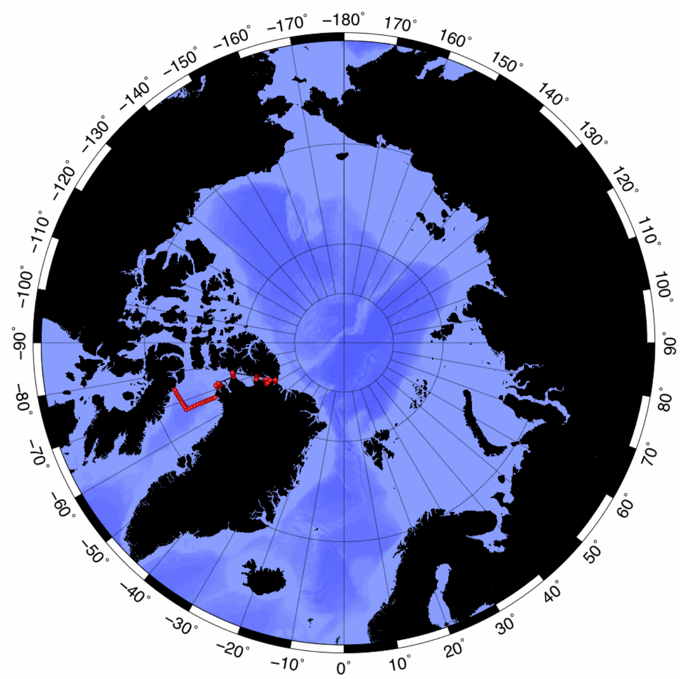
CRUISE REPORT: HLY0301

(Updated NOV 2010)



A. HIGHLIGHTS

A.1. CRUISE SUMMARY INFORMATION

CCHDO Section Designation	**HLY0301**
Expedition designation (ExpoCodes)	**32H120030721**
Chief Scientists	**Dr. Kelly Kenison Falkner / OSU**
Dates	2003-07-21 to 2003-08-16
Ship	*R/V Healy*
Ports of call	St. John's, Newfoundland, Canada - Thule, Greenland
Geographic Boundaries	82° 7' 32" N 74° 53' 52" W 60° 22' 47" W 72° 20' 9.6 N
Stations	54
Floats and drifters deployed	0
Moorings deployed or recovered	5 Moorings Deployed in Nares Strait 18 Moorings Deployed in Kennedy Channel

Chief Scientist:

Dr. Kelly Kenison Falkner • Professor of Chemical Oceanography

College of Oceanic & Atmospheric Sciences • Oregon State University

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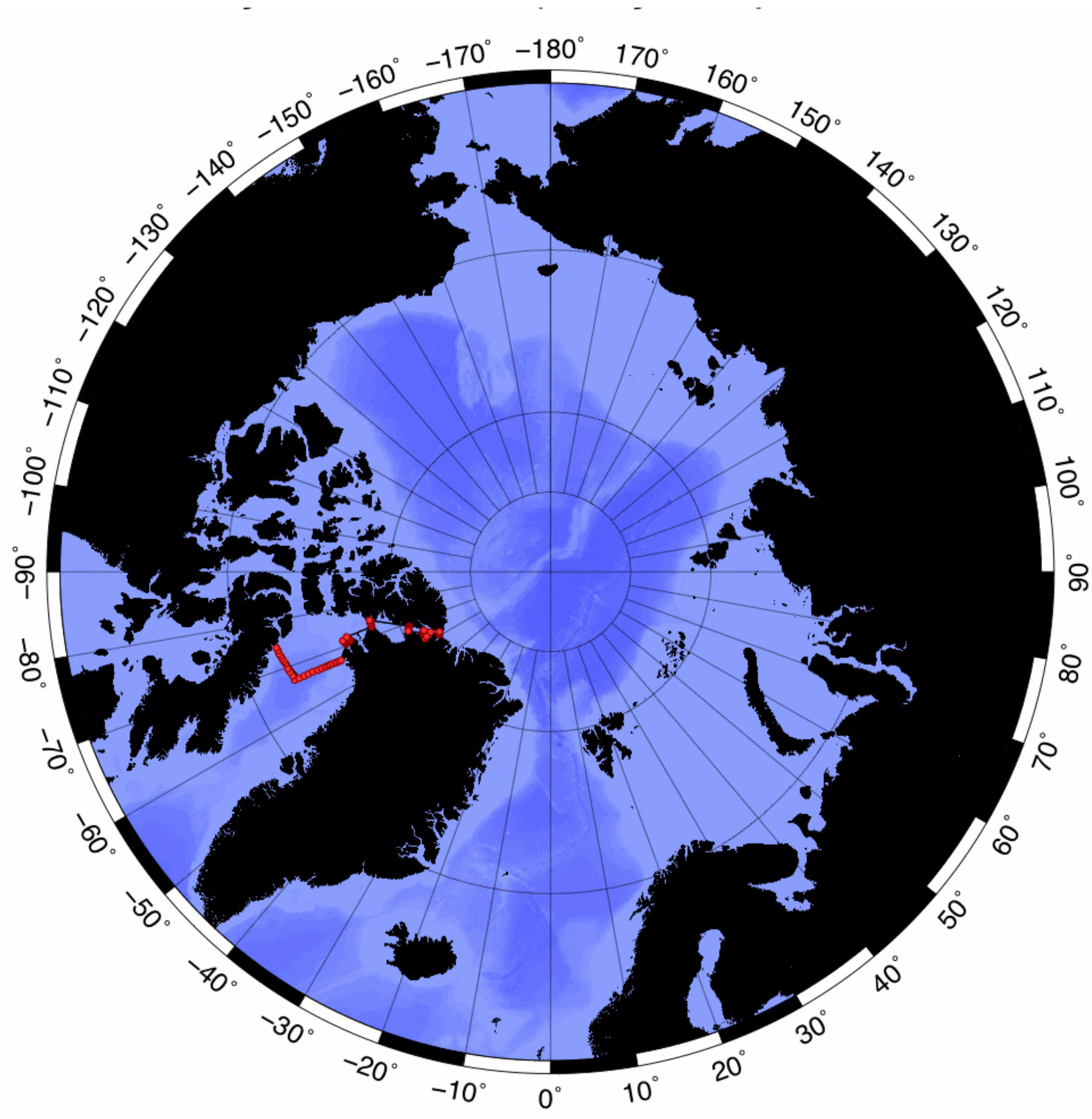
LINKS TO SELECT LOCATIONS

Shaded sections are not relevant to this cruise or were not available when this report was compiled

Cruise Summary Information	**Hydrographic Measurements**
Description of Scientific Program	**CTD Data:**
Geographic Boundaries	Acquisition
Cruise Track (Figure): PI CCHDO	Processing
Description of Stations	Calibration
Description of Parameters Sampled	Temperature Pressure
Bottle Depth Distributions (Figure)	Salinities Oxygens
Floats and Drifters Deployed	**Bottle Data**
Moorings Deployed or Recovered	Salinity
	Oxygen
Principal Investigators	Nutrients
Cruise Participants	Carbon System Parameters
	CFCs
Problems and Goals Not Achieved	Helium / Tritium
Other Incidents of Note	Radiocarbon
Underway Data Information	**References**
Navigation Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	
Thermosalinograph	
XBT and/or XCTD	
Meteorological Observations	**Acknowledgments**
Atmospheric Chemistry Data	
Data Processing Notes	

HLY0301 Station Locations • Kelly Falkner • *R/V Healy* • 2003



RESEARCH CRUISE REPORT: MISSION HLY031

Conducted aboard USCGC Healy In Northern Baffin Bay and Nares Strait

21 July –16 August 2003

PROJECT TITLE:

VARIABILITY AND FORCING OF FLUXES THROUGH NARES STRAIT AND JONES SOUND: A FRESHWATER EMPHASIS

Sponsored By The Us National Science Foundation, Office Of Polar Programs, Arctic Division

Table of Contents

INTRODUCTION

Dr. Kelly Kenison Falkner
Chief Scientist
Oregon State University

In the very early hours of July 17, 2003, I arrived at the USCGC Healy moored at the fueling pier in St. John's Newfoundland, Canada to assume my role as chief scientist for an ambitious interdisciplinary mission to northern Baffin Bay and Nares Strait. This research cruise constitutes the inaugural field program of a five year collaborative research program entitled ***Variability And Forcing Of Fluxes Through Nares Strait And Jones Sound: A Freshwater Emphasis*** and sponsored by the U.S. National Science Foundation. Scientists Andreas Muenchow and Dave Huntley of the University of Delaware were already on board having met the ship in Curaçao in order to gain familiarity with the hull mounted ADCP systems. Over the next several days, other members of the science party arrived in groups and busily prepared science spaces in the ship before we set sail on July 2, 2003.

Twenty-five days later, as we are steaming back to Thule, Greenland I am happy to report that the cruise has been a resounding success. We met all of our priority science objectives and many additional ones as attested to by the pages to follow. Eighty-three casts of the ctd-rosette package were made to produce detailed hydrographic sections along east-west and north-south trending tracks in northern Baffin bay, across smith sound, southern Kennedy channel and Robeson channel. Additional casts were made in the heretofore un-sampled Peterman Glacier Fiord along its sill and in its deepest area (> 1000 m) and in deep hall basin (800 m). Four piston cores that appear to extend to the last glacial were taken over the slope off of Bylot Island and a gravity core-of-opportunity was taken in deep hall basin. Eighteen moorings were deployed in southern Kennedy Channel to monitor current speed and direction as well as temperature and conductivity and ice draft. Five shallow pressure sensor moorings were deployed from small boat with the assistance of divers at sites well distributed along and across Nares Strait, from smith sound in the south to Robeson Channel in the north. Bivalves were also successfully collected at all of these sites for a project aimed at using shell layers to reconstruct chemical conditions in the strait over the past few decades. While ADCP data were logged all along our track, more importantly directed surveys were conducted at several locations including the coastal current near Thule, Smith Sound, Kennedy Channel, Robeson Channel and the Peterman Glacier Fiord sill. In addition to these priorities, the first swath bottom mapping data for the region were collected via the ship's seabeam system and the underway thermosalinograph system was put to good use throughout much of the cruise.

Part of our success can be attributed to luck with mother nature. Winds and ice worked largely in our favor as we wound our way northward. Our winds were generally moderate and out of the south and the ice normal to light. As an example of serendipity, we managed to deploy the main mooring array during the small window of time in which the ice conditions in southern Kennedy Channel were light enough to allow for straightforward anchor last deployments. Of course, as aptly put by science party member Jay Simpkins, you can't benefit from luck unless you are prepared. In this regard, months of planning and hard work by both the science party and the coast guard paid off. Helicopter based reconnaissance and on board consultation with ice technician Yves Sivret of the Canadian ice service, and Ed Hudson of the Canadian meteorological service in conjunction with the mst's, contributed immeasurably to effective decision making in this challenging environment. While we did experience malfunctioning gear, we were nearly always prepared to trouble shoot and repair or replace items efficiently. When sea state hampered deck activities, we generally were able to work in a productive adcp/seabeam survey mode. All of this required extensive teamwork among and between the science party and Coast Guard personnel. Ultimately it takes dedicated people to get the job done and done well. I consider myself extremely fortunate indeed to have had the privilege of coordinating one of the more diverse yet more cohesive science parties that I have encountered in over 20 years of seagoing oceanography. It has been a pleasure working the officers and crew of the Healy under captain Dan Oliver. Their flexibility and dedication toward science planning and execution has been key to a productive safe mission.

We are committed to making our research program accessible to the public and undertook a range of activities on board to facilitate this. We are happy to have had participation of Pauloosie Akeeagok of Grise Fiord, Nunavut, Canada. Pauloosie made significant contributions to the science programs and the coring in particular. He also endeavored to teach us some Inuktitut and gave an excellent presentation regarding the founding of Nunavut. The fact that Pauloosie was able to sensitize us to several issues in his written observations of activities on board underscores the need for Inuit participation as we move ahead in arctic science. Teachers Gerhard Behrens and Robert McCarthy were an excellent addition to the science party. Their daily web postings brought home to many the nature of our science and life aboard the Healy. They were cheerfully assisted in this technically challenging task by UDel undergraduate Lauren Brown and the Coast Guard contracted networking specialist, Joe Digiovanni. Our talented Canadian photojournalist, Lee Narraway, was seen behind the lens throughout much of the cruise. We very much look forward to the articles she is producing. Given all of the digital cameras on board, the number of pictures produced and shared by us is enormous. Among them are many stunning shots of the seascape, landscape, the ship and people. To me, this seems befitting of our endeavor to better understand a stunning piece of our planet.

SCIENCE PROJECT OVERVIEW

The Arctic Ocean plays a pivotal role in the global hydrologic cycle by returning freshwater, in the form of freshened seawater and ice, to the North Atlantic at Fram Strait and through passages of the Canadian Archipelago. Available estimates suggest that freshwater fluxes of comparable magnitude pass through Fram Strait and the combined three main passages of the Archipelago. Spatial and temporal variability in its delivery potentially impacts formation of deepwater in the North Atlantic and thus global thermohaline circulation. Over the past decade it has become clear that forces affecting the Arctic freshwater pump have undergone marked changes and resultant signals are propagating throughout the North Atlantic. Concern about possible consequences of these changes motivated development of the Studies of Environmental ARctic CHange (SEARCH) program and Arctic-Subarctic Ocean Flux (ASOF) study. As a contribution to these initiatives under the Arctic Freshwater Cycle Announcement of Opportunity (NSF-02-071), we proposed to both quantify and determine driving forces of fluxes though two of the three main passages of the Canadian Archipelago, Nares Strait and Jones Sound. These account for about half of the freshwater flux through Archipelago, and the remaining Lancaster Sound will be under study by colleagues. The head of Nares Strait sits at the confluence of major water mass boundaries within the Arctic that have recently been observed to shift, possibly in response to changed atmospheric pressure patterns. Hence it is an excellent location for observing changes in Arctic freshwater output. Specifically, our interdisciplinary American-Canadian-Japanese research team will apply a combination of proven and innovative technologies to:

- *monitor water properties and currents over a 3.5 year period in Nares St., Cardigan St. and Hell Gate via mooring arrays that resolve barotropic and baroclinic motions at their relevant scales*
- *measure ice fluxes through satellite-based and moored observations of ice advection and thickness*
- *track remote and local forcing of throughflow via a moored pressure sensor array and mesoscale atmospheric modeling for Nares St.*
- *determine water mass origins and transformations via modern tracer hydrographic times series in the straits and Northern Baffin Bay*
- *explore bivalve shell records as a proxy of historical throughflow variability and retrieve sediment cores that can used to address longer time-scale variability in future studies*
- *exploit the findings of this study to improve parameterization of Archipelago throughflow in Arctic and global models*

In terms of broader impacts, our collaborative project takes advantage of currently supported research and expertise in Canada and Japan. Our plan is closely coordinated with proposed research by others in the Archipelago region. The collective Canadian Archipelago Throughflow Study (CATS) leverages substantial investment by Europeans to document variability in Arctic-Atlantic exchanges east of Greenland and on-going American-lead efforts to monitor fluxes at Bering Strait. The first ever, simultaneous observations of global-Arctic Ocean exchanges will offer unprecedented constraints for testing regional and global models and so improve capabilities for prediction the earth system response to rising greenhouse gas concentrations. Our specific study will indicate critical, more sustainable measurements that will be needed to reveal the role of the Arctic freshwater output in decadal climate variability. Training the younger generation in the know-how of high-latitude research is an essential component of this project to assure that the talent will be in place to implement and make use of those critical measurements. Outreach to the secondary education and general public levels via teacher participation in cruises, media and internet, interactions with local communities, undergraduate, graduate and technician training, and communication to the broader scientific community are all integral to our research plan.

Science Participant List

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Zweng	Melissa zwengm@udel.edu	UDel	Grad. student 815 Leeds Ln, Newark DE 19711	302-831-6959

Ship's Crew

Permanent Crew, Officers

Capt Daniel Oliver
Cdr William J. Rall
Lcdr Daryl Peloquin
Lcdr Gregory Stanclik
Lt Robert Clarke
Ltjg Neal Amaral
Ltjg Joseph Castaneda
Ens Kevin M. Hasselman
Ens Darain S. Kawamoto
Ens James Cooley
Ens Sara Runyan
Ens Jason Plumley
Cwo2 Richard Mills
Cwo4 James A. Robson
Cwo2 William Levitch

Tad Crew, Officers

Cdr Barbara Schoen (Isc Seattle)
Lcdr Robert Young (Popdiv)
Lt Gregory Matyas (Popdiv)
Lt Gary Naus (Popdiv)
Lt Damon Williams (Popdiv)

Permanent Crew, Enlisted

Bmcm Joseph Gispert
Emcm John P. Mospens
Etcm James L. O'brien
Mstcs Glen T. Hendrickson
Fscs Karl Kaniss
Hscs Kevin Gordon
Bmc James W. Bride
Dcc Peter A. Schaffner
Emc Frank R. Donze
Etc Michael F. Mcguire
Mkc Joseph Diaz
Osc Lewis Winningham
Skc Karl Keyes
Ync Maria Kirby
Bm1 Patrick W. Morkis
Bm1 David J. Grob
Dc1 Bianca P. Witkowski
Em1 Devin D. Pritchard
Et1 Roger J. Retzlaff
Et1 Chris Martin
Fs1 David P. Casteel
It1 Stephen A. Chipman
Mk1 Chad J. Serfass
Mk1 Justin P. Fitzpatrick
Mk1 Michael Weaver
Mk1 Garrett Rogers
Mst1 Bridget A. Cullers
Sk1 Susan M. Peterson
Bm2 James Geist
Bm2 Darrel L. Bresnahan
Bm2 John C. Lobherr
Dc2 Paul Thomas
Dc2 Todd A. Gillick
Em2 Benjamin Garrett
Em2 Brad Jopling
Em2 Joseph Fratto
Et2 Joshua J. Rasmussen
Et2 Ryan P. Macneil
Et2 Timothy Marvin
Fs2 Joseph J. Stoddard
Mk2 Richard Titus
Mk2 Martin A. Bowley
Mk2 John W. Tebo
Mst2 Joshua T. Robinson
Mst2 Daniel Gaona
Os2 Elizabeth Neill
Sk2 Christopher Sisson
Bm3 Scott A Lussier
Bm3 Adam Gunter
Fs3 Jonathan D. Scott
Fs3 Vanessa A. Agosto
Fs3 Johnny M Hanika
Mk3 Timothy B. Gogolla
Mk3 Richard Erickson
Mk3 Michael J. Lund
Mk3 Malinda A. Nesvold
Mk3 Brandon S. Schreck
Mst3 Suzanne Scriven
Fn Robert J. Brock
Sn Heidi M. Schumann
Sn Trevor A. Hughes
Sn Garrett Young
Sn Jonathan Bilby
Fa Tomasz M. Dawlidowicz
Fa Shawn Chapin
Sa Robert Troha
Sa Sheryll Comonpearce
Sa Gaylin Swibold

Tad Crew, Enlisted

Amtc Lorion Ledkins (Popdiv)
Amt1 Trevin Dabney (Popdiv)
Amt1 Raymond O'dell(Popdiv)
Avt2 John Maghupoy (Popdiv)

125 Total Onboard
015 Officers (Perm Party)
005 Officers (Tad)
068 Enlisted (Perm Party)
004 Enlisted (Tad)
033 Civilians

CTD-ROSETTE HYDROGRAPHY

CTD-ROSETTE HYDROGRAPHY

Dr. Kelly Kenison Falkner
Oregon State University

1. Overview

Hydrographic sampling was conducted by means of equipment provided by the Coast Guard. The MST's interfaced with the bridge for deck operations, operated the winch, took care of emptying and cocking the bottles, resetting the pylon, and cleaning the optical windows and undertook trouble-shooting as required. Both the electronics technicians of the Coast Guard crew and science party contributed to trouble shooting when needed as well. The science party determined the locations and modes of sampling, operated the Sea-Bird software, recorded information on each cast in a hand written cast sheet, archived the data electronically and sampled the rosette. A total of 79 casts were made. Numbers 25 and 27 are missing from the sequence as we attempted to intersperse internally recording CTD casts in our numbering scheme. We abandoned such an approach after cast 27. Chi Meredith of OSU served as "sample cop" at the rosette operation. She directed the sampling and assured that the hydrocast logsheets were filled out correctly for each sampled cast. Water samples were not taken from all bottles at all casts. Every time a Niskin was sampled, a bottle salinity was drawn and run on board. Detailed information on the cast locations and which parameters were sampled from the casts can be found in the HydrocastList and RosSampRecord spreadsheets respectively. These spreadsheets are digitized versions of the hand entered logsheets created during the cruise.

2. Equipment specifics

A. Pre-HLY031

During the transit leg between Puerto Vallarta and Panama, under contract to the Coast Guard, Carl Mattson of the Scripps Institution of Oceanography in conjunction with the MST's performed tests on hydrographic equipment. He issued a report (that is available through Dave Forcucci) on Healy hydrographic systems. Certain items from his report are summarized or reproduced here.

It was necessary to cut over 1000 m of cable on winch #1 to leave the systems in working order. Over 9400 m of viable cable remain, however. Carl reported that, in general, all hydrographic equipment on Healy was found to be in very good condition and well maintained. All CTD Sensors, thermosalinographs and autosals were recently calibrated at the appropriate facility. Spare parts kits for all equipment is well stocked. Lab areas were clean and well organized.

After the completion of work by Carl and the MST's on July1, there were two fully operational CTD/Rosette systems. There is a third rosette that still needs a part of a frame in order to make it operational. Details for the systems and tests follow.

