remnant lamination defined by concentrations of dk gy mottles. Otherwise mottles are 3 to 10 mm Ø and scattered throughout (low degree of mottling). Mottles reflect bioturbation. 55-145cm massive, olive silty clay. Rare, remnant lamination defined by concentrations of dk gy mottles, as above, but c slightly higher evidence of primary bdg. (esp. between 120-130cm		G.S. 50-51cm

NOTES:

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SYMBOL LEGEND: clay; silt; granule; mottles; pebble

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
100–145	none	soft		5Y 4/2	115cm quartz and reddish, granular clast in calcareous rich, tan mud. Clast is subangular 10x5mm. 145cm E of D/E		G.S. 135–136cm
145–200	none	soft		5Y 4/2	145–280cm massive, olive, silty clay. Low degree of circular and elongated dk gry mottles <5mm ø throughout (result of bioturbation). Some mottles are concentrated into wispy lenses defining remnant primary bdg.		lt forest grn. mudclast

NOTES:

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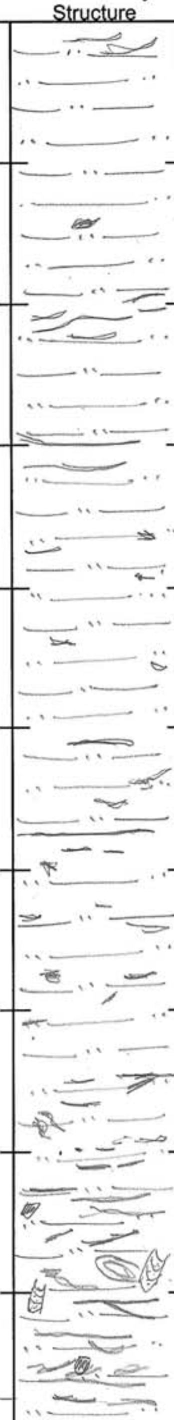
SYMBOL LEGEND

	clay		Pyritized worm tube		
	slt		granule		
	mottles				

Depth (cm)	Deformation	Consistency	$CaCO_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
200							
210							
220							
230	none	firm		5Y 4/2			G.S. 235-236cm
240							
250					250-280 cm concentration of mottles increases here, slightly degree. Mottles also become dk gy.		
260							
270					280-297cm massive, olive silty cly c̄ moderate degree of dk gy mottles throughout; some defining primary bdg. 284cm subrd granule <2mm.		
280				mottles 5Y 2.5/1			
290				5Y 4/2	297 cm E of S C/D		G.S. 290-291cm
300							



NOTES:

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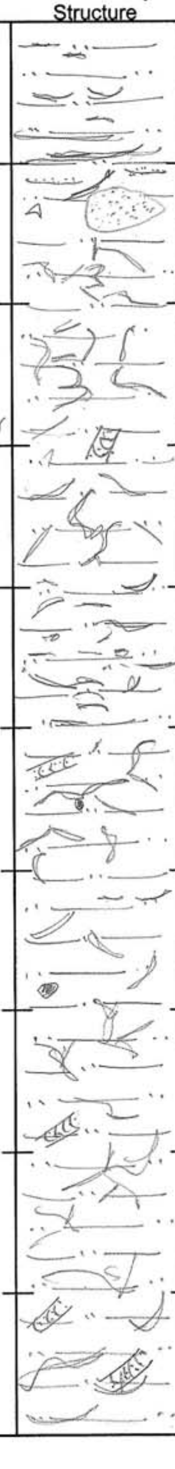
SYMBOL LEGEND

	cly		pyritized worm tubes		Wrmb
	slt		Sand	●	granule
	mottles		Shellfrag.		shell

Depth (cm)	Deformation	Consistency	CaCo3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
300–400	none	firm		5Y 4/2	297–315cm olive silty cly, massive c̄ moderate degree of dk gy mottles. Remnant lamination defined by ssy wrmb and concentrations of mottles. Large, subrd, muddy granular clast at 314–316cm 2x3cmØ. Distinct ↓ contact on change in type of burrowing. 315–423cm Massive, olive slty cly. Distinctly burrowed. Wrm traces are <3mm wide and <3cm long. Some contain rare vfnS. Pyritized wrmb tubes and isolated subang granules <2mm.		14C 316-317cm Shell 2 valves 348cm Ø For AMS Dating G.S 360-361cm Shell 389.5 14C