CTD/Rosette System #1 24 Place 12 Liter bottles 1 July 2003

Description	MFG	Model	Serial no.	Calibration Date
Carousel 24 Bottle Frame	Sea-Bird	SBE32	3224152-0348	N/a
CTD	Sea-Bird	SBE9Plus	09P24152-0638	
CTD Pressure	Paroscientific	Digiquartz	83009	09-Jan-01
Primary Temperature	Sea-Bird	SBE3Plus	03P2796	04-May-03
Primary Conductivity	Sea-Bird	SBE4C	042545	15-May-03
Secondary Temperature	Sea-Bird	SBE3Plus	03P2824	04-May-03
Secondary Conductivity	Sea-Bird	SBE4C	042568	16-May-03
Pump1	Sea-Bird	SBE5T	053112	N/a
Pump2	Sea-Bird	SBE5T	053114	N/a
Oxygen	Sea-Bird	SBE43	0430459	15-May-03
Transmissometer	Wetlabs	Cstar	CST-390DR	19-Dec-00
Fluorometer	Chelsea	AquaTrackaIII	088233	19-Mar-01
Altimeter	Benthos	916D	872	N/a
Water Samplers 24 EA 12 Liters External springs	OceanTest Equipment Inc.	110	N/a	N/a

System #1 is the primary rosette system.

Carl disconnected and inspected all underwater cables and bulkhead connectors. On CTD #638 he discovered corrosion on several of the CTD bulkhead connectors and the mating cable assemblies. He cleaned corrosion off the connectors and determined that the connectors were not damaged to the point that they needed to be replaced. Every connector on the CTD, sensors and carousel was inspected, cleaned and properly lubricated.

Carl reconnected all cables. He connected test cable to deck unit. He powered up the CTD system and checked for proper operation. He tested CTD, transmissometer, fluorometer, altimeter and oxygen sensor for proper operation. He tested pumps for proper operation and verified that they turned on after at least one minute after salt water was inserted into conductivity cell.

Carl tested Sea-Bird carousel for proper operation and actuated each bottle location to ensure that each latch released as it should.

The Niskin bottles were all in good condition. They all are configured with external springs. Water tests performed on all 24 bottles. Bottles were filled. Testing involved opening the spigot while the vent remained closed. Tests indicated there are no leaky bottles.

CTD/Rosette System #2 24 Place 12 Liter bottles 1 July 2003

Description	MFG	Model	Serial no.	Calibration Date
Carousel 24 Bottle Frame	Sea-Bird	SBE32	3224152-0347	N/a
CTD	Sea-Bird	SBE9Plus	09P24152-0639	
CTD Pressure	Paroscientific	Digiquartz	83012	09-Jan-01
Primary Temperature	Sea-Bird	SBE3Plus	03P2841	04-May-03
Primary Conductivity	Sea-Bird	SBE4C	042561	02-May-03
Secondary Temperature	Sea-Bird	SBE3Plus	03P2945	01-May-03
Secondary Conductivity	Sea-Bird	SBE4C	042575	02-May-03
Pump1	Sea-Bird	SBE5T	053115	N/a
Pump2	Sea-Bird	SBE5T	053116	N/a
Oxygen	Sea-Bird	SBE43	0430458	21-May-03
Transmissometer	Wetlabs	Cstar	CST-436DR	30-Mar-01
Fluorometer	Chelsea	AquaTrackaIII	088234	19-Mar-01
Altimeter	Benthos	916D	843	N/a
Water Sampler 24 EA 12 Liters External Springs	OceanTest Equipment Inc.	110	N/a	N/a

CTD System #2 was converted from a 12PL 30L system to a 24PL 12L system. Carl is connected and inspected all underwater cables and bulkhead connectors. Every connector on the CTD, sensors and carousel was inspected, cleaned and properly lubricated.

Carl reconnected all cables. He connected test cable to deck unit. He powered up the CTD system and checked for proper operation. He tested the CTD, transmissometer, fluorometer, altimeter and oxygen sensor for proper operation. He tested pumps for proper operation and verified that they turned on after at least one minute after salt water was inserted into conductivity cell.

He tested Sea-Bird carousel for proper operation and actuated each bottle location to ensure that each latch released as it should.

The Niskin bottles are all in good condition. They all are configured with external springs. Water tests performed on all 24 bottles. Bottles were filled. Testing involved opening the spigot while the vent remained closed. Tests indicated there are two leaky bottles.

There were two autosals on Healy.

Description	MFG	Model	Serial no.	Cal Date
Autosal	Guildline	8400B	65-715	
Autosal (From Polarstar)	Guildline	8400B	65-743	28-May-03

Carl set up both autosals in BIO lab. He filled the tanks and let temperature stabilize.

Autosal #65-743

He noticed that this autosal would not temperature stabilize. After doing some checking Carl discovered that the rear panel fan was not working. He opened the rear panel and found that the rear motor was disconnected. He reconnected the motor and after a period of time the machine was able to stabilize.

After the machine stabilized , the following checks were performed.

1. Bath thermistor operation
2. Pump operation
3. Conductivity Zero and Gain
4. Sample water analysis and stability of conductivity ratio

Testing showed that the conductivity gain setting is somewhat off. It is off by about 3-4 units. The allowable tolerance is 0-1 units.

Autosal #65-715

The following checks were performed.

5. Bath thermistor operation
6. Pump operation
7. Conductivity Zero and Gain
8. Sample water analysis and stability of conductivity ratio

Autosal #65-715 seems to be the most stable of the two although both machines work ok. Running the same seawater samples on both autosal machines Carl got about the same conductivity ratio values. Depending on the salinity of the sample, differences in conductivity readings can be as much as +/- 0.00003. This would equate to about +/- 0.0006 in salinity units. This small difference is probably due to the gain setting error on #65-743.

Carl attached ACI2000 Interfaces to each autosal. He checked out a Laptop from the Computer lab and hooked it into one of the autosal interfaces. After the ACI2000 software was loaded he tried to acquire data. He could receive the data string but the field that contains the conductivity ratio is always zero no matter what number the autosal displayed. He connected the other ACI2000 Interface and obtained the same result on both autosals.

The problem was determined to be in the autosals and not in the ACI2000 Interface boxes. After some checking, Carl found that a wrong integrated circuit was installed in the data output circuitry. The wrong IC was also installed in the other autosal AND … on the spare circuit card in the spares kit. He located a similar but not exact part on another circuit card in the spares kit and installed it in one of the autosals. He then tried the interface and everything worked ok. The data stream came out with all data fields.

The ACI2000 Interface worked ok on autosal #65-743 with the right IC. He transferred the IC to 65-715. It works for the most part but the datalog switch on 65-715 seems to be miswired as it doesn't function as it should. The result is erratic logging of the data when using the ACI2000 software on #65-715.

Carl installed the SIO autosal logging software on the laptop and it works ok on both autosals. The SIO software doesn't utilize the autosal datalog switch so it works well on 65-715. It also works with the ACI2000 Interface. Both SIO and ACI2000 software is installed so the user can take their pick.

The part needed to fix the Autosal interface is Z311 located on the Meter PCB. It can be obtained at any electronics distributor.

Manufacturer Bourns part no. 4116R-2-102

Training on the operation and care of autosals was given to all MST's.
Topics included:

1. Preparing the autosal for use
2. Conducting operational checks prior to use
3. Operating the Autosal using the OSI ACI2000 logging software
4. Operating the Autosal using the SIO logging software
5. Autosal standardization
6. Running samples
7. End standard check
8. Procedures to be taken after using the autosal
9. Packing and storing the autosal

After the training, all of the MST's participated in running the samples obtained from the CTD test casts. The autosal used to run the salinity samples was #65-715. Samples obtained from the underway system for checks on the thermosalinographs were also completed.

Action item: Procure correct parts to repair Autosal interfaces on both autosals and spare board.

B. During HLY031

As the science party embarked for the HLY031 mission, Chief Scientist Kelly Falkner informed them that Autosal #65-715 and CTD System #1 would be used for the mission.

1. Autosal

Autosal #65-715 was moved into a climate control chamber on July 20 and the automated data collection system disabled. The climate control chamber initially experienced regular positive temperature spiking of 10's of degrees. This was due to improper programming for room temperature operation. The temperature was set to 24 deg C, defrosting disabled and then the chamber maintained very stable temperatures throughout the remainder of the cruise. It is noted that filtration for trace metal samples was also carried out in the climate control chamber. The stable temperatures resulted in excellent stability for the autosal the bath temperature of which was set at 27 deg C. The autosal required but small calibration adjustments infrequently (once every several days to weeks). We experienced only one malfunctioning incident when the cell failed to flush. Upon opening the instrument a loose connection for the flushing tubing was noted and corrected. The instrument produced excellent data to the advertised precision throughout the cruise. The OSU group established a log book for this instrument that was left with the ship.

2. CTD-Rosette

On July 20, Kelly instructed Chi Meredith to replace all O-rings on the bottles of CTD System #1 with red silicone rubber variants that had been acid cleaned and baked for compatibility with trace metal and CFC analysis. Jay Simpkins and the MST'S then added the "ZAPS" DOC-sensor to the CTD-system #1 sensor array. ZAPS stands for zero-angle photon sensor. ZAPS is a fiber-optic based fluorometer designed by and run on behalf of OSU Investigator Gary Klinkhammer. ZAPS was configured to excite and monitor for wavelengths characteristic of dissolved organic matter and nominally draws 300 mA. ZAPS had been successfully deck tested for compatibility with the Sea-Bird CTD in Seattle in June 2003 before Healy left port. While in port in St. John's, it was mounted below the bottles on the rosette frame. It was connected to the CTD via a Y-cable shared with the dissolved O_2-sensor provided by OSU. Deck testing of the package indicated all sensors to be recording within the expected ranges and no data losses to be occurring. Unfortunately, no simultaneous, sensible, in-the-water ZAPS and O_2 data were obtained during this mission. For the first few casts, ZAPS appeared to be recording properly but the O_2 data was nonsensical. In retrospect, this situation appears to have been a short cause by a leak in the connector. In fact, we experienced several problems with the CTD-system that probably were due to shorts caused by leaks at the connectors. These occurred despite the proper greasing and "burping" of the connectors and actually resulted in the malfunctioning of CTD System #1 including the deck unit at cast 51. After much trouble-shooting, CTD System #1 was declared non-functioning and it and its sensors were replaced by placing CTD System #2 on rosette frame #1. For further specific details regarding the equipment, please refer to the comments lines in HydrocastInfo spreadsheet.

We also note that somewhere around cast 50, bottle salinities suggested that we might be having trouble with random tripping of bottles. Humfrey Melling had experienced this problem last year with another Sea-Bird pylon and was advised by Sea-Bird to regularly remove and clean the block holding the pylon in place. We removed and soaked the block in detergent and rinsed it copiously in freshwater. On reinspection of the data post cruise, it appears that we had 3 to 5 such random trips. These are noted in the HydrocastList spreadsheet comments. None occurred after cleaning the pylon block.

3. Mode of Operation

The science party engaged in much discussion of the optimal way in which to conduct water sampling during the CTD-rosette up cast. Humfrey Melling advocated that in his experience, tripping bottles "on the fly" took less time and avoided wake issues associated with the package. As long as the package speed is constant, samples tripped on the fly should display a predictable offset distance from properties recorded at the CTD sensors. Other people were more used to the convention of bringing the rosette to a desired trip depth and waiting some specific amount of time. Since time was at a premium, the chief scientist decide to give Humfrey's approach a try and to compare bottle sensor data with measured bottle salinities as a check on the validity of such an approach.

As data were accumulated, Humfrey's claims appeared to be born out. Without even correcting for the vertical offset, bottle salinities appeared to be within acceptable limits of sensor salinities except perhaps in the very surface where gradients were largest.

There remained some discomfort among the science party about the approach and so we took the opportunity to compare profiles collected in one location "on the fly" and with a 5-minute stop at each bottle depth at casts 16 and 17. Again, a comparison of bottle salinities with the sensors reflected favorably on the "on the fly" approach with considerable savings of time (2 hours per cast).

For the remainder of the cruise, we used this approach. Typically the package was lowered at a rate of 30 m/min for the first 100 m and then 60 m/min to the deepest desired depth. The first bottle was tripped either immediately or within 1 minute of acquiring the deepest depth. We generally used the altimeter as the indication of when to terminate the cast at either at 10 or 15 m above the bottom. The package was then raised at 60 m/min through the water column to 100 m and bottles tripped "on the fly". As doing so made things go quite quickly, it was useful to have two operators, one controlling the software and the other hand recording target trip depths on the logsheet. At 100 m, the ascent rate was slowed to 30 m/min and the remaining bottles tripped on the fly.

Appendix: Factory SBE43 Calibration Coefficients

	CASTS 1-50 **S/N 0459** **15-May-2003**	**CASTS 51-81** **S/N 0458** **21-May-2003**
Soc =	0.3522	0.3786
Voffset =	-0.4827	-0.4901
Tcor =	0.0015	0.0014
Pcor =	1.350e-04	1.350e-04
τ_{RT} =	1.2	1.4

References:

García, H. E., and Gordon, L. I. 1992. Oxygen solubility in seawater: Better fitting equations. Limnol. Oceanogr. **37**: 1307-1312.

HLY031 Cruise Report.

HLY031 CTD Bottle Processing Report.

HLY031 CTD Data Processing Report.

Weiss, R. F. 1970. The solubility of nitrogen, oxygen and argon in water and seawater. Deep-Sea Res. **17**: 721-735.

Hydrocast List

Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	Time Zone	Date	Time	Water depth start	Water depth end	Trip style	True Wind Speed (kt)
	1	n										2364		Up:NoStop	<2
hly031-0002.ios	2	B1	72	45.18	N	67	1.47	W	UTC	26-Jul-03	4:29	2374		Up:NoStop	approx 5
hly031-0003.ios	3	B1	72	44.86	N	67	0.13	W	UTC	26-Jul-03	11:15	2365	2371	**Up:Stop**	18
hly031-0004.ios	4	BEW2	72	45.17	N	68	0.34	W	UTC	26-Jul-03	14:59	2278	2279	Up:NoStop	11
hly031-0005.ios	5	BEW3	72	39.81	N	68	59.59	W	UTC	26-Jul-03	21:21	2070	2068	Up:NoStop	approx 17
hly031-0006.ios	6	BEW4	72	37.13	N	69	46.71	W	UTC	27-Jul-03	0:43	1837	1835	Up:NoStop	7
hly031-0007.ios	7	BEW5	72	35.16	N	70	49.56	W	UTC	27-Jul-03	4:23	1476	1457	Up:NoStop	17
hly031-0008.ios	8	BEW6	72	32.6	N	71	21.25	W	UTC	27-Jul-03	6:52	1199	1203	Up:NoStop	21
hly031-0009.ios	9	BEW7	72	29.86	N	72	0.19	W	UTC	27-Jul-03	9:11	1029	1037	Up:NoStop	16
hly031-0010.ios	10	BEW8	72	26.92	N	72	34.77	W	UTC	27-Jul-03	11:19	899	902	Up:NoStop	11
hly031-0011.ios	11	BEW9	72	24.71	N	73	10.19	W	UTC	27-Jul-03	13:22	683	693	Up:NoStop	13
hly031-0012.ios	12	BEW10	72	23.02	N	73	50.15	W	UTC	27-Jul-03	15:25	155	152	Up:NoStop	3
hly031-0013.ios	13	BEW11	72	20.16	N	74	26.48	W	UTC	27-Jul-03	17:27	107		Up:NoStop	2
hly031-0014.ios	14	BNS2	73	3.23	N	66	59.77	W	UTC	30-Jul-03	9:12	2378	2383	Up:NoStop	9
hly031-0015.ios	15	BNS3	73	22.94	N	66	59.76	W	UTC	30-Jul-03	13:19	2355	2356	Up:NoStop	11.5
hly031-0016.ios	16	BNS4	73	40.93	N	67	0.09	W	UTC	30-Jul-03	17:22	2340	2339	**Up:Stop**	11.5
hly031-0017.ios	17	BNS5	73	58.14	N	67	3.66	W	UTC	30-Jul-03	23:08	2244		Up:NoStop	12
hly031-0018.ios	18	BNS6	74	17.27	N	66	59.16	W	UTC	31-Jul-03	2:50	2220	2215	Up:NoStop	22
hly031-0019.ios	19	BNS7	74	33.15	N	66	59.37	W	UTC	31-Jul-03	6:16	2142	2144	Up:NoStop	24
hly031-0020.ios	20	BNS08	74	47.14	N	67	0.08	W	UTC	31-Jul-03	9:07	1694	1658	Up:NoStop	25-29
hly031-0021.ios	21	BNS09	74	58.27	N	67	0.08	W	UTC	31-Jul-03	11:32	666	590	Up:NoStop	15-20
hly031-0022.ios	22	BNS10	75	8.07	N	66	59.76	W	UTC	31-Jul-03	13:20	482	484	Up:NoStop	15-20
hly031-0023.ios	23	BNS11	75	18.69	N	67	0.12	W	UTC	31-Jul-03	15:01	422	425	Up:NoStop	18
hly031-0024.ios	24	BNS12	75	31.96	N	67	0.06	W	UTC	31-Jul-03	17:13	394	397	Up:NoStop	15

Hydrocast List

Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	Time Zone	Date	Time	Water depth start	Water depth end	Trip style	True Wind Speed (kt)
hly031-0026.ios	26	BNS13	75	42.04	N	67	0.32	W	UTC	31-Jul-03	19:14	448	452	Up:NoStop	15
hly031-0028.ios	28	BNS14	75	50.12	N	67	1.61	W	UTC	31-Jul-03	21:26	117	117	Up:NoStop	17
hly031-0029.ios	29	KCS1	76	32.04	N	70	31.87	W	UTC	2-Aug-03	17:56	119		No bottles tripped	
hly031-0030.ios	30	KCS2	76	29.84	N	70	45.66	W	UTC	2-Aug-03	18:41	213		No bottles tripped	
hly031-0031.ios	31	KCS3	76	27.48	N	70	59.18	W	UTC	2-Aug-03	19:28	330		No bottles tripped	
hly031-0032.ios	32	KCS4	76	25.11	N	71	13.23	W	UTC	2-Aug-03	20:20	468		No bottles tripped	
hly031-0033.ios	33	KCS5	76	21.67	N	71	32.98	W	UTC	2-Aug-03	21:27	649		No bottles tripped	
hly031-0034.ios	34	KCS6	76	50.08	N	71	3.82	W	UTC	2-Aug-03	1:34	148		No bottles tripped	
hly031-0035.ios	35	KCS7	76	48.37	N	71	8.9	W	UTC	2-Aug-03	2:09	422		No bottles tripped	
hly031-0036.ios	36	KCS8	76	46.01	N	71	30.51	W	UTC	2-Aug-03	3:14	768		No bottles tripped	
hly031-0037.ios	37	KCS9	76	43.44	N	71	47.79	W	UTC	2-Aug-03	4:25	696		No bottles tripped	
hly031-0038.ios	38	KCS10	76	41.12	N	72	11.95	W	UTC	2-Aug-03	5:35	244		No bottles tripped	
hly031-0039.ios	39	S01	78	19.89	N	72	54.85	W	UTC	2-Aug-03	23:49	120	125	Up:NoStop	13.9
hly031-0040.ios	40	S02	78	20.34	N	73	22.57	W	UTC	3-Aug-03	4:23	490	400	Up:NoStop	17
hly031-0041.ios	41	S03	78	19.9	N	73	53.37	W	UTC	3-Aug-03	6:10	574		Up:NoStop	20
hly031-0042.ios	42	S03	78	20.02	N	73	54.2	W	UTC	3-Aug-03	7:58	565	591	**Up:Stop**	19
hly031-0043.ios	43	S04	78	19.99	N	74	26.19	W	UTC	3-Aug-03	9:56	486		Up:NoStop	20
hly031-0044.ios	44	S05	78	19.89	N	74	53.87	W	UTC	3-Aug-03	11:34	203	223	Up:NoStop	44
hly031-0045.ios	45	KS01	80	33.55	N	68	55.54	W	UTC	4-Aug-03	18:18	170	135	Up:NoStop	5.6
hly031-0046.ios	46	KS03	80	32.6	N	68	46.49	W	UTC	4-Aug-03	20:53	357	355	Up:NoStop	5.2
hly031-0047.ios	47	KS05	80	31.07	N	68	35.07	W	UTC	4-Aug-03	23:05	354		Up:NoStop	20
hly031-0048.ios	48	KS07	80	29.2	N	68	19.33	W	UTC	5-Aug-03	0:53	378	374	Up:NoStop	24
hly031-0049.ios	49	KS09	80	27.27	N	68	3.65	W	UTC	5-Aug-03	2:38	336		Up:NoStop	27
hly031-0050.ios	50	KS09	80	27.69	N	68	2.36	W	UTC	5-Aug-03	11:52	342	339	Up:NoStop	10
hly031-0051.ios	51	KS11	80	25.19	N	67	48.97	W	UTC	5-Aug-03	16:35	285		Up:NoStop	14
hly031-0052.ios	52	KS13	80	23.62	N	67	34	W	UTC	5-Aug-03	17:53	215		Up:NoStop	7
hly031-0053.ios	53	KS15	80	22.26	N	67	25.34	W	UTC	5-Aug-03	19:49	85	82	Up:NoStop	11
hly031-0054.ios	54	KN7	81	8.61	N	64	6.95	W	UTC	6-Aug-03	21:15	170		Up:NoStop	15
hly031-0055.ios	55	KN6	81	10.02	N	64	17.79	W	UTC	6-Aug-03	22:22	440		Up:NoStop	13
hly031-0056.ios	56	KN5	81	11.48	N	64	29.85	W	UTC	6-Aug-03	23:28	500		Up:NoStop	13
hly031-0057.ios	57	KN4	81	12.94	N	64	39.69	W	UTC	7-Aug-03	0:45	459		Up:NoStop	12

Hydrocast List

Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	Time Zone	Date	Time	Water depth start	Water depth end	Trip style	True Wind Speed (kt)
hly031-0058.ios	58	KN3	81	14.42	N	64	50.28	W	UTC	7-Aug-03	1:58	406		Up:NoStop	weak
hly031-0059.ios	59	KN2	81	15.79	N	65	1.22	W	UTC	7-Aug-03	3:19	413	396	Up:NoStop	7
hly031-0060.ios	60	KN1	81	17.06	N	65	8.74	W	UTC	7-Aug-03	4:50	217	175	Up:NoStop	6
hly031-0061.ios	61	RN7	82	0.52	N	60	21.54	W	UTC	9-Aug-03	12:17				
hly031-0062.ios	62	RN7	82	0.51	N	60	22.79	W	UTC	9-Aug-03	18:10	425		Up:NoStop	11.9
hly031-0063.ios	63	RN6	82	1.49	N	60	35.51	W	UTC	9-Aug-03	19:37	388		Up:NoStop	30
hly031-0064.ios	64	RN5	82	3.07	N	60	47.63	W	UTC	9-Aug-03	20:37	418	405	Up:NoStop	24
hly031-0065.ios	65	RN4	82	4.14	N	61	0.74	W	UTC	9-Aug-03	21:35	518		Up:NoStop	16
hly031-0066.ios	66	RN3	82	5.48	N	61	11.02	W	UTC	9-Aug-03	22:34	513	513	Up:NoStop	18
hly031-0067.ios	67	RN2	82	6.67	N	61	23.29	W	UTC	9-Aug-03	23:40	530		Up:NoStop	20
hly031-0068.ios	68	RN1	82	7.54	N	61	36.65	W	UTC	10-Aug-03	1:24	420		Up:NoStop	28
hly031-0069.ios	69	PG1	81	7.59	N	61	50.2	W	UTC	10-Aug-03	15:24	1048	1048	Up:NoStop	26
hly031-0070.ios	70	PG2	81	16.75	N	62	32.1	W	UTC	11-Aug-03	5:00	394	390	No bottles tripped	
hly031-0071.ios	71	PG2	81	16.76	N	62	31.1	W	UTC	11-Aug-03	5:18	390	390	No bottles tripped	
hly031-0072.ios	72	PG2	81	16.75	N	62	30.34	W	UTC	11-Aug-03	5:35	390	390	No bottles tripped	
hly031-0073.ios	73	PG2	81	16.73	N	62	29.8	W	UTC	11-Aug-03	5:50	390	390	No bottles tripped	
hly031-0074.ios	74	PG2	81	16.63	N	62	28.36	W	UTC	11-Aug-03	6:29	394	392	No bottles tripped	
hly031-0075.ios	75	PG2	81	16.59	N	62	27.8	W	UTC	11-Aug-03	6:44	394	397	No bottles tripped	
hly031-0076.ios	76	PG2	81	16.61	N	62	26.23	W	UTC	11-Aug-03	7:01	396	394	No bottles tripped	
hly031-0077.ios	77	PG2	81	16.66	N	62	24.23	W	UTC	11-Aug-03	7:19	394	392	No bottles tripped	
hly031-0078.ios	78	PG2	81	16.82	N	62	23.99	W	UTC	11-Aug-03	7:35	391	383	No bottles tripped	
hly031-0079.ios	79	PG2	81	17.07	N	62	24.12	W	UTC	11-Aug-03	7:52	383	379	No bottles tripped	
hly031-0080.ios	80	HB	81	37.27	N	63	14.95	W	UTC	11-Aug-09	11:04	795	765	Up:NoStop	18
hly031-0081.ios	81	HB	81	37.18	N	63	14.67	W	UTC	11-Aug-09	13:00	794		**Up:Stop**	30

Filename	True Wind Direction	Sea State	Ice	Air Temp (degC)
	boxing	calm	none	3.35
hly031-0002.ios	340	small swell	none	3.48
hly031-0003.ios	2	slight swell	none	3.61
hly031-0004.ios	290	slight chop	none	3.09
hly031-0005.ios	328	slight chop	none	4.25
hly031-0006.ios	190	3 feet	none	2.45
hly031-0007.ios	150	slight chop	icebergs in sight	2.84
hly031-0008.ios	160	slight chop	none	3.48
hly031-0009.ios	165	1 metre	none	3.2
hly031-0010.ios	200	0.5 metres	none	3.9 (4.5)
hly031-0011.ios	255	calm	pieces on horizon	5.8
hly031-0012.ios	137	calm		8
hly031-0013.ios	190	calm	none	9.6
hly031-0014.ios	0	3 feet	none	4.4
hly031-0015.ios	256	3-5 foot swell	none	4.8
hly031-0016.ios	277	6 foot swell	none	4.76
hly031-0017.ios	215	5-6 feet	none	4.8
hly031-0018.ios	193	10 foot swell	none	2.5
hly031-0019.ios	210	10 foot swell	none	4.1
hly031-0020.ios	200	choppy	none	5.03/4.90
hly031-0021.ios	196	choppy	none	4.13
hly031-0022.ios	232	3 metres	none	4.3
hly031-0023.ios	190	2 metres	none	4.5
hly031-0024.ios	179	choppy	none	3.88

Hydrocast List

Filename	True Wind Direction	Sea State	Ice	Air Temp (degC)
hly031-0026.ios	153	3 metre swell	none	3.5
hly031-0028.ios	140	1.5 metres	bergs nearby	3.3
hly031-0029.ios				
hly031-0030.ios				
hly031-0031.ios				
hly031-0032.ios				
hly031-0033.ios				
hly031-0034.ios				
hly031-0035.ios				
hly031-0036.ios				
hly031-0037.ios				
hly031-0038.ios				
hly031-0039.ios	196	calm	bergs	4.37
hly031-0040.ios	121	calm	BIG! BERG	3.22
hly031-0041.ios	190	slightly choppy	big berg	
hly031-0042.ios	175	calm to choppy	some bergs	2.82
hly031-0043.ios	197	slightly choppy	distant berg	1.81
hly031-0044.ios	20	3 foot chop	scattered bergy bits	1.4
hly031-0045.ios	10	very calm	bits in area	
hly031-0046.ios	157	very calm	bits in area	31 degF
hly031-0047.ios	208	2 foot chop	< 1/10	-1
hly031-0048.ios	185	calm	small patches	1.5
hly031-0049.ios	185	calm	drifting pieces	1.2
hly031-0050.ios	230	calm	3/10 - 5/10	1.2
hly031-0051.ios	200	flat	2/10 - 5/10	1.7
hly031-0052.ios	255	flat	5/10	0.5
hly031-0053.ios	220	flat	9/10	4.5
hly031-0054.ios	250	light chop	clear	1.3
hly031-0055.ios	225	1 foot chop	< 1/10	2.2
hly031-0056.ios	200	calm	1/10	1.8
hly031-0057.ios	225	light chop	none near	1.4

Hydrocast List

Filename	True Wind Direction	Sea State	Ice	Air Temp (degC)
hly031-0058.ios		calm < 1 foot chop	>1/10	1.4
hly031-0059.ios	270	flat	none in sight	0.5
hly031-0060.ios	30	flat	none	1.56
hly031-0061.ios				
hly031-0062.ios	236			2.2
hly031-0063.ios	215	3 foot sea	<1/10	
hly031-0064.ios	220	1 foot chop	none	warm
hly031-0065.ios	243	3 foot waves	<1/10	
hly031-0066.ios	220	1 foot chop	none	warm/sunny
hly031-0067.ios	205	Beaufort 3	edge between 0/10 and 7/10	
hly031-0068.ios	200	3 foot	clear	
hly031-0069.ios	28	small chop	near glacier	warm
hly031-0070.ios				
hly031-0071.ios				
hly031-0072.ios				
hly031-0073.ios				
hly031-0074.ios				
hly031-0075.ios				
hly031-0076.ios				
hly031-0077.ios				
hly031-0078.ios				
hly031-0079.ios				
hly031-0080.ios	190	slight chop	none	
hly031-0081.ios	217	slight chop	none	

Hydrocast List

Filename		Comments on ctd/ros casts from deck sheets :	Comments post cruise
		Cast aborted @ 500m, O2 sensor dropped out at ~20m: DOC dropped out at 380m with both O2 sensor plus DOC giving larger sporadic shifts.	
hly031-0002.ios		DOC sensor secured w/dummy plug:straight cable to O2 sensor stopped at bottom plus 2250; then tripped on the fly ` 4m ahead of target (m).	
hly031-0003.ios	3	Had reconfigured for straight cable connection to ZAPS but got no signals in the water. Came back on deck; no signals w/test cable; changed back to o2 sensor, signals OK;changed back to conducting cable.	
hly031-0004.ios	4	Stopped at bottom and at 2250m then tripped on the fly approximately 4m ahead of target.	
hly031-0005.ios	5	Seabeam depths	
hly031-0006.ios	6	Iceberg ~2 mile distant; powered down just before surface.	
hly031-0007.ios	7	none	
hly031-0008.ios	8	none	
hly031-0009.ios	9	none	Bottle 10 may have tripped early (target 175m). It follows the Bottle 7 data closely in nutrients and salinity.
hly031-0010.ios	10	none	
hly031-0011.ios	11	none	
hly031-0012.ios	12	none	
hly031-0013.ios	13	none	
hly031-0014.ios	14	none	
hly031-0015.ios	15	Obs slight O2 increase/T decrease at 100 m coincident with change from 30 m/min to 60 m/min; Btl 18 = fluorescent max	
hly031-0016.ios	16	5 minute soak @ each depth. Had a bit of a wire angle such that bottledepth tended to increase; by ~ 2 m during five minute soak for depth < ~ 400 m; Fired 2 bottles at the surf after 5 minute wait	
hly031-0017.ios	17	none	
hly031-0018.ios	18	A few negative "descent rates" due to ship's roll.	
hly031-0019.ios	19	Ship rolling sufficiently to cause some negative downwater velocities.	
hly031-0020.ios	20	none	
hly031-0021.ios	21	Increase to 60 m/min @ ~150 m.; 5/6 tripped on way, 13 btls instead of 12	
hly031-0022.ios	22	Low fluorometer values at this station; senior confirms that optics have not been cleaned so far during survey.	
hly031-0023.ios	23	none	Bottle 5 salinity off (target 140m), but right at a large temperature change.
hly031-0024.ios	24	18 fl max (bottle 9) Btl# 1 Rob took a paper towel and "filtered sample for later microscopic examination. # 9 also.	

Hydrocast List

Filename		Comments on ctd/ros casts from deck sheets :	Comments post cruise
hly031-0026.ios	26	Note Cast no. 25-internally recording CTD @ stn BNS 12 a. Bottle 9 = Fl max; Btl 10 = O2 max	
hly031-0028.ios	28	Bottle #1 10 m off bottom recording to altimeter.	
hly031-0029.ios			
hly031-0030.ios			
hly031-0031.ios			
hly031-0032.ios			
hly031-0033.ios			
hly031-0034.ios			
hly031-0035.ios			
hly031-0036.ios			
hly031-0037.ios			
hly031-0038.ios			
hly031-0039.ios	39	Windows cleaned (fluorometer, transmissometer) before cast; 30 m/min lowering rate.	
hly031-0040.ios	40	Lowered slowly due to high wire angle + large variation in bottom Depth (440 - 500 m)	
hly031-0041.ios	41	Cleaned windows on Trans and Fluoromater,	
hly031-0042.ios	42	Windows clean: 2nd cast for Cs and salt only.	
hly031-0043.ios	43	Windows clean.	
hly031-0044.ios	44	none	
hly031-0045.ios	45	Sixth bottle did not fire for no apparent reason.	
hly031-0046.ios	46	Second 10 m bottle collected for CFC soaking bucket.	
hly031-0047.ios	47	The stn is a layer cake!	
hly031-0048.ios	48	The 2 top bottles (9 and 8) are extra water for John.	Bottle 5 salinity off (target 80m), but cast sheet comments say that the cast was like a layer cake
hly031-0049.ios			
hly031-0050.ios	50	none	
hly031-0051.ios	51	Fuses blew again on first attempt, suspended casts - replaced fish and connector; (both appear to have problems: note new config file installed for CTD (O639.con).	
hly031-0052.ios	52	none	
hly031-0053.ios	53	none	
hly031-0054.ios	54	Downcast @ 30 m/min for entire cast.	
hly031-0055.ios	55	none	
hly031-0056.ios	56	none	Bottle 9 may have tripped at wrong depth (Target 150m), consistent with nutrient data
hly031-0057.ios	57	none	

Hydrocast List

Filename	Comments on ctd/ros casts from deck sheets :		Comments post cruise
hly031-0058.ios	58	none	
hly031-0059.ios	59	none	
hly031-0060.ios	60	Wire was under ship as it was pulled up, ship drifed a lot during cast.	Bottle 5 salinity off (target 38 m), but right at a large temperature change
hly031-0061.ios		No cast sheet available	
hly031-0062.ios	62	Rosette went down 43 m and brought back up to 10 m before bringing to surface and sending down. Altimeter reads 88 at surface.	
hly031-0063.ios	63	Altimeter reads ~ 20 m to low, e.g. states 30 m off bottom when it's really 50 m off the bottom wire out agrees with pressure reading + f bottom = 354 (rosette) = 354 winch wire out.	Bottle 5 salinity off (target 100m), but right at a large temperature change
hly031-0064.ios	64	383 wire out, altimeter 15 = 397 m seabeam reads 405 m.	
hly031-0065.ios	65	none	
hly031-0066.ios	66	(Started bot 7) 80 m depth by overturned (subducted) water near a frontal zone? 71 m upcast bottle in subducted layer: 478 m wire out at 471 m depth seabeam 505 m; altimeter reads 12 - m @ 485 m.	
hly031-0067.ios	67	Bottle #1 fired @ 12 m on the way down. Stopped @ 528 m (wire out) to allow for wire angle to decrease. Bringing rosette back to surface to bebin again. Wire out and bottom depth are too close. (This was overruled however, and the cast continued up).	
hly031-0068.ios	68	none	
hly031-0069.ios	69	Wire out identical to depth @ 1018 m.	
hly031-0070.ios			
hly031-0071.ios			
hly031-0072.ios			
hly031-0073.ios			
hly031-0074.ios			
hly031-0075.ios			
hly031-0076.ios			
hly031-0077.ios			
hly031-0078.ios			
hly031-0079.ios			
hly031-0080.ios	80	Transmissometer is not responding, windows were cleaned.	HB Bottle 13 (target 50m) may have tripped at wrong depth, consistent with nutrient data
hly031-0081.ios	81	Windows clean. Bottles triggered after 1 min wait at each depth. Bottle # 10 fired immediately.	

Ross Sample Record

															Count of samples												
															160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
												water															
Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
hly031-0001.ios	1	B1	72	45.03	N	67	0.68	W	UTC	07/26/2003	02:27	00:00															
hly031-0002.ios	2	B1	72	45.18	N	67	1.47	W	UTC	07/26/2003	04:29	2374	264501	1	X	X	X	X	X	X	X		X	X	X		X
	2												264502	2	X	X	X	X			X		X	X			X
	2												264503	3	X		X	X	X	X	X		X	X	X		X
	2												264504	4	X		X	X	X	X	X		X	X			X
	2												264505	5	X	X	X	X	X	X	X		X	X	X		X
	2												264506	6	X		X	X	X	X	X		X	X			X
	2												264507	7	X		X	X			X		X	X			X
	2												264508	8	X		X	X			X		X	X			X
	2												264509	9	X	X	X	X	X	X	X		X	X	X		X
	2												264510	10	X		X	X			X		X	X			X
	2												264511	11	X,X		X	X	X	X	X		X	X	X		X
	2												264512	12			X	X			X		X	X			X
	2												264513	13	X		X	X	X	X	X		X	X	X		X
	2												264514	14	X	X	X	X			X		X	X	X		X
	2												264515	15	X		X	X			X		X	X	X		X
	2												264516	16	X	X	X	X	X	X	X		X	X	X		X
	2												264517	17	X		X	X			X		X	X	X		X
	2												264518	18			X	X			X		X	X			X
	2												264519	19	X,X		X	X	X	X	X		X	X	X		X
	2												264520	20	X	X	X	X	X	X	X		X	X	X		X
	2												264521	21	X	X	X	X			X		X	X			X
	2												264522	22	X	X	X	X			X		X	X			X
	2												264523	23	X	X	X	X	X	X	X		X	X	X		X
	2												264524	24	X		X	X			X		X	X			X
hly031-0003.ios	3	B1	72	44.86	N	67	0.13	W	UTC	07/26/2003	11:15	2365	264525	1										X		X	
	3												264526	2										X		X	
	3												264527	3										X		X	
	3												264528	4										X		X	
	3												264529	5										X		X	
	3												264530	6										X		X	
	3												264531	7										X		X	
	3												264532	8										X		X	
	3												264533	9										X		X	
	3												264534	10										X		X	
	3												264535	11										X		X	
	3												264536	12										X		X	
	3												264537	13										X		X	
	3												264538	14										X		X	
	3												264539	15										X		X	
hly031-0004.ios	4	BEW2	72	45.17	N	68	0.34	W	UTC	07/26/2003	14:59	2278	264540	1		X	X	X	X		X		X	X			
	4												264541	2			X	X			X		X	X			
	4												264542	3		X	X	X			X		X	X			
	4												264543	4			X	X	X		X		X	X			
	4												264544	5			X	X	X		X		X	X			
	4												264545	6			X	X			X		X	X			
	4												264546	7			X	X			X		X	X			
	4												264547	8			X	X			X		X	X			
	4												264548	9			X	X	X		X		X	X			
	4												264549	10			X	X			X		X	X			
	4												264550	11		X	X	X	X		X		X	X			
	4												264551	12			X	X			X		X	X			
	4												264552	13			X	X			X		X	X			
	4												264553	14			X	X	X		X		X	X			
	4												264554	15		X	X	X			X		X	X			
	4												264555	16			X	X			X		X	X			
	4												264556	17		X	X	X	X		X		X	X			
	4												264557	18			X	X			X		X	X			
	4												264558	19			X	X			X		X	X			
	4												264559	20		X	X	X	X		X		X	X			
	4												264560	21			X	X			X		X	X			
	4												264561	22		X	X	X	X	X	X		X	X			
	4												264562	23		X	X	X	X		X		X	X			
	4												264563	24			X	X	X	X	X		X	X			
hly031-0005.ios	5	BEW3	72	39.81	N	68	59.59	W	UTC	07/26/2003	21:21	2070	264564	1	X	X	X	X	X		X		X	X			
	5												264565	2	X	X	X	X			X		X	X			
	5												264566	3	X		X	X			X		X	X			
	5												264567	4	X		X	X	X		X		X	X			
	5												264568	5	X	X	X	X	X		X		X	X			
	5												264569	6	X		X	X			X		X	X			
	5												264570	7	X		X	X			X		X	X			
	5												264571	8	X		X	X			X		X	X			
	5												264572	9	X	X	X	X	X		X		X	X			
	5												264573	10	X		X	X			X		X	X			
	5												264574	11	X		X	X			X		X	X			
	5												264575	12	X		X	X	X		X		X	X			
	5												264576	13	X		X	X			X		X	X			
	5												264577	14	X	X	X	X	X		X		X	X			
	5												264578	15	X	X	X	X			X		X	X			
	5												264579	16	X		X	X			X		X	X			
	5												264580	17	X		X	X	X		X		X	X			
	5												264581	18	X	X	X	X			X		X	X			
	5												264582	19	X		X	X			X		X	X			
	5												264583	20	X		X	X	X		X		X	X			X
	5												264584	21	X		X	X			X		X	X			
	5												264585	22	X		X	X	X	X	X		X	X			X
	5												264586	23	X,X	X	X	X			X		X	X			
	5												264587	24		X	X	X	X	X	X		X	X			X
hly031-0006.ios	6	BEW4	72	37.13	N	69	46.71	W	UTC	07/27/2003	00:43	1837	264588	1		X		X	X		X		X	X			
	6												264589	2				X			X		X	X			
	6												264590	3				X	X		X		X	X			
	6												264591	4				X			X		X	X			
	6												264592	5				X			X		X	X			
	6												264593	6		X		X	X		X		X	X			
	6												264594	7				X			X		X	X			
	6												264595	8				X			X		X	X			
	6												264596	9				X	X		X		X	X			
	6												264597	10				X			X		X	X			
	6												264598	11		X		X	X		X		X	X			
	6												264599	12				X			X		X	X			
	6												264600	13				X			X		X	X			
	6												264601	14				X	X		X		X	X			
	6												264602	15				X			X		X	X			