Depth scale: 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400

NOTES:

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SYMBOL LEGEND

clay	pyritized wrmb	shell frag.
silt	granule	
mottles	shell	

Depth (cm)	Deformation	Consistency	$CaCo_3$	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
400–449	none	firm		5Y 4/2; 5Y 2.5/2 mottles; 5Y 4/2	423 - 449 cm massive, olive, silty clay. Overall gr. sz should be coarser because of blk, v.fn s mottles <3mm, throughout. Conc. of blk mottles define remnant primary bdg. Otherwise structureless. Isolated subang. granules, pyritized wrmb tubes. branching pyritized wrmb tubes? 449 cm EofS B/C		Brn ssy clast Shell 428cm G.S. 440-442 Shell 442-443cm wrmb tube 445cm
449–500	none	firm	5Y 2.5/2 mottles; 5Y 4/2; 5Y 4/2		449-458cm. massive olive silty clay. As in 423 - 449cm. Distinct + contact on absence of black ssy mottles. 458 - 463 cm As in 315-423cm. Distinct med. gy burrow traces 463-485cm As in 423 - 449 and 449 -458cm. Distinct + contact on absence of blk, ssy mottles.		G.S. 470-471 cm

NOTES:
pollen, forams, grn size, geochem, paleomag.

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SYMBOL LEGEND: clay; granule; slt; wrmb

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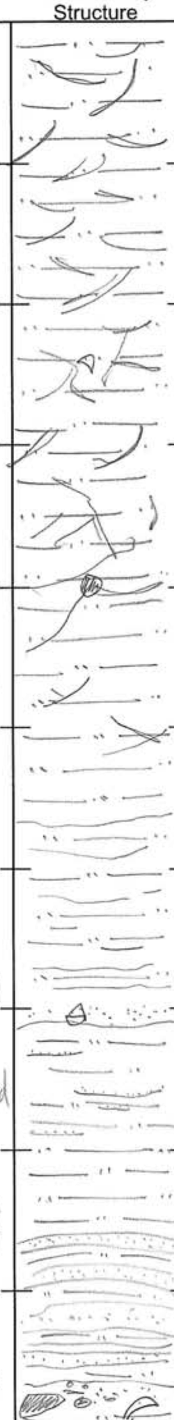
Depth (cm)	Deformation	Consistency	CaCO3	Munsell Colour	Sedimentologic Description	Lithology & Sedimentary Structure	Subsamples
500–520	none	firm		5Y 5/2	485 - 548cm As in 315-423 cm massive olive silty cly. Distinctly burrowed with med grey wrmb traces <3mm wide and < 3cm long. Isolated sub ang granules. Distinct & contact on subtle change in colour.		Shell 514cm 525-526cm Shell frags.
520–550				5Y 4/3	548 - 572cm. Massive olive silty clay. As above only there is a low degree of wrmb and ∴ primary bdg. is more obvious (but still subtle). Colour changes subtly into brownish tinge. Sharp & contact. Interval becomes ssy to base but s is still c in slty cly. (572-574)		G.S. 540-541 cm
550–572	none	firm	mod. fizz	2.5Y 4/3			G.S. 572-573 Shell 573 cm
572–585				10YR 4/2	572-585cm med brn silty clay. Interlaminated well sorted vfn s concentrated in what appears to be wrmb. Subtle colour variation from med - lt brn defines laminae. Sharp & contact on colour.		G.S. 580-581 cm
585–600				2.5Y 5/2	585 - 591cm Interlaminated lt brn vfn sand med brn silty clay. Sharp & contact.		G.S. 590-591 cm GS. (crs.) 595-596cm GS. 596-597cm

Shell frags (596cm) (fn)

NOTES: 591 - 596cm
Interlaminated med brn silty clay and well sorted vfn s lenses <1mm. Sharp & contact

595 - 596 cm
poorly sorted crs s, granule, subang pebbles.