Ross Sample Record

															Count of samples												
															160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	water depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
	6												264603	16				X			X		X	X			
	6												264604	17		X		X			X		X	X			
	6												264605	18		X		X			X		X	X			
	6												264606	19		X		X	X		X		X	X			X
	6												264607	20				X	X	X	X		X	X			
	6												264608	21				X			X		X	X			
	6												264609	22				X			X		X	X			X
	6												264610	23				X	X	X	X		X	X			
	6												264611	24				X			X		X	X			X
hly031-0007.ios	7	BEW5	72	35.16	N	70	49.56	W	UTC	07/27/2003	04:23	1476	264612	1		X		X	X		X		X	X			
	7												264613	2	X			X	X		X		X	X			
	7												264614	3				X			X		X	X			
	7												264615	4				X	X		X		X	X			
	7												264616	5	X			X			X		X	X			
	7												264617	6				X			X		X	X			
	7												264618	7	X			X	X		X		X	X			
	7												264619	8		X		X			X		X	X			
	7												264620	9	X			X	X		X		X	X			
	7												264621	10	X	X		X			X		X	X			
	7												264622	11	X			X	X		X		X	X			
	7												264623	12	X			X			X		X	X			
	7												264624	13	X			X			X		X	X			
	7												264625	14	X	X		X			X		X	X			
	7												264626	15	X			X	X		X		X	X			
	7												264627	16	X			X			X		X	X			
	7												264628	17				X	X	X	X		X	X			
	7												264629	18	X			X			X		X	X			
	7												264630	19				X	X	X	X		X	X			
hly031-0008.ios	8	BEW6	72	32.6	N	71	21.25	W	UTC	07/27/2003	06:52	1199	264631	1		X		X	X		X		X	X			
	8												264632	2				X			X		X	X			
	8												264633	3				X			X		X	X			
	8												264634	4				X	X		X		X	X			
	8												264635	5				X			X		X	X			
	8												264636	6				X			X		X	X			
	8												264637	7		X		X	X		X		X	X			
	8												264638	8		X		X	X		X		X	X			
	8												264639	9				X	X		X		X	X			
	8												264640	10				X			X		X	X			
	8												264641	11				X			X		X	X			
	8												264642	12				X	X		X		X	X			
	8												264643	13				X	X	X	X		X	X			
	8												264644	14				X			X		X	X			
	8												264645	15		X,X		X	X	X	X		X	X			
hly031-0009.ios	9	BEW7	72	29.86	N	72	0.19	W	UTC	07/27/2003	09:11	1029	264646	1		X		X	X		X		X	X			
	9												264647	2				X			X		X	X			
	9												264648	3				X			X		X	X			
	9												264649	4		X		X	X		X		X	X			
	9												264650	5				X			X		X	X			
	9												264651	6				X	X		X		X	X			
	9												264652	7				X	X		X		X	X			
	9												264653	8				X	X		X		X	X			
	9												264654	9				X	X		X		X	X			
	9												264655	10				X			X		X	X			
	9												264656	11		X		X	X		X		X	X			
	9												264657	12			X	X	X	X	X		X	X			X
	9												264658	13			X	X	X		X		X	X			X
	9												264659	14		X	X	X	X	X	X		X	X			X
hly031-0010.ios	10	BEW8	72	26.92	N	72	34.77	W	UTC	07/27/2003	11:19	899	264660	1		X		X	X		X		X	X			
	10												264661	2				X	X		X		X	X			
	10												264662	3				X			X		X	X			
	10												264663	4		X		X			X		X	X			
	10												264664	5				X	X		X		X	X			
	10												264665	6				X	X		X		X	X			
	10												264666	7				X	X		X		X	X			
	10												264667	8				X	X		X		X	X			
	10												264668	9		X		X	X		X		X	X			
	10												264669	10				X	X	X	X		X	X			X
	10												264670	11				X			X		X	X			X
	10												264671	12		X		X	X	X	X		X	X			X
hly031-0011.ios	11	BEW9	72	24.71	N	73	10.19	W	UTC	07/27/2003	13:22	683	264672	1		X		X	X		X		X	X			
	11												264673	2				X			X		X	X			
	11												264674	3				X	X		X		X	X			
	11												264675	4		X		X	X		X		X	X			
	11												264676	5				X	X		X		X	X			
	11												264677	6		X		X	X		X		X	X			
	11												264678	7			X	X	X		X		X	X			
	11												264679	8			X	X			X		X	X			
	11												264680	9			X	X	X	X	X		X	X			
	11												264681	10			X	X			X		X	X			X
	11												264682	11			X	X			X		X	X			X
	11												264683	12			X	X			X		X	X			X
	11												264684	13		X	X	X	X	X	X		X	X			X
hly031-0012.ios	12	BEW10	72	23.02	N	73	50.15	W	UTC	07/27/2003	15:25	155	264685	1		X		X	X		X		X	X			
	12												264686	2				X	X		X		X	X			
	12												264687	3		X		X			X		X	X			
	12												264688	4				X	X	X	X		X	X			X
	12												264689	5		X		X			X		X	X			X
	12												264690	6				X	X	X	X		X	X			X
hly031-0013.ios	13	BEW11	72	20.16	N	74	26.48	W	UTC	07/27/2003	17:27	107	264691	1		X		X	X		X		X	X			X
	13												264692	2		X		X			X		X	X			X
	13												264693	3		X		X	X	X	X		X	X			X
	13												264694	4		X		X			X		X	X			X
	13												264695	5		X		X	X	X	X		X	X			X
hly031-0014.ios	14	BNS2	73	3.23	N	66	59.77	W	UTC	07/30/2003	09:12	2378	264696	1		X,X	X	X	X		X		X	X			
	14												264697	2			X				X		X	X			
	14												264698	3				X	X		X		X	X			
	14												264699	4					X		X		X	X			
	14												264700	5				X	X		X		X	X			
	14												264701	6							X		X	X			
	14												264702	7				X	X		X		X	X			
	14												264703	8							X		X	X			
	14												264704	9				X			X		X	X			
	14												264705	10		X			X		X		X	X			

Ross Sample Record

Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	water depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
															Count of samples												
															160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
	14												264706	11				X			X		X	X			
	14												264707	12		X			X		X		X	X			
	14												264708	13				X			X		X	X			
	14												264709	14				X	X		X		X	X			
	14												264710	15				X			X		X	X			
	14												264711	16				X			X		X	X			
	14												264712	17				X			X		X	X			
	14												264713	18				X	X		X		X	X			
	14												264714	19				X			X		X	X			
	14												264715	20		X		X	X	X	X		X	X			
	14												264716	21			X	X			X		X	X			
	14												264717	22		X	X	X			X		X	X			X
	14												264718	23				X			X		X	X			X
	14												264719	24				X	X	X	X		X	X			X
hly031-0015.ios	15	BNS3	73	22.94	N	66	59.76	W	UTC	07/30/2003	13:19	2355	264720	1				X	X		X		X	X			
	15												264721	2	X	X					X			X			
	15												264722	3	X	X		X			X		X	X			
	15												264723	4	X,X				X		X			X			
	15												264724	5	X			X	X		X		X	X			
	15												264725	6	X				X		X			X			
	15												264726	7	X			X			X		X	X			
	15												264727	8	X				X		X			X			
	15												264728	9	X	X		X	X		X		X	X			
	15												264729	10	X						X			X			
	15												264730	11	X	X		X	X		X		X	X			
	15												264731	12	X						X			X			
	15												264732	13	X			X	X		X		X	X			
	15												264733	14	X			X			X		X	X			
	15												264734	15	X			X			X		X	X			
	15												264735	16	X			X	X		X		X	X			
	15												264736	17				X	X	X	X		X	X			X
	15												264737	18	X			X			X		X	X			X
	15												264738	19	X	X		X			X		X	X			X
	15												264739	20	X			X	X	X	X		X	X			X
hly031-0016.ios	16	BNS4	73	40.93	N	67	0.09	W	UTC	07/30/2003	17:22	2340	264740	1				X	X		X		X	X			
	16												264741	2		X					X			X			
	16												264742	3		X		X			X		X	X			
	16												264743	4					X		X			X			
	16												264744	5				X	X		X		X	X			
	16												264745	6					X		X			X			
	16												264746	7				X			X		X	X			
	16												264747	8					X		X			X			
	16												264748	9		X		X	X		X		X	X			
	16												264749	10							X			X			
	16												264750	11		X		X	X		X		X	X			
	16												264751	12							X			X			
	16												264752	13				X	X		X		X	X			
	16												264753	14				X			X		X	X			
	16												264754	15				X			X		X	X			
	16												264755	16				X	X		X		X	X			
	16												264756	17				X	X	X	X		X	X			X
	16												264757	18				X			X		X	X			X
	16												264758	19		X		X			X		X	X			X
	16												264759	20				X			X		X	X			X
	16												264760	21					X	X							
hly031-0017.ios	17	BNS5	73	58.14	N	67	3.66	W	UTC	07/30/2003	23:08	2244	264764	1		X		X			X		X	X			
	17												264765	2		X		X			X		X	X			
	17												264766	3							X			X			
	17												264767	4							X			X			
	17												264768	5							X			X			
	17												264769	6							X			X			
	17												264770	7							X			X			
	17												264771	8							X			X			
	17												264772	9		X					X			X			
	17												264773	10							X			X			
	17												264774	11							X			X			
	17												264775	12							X			X			
	17												264776	13							X			X			
	17												264777	14							X			X			
	17												264778	15							X			X			X
	17												264779	16		X		X			X		X	X			X
	17												264780	17				X			X		X	X			X
hly031-0018.ios	18	BNS6	74	17.27	N	66	59.16	W	UTC	07/31/2003	02:50	2220	264781	1	X	X		X	X		X		X	X			
	18												264782	2							X			X			
	18												264783	3	X	X		X			X		X	X			
	18												264784	4	X,X				X		X			X			
	18												264785	5	X				X		X			X			
	18												264786	6	X						X			X			
	18												264787	7	X				X		X			X			
	18												264788	8	X				X		X			X			
	18												264789	9	X				X		X			X			
	18												264790	10	X	X					X			X			
	18												264791	11	X				X		X			X			
	18												264792	12	X						X			X			
	18												264793	13	X				X		X			X			
	18												264794	14	X			X	X	X	X		X	X			
	18												264795	15	X			X			X		X	X			X
	18												264796	16	X	X		X			X		X	X			X
	18												264797	17	X,X			X	X	X	X		X	X			X
hly031-0019.ios	19	BNS7	74	33.15	N	66	59.37	W	UTC	07/31/2003	06:16	2142	264798	1		X			X		X		X	X			
	19												264799	2							X		X	X			
	19												264800	3					X		X			X			
	19												264801	4					X		X			X			
	19												264802	5		X			X		X			X			
	19												264803	6					X		X			X			
	19												264804	7					X		X			X			
	19												264805	8					X		X			X			
	19												264806	9							X			X			
	19												264807	10		X		X	X		X		X	X			
	19												264808	11				X			X		X	X			
	19												264809	12				X			X		X	X			
	19												264810	13		X		X	X		X		X	X			
	19												264811	14				X	X	X	X		X	X			

Ross Sample Record

															Count of samples												
															160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	water depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
	19												264812	15				X			X		X	X			X
	19												264813	16		X		X			X		X	X			X
	19												264814	17				X	X	X	X		X	X			X
hly031-0020.ios	20	BNS08	74	47.14	N	67	0.08	W	UTC	07/31/2003	09:07	1694	264815	1		X		X			X		X	X			
	20												264816	2				X			X		X	X			
	20												264817	3							X			X			
	20												264818	4		X					X			X			
	20												264819	5							X			X			
	20												264820	6				X			X		X	X			
	20												264821	7							X			X			
	20												264822	8							X			X			
	20												264823	9		X					X			X			
	20												264824	10							X			X			
	20												264825	11							X			X			
	20												264826	12							X			X			
	20												264827	13		X		X			X		X	X			
	20												264828	14		X		X			X		X	X			
hly031-0021.ios	21	BNS09	74	58.27	N	67	0.08	W	UTC	07/31/2003	11:32	666	264829	1	X	X	X	X	X		X		X	X			
	21												264830	2	X	X			X		X			X			
	21												264831	3	X				X		X			X			
	21												264832	4	X		X	X	X		X		X	X			
	21												264833	5	X		X	X			X			X			
	21												264834	6							X			X			
	21												264835	7	X				X		X			X			
	21												264836	8	X	X			X		X			X			
	21												264837	9	X						X			X			
	21												264838	10	X				X	X	X			X			
	21												264839	11	X	X	X	X			X		X	X			X
	21												264840	12	X,X	X	X	X	X		X		X	X			X
	21												264841	13	X	X	X	X	X	X	X		X	X			X
hly031-0022.ios	22	BNS10	75	8.07	N	66	59.76	W	UTC	07/31/2003	13:20	482	264842	1		X	X	X	X		X		X	X			X
	22												264843	2					X		X			X			X
	22												264844	3							X			X			X
	22												264845	4			X	X	X		X			X			
	22												264846	5		X			X		X		X	X			
	22												264847	6			X	X	X		X			X			
	22												264848	7							X			X			
	22												264849	8					X		X			X			
	22												264850	9							X			X			
	22												264851	10			X	X	X	X	X			X			X
	22												264852	11		X					X		X	X			X
	22												264853	12					X	X	X		X	X			X
hly031-0023.ios	23	BNS11	75	18.69	N	67	0.12	W	UTC	07/31/2003	15:01	422	264854	1		X		X	X		X		X	X			
	23												264855	2							X			X			
	23												264856	3				X	X		X		X	X			
	23												264857	4		X			X		X			X			
	23												264858	5							X			X			
	23												264859	6					X		X			X			
	23												264860	7		X		X	X	X	X		X	X			
	23												264861	8				X			X		X	X			X
	23												264862	9				X			X		X	X			X
	23												264863	10				X	X	X	X		X	X			X
hly031-0024.ios	24	BNS12	75	31.96	N	67	0.06	W	UTC	07/31/2003	17:13	394	264864	1		X		X	X		X		X	X			
	24												264865	2				X			X			X			
	24												264866	3				X	X		X			X			
	24												264867	4				X			X			X			
	24												264868	5		X		X	X		X			X			
	24												264869	6				X			X			X			
	24												264870	7		X		X	X	X	X		X	X			
	24												264871	8		X		X			X		X	X			X
	24												264872	9				X			X		X	X			X
	24												264873	10				X	X	X	X		X	X			X
hly031-0026.ios	26	BNS13	75	42.04	N	67	0.32	W	UTC	07/31/2003	19:14	448	264874	1		X		X	X		X		X	X			
	26												264875	2							X			X			
	26												264876	3							X			X			
	26												264877	4							X			X			
	26												264878	5		X		X	X		X		X	X			
	26												264879	6							X			X			
	26												264880	7							X			X			
	26												264881	8							X			X			
	26												264882	9				X	X	X	X		X	X			
	26												264883	10		X		X			X		X	X			X
	26												264884	11		X		X			X		X	X			X
	26												264885	12				X	X	X	X		X	X			X
hly031-0028.ios	28	BNS14	75	50.12	N	67	1.61	W	UTC	07/31/2003	21:26	117	264886	1		X		X	X		X		X	X			
	28												264887	2		X		X			X		X	X			
	28												264888	3					X	X	X			X			
	28												264889	4		X		X			X		X	X			X
	28												264890	5		X		X			X		X	X			X
	28												264891	6				X	X	X	X		X	X			X
hly031-0039.ios	39	S01	78	19.89	N	72	54.85	W	UTC	08/02/2003	23:49	120	264892	1		X	X	X	X		X	X	X	X	X		X
	39												264893	2			X	X			X		X	X			
	39												264894	3		X	X	X			X		X	X			
	39												264895	4			X	X			X	X	X	X			X
	39												264896	5		X	X	X	X	X	X		X	X	X		
	39												264897	6			X	X			X		X	X			
	39												264898	7			X	X			X	X	X	X	X		X
	39												264899	8			X	X			X	X	X	X			X
	39												264900	9		X	X	X	X	X	X	X	X	X	X		X
hly031-0040.ios	40	S02	78	20.34	N	73	22.57	W	UTC	08/03/2003	04:23	490	264901	1	X			X	X		X		X	X			X
	40												264902	2		X		X			X		X	X			
	40												264903	3	X			X			X		X	X			
	40												264904	4		X		X	X		X		X	X			
	40												264905	5	X			X			X		X	X			X
	40												264906	6		X		X	X		X		X	X			
	40												264907	7	X			X			X		X	X			
	40												264908	8				X			X		X	X			
	40												264909	9	X			X			X		X	X			
	40												264910	10				X	X	X	X		X	X			
	40												264911	11	X,X			X			X		X	X			
	40												264912	12		X		X			X		X	X			
	40												264913	13				X	X	X	X		X	X			X
hly031-0041.ios	41	S03	78	19.9	N	73	53.37	W	UTC	08/03/2003	06:10	574	264914	1	X		X	X	X	X	X	X	X	X	X		X

Ross Sample Record

															Count of samples 160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	water depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
	41												264915	2	X	X	X	X	X	X	X		X	X	X		X
	41												264916	3			X	X	X	X	X		X	X	X		
	41												264917	4	X			X	X	X	X		X	X	X		
	41												264918	5				X	X	X	X		X	X			
	41												264919	6	X	X		X			X		X	X	X		X
	41												264920	7		X		X	X	X	X	X	X	X	X		
	41												264921	8	X			X			X	X	X	X			
	41												264922	9			X	X	X	X	X	X	X	X	X		
	41												264923	10	X,X			X			X	X	X	X			X
	41												264924	11		X	X	X			X	X	X	X			X
	41												264925	12			X	X	X	X	X	X	X	X	X		X
hly031-0042.ios	42	S03	78	20.02	N	73	54.2	W	UTC	08/03/2003	07:58	565	264926	1										X		X	
	42												264927	2										X		X	
	42												264928	3										X		X	
	42												264929	4										X		X	
	42												264930	5										X		X	
	42												264931	6										X		X	
	42												264932	7										X		X	
	42												264933	8										X		X	
	42												264934	9										X		X	
	42												264935	10										X		X	
	42												264936	11										X		X	
	42												264937	12										X		X	
	42												264938	13										X		X	
	42												264939	14										X		X	
	42												264940	15										X		X	
hly031-0043.ios	43	S04	78	19.99	N	74	26.19	W	UTC	08/03/2003	09:56	486	264941	1			X	X	X		X	X	X	X			X
	43												264942	2		X		X			X		X	X			
	43												264943	3				X	X		X		X	X			
	43												264944	4				X			X		X	X			
	43												264945	5				X			X		X	X			X
	43												264946	6		X	X	X	X		X		X	X			
	43												264947	7			X	X			X	X	X	X			
	43												264948	8		X		X	X		X		X	X			
	43												264949	9				X			X		X	X			
	43												264950	10				X	X	X	X		X	X			
	43												264951	11		X		X			X		X	X			
	43												264952	12			X	X	X		X		X	X			
	43												264953	13			X	X			X	X	X	X			X
	43												264954	14			X	X	X	X	X	X	X	X			X
hly031-0044.ios	44	S05	78	19.89	N	74	53.87	W	UTC	08/03/2003	11:34	203	264955	1		X	X	X	X		X	X	X	X			X
	44												264956	2		X	X	X			X	X	X	X			
	44												264957	3		X	X	X	X		X	X	X	X			
	44												264958	4		X	X	X			X	X	X	X			X
	44												264959	5		X	X	X			X	X	X	X			
	44												264960	6		X	X	X	X	X	X	X	X	X			
	44												264961	7		X	X	X			X	X	X	X			
	44												264962	8		X	X	X			X	X	X	X			X
	44												264963	9		X	X	X	X	X	X	X	X	X			X
hly031-0045.ios	45	KS01	80	33.55	N	68	55.54	W	UTC	08/04/2003	18:18	170	264965	1		X	X	X	X		X		X	X			X
	45												264966	2				X			X		X	X			
	45												264967	3			X	X	X		X		X	X			
	45												264968	4		X		X			X		X	X			
	45												264969	5		X	X	X	X		X		X	X			
	45													6													
	45												264970	7			X	X	X	X	X		X	X			X
	45												264971	8		X	X	X			X		X	X			X
	45												264972	9			X	X	X	X	X		X	X			X
hly031-0046.ios	46	KS03	80	32.6	N	68	46.49	W	UTC	08/04/2003	20:53	357	264973	1	X	X	X	X	X		X		X	X			X
	46												264974	2	X,X			X	X		X		X	X			
	46												264975	3	X		X	X	X		X		X	X			
	46												264976	4	X	X		X	X		X		X	X			
	46												264977	5	X		X	X	X		X		X	X			X
	46												264978	6	X	X	X	X	X	X	X		X	X			
	46												264979	7			X	X	X		X		X	X			X
	46												264980	8	X	X	X	X	X		X		X	X			X
	46												264981	9			X	X	X	X	X		X	X			X
	46													10													
hly031-0047.ios	47	KS05	80	31.07	N	68	35.07	W	UTC	08/04/2003	23:05	354	264982	1		X	X	X	X	X	X		X	X	X		
	47												264983	2			X	X		X	X		X	X	X		
	47												264984	3			X	X		X	X		X	X	X		
	47												264985	4		X	X	X		X	X		X	X	X		
	47												264986	5			X	X			X		X	X			
	47												264987	6		X	X	X	X	X	X		X	X	X		
	47												264988	7			X	X	X	X	X		X	X			
	47												264989	8			X	X	X	X	X		X	X			
	47												264990	9		X	X	X	X	X	X		X	X			
	47												264991	10			X	X	X	X	X		X	X			
hly031-0048.ios	48	KS07	80	29.2	N	68	19.33	W	UTC	08/05/2003	00:53	378	264992	1		X	X	X	X		X		X	X			
	48												264993	2				X	X		X		X	X			
	48												264994	3				X	X		X		X	X			
	48												264995	4		X		X	X		X		X	X			
	48												264996	5			X	X	X		X		X	X			
	48												264997	6		X		X	X		X		X	X			
	48												264998	7			X	X	X	X	X		X	X			
	48												264999	8			X	X	X		X		X	X			
	48												265000	9		X	X	X			X		X	X			
	48												265001	10		X	X	X	X	X	X		X	X			
	48													11													
	48													12													
hly031-0050.ios	50	KS09	80	27.69	N	68	2.36	W	UTC	08/05/2003	11:52	342	265002	1	X	X	X	X	X		X		X	X			
	50												265003	2	X				X		X			X			
	50												265004	3	X				X		X			X			
	50												265005	4			X	X			X		X	X			
	50												265006	5	X	X			X		X			X			
	50												265007	6	X		X	X	X		X		X	X			
	50												265008	7	X	X	X	X			X		X	X			
	50												265009	8	X,X		X	X	X	X	X		X	X			
	50												265010	9			X	X	X		X		X	X			
	50												265011	10		X	X	X	X		X		X	X			
	50												265012	11		X	X	X	X	X	X		X	X			
hly031-0051.ios	51	KS11	80	25.19	N	67	48.97	W	UTC	08/05/2003	16:35	285	265013	1		X	X	X	X		X		X	X			
	51												265014	2			X	X	X		X		X	X			

Ross Sample Record

Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	water depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
															Count of samples												
															160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
	51												265015	3		X	X	X	X		X		X	X			
	51												265016	4			X	X	X		X		X	X			
	51												265017	5		X	X	X	X	X	X		X	X			
	51												265018	6		X	X	X	X		X		X	X			
	51												265019	7		X	X	X	X	X	X		X	X			
hly031-0052.ios	52	KS13	80	23.62	N	67	34	W	UTC	08/05/2003	17:53	215	265020	1	X	X	X	X	X		X	X	X	X	X		
	52												265021	2	X		X	X	X		X		X	X	X		
	52												265022	3	X	X	X	X	X		X	X	X	X	X		
	52												265023	4	X		X	X			X		X	X			
	52												265024	5	X	X	X	X	X		X	X	X	X	X		
	52												265025	6	X		X	X			X	X	X	X	X		
	52												265026	7	X	X	X	X	X	X	X	X	X	X			X
	52												265027	8		X	X	X			X	X	X	X			X
	52												265028	9			X	X	X	X	X	X	X	X			X
hly031-0053.ios	53	KS15	80	22.26	N	67	25.34	W	UTC	08/05/2003	19:49	85	265029	1		X	X	X	X		X	X	X	X			
	53												265030	2			X	X			X	X	X	X			
	53												265031	3		X	X	X	X	X	X	X	X	X			
	53												265032	4			X	X			X	X	X	X			
	53												265033	5		X	X	X	X		X	X	X	X			X
	53												265034	6			X	X			X	X	X	X			X
	53												265035	7		X	X	X	X	X	X	X	X	X			X
hly031-0054.ios	54	KN07	81	8.61	N	64	6.95	W	UTC	08/06/2003	21:15	170	265036	1		X	X	X			X		X	X			
	54												265037	2			X	X			X		X	X			
	54												265038	3		X	X	X			X		X	X			
	54												265039	4			X	X			X	X	X	X			
	54												265040	5		X	X	X			X	X	X	X			
	54												265041	6			X	X			X	X	X	X			
	54												265042	7		X	X	X			X	X	X	X			
	54												265043	8			X	X			X	X	X	X			
hly031-0055.ios	55	KN06	81	10.02	N	64	17.79	W	UTC	08/06/2003	22:22	440	265044	1		X	X	X	X		X	X	X	X			
	55												265045	2			X	X			X		X	X			
	55												265046	3			X	X	X		X		X	X			
	55												265047	4		X	X	X	X		X		X	X			
	55												265048	5			X	X	X		X	X	X	X			
	55												265049	6		X	X	X	X		X	X	X	X			
	55												265050	7			X	X			X	X	X	X			
	55												265051	8		X	X	X	X		X	X	X	X			
	55												265052	9			X	X	X		X	X	X	X			
hly031-0056.ios	56	KN05	81	11.48	N	64	29.85	W	UTC	08/06/2003	23:28	500	265053	1		X		X			X		X	X			
	56												265054	2				X			X		X	X			
	56												265055	3				X			X		X	X			
	56												265056	4				X			X		X	X			
	56												265057	5		X		X			X		X	X			
	56												265058	6		X		X	X		X		X	X			
	56												265059	7		X		X			X		X	X			
	56												265060	8				X			X		X	X			
	56												265061	9		X		X	X		X		X	X			
	56												265062	10				X			X		X	X			
hly031-0057.ios	57	KN04	81	12.94	N	64	39.69	W	UTC	08/07/2003	00:45	459	265063	1		X		X	X		X		X	X			
	57												265064	2				X	X		X		X	X			
	57												265065	3				X	X		X		X	X			
	57												265066	4		X		X	X		X		X	X			
	57												265067	5				X			X		X	X			
	57												265068	6		X		X	X		X		X	X			
	57												265069	7		X		X	X		X		X	X			
	57												265070	8				X	X		X		X	X			
	57												265071	9		X		X			X		X	X			
	57												265072	10				X	X		X		X	X			
hly031-0058.ios	58	KN03	81	14.42	N	64	50.28	W	UTC	08/07/2003	01:58	406	265073	1		X		X			X		X	X			
	58												265074	2				X			X		X	X			
	58												265075	3				X			X		X	X			
	58												265076	4		X		X			X		X	X			
	58												265077	5				X			X		X	X			
	58												265078	6		X		X	X		X		X	X			
	58												265079	7				X			X		X	X			
	58												265080	8		X		X			X		X	X			
	58												265081	9				X	X		X		X	X			
hly031-0059.ios	59	KN02	81	15.79	N	65	1.22	W	UTC	08/07/2003	03:19	413	265082	1		X	X	X			X	X	X	X			
	59												265083	2			X	X			X		X	X			
	59												265084	3			X	X			X	X	X	X			
	59												265085	4		X	X	X			X		X	X			
	59												265086	5			X	X			X	X	X	X			
	59												265087	6		X	X	X			X	X	X	X			
	59												265088	7			X	X	X		X	X	X	X			
	59												265089	8		X	X	X			X	X	X	X			
	59												265090	9			X	X			X	X	X	X			
	59												265091	10			X	X	X		X	X	X	X			
hly031-0060.ios	60	KN01	81	17.06	N	65	8.74	W	UTC	08/07/2003	04:50	217	265092	1		X	X	X	X		X	X	X	X			
	60												265093	2			X	X	X		X	X	X	X			
	60												265094	3		X	X	X	X		X	X	X	X			
	60												265095	4			X	X			X	X	X	X			
	60												265096	5			X	X	X		X	X	X	X			
	60												265097	6		X	X	X	X		X	X	X	X			
	60												265098	7			X	X	X		X	X	X	X			
	60												265099	8		X	X	X	X		X	X	X	X			
hly031-0062.ios	62	RN7	82	0.51	N	60	22.79	W	UTC	08/09/2003	18:10	425	265111	1		X	X	X	X		X		X	X			
	62												265112	2			X	X			X		X	X			
	62												265113	3			X	X			X		X	X			
	62												265114	4			X	X	X		X		X	X			
	62												265115	5		X	X	X			X		X	X			
	62												265116	6		X	X	X			X		X	X			
	62												265117	7		X			X		X			X			
	62												265118	8			X	X	X		X		X	X			
	62												265119	9							X			X			
	62												265120	10			X	X	X		X		X	X			
	62												265121	11							X			X			
	62												265122	12		X	X	X	X		X		X	X			
	62												265123	13		X					X			X			
	62												265124	14			X	X	X		X		X	X			
	62												265125	15							X			X			
hly031-0063.ios	63	RN6	82	1.49	N	60	35.51	W	UTC	08/09/2003	19:37	388	265126	1		X	X	X			X		X	X			
	63												265127	2			X	X			X		X	X			
	63												265128	3			X	X			X		X	X			

Ross Sample Record

															Count of samples												
															160	238	254	570	322	95	664	77	572	709	44	45	126
														ctdraw	Record of samples collected												
Filename	Event	Station	LatDeg	LatMin	N	LongDeg	LongMin	W	TimeZone	Date	Time	water depth	sample#	RosBot#	CFC	O2	Cd	Ba	TCO2/Alk	del13CDIC	Nutrients	DOC	del018	Salinity	I-129	Cs-137	Ra-226
	63												265129	4			X	X			X		X	X			
	63												265130	5			X	X			X		X	X			
	63												265131	6			X	X			X		X	X			
	63												265132	7		X	X	X			X		X	X			
	63												265133	8			X	X			X		X	X			
	63												265134	9			X	X			X		X	X			
hly031-0064.ios	64	RN5	82	3.07	N	60	47.63	W	UTC	08/09/2003	20:37	418	265135	1		X		X			X		X	X			
	64												265136	2				X			X		X	X			
	64												265137	3				X			X		X	X			
	64												265138	4				X			X		X	X			
	64												265139	5				X			X		X	X			
	64												265140	6				X			X		X	X			
	64												265141	7		X		X			X		X	X			
	64												265142	8				X			X		X	X			
	64												265143	9				X			X		X	X			
	64												265144	10				X			X		X	X			
hly031-0065.ios	65	RN4	82	4.14	N	61	0.74	W	UTC	08/09/2003	21:35	518	265145	1				X			X		X	X			
	65												265146	2		X		X			X		X	X			
	65												265147	3				X			X		X	X			
	65												265148	4				X			X		X	X			
	65												265149	5				X			X		X	X			
	65												265150	6				X			X		X	X			
	65												265151	7				X			X		X	X			
	65												265152	8				X			X		X	X			
	65												265153	9		X		X			X		X	X			
	65												265154	10				X			X		X	X			
hly031-0066.ios	66	RN3	82	5.48	N	61	11.02	W	UTC	08/09/2003	22:34	513	265155	1	X	X		X	X		X		X	X			
	66												265156	2	X			X			X		X	X			
	66												265157	3	X			X	X		X		X	X			
	66												265158	4	X			X			X		X	X			
	66												265159	5	X			X	X		X		X	X			
	66												265160	6	X			X	X		X		X	X			
	66												265161	7	X	X		X			X		X	X			
	66												265162	8	X	X		X			X		X	X			
	66												265163	9	X			X	X		X		X	X			
	66												265164	10				X			X		X	X			
	66												265165	11				X	X		X		X	X			
hly031-0067.ios	67	RN2	82	6.67	N	61	23.29	W	UTC	08/09/2003	23:40	530	265166	1		X		X			X		X	X			
	67												265167	2		X		X			X		X	X			
	67												265168	3				X			X		X	X			
	67												265169	4				X			X		X	X			
	67												265170	5				X			X		X	X			
	67												265171	6				X			X		X	X			
	67												265172	7		X		X			X		X	X			
hly031-0068.ios	68	RN1	82	7.54	N	61	36.65	W	UTC	08/10/2003	01:24	420	265173	1		X		X	X		X		X	X			
	68												265174	2				X	X		X		X	X			
	68												265175	3				X	X		X		X	X			
	68												265176	4				X			X		X	X			
	68												265177	5				X	X		X		X	X			
	68												265178	6				X			X		X	X			
	68												265179	7		X		X	X		X		X	X			
	68												265180	8				X	X		X		X	X			
	68												265181	9				X			X		X	X			
	68												265182	10		X		X	X		X		X	X			
hly031-0069.ios	69	PG1	81	7.59	N	61	50.2	W	UTC	08/10/2003	15:24	1048	265183	1		X	X	X			X		X	X			
	69												265184	2				X			X		X	X			
	69												265185	3				X			X		X	X			
	69												265186	4			X	X			X		X	X			
	69												265187	5				X			X		X	X			
	69												265188	6			X	X			X		X	X			
	69												265189	7		X		X			X		X	X			
	69												265190	8			X	X			X		X	X			
	69												265191	9			X	X			X		X	X			
	69												265192	10			X	X			X		X	X			
	69												265193	11			X	X	X		X		X	X			
	69												265194	12		X	X	X	X		X		X	X			
hly031-0080.ios	80	HB	81	37.27	N	63	14.95	W	UTC	08/11/2003	11:04	795	265195	1	X,X		X	X	X		X	X	X	X	X		
	80												265196	2	X	X		X			X		X	X	X		
	80												265197	3	X	X		X	X		X		X	X	X		
	80												265198	4	X	X	X	X			X		X	X	X		
	80												265199	5	X			X	X		X	X	X	X	X		
	80												265200	6	X			X			X		X	X	X		
	80												265211	7	X			X	X		X		X	X			
	80												265212	8	X			X			X	X	X	X			
	80												265213	9	X	X	X	X	X		X	X	X	X	X		
	80												265214	10	X			X			X	X	X	X			
	80												265215	11	X			X			X	X	X	X			
	80												265216	12	X		X	X	X	X	X	X	X	X			
	80												265217	13	X			X			X	X	X	X	X		
	80												265218	14	X			X	X		X	X	X	X			
	80												265219	15	X		X	X			X	X	X	X			
	80												265220	16		X	X	X	X	X	X	X	X	X	X		
hly031-0081.ios	81	HB	81	37.18	N	63	14.67	W	UTC	08/11/2003	13:00	794	265221	1										X		X	
	81												265222	2										X		X	
	81												265223	3										X		X	
	81												265224	4										X		X	
	81												265225	5										X		X	
	81												265226	6										X		X	
	81												265227	7										X		X	
	81												265228	8										X		X	
	81												265229	9										X		X	
	81												265230	10										X		X	
	81												265231	11										X		X	
	81												265232	12										X		X	
	81												265233	13										X		X	
	81												265234	14										X		X	
	81												265235	15										X		X	
	81													16													
	81													17													
	81													18													
	81													19													
	81													20													
	81													21													
	81													22													
	81													23													
	81													24													

INTERNALLY RECORDING CTD DATA

PRELIMINARY REPORT ON CTD DATA COLLECTION

Melissa Zweng
Graduate College of Marine Studies
University of Delaware, Aug 14 2003

Introduction

The data were taken with an Ocean Sensors 200 Conductivity-Temperature-Depth sensor (OS200). This instrument consists of three different sensors: a conductivity sensor, a temperature sensor, and a pressure sensor. The OS200 has the advantage of being highly portable as well as easily and quickly deployable, so it was used for quick casts in between stations and casts by hand from the small boat.

Data Collection

The instrument was deployed in one of two ways: attached to a frame that was lowered into the water by crane or hand; or strapped onto the CTD rosette. During each deployment, time, raw voltages from the sensors, and the instrument's pressure value were recorded. (The instrument does not recognize dates after 1999, so date stamps are MM/DD/90, when they ought to be MM/ DD/03. The names of the files have the correct year.) After each set of casts, the instrument was plugged into a computer and the data was uploaded.

Data Processing

The data were processed using the calibration coefficients below to obtain temperature and conductivity. Salinity and density were calculated using the 1978 Practical Salinity Scale and Gill, 1981.

Equations to obtain engineering units from raw voltages and calibration coefficients:

Conductivity = A + B(CR0 – CR6)

Temperature = A + B(ln(CR3-CR6)) + C(ln(CR3-CR6))2 + D(ln(CR3-CR6))3

Pressure = A + B(CR1-CR6)

Note that testing the OS200 against the forward TSG and CTD rosette revealed that the instrument is properly calibrated for temperature but not for conductivity and pressure. However, the values for pressure that the unit outputs and the pressure calculated from the equation and calibration coefficients above are different. The casts titled 7-27-03_OS200_X_TSD.txt were obtained by attaching the OS200 to the CTD rosette. The pressure that the unit outputs and that from the rosette agree, so I assume that the output pressure is correct and include that value in the data file, as well as using it for the salinity and density calculations.

Calibration Coefficients

	A	B	C	D
COND	+2.865658E-01	+8.175572E+01	+0.000000E+00	+0.000000E+00
TEMP	-1.308210E+01	-2.032210E+01	+1.598410E+00	+2.676918E-02
PRESS	+8.904581E+01	+2.137851E+04	+0.000000E+00	+0.000000E+00

Columns in files: Date, Time, CR0, CR1, CR3, CR6, Pressure, Conductivity, Temperature, Salinity, Density

List of Files

File name	UTZ Time and Info	Latitude N	Longitude W
7-27-03_OS200_1_TSD.txt	13:18 (on rosette cast BEW 9)	72º 24.71’	073º 10.19’
7-27-03_OS200_2_TSD.txt	15:22 (on rosette cast BEW 10)	72º 23.02’	073º 50.15’
7-31-03_OS200_TSD.txt	22:17	75º 53.959’	067º 00.405’
8-02-03_OS200_TSD.txt	22:21	78º 22.237’	072º 57.558’
8-10-03_OS200_1_TSD.txt	22:36 Off ey Island	81º 17.808’	061º 43.904’
8-10-03_OS200_2_TSD.txt	(8-11-03) 00:44 Off ey Island	81º 18.408’	061º 48.810’
8-10-03_OS200_3_TSD.txt	(8-11-03) 01:41 Off ey Island	81º 18.408’	061º 48.810’
8-12-03_OS200_TSD.txt	18:24 Scorseby Bay	79º 54.65’	071º 21.40’

PROCESSING SBE9 DATA

Humfrey Melling
Oregon State University
May 15 2006

Project

This expedition was the result of DFO collaboration (Dr H Melling) with Oregon State University (Dr. Kelly Falkner and University of Delaware (Dr Andreas Münchow) in the US NSF-funded project, “Variability and Forcing of Fluxes through Nares Strait and Jones Sound: A Freshwater Emphasis”. The observations were collected during 26 July to 11 August 2003 from the USCGC Healy.

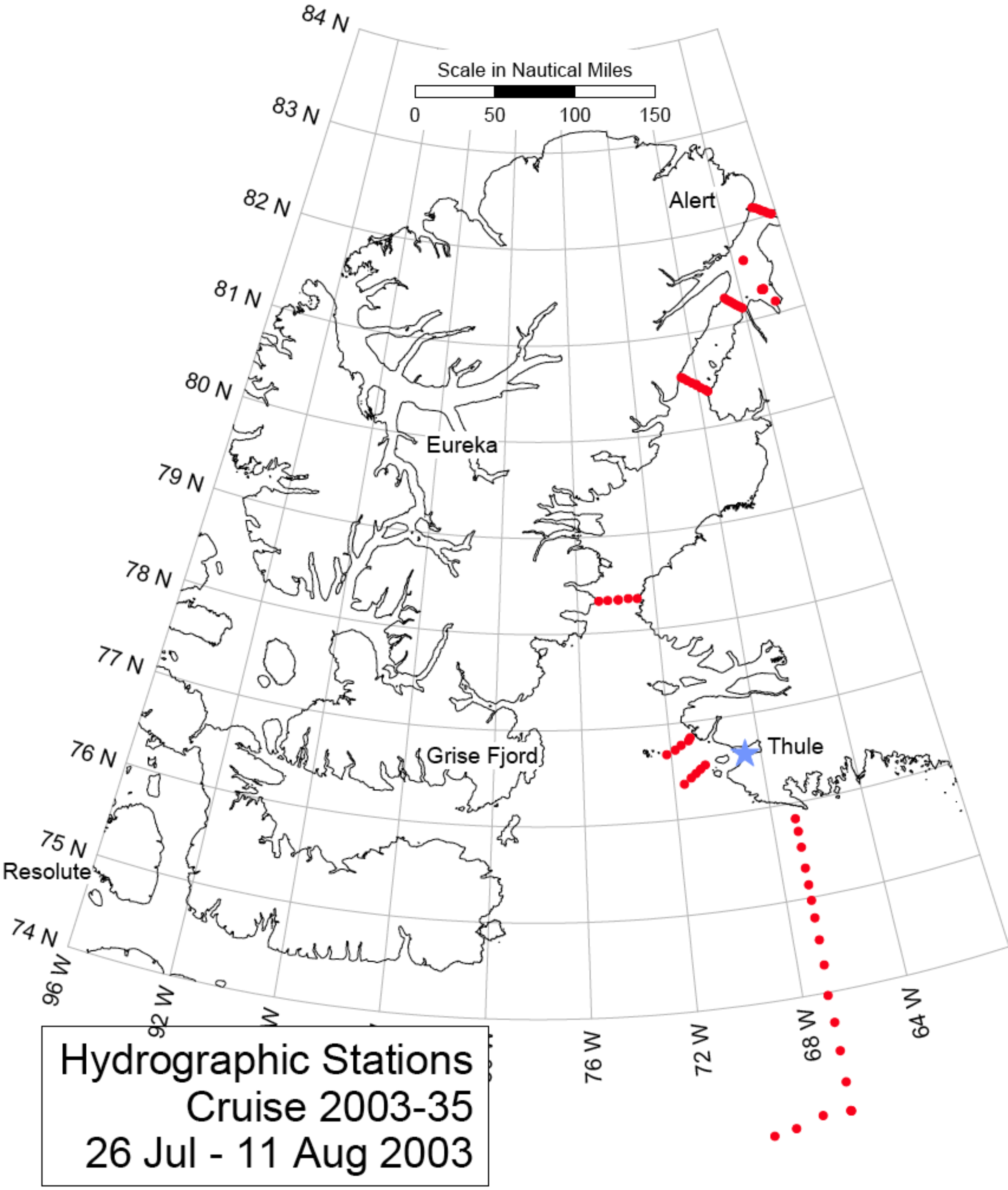
The objective was study of the exchanges of seawater, including added fresh water, heat, and trace chemical constituents, through Nares Strait from the Arctic to Baffin Bay. During the period of the hydrographic survey, 25 moorings were positioned with instruments to measure current, ice drift, seawater temperature and salinity, ice thickness and spatial gradients in hydrostatic pressure. The instruments were set to record data at least hourly for 2-3 years.

Configuration

This survey was conducted from the rosette station of the USCGC Healy, using SBE9 equipment from the ship. The CTD was powered on deck and then submerged for a minute or two to permit stabilization of the SBE pumping system and sensor checks. The rosette station on the Healy is just forward of the propellers on the starboard side. At this location, the upper ocean may be seriously churned up by the screws during positioning of the ship for the rosette cast. At times we could detect significant disturbance to a depth of 15 m (inversion in density, erratic profiles, erratic temperature-salinity correlation). For this reason, we frequently started profiles at 10-m depth, although some data acquired as shallow as 2-3 m seem reasonable. In other cases, data have been removed in processing down to 15-m depth.

The upper 100 m of the cast was conducted at a drop speed of 0.5 m/s. At 100-m depth, the descent rate was increased to 1 m/s. The rosette was again slowed to 0.5 m/s when the altimeter indicated seabed proximity (typically at 50-75 m of the bottom). The slow rate of descent, intended to provide higher resolution in upper-ocean data, was problematic. Even modest waves in Baffin Bay slowed the descent sufficiently that the CTD-rosette was periodically engulfed by its wake. This introduced anomalous pulses in the measured profiles, which had to be removed by cut out in editing.

Water samples were acquired on the up-cast, with the rosette rising at a nominal 1 m/s. The package was not stopped at sampling levels; bottles were closed on the fly. The intent of this approach was avoidance of wake sampling, with the added benefit of much reduced station time. Samples were drawn for the bottles for a variety of geochemical analyses; of these only salinity, analyzed on board via Guildline Autosal in a temperature-controlled room, is of concern here.



Hydrographic Stations
Cruise 2003-35
26 Jul - 11 Aug 2003

Sea-Bird SBE-9 CTD Equipment

Two Sea-Bird CTD systems were used. Each was equipped with tandem sensors for temperature (SBE3) and conductivity (SBE4), in independent pumped (SBE5) ducts and single sensors for pressure (SBE29), for dissolved oxygen (SBE43, pumped from the secondary TC duct), for chlorophyll fluorescence (Chelsea Instruments Aqua 3), for light transmissivity (Chelsea Cstar) and for seabed proximity (Benthos Echo sounder). The sampling rate was 24 Hz.

System A was used for casts 1-50, when it experienced catastrophic failure in association with a leak of the under-water power connector. System B was used for casts 51-81.

The light transmissivity sensor on System B was unstable. There are no transmittance data available for profiles 51-81.

The temporal response of the primary temperature sensor slowed significantly partway through cast 33, perhaps because of biological fouling of the thermistor pin. The slowed response impeded effective time-response matching with conductivity for calculating salinity. For this reason, data from the secondary temperature-salinity system were used in preference to the primary system for casts 33-47, 49 and 50.

	Sea-Bird SBE-9 System A		Sea-Bird SBE-9 System B		
Variable	**Serial No**	**Calibration Date**	**Serial No**	**Calibration Date**	**Channel**
Temperature:Primary	2796	4 May 2003	2841	4 May 2003	Freq 0
Conductivity:Primary	2545	15 May 2003	2561	2 May 2003	Freq 1
Pressure	83009	9 Jan 2001	83012	9 Jan 2001	Freq 2
Temperature:Secondary	2824	4 May 2003	2945	1 May 2003	Freq 3
Conductivity:Secondary	2568	16 May 2003	2575	2 May 2003	Freq 4
Oxygen:SBE	0459	15 May 2003	0458	21 May 2003	Volt 1
Transmissometer:Primary	390DR	19 Dec 2000	436DR	30 Mar 2001	Volt 2
Fluorometer (Chelsea)	088233	19 Mar 2001	088234	19 Mar 2001	Volt 4
Altimeter (Benthos)					

Summary of Processing

File extension	Processing step	Generated by …
Hex	Field logging	SeaSave-Win32
Cnv	Convert to ASCII from hexadecimal	Data conversion (SBEDataProcessing-Win32)
Ios	Convert to IOS header format	Convert Sea-Bird ASCII Files (IOSSHELL SBE_IOS)
Clip	Remove unwanted records from file	Clip records (IOSSHELL CLIP)
Edt	Correct data spikes by interpolation	View edit (IOSSHELL VIEWEDIT)
Shf1	Shift C1 values to later time	Delay C1 by 0.4 scans (IOSSHELL SHIFTDAT)
Shf1&2	Shift C2 values to earlier time	Advance C2 by 1.3 scans (IOSSHELL SHIFTDAT)
Avp	Smooth pressure values	5-point running average (IOSSHELL FILTERS)
Ctm1	Computes primary cell temperature	Compute cell temperature (IOSSHELL CELLTM)
Ctm1&2	Computes secondary cell temperature	Compute cell temperature (IOSSHELL CELLTM)
Cal	Calibration using T1C1 or T2 C2 for S	Calibration (IOSSHELL CALIBRATE)
Dat	Create files w/o DO sensor voltage	Remove channels (IOSSHELL REMOVECH)
Calo	Duplicate file with p, S, T, DO volts (see below)	Remove channels (IOSSHELL REMOVECH)
View	Interactive T & S editing of wake & ship effects	View edit (IOSSHELL VIEWEDIT)
Bas	Remove unneeded channels	Remove channels (IOSSHELL REMOVECH)
Bin	Average data within 0.2-db bins	Bin averaging (IOSSHELL BINAVE)
Final	Calculate depth, potential temperature, gamma	Derived quantities (IOSSHELL DERIVE)

Processing Notes

1) Verify station information - date, time, latitude, longitude, water depth, number of samples and summarize in a spreadsheet.

2) Convert hex files to ascii form (cnv for profiles & ros for bottle closing depths) using SBE Data Processing 5.25, Data Conversion

3) Convert cnv files to IOSSHELL format

4) Add an "Event Number: " line in *.ios files.

5) Plot all channels of raw signal data against sample number for general assessment of sensor operation, data spiking, etc. Look for spiking, fall speed reversals by surface waves and other irregularities.

   Wave influence is appreciable during casts 1-3, 14-24, 26, 28 and 31. There are fall-speed reversals in profiles 16-21 and appreciable fall-speed variation in 15 & 22-24.

   There are jumps in pressure of about 0.5 db in profile 49, at 29 and 104 db.

   In general, the pressure records are noisy. Smoothing pressure by running average over 5 scans is recommended.

   The values for % transmission dropped down by 12% at cast 51 and shifted up by 21% at cast 61 (values based on maximum transmittance). The shifts at minimum transmittance are consistent with these values, but greater variability in the minimum value precludes an accurate estimate. However, the high values of maximum transmittance for cast 61 et seq. are associated with clipping of the transmittance signal at 80%. There are also uncharacteristic broad smooth dips in transmittance centered on depths between 150-250 m. It appears that the transmissometer on CTD B was unreliable, For this reason the transmittance channel is deleted from casts 51-81.

6) Identify the scans to be used from each file.

7) Use IOSSHELL CLIP programme to remove unwanted scans from each file.

   Certain profiles have problems during the upper few tens of metres on the first drop. These are likely a result of the severe disturbance of the upper 10-20 m of the water column by the ship's propellers. These profile sections have been discarded.

8) Examine the profiles for unreasonable 'spikes' in value. This is a subjective procedure based on the interactive use of the IOSSHELL VIEWEDIT programme, which is used to interpolate or assign values at spikes. Pressure: No spikes

   Temperature 1 & 2 and conductivity 1 & 2: Edited for spikes

   Fluorescence and transmissivity: In general NOT edited for spikes. Negative-going spikes may indicate ingestion of plankton. One positive going spike was edited in cast 49. Channels are used qualitatively.

   DO voltage: No spikes, but the DO voltage in profile 1 wraps around from 0V to 5V at very low values. Values at such occurrences are set to zero.

9) Select profiles suited to the determination of TIMING ADJUSTMENTS for T & C. With two SBE9s, each with tandem TC assemblies, there are 4 different configurations requiring assessment.

   Note that different values are appropriate for the primary and secondary TC systems. First, there is a 1.5-scan timing advance of primary conductivity implemented via hardware for the primary system within the SBE9, but not for the secondary system (see Manual for the SBE9). Second, the flow rate through the secondary system is likely slower, because the SBE43 DO sensor is plumbed to it.

   For CTD A, casts 18 and 47 have suitable characteristics for evaluation of timing. For CTD B, only cast 72 is suitable. Casts 60 and 80 can be used for independent assessment of choices. Results are derived from careful inspection of C, T and S relative to Scan No at times of rapid transitions.

   For cast 47, C2 lags C1 by about 2.5 scans; T2 lags T1 by about 1 scan; C1 leads T1 by about 1 scan; C2 leads T2 by about 0.5 scan (not a clear result).

   For cast 18 (at scans 13500-15000), T2 lags by about 0.5-1 scan relative to T1, but may respond slightly faster; C2 lags by slightly more than 2 scans relative to C1, but may respond faster; T1 lags C1 by about 0.5 scan; T2 leads C2 by about 1.5 scan.

   C1 at 0.0; T1 at 0.5 scan lag; T2 at 0.0-0.5 scan lag; C2 at 2.0 scan lag (1.5 scans after T2)

   For cast 71 (CTD B), no lag between T1 & T2; C2 lags C1 by 2-3 scans; C2 lags T2 by 1.5 scans; C1 lags T1 by 0.5 scans.

   Experiment with profiles 18, 60, 72 & 80: Best results come by advancing primary conductivity by -0.4 scans and secondary conductivity by 1.3 scans

10) Select profiles suited to the determination of TIMING LAG for DO voltage. The lag results from the time required to flush the tubing connecting the C-cell to the DO cell. Suitable profiles have a sharp transition in T and S, with indication of an associated abrupt change in DO (i.e. exponential roll-off).

Only two instances were found, in casts 9 and 41, both by CTD A. The apparent delays in response by the SBE43 were 25 and 22 scans respectively (i.e. about 1 second). A value of 24 scans was adopted for use.

11) The Sea-Bird CONDUCTIVITY CELL and its mounting (SBE4) have significant HEAT CAPACITY. Cooling occurs over many seconds following passage from a warm layer into a cold layer. Some heat from the cell is conducted into the water passing through it, raising its temperature and therefore its conductivity. Since this change in temperature is not sensed by the thermistor, values of salinity calculated from raw data on a progressively cooling profile are too high (and vice versa).

    Hydrographic profiles suited to the empirical determination of the correction for cell temperature are rare. A virtually two-layer structure was measured by SBE19 in Bering Strait in 1998 (Cast 1998-26-0050). The temperature gradient was about -1.2 C per db sustained over 5 db. Values of 12.0 s for the C-cell thermal time constant and 0.018 for the contribution factor α gave the best results for the SBE19.

    Best estimates for the SBE4 conductivity module used on the SBE25, based on similar analysis, are 9.5-s for the thermal time constant and 0.0245 for the contribution factor α.

12) CALIBRATION of PRESSURE: Extract the value of pressure when the C-cell has drained after the cast (easy using <digitize> feature of Grapher).

    The standard deviation of values is about 0.15 db for each of the two SBE9s. The mean values are -0.39 db for CTD A and -0.45 db for CTD B. These values define the calibration offsets for pressure for casts 1-50 (0.39 db) and for casts 51-81 (0.45 db).

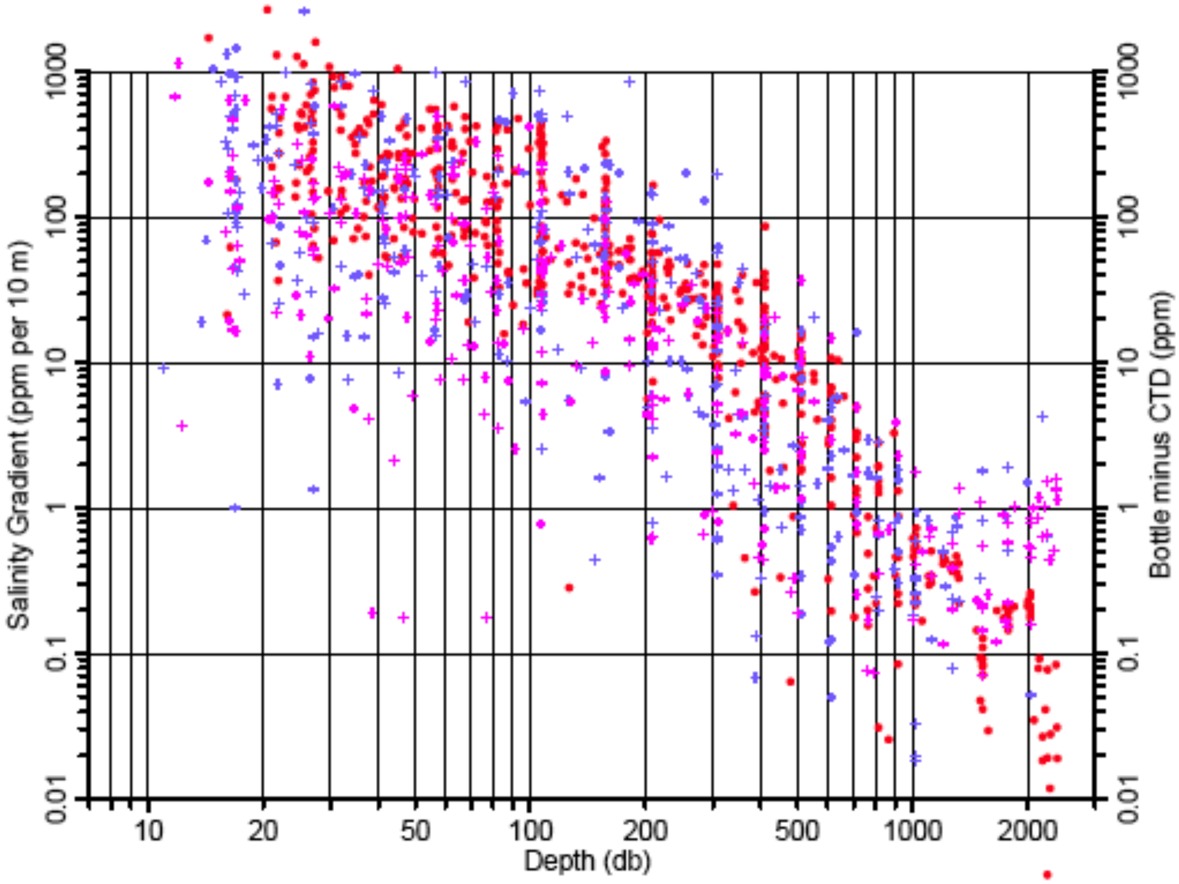
13) Check on CALIBRATION for TEMPERATURE: There was no facility for in situ calibration of temperature. Since the calibrations of aged thermistors are generally stable, we are content with consistency checks. The consistency of temperature values from the SBE4 sensors of the two CTDs was assessed based on values from deep, uniform waters in Baffin Bay (CTD A, cast 9) and in Hall Basin (CTD B, cast 69). Wake effects were judged negligible on both profiles.

    On CTD A, thermistor 2 reads warmer than thermistor 1 by only 0.35 m°C

    On CTD B, thermistor 2 reads warmer than thermistor 1 by only 0.3 m°C

14) Check on CALIBRATION for CONDUCTIVITY (viz.salinity): Salinity calculated from the sensors on the SBE9 probe are compared with values analyzed from water samples. The correspondence between the depth at which the sample was acquired and the CTD data stream was established via a procedure discussed in the next section.

    In general, the flushing of sampling bottles on a rosette is a turbulent (i.e. stochastic) process with a relatively long characteristic time. Although a relationship can be established between the average separation of CTD and water sample on the profile, sample-to-sample variations are large. Thus samples acquired (at a poorly known location) in a zone of appreciable vertical salinity gradient are not suitable for calibration. The close relationship between salinity difference (bottle minus CTD) and salinity gradient for the data from cruise 2003-35 is shown below.



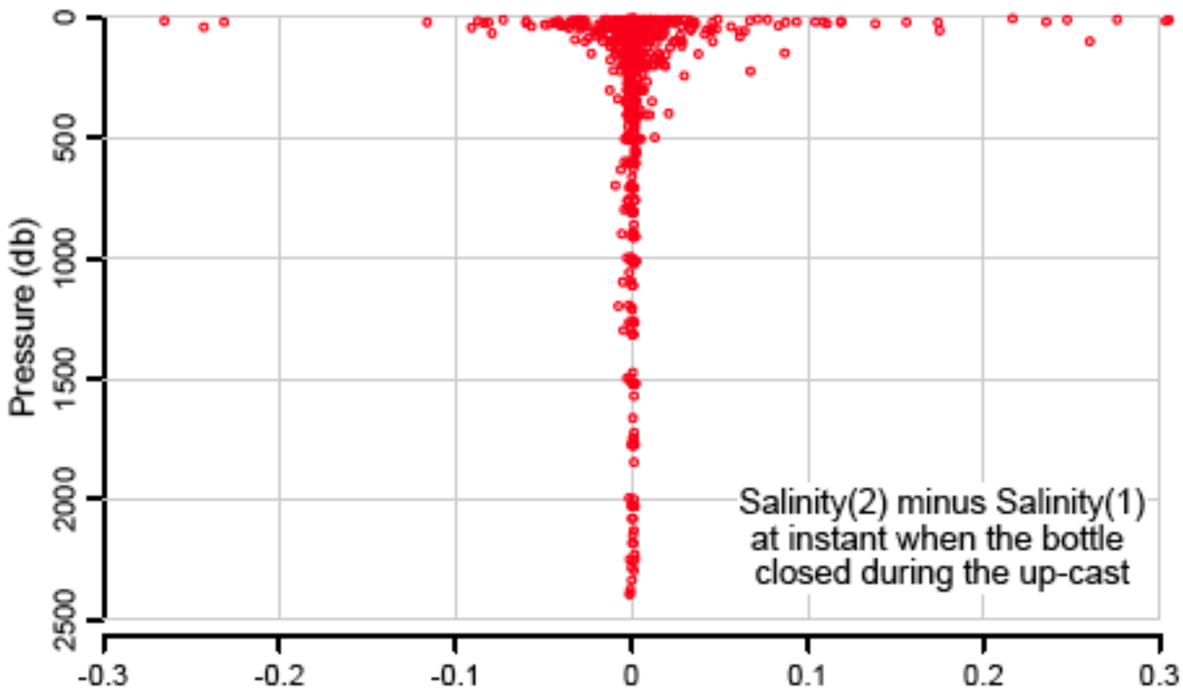
We use data acquired where the salinity gradient is less than 0.001 per metre, typically below 450 m in the region of study. Both TC systems of both SBE9 CTDs indicated salinity too low at 1000 m depth. The calibration data are as follows:

CTD	TC Unit	Bottle minus CTD	Cell Constant
A	1	0.004	1.000 106
A	2	0.001	1.000 026
B	1	0.003	1.000 079
B	2	0.003	1.000 079

15) INVALID PRIMARY TEMPERATURE, casts 33-50 (except not 48): Salinity computed from primary sensors for these casts showed serious impact of response-time mismatch. The temporal response of the primary temperature sensor appeared to slow significantly partway through cast 33, perhaps because of biological fouling of the thermistor pin. For this reason, data from the secondary temperature-salinity system were used in preference to the primary system for casts 33-47, 49 and 50.

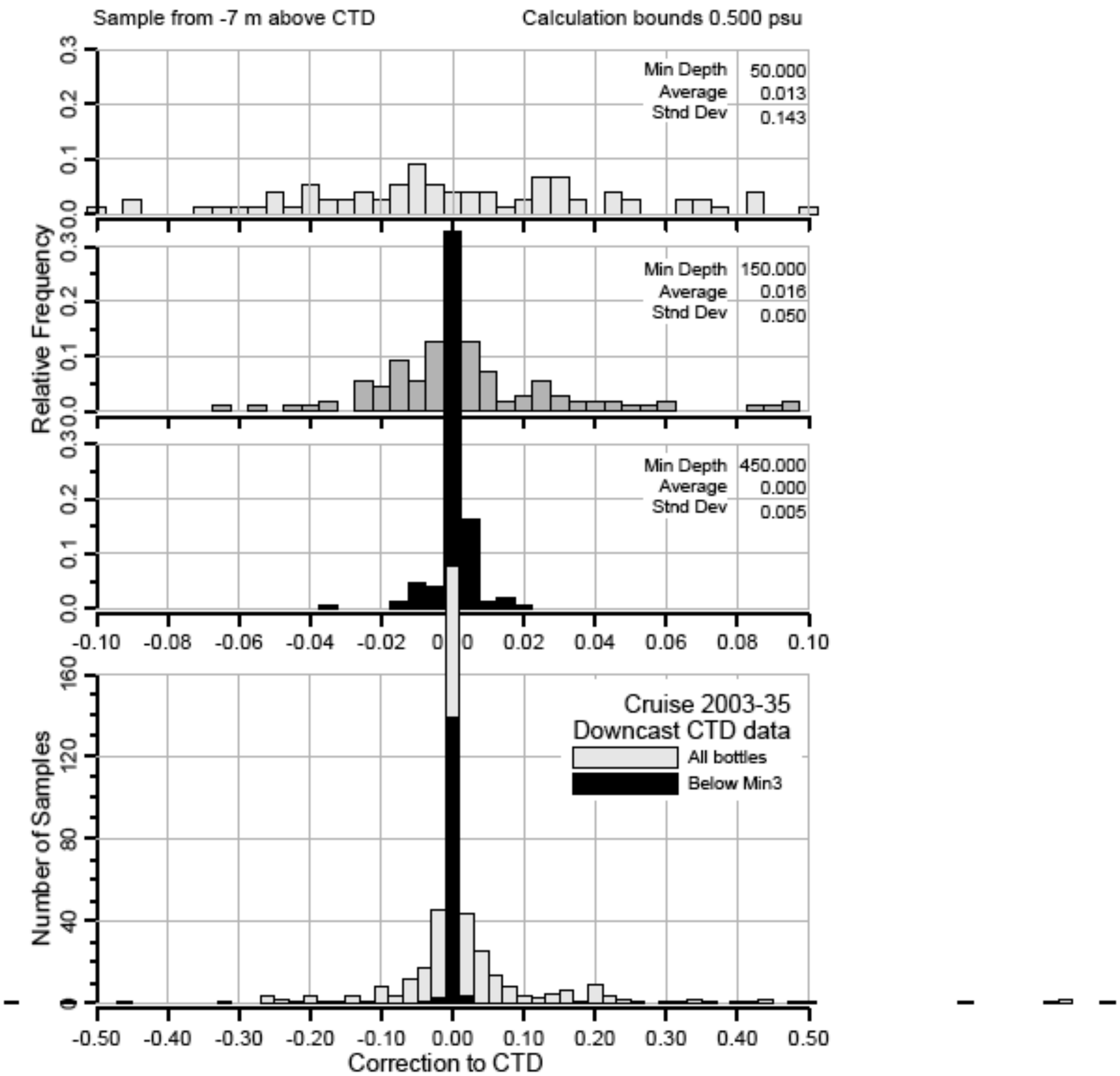
16) LAG DISTANCE for water samples. Seawater samples were captured on the up-cast without stopping. Salinity values computed from simultaneous data from the two independent pumped

systems on the SBE 9 differ by amounts proportional to the vertical salinity gradient. The difference is more than 0.100 near the surface despite the close proximity of the TC-duct intakes. These data illustrate the turbulent and poorly mixed character of the wake that the CTD samples on the way up.



The objective is to establish the relationship between the samples captured on the up-cast, and the undisturbed profiles of temperature and salinity measured by the CTD on the down-cast. The distribution based on CTDSalinity at the depth of bottle closure is skewed to positive values, since the captured sample is water from a depth greater than the CTD at the time of bottle closure. The optimal value is taken to be that which results in a symmetric distribution of (BottleSalinity - CTDSalinity).

For 2003-35, the most symmetrical distribution of salinity difference between bottle and CTD values is obtained when the CTD data are those measured 7 db below the level that the bottle was closed. A summary for data acquired with CTD A is shown in the figure that on the next page.

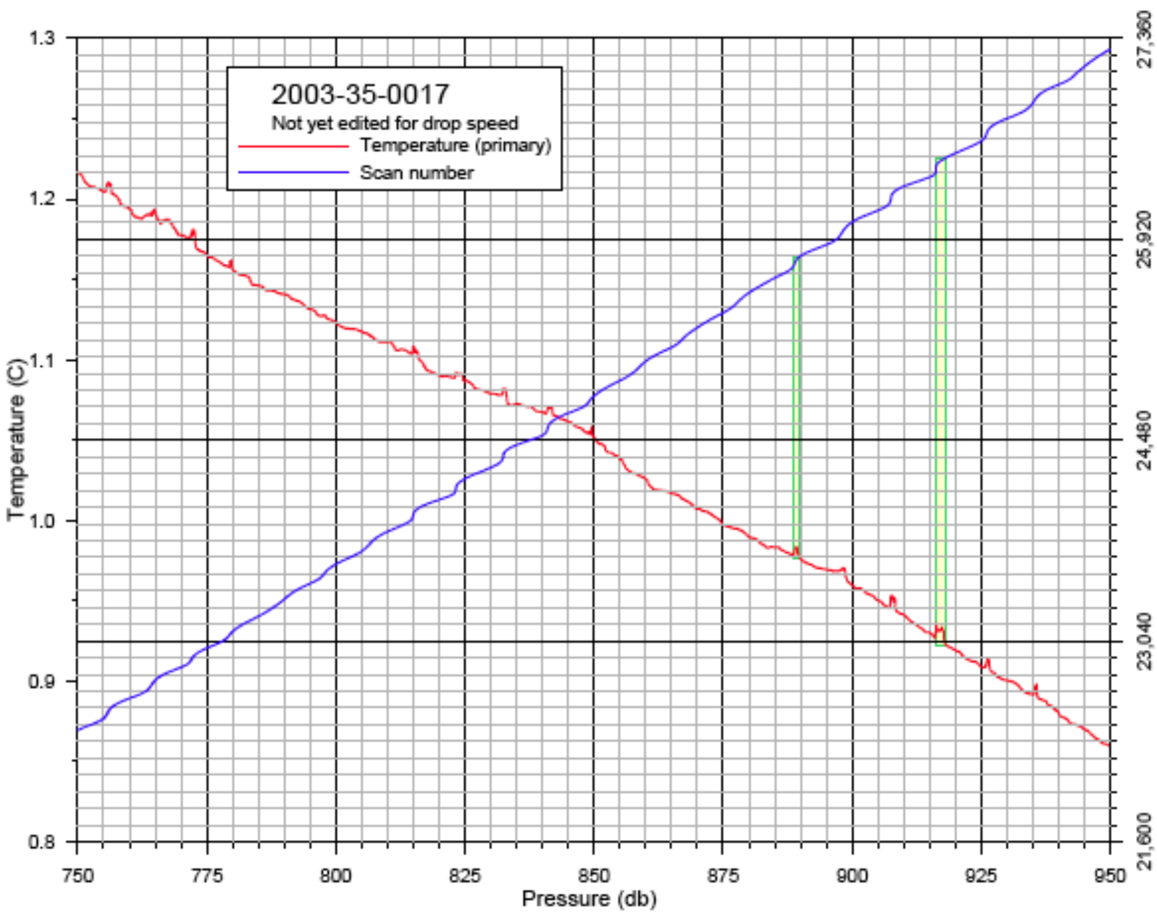


17) TWO VERSIONS OF THE PROFILE DATA were created following calibration and calculation of salinity. One is the standard, high sampling rate stream with variables pressure, temperature, conductivity, salinity, fluorescence and transmissivity. The other is intended for further processing of the DO signal voltage, which is not amenable to further editing since a continuous time series is needed. This second file set contains variables pressure, temperature, salinity and DO voltage. See the end of this document for further information.

18) Examine graphically the top and bottom portions of each profile. Delete scans at either end of the profile that are unrepresentative, because the data are contaminated by ship-generated mixing, or by wake engulfment when the rosette slows down at the bottom of the cast. The problem of wake engulfment is frequently characteristic of the entire profile when the ship heaves in a sea. Each time the ship rises, the descent of the rosette-CTD slows, allowing the wake to catch up. It is customary to edit CTD profiles for this effect by removing scans that were acquired at slow descent rate.

This is not appropriate. Engulfment occurs as the probe decelerates, and escape from the wake is not achieved until the probe has fallen some distance at increased speed. Deletions guided by fall speed eliminate some good data early in the heave, and leave some bad data later on.

The figure below illustrates the problem. In the absence of automated methods of automated methods of removing wake-contaminated data from the profile, those profiles most influenced by waves (1-3, 14-31) were inspsubjectively and temperature and salinity values were edited by interpolation over wake-influenced intervals. Other channels were left untouched.



19) File size is reduced by removing spurious channels (unused temperature and conductivity channels, altimeter data and flags).

20) File size is reduced 5-fold by computing averages of base variables (pressure, temperature, salinity, fluorescence, transmissivity) over 0.2-db increments.

21) Calculate the derived quantities potential temperature (Theta0), depth and gamma (Gamma0) using bin-averaged values of the profile data.

22) Salinity of water samples: Intrinsic to the above analysis is the assumption that all discrepancies in

salinity between bottles and the CTD result from stochastic variations in the water retained in the bottle through turbulent wake effects. It is also possible that large discrepancies occur because bottle closed at a depth different from that logged.

The figure illustrating the correlation of bottle-minus-CTD salinity and salinity gradient implies that discrepancies exceeding 0.100 are unlikely to result from wake effects at depths greater than about 100 m. This figure might be a useful guide in assessing issues related to possible errors in the depth of sample acquisition.

Processing for Dissolved Oxygen Sensor (SBE43)

1) At the processing stage prior to interactive editing of the high-resolution profile data (pressure, temperature and conductivity), a file was retained with variables pressure, temperature, salinity and DO voltage. The reason was to retain continuity of sampling for the variables relevant to the slowly responding DO sensor.

   Plumbing delay in the response of the oxygen sensor relative to pressure, temperature and conductivity was determined in stage 10, using casts 9 and 41. A value of 24 scans was adopted for use (about 1 second).

   Data were corrected for this delay using the IOSSHELL programme SHIFT to advance DO values upward in the file by 24 scans.

2) The response time of the SBE43 sensor is sensitive to pressure and to temperature. The value at 22.7°C is determined during calibration at Sea-Bird Electronics. The following algebraic relation is used to compute the effective time constant during field use.

$$\tau(p,T) = \tau_{23} \cdot D_0 \cdot e^{(D_1 \cdot p + D_2 \cdot T)}$$

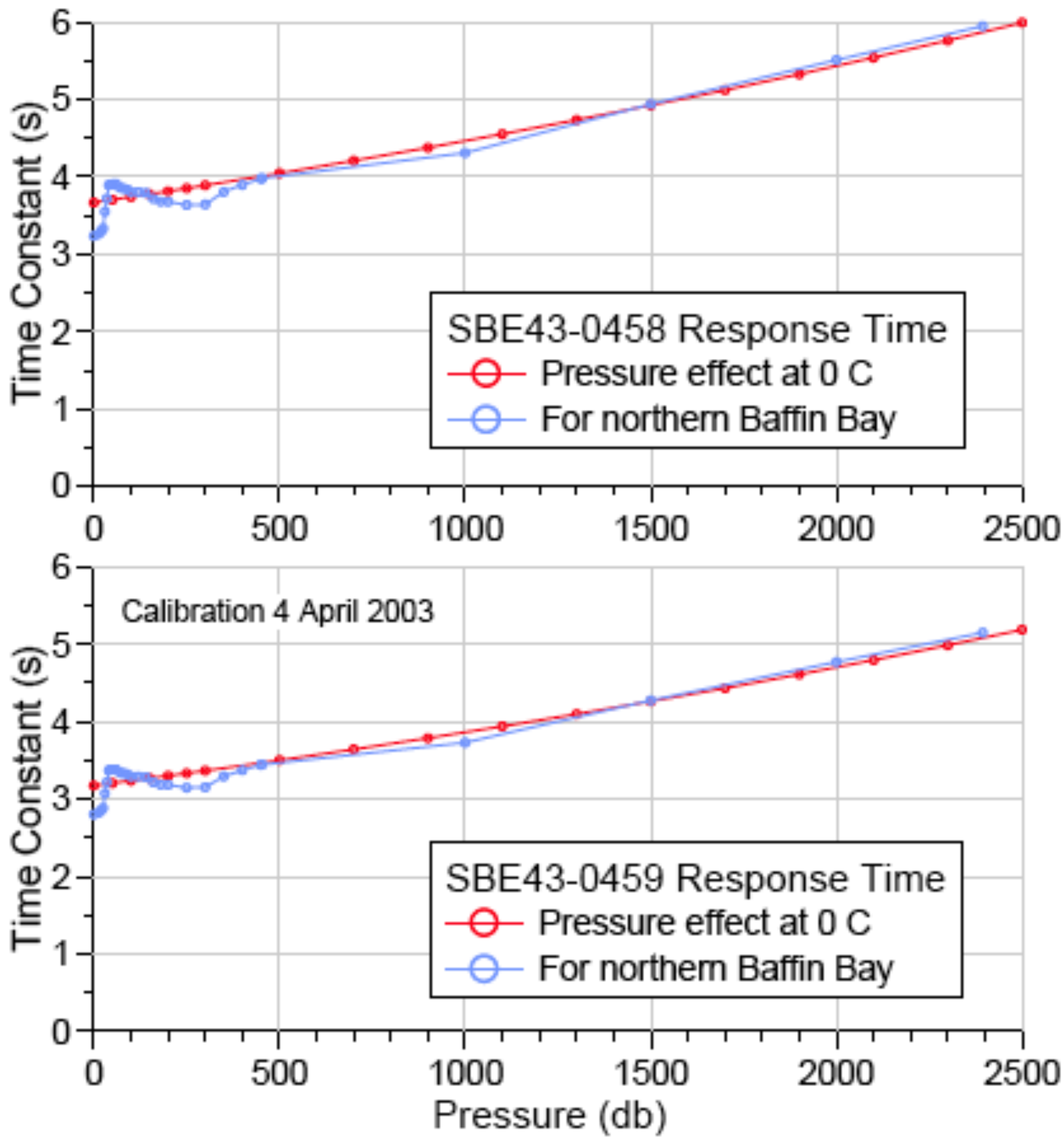
   where D_0 = 2.5826 at 22.7°C, D_1 = 1.9640 x 10^{-4} and D_2 = -4.1776 x 10^{-2}

   Laboratory values for the two units used in August 2003 were measured on 4 April 2003:

   s/n 0458 τ_{23} = 1.42 s
   s/n 0459 τ_{23} = 1.23 s

   The curves plotted here display the change in these values with pressure at constant temperature (0°C), and with depth at observed temperature in northern Baffin Bay. In view of our incomplete understanding of the SBE43 and of the likely absence of fine-scale vertical structure in DO at depth below 1000 m, we adopt constant values appropriate for the upper kilometre for exploratory processing of these data.

   4.0 s for s/n 0458, CTD-B
   3.5 s for s/n 0459, CTD-A



3) Pressure, temperature and salinity channels are smoothed using an exponential mapped-past filter (IOSSHELL programme EXPFILT) to match the variation in these variables to the slowly responding output voltage of the DO sensor.

The DO-sensor output is proportional to the fractional saturation of seawater by dissolved oxygen. The actual concentration of dissolved oxygen is calculated by scaling the voltage to the range (0, 1) and multiplying it by a value for the saturation concentration of oxygen calculated using the slowed-down signals for temperature and salinity. There are small corrections for a sensor offset voltage and for changes in the dimensions of the DO cell with pressure and temperature.

Note that if slowed-down signals for temperature and salinity are not used in computing the saturation concentration, then fine structure in temperature and salinity, to which the DO sensor is not sensitive, will be imprinted upon the profile of oxygen concentration. This is not appropriate.

$$DO = S_{oc}\left(V\text{-}V_{off}\right)\text{-}T_{cor}(T)\cdot P_{cor}(p,T)\cdot Ox_{sat}(T,S)$$

Here $T_{cor}(T)$ is a 3rd order polynomial in temperature [Celsius] with coefficients A, B, C.

$$P_{cor}(p,T) = e^{E\cdot p/(273.15+T)}$$

This following step is not recommended until more experience with the DO sensor is gained:

It may be practical to re-constitute some of the variance lost to the slow response of the DO sensor. Murphy (Sea-Bird Electronics, 2005) proposes adding a term $T_{cor}(V,\ T,\ p)$ to the signal voltage to restore some high frequency variance that remains small but detectable on the sensor voltage output. The added term uses the temporal derivative of voltage to detect this variance:

$$T_{cor}(V,\ T,\ p) = \tau\ (T, p)\ \cdot\ \frac{dV}{dt}$$

4) Murphy recommends smoothing the 24-Hz DO voltage signal with a 0.5-second running average before differentiation. Files are subsequently thinned to a sampling rate of 2 Hz (1 sample per half second).

5) Subsequent processing and calibration of the DO voltage is pending at this time (18 May 2005).

CTD Data Processing: Oxygen

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Oregon State University
April 2010

CTD data consisting of casts numbered from 1 to 81 were acquired using two Sea-Bird SBE911+ systems, including two SBE43 Clark-type oxygen sensors. Humfrey Melling used standard CTD data processing techniques (Melling's data processing report is also available at this CCHDO site) to create 24 Hz data files of pressure, temperature, salinity, and raw oxygen sensor voltage. Note that we differed in opinion with Melling as to how to process the oxygen data; our preferred approach is described below. Cast 1 data are not useful due to shipboard problems, and there are no data for casts 25 and 27. For instrumentation details, consult the cruise report.

The oxygen sensor data were processed using the Sea-Bird SBE43 Owens-Millard calibration equation:

$$[O_2] = Soc * \left(V_{43} + V_{offset} + \tau(P,T) * \frac{\partial V_{43}}{\partial t} \right) * Oxsat(T,S) * e^{T_{cor} * T} * e^{P_{cor} * P}$$

where:

$[O_2]$ is the concentration of oxygen, in the same units as Oxsat;
Soc $[V^{-1}]$ is the linear scaling calibration coefficient;
V_{43} [V] is the oxygen sensor voltage;
V_{offset} [V] is the sensor voltage at zero oxygen, a calibration coefficient;
τ [s] is the sensor time constant, dependent on pressure and temperature;
$\partial V_{43}/\partial t$ [V/s] is the smoothed time derivative of the smoothed voltage signal;
Oxsat(T,S) is the oxygen saturation concentration as parameterized by Weiss (1970);
Tcor $[C^{-1}]$ is the temperature correction coefficient;
Pcor $[db^{-1}]$ is the pressure correction coefficient.

The ($\tau * \partial V/\partial t$) term mathematically diminishes signal broadening effects resulting from the time response of the sensor characterized by the 1/e time constant τ. For the ideal case of a single exponential time response and a signal with no noise, inclusion of this term would exactly cancel the broadening. The dependence of τ on temperature [°C] and pressure [db] was given by Sea-Bird (2006) as:

$$\tau(P,T) = \tau_{RT} * D_0 * e^{D_1 * P} * e^{D_2 * T}$$

where τ_{RT} is the sensor time constant measured at room temperature (22.7°C), $D_0 = 2.5826$, $D_1 = 1.964*10^{-4}$, and $D_2 = -4.1776*10^{-2}$.

The oxygen saturation algorithm of Garcia and Gordon (1992) provides better estimates of oxygen saturation concentrations at temperatures near freezing than does that of Weiss (1970), because they used more accurate experimental data and an improved functional form for the fitting equation. However, the Sea-Bird calibrations available to us were based on the Weiss algorithm. Because Oxsat(W) = 0.99903 * Oxsat(GG) at the lowest temperature calibration points (5°C; only two temperature values were used in the factory calibrations, the other at 25°C), we modified the Owens-Millard equation above by replacing Oxsat(W) with 0.99903 * Oxsat(GG). This substitution obviously does not change the numerical values calculated for $[O_2]$ at 5°C. The factor 0.99903 can be interpreted as an adjustment to the original Soc value determined using Oxsat(W), resulting in an effective Soc value 0.1% smaller than the original.

The pre-cruise SBE calibration coefficients for the two oxygen sensors were used (see Appendix) with the exception of τ_{RT} in the upper water column, which was determined empirically from the cruise data as described below. No post-cruise calibrations were possible because the oxygen sensor membranes were damaged after cruise completion and before the sensors were received by Sea-Bird at their factory.

The major problem associated with processing oxygen Clark-type sensor data is that the sensor time response (seconds for the SBE43) is much slower than those of our temperature and conductivity sensors (60 milliseconds), resulting in oxygen fractional saturation signals "smeared" in time relative to those of temperature and salinity. The standard processing approach at the time of this cruise (using the Owens-Millard equation with $\tau = 0$) would have been to crudely line up the oxygen record to those of temperature, salinity, and pressure by advancing the oxygen sensor data stream in time. Such empirical time advances would be larger than warranted by the physical flow lag from the TC sensors to the oxygen sensor by about the magnitude of the oxygen sensor time constant. However, this procedure can produce artifactual oxygen structure: the Oxsat(T,S) term in the calibration equation will reflect any high resolution structure present in the temperature and salinity records, whereas the fractional saturation values proportional to the sensor voltages will be unable to respond to the fine scale *in situ* oxygen fractional saturation structure that, if present, may or may not be correlated with the temperature and salinity structure.

One solution would be to smooth temperature and salinity data used in the calculation of Oxsat, before it is used in the calibration equation to determine oxygen concentrations. However, in this approach, the calculated oxygen concentration data are artifactually broadened in certain circumstances (for example when there are step gradients in oxygen concentration, temperature, and salinity, but constant oxygen fractional saturation). The method we prefer uses the ($\tau * \partial V/\partial t$) term to sharpen the oxygen sensor response in an attempt to match it to those of the temperature and conductivity sensors. Data acquired within the top of the water column in regions of steep temperature gradients appeared to require different values for the processing variables (τ, flow advance) than did data acquired deeper in the water column later in the casts. Possible explanations for this empirical observation are discussed after the presentation of the following four figures characterizing it.

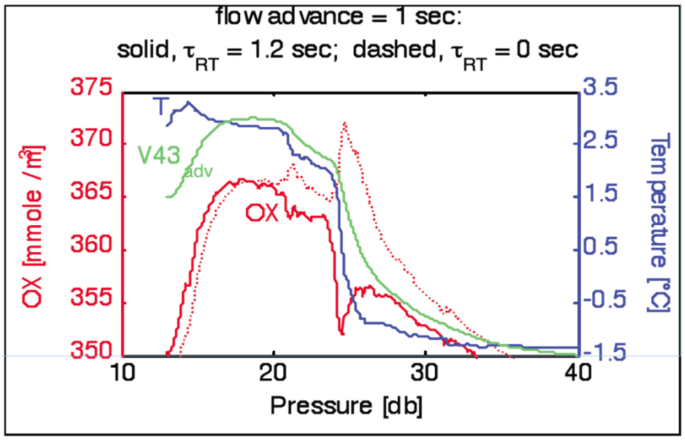

Figure 1

A value of 1 second for the oxygen flow advance was determined by visually comparing the oxygen sensor voltage record relative to the temperature record in regions of steep gradients (casts 9 and 41). Figure 1 shows temperature (blue), oxygen sensor voltage (green) advanced by 1 second, and calculated oxygen signal for cast 41, with τ_{RT} set equal to that of this sensor's factory-determined calibration coefficient, 1.2 seconds (solid red trace). For comparison, the calculated oxygen signal for $\tau_{RT} = 0$ at this flow advance is also shown (dashed red trace). Both traces show artifacts analogous to salinity spikes at the locations of steep temperature gradients at about 21 and 25 db. Such features arise because of the mismatch in sensor time constants and/or synchronization.

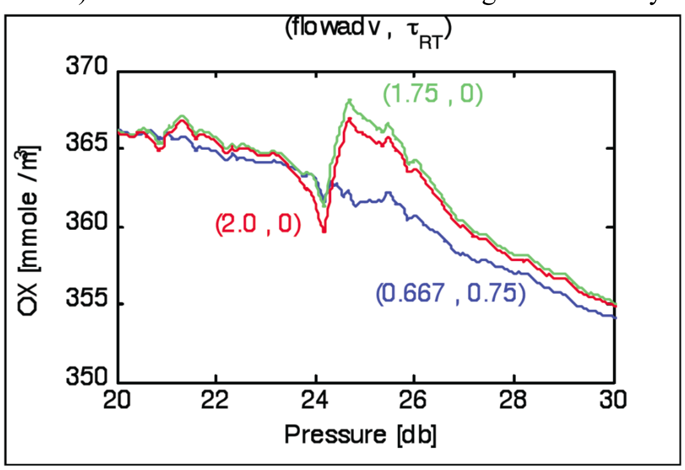

Figure 2

Processing parameters for the upper part of the water column (flow advance = 0.667 sec, τ_{RT} = 0.75 sec) were chosen to be those that minimized the sizes of the spike artifacts (blue trace, Figure 2). Also shown is the best result for $\tau_{RT} = 0$ (flow advance = 1.75 seconds, green trace); at larger flow advances, the magnitude of the positive spike decreases at the expense of the appearance of a negative spike at the beginning of the feature at 24 db (red trace).

Deeper in the water column, however, a different set of processing parameters was required to process the data. Many casts exhibited fine scale temperature structure which was anti-correlated with the oxygen sensor voltage record. Figure 3 shows such a case, also occurring in cast 41, in which the processing parameters which gave good results in the upper part of this cast failed to line up the calculated oxygen features with temperature. The advanced sensor voltage record is shown in green; processing by inclusion of the $\tau * \partial V/\partial t$ term results in the fractional saturation trace shown in red, sharpening (and effectively further advancing) the flow-advanced sensor voltage. Fractional saturation is calculated as $[O_2]$/Oxsat, and so is only insignificantly influenced by temperature through the T_{cor} correction term. Since oxygen solubility is inversely correlated with temperature, Oxsat(T,S) (in blue) and fractional saturation are positively correlated in this region. The Oxsat and fractional saturation features at 225 db and 245 db do not line up.

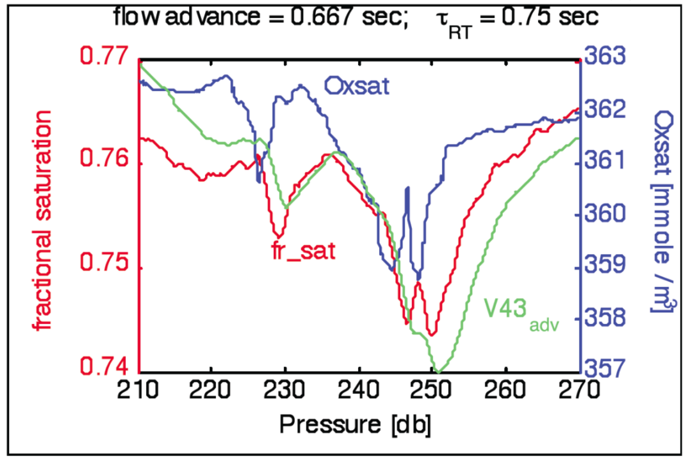

Figure 3

A better fit to subsurface data was obtained by using a flow advance of 2.5 seconds while retaining the factory calibration value for τ_{RT} (red trace, Figure 4). On the other hand, using increasingly larger values for τ_{RT} instead of increasing the flow advance did not shift the calculated fractional saturation record far enough to earlier times, so that the fine scale features would not coincide. In addition, larger values for τ_{RT} resulted in a distorted fractional saturation record.

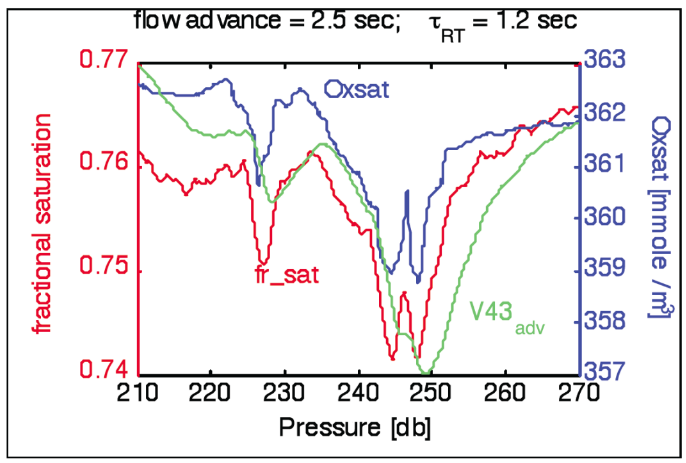

Figure 4

Each cast was processed in three parts. At and above the thermocline, (0.667, 0.75) was used, as in Figure 2. Twenty db below the thermocline, (2.5, 1.2) or (2.5, 1.4) was used (Figure 4), depending on which oxygen sensor was employed. At intermediate pressures, oxygen values were determined by using a progressively weighted average to splice together records calculated using each set of parameters.

We can advance two possible explanations for the disparate time response characteristics of the sensor signal during each cast. First, the oxygen sensors may not have been at thermal equilibrium, thereby leading to the observed longer effective τ values as the internal temperature of the sensor dropped. Second, it may be that the time responses of these oxygen sensors are not adequately modeled by a single exponential decay, and in fact may be more accurately modeled as a double exponential decay. In the latter case, inclusion of the $\tau * \partial V/\partial t$ term in the calibration equation would not identically cancel the effects of broadening on the sensor voltage signal.

Arithmetically, the short empirically determined τ_{RT} value used at the top of the water column is effective because as the multiplier to $\partial V/\partial t$, it adjusts the sharpening of the sensor voltage response to match the sharpness of the steep temperature gradient so that spiking does not occur. Below the thermocline, there may be a longer time component to the sensor response which cannot be fully corrected using any value of τ_{RT} because of the non-ideal (not single exponential) time response of the oxygen sensor. However, this hypothesized longer time response would be empirically compensated for in our data with an increased flow advance to 2.5 seconds.

Winkler titrations of water samples collected by the CTD rosette system (see meta data for bottle samples for analytical details) were used to calibrate the oxygen sensor data. Only values acquired from water samples in regions of slowly varying oxygen concentration were used, which limited the samples to those collected below 300 meters (5 outliers were discarded). When the deviations of the sensor data from the bottle data were plotted against time, 4 distinct groups of points resulted (Figure 5, blue points).

The first two groups of data were merged because their means were not significantly different. The mean of the values in the merged group was used to determine the Winkler calibration offset for casts acquired before cruise day 5.8. For the same reason, the Winkler calibration offset used for casts acquired after cruise day 8.2 was determined from the mean of the values comprising the last two groups of data. (Note that the difference in calibration offsets is not due to the different oxygen sensors used, because the sensors were switched on about cruise day 11). Casts acquired between days 5.8 and 8.2, depicted by the red crosses in Figure 5, fell into three groups in time. The 3 earlier casts, before day 6, were assigned the same calibration offset as determined for the casts in the first two groups of data; the last 2 casts, after day 8, were assigned the same offset as determined for the last two groups of data;

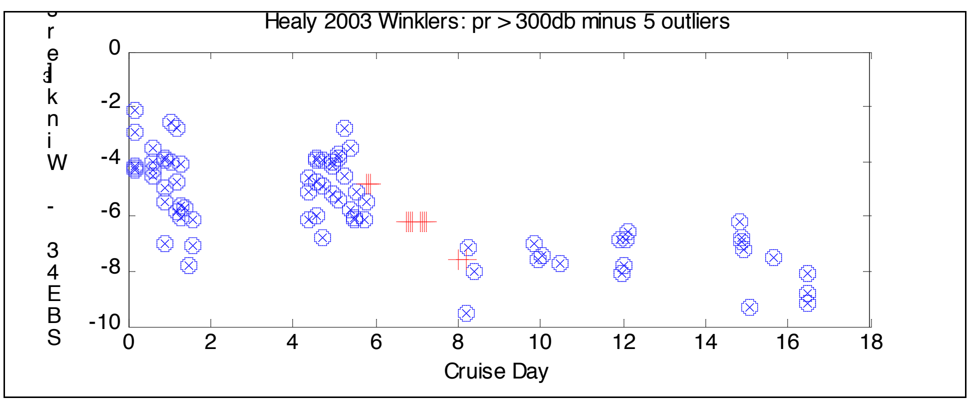

Figure 5

and the calibration offset for the middle casts was assigned as the mean of these two values. The calibration statistics are presented below in Table 1. The absolute values of the mean deviations were added as offsets to the sensor data to correct them to the Winkler determinations.

Table 1: Winkler calibration statistics

cruise day:	d<6	6<d<8	d>8
cast number:	c≤28	29≤c≤38	c≥39
|mean| [mmole/m^3]:	4.8	((6.2))	7.6
stdev [mmole/m^3]:	1.2	-	0.9
number of bottles:	51	-	21

Casts were truncated at the top and bottom of the water column with the intent to capture data occurring only during the monotonically increasing part of the pressure records (the latter minimally smoothed to eliminate bit noise). Some casts (2, 14, 17-24, 26, and 28) did exhibit significant pressure reversals after the start of the CTD's descent; these data were retained, processed, and noted in the corresponding data files as a notation at the `#pressure reversals:` header line. The data were then binned into 1 db bins, derived quantities calculated, and data files created in accordance with CCHDO formats. The data files are named hly031-00??-oxy_ct1.csv, where ?? = cast number. The column headings denoting the variables and their units are:

```
CTDPRS  DBAR  pressure
CTDDEP  METERS  depth
CTDTMP  ITS-90  temperature
CTDPOTTMP  ITS-90  potential temperature
CTDSAL  PSS-78  salinity
CTDSIGTH  KG/M^3  sigma-theta
CTDOXYV  VOLTS   unprocessed oxygen sensor voltage
CTDOXY  MMOLE/M^3  oxygen concentration
CTDOXPCSAT  PERCENT  percent oxygen saturation
CTDOXSAT  MMOLE/M^3  oxygen saturation (Garcia-Gordon)
CTDNOBS  NUMBER  number of points per bin
```

The unprocessed oxygen sensor voltage records are included as a diagnostic for the user, and in case the user would want to process the raw sensor data in a different manner.

KENNEDY CHANNEL MOORINGS

DEPLOYMENT OF THE FRESHWATER FLUX ARRAY

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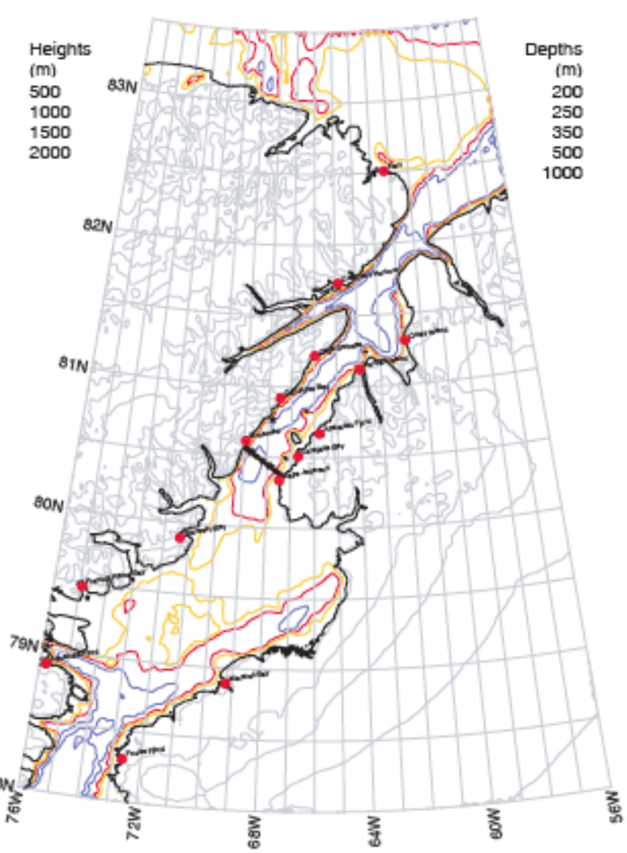
Design of the Array

The freshwater flux array is a “picket fence” designed to measure ocean current, temperature and salinity over the full depth of the channel, and ice drift and thickness at the surface. The picket-fence analogy refers to the close (5 km) spacing of moorings. This spacing is comparable to the internal Rossby radius in Nares Strait and to the topographic length scale at the channel walls. We anticipate that the time series recorded by instruments at this spacing will be coherent. If this is so, then fluxes may be calculated by integration of salinity and current values interpolated between moorings.

The “picket fence” was established at the southern end of Kennedy Channel, about 200 km north of the sill separating waters of the Arctic Ocean from those of Baffin Bay. The channel here is only 38 km wide, and the depth everywhere is less than 400 m. At this section, we require only 8 moorings of each type to measure the flow on a 5-km scale. The depth of the section is within the anticipated year-round effective range of operation of the 75-kHz acoustic Doppler current profilers selected for this project.

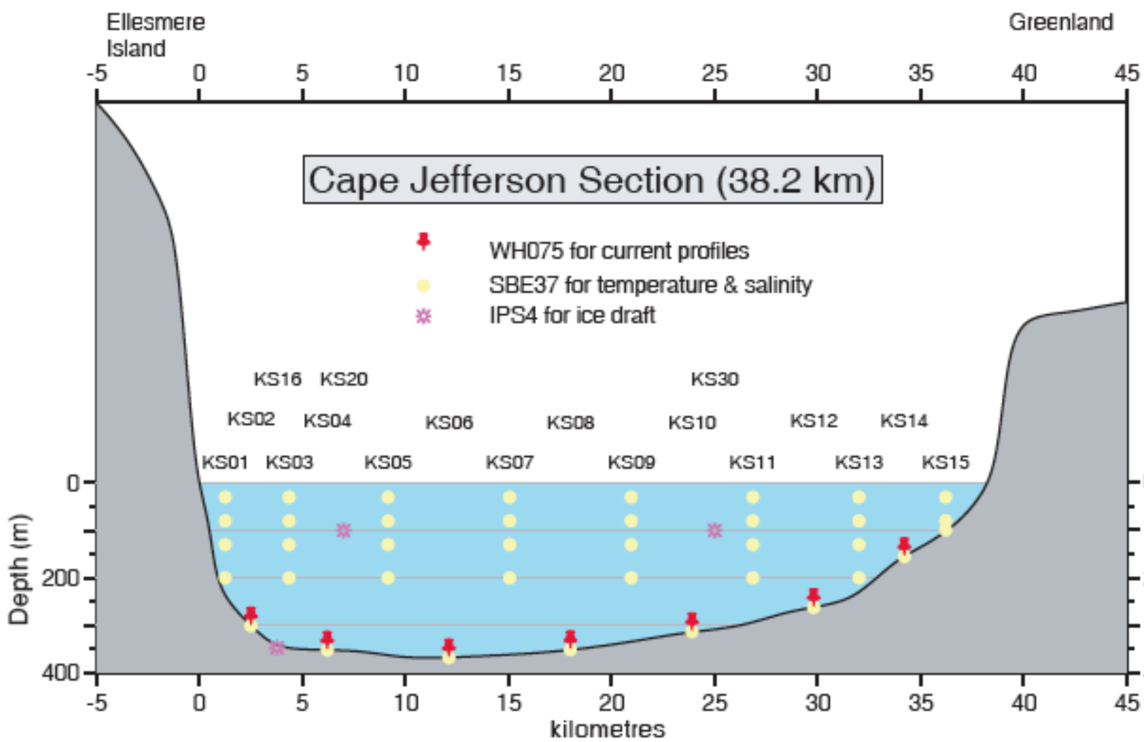
Location of the picket fence in Nares Strait



The location of the picket fence in Nares Strait is marked on the adjacent map by the dense line of symbols touching the Greenland coast at Cape Jefferson. The geometry and layout of the section is illustrated below.

Mooring Description

Three types of moorings have been used on the section. These support 75-kHz ADCPs, temperature-salinity recorders and ice-profiling sonar, respectively. There are 8 moorings for temperature-salinity measurement on the section, interleaved with 7 ADCP moorings to measure current and ice drift. An eighth ADCP mooring has been positioned on the Ellesmere side, 30-km north of main array, to assist in identifying disturbances that propagate along the channel. Two additional moorings on the main section carry ice-profiling sonar for measuring the thickness of drifting ice.



Geometry and layout of Cape Jefferson Section

Five moorings in a pressure-measuring array, described elsewhere in this report, supplement the moorings of the freshwater-flux array.

Each type of mooring has unique features designed to cope with the challenges of this high latitude environment – hazard from drifting ice in the upper 30 m of the water column, hazard from icebergs in the upper 200 m, and the absence of a stable geomagnetic reference for current direction.

The ADCP moorings avoid ice by rising less than 3 m above the seafloor in depths of 150-380 m. For the same reason, the ice-profiling sonar have been positioned at 100-m depth, the maximum practical for effective performance of this instrument. The floatation supporting the temperature-salinity moorings, which rise to within 30 m of the surface, is distributed in long strings of small plastic floats. This floatation is less prone to snagging in the crevices of drifting ice and icebergs. The moorings are also "soft" and thus easily depressed by drifting ice. The changing depth of temperature-salinity recorders can be determined from the records of pressure recorded in two SBE37s on each mooring, one at a nominal depth of 30 m and the second at the 30-inch steel float at 200-m nominal depth.

The ADCP moorings are torsionally rigid, so that each instrument is held in a fixed (unknown) orientation throughout its deployment. The orientation is determined through a tidal-stream analysis of the current record, following retrieval of data from the instrument at the end of the deployment. Because torsional rigidity requires a solid coupling between the instrument and its anchor, the anchor weight is distributed in long loops that cushion the impact with the seafloor after free-fall from the surface at 3 m/s.

All moorings are designed for recovery and redeployment through sea ice using aircraft in springtime. The limitations of aircraft, of human muscle power and of access to the ocean through thick sea ice impose tight constraints on the weight, bulk and buoyancy of mooring components.

Representative diagrams of the three mooring types are shown in the figures that follow.

Testing

Much of the instrumentation for deployment as the freshwater measuring array was purchased new for the project. The primary components, acoustic release-transponders and Work Horse 75 kHz ADCPs, were tested for full functionality in water prior to their use on the moorings.

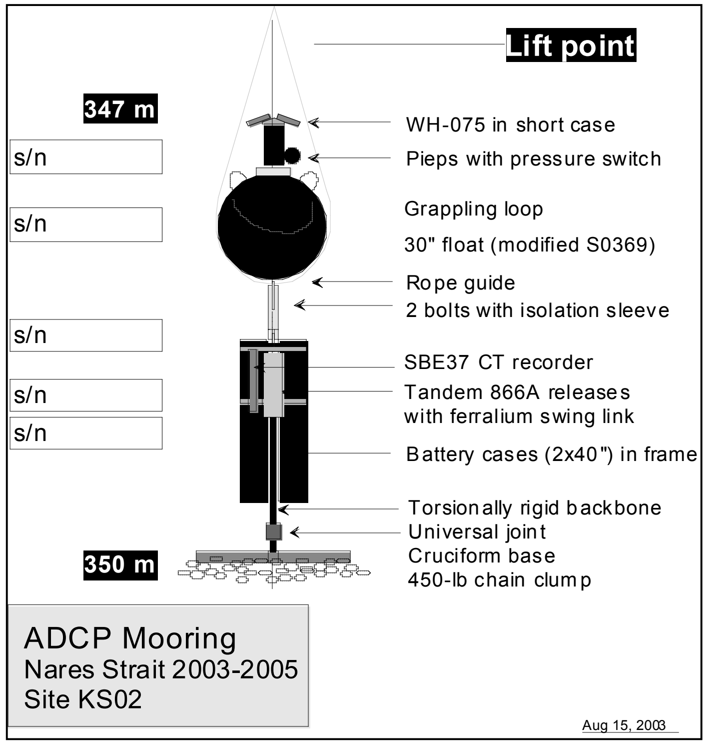
The Benthos 866A releases can withstand of deep immersion (2000 m). The releases were tested in groups of eight within which no receiving channel frequency was replicated. The groups were secured to a spare rosette frame and lowered to approximately 1000-m depth from the aft A-frame. Functionality was tested on a vertical propagation path by lowering the Benthos hydrophone over the stern. The Benthos 867A release cannot withstand the pressure at 1000 m. This model was tested with the rosette to 30-m depth and the hydrophone deployed from the RHI at 100-m range from Healy. Sonar operating at 3.5 kHz and 12 kHz from Healy was shut down during each trial.

The following checks were performed for each release individually: 1) Enable the operation of each release acoustically using the appropriate coded transmission; 2) Send the transpond command to test the ranging capability; 3) Send the release command to test this function.

Tests of the 867A releases on a horizontal propagation proceeded smoothly. All releases operated without ambiguity.

There were difficulties in acoustic communication with the 866A releases on the vertical propagation path, with the hydrophone at shallow depth (less than 5 m). Several releases were inoperable in the acoustic environment of the ship. However, these poor performers were later tested with the 867As on a horizontal path, where the hydrophone was remote from Healy. In this acoustic environment, they passed testing without problem. Marginal operation at 1000-m range is apparently related to the high noise level in the vicinity of Healy. A lengthened hydrophone cable is recommended for use during mooring recoveries from Healy.

Note that the standard Benthos release has been modified for this project to operate on a schedule of 1-minute ON followed by 2-minutes OFF. This modification was required to extend the release operation to 2-3 years on the standard 20 amp-hour battery. With this modification, enabling the release typically requires repeated transmission of the enable command at 30-second intervals. Following activation with the enable command, the release is operable at all times.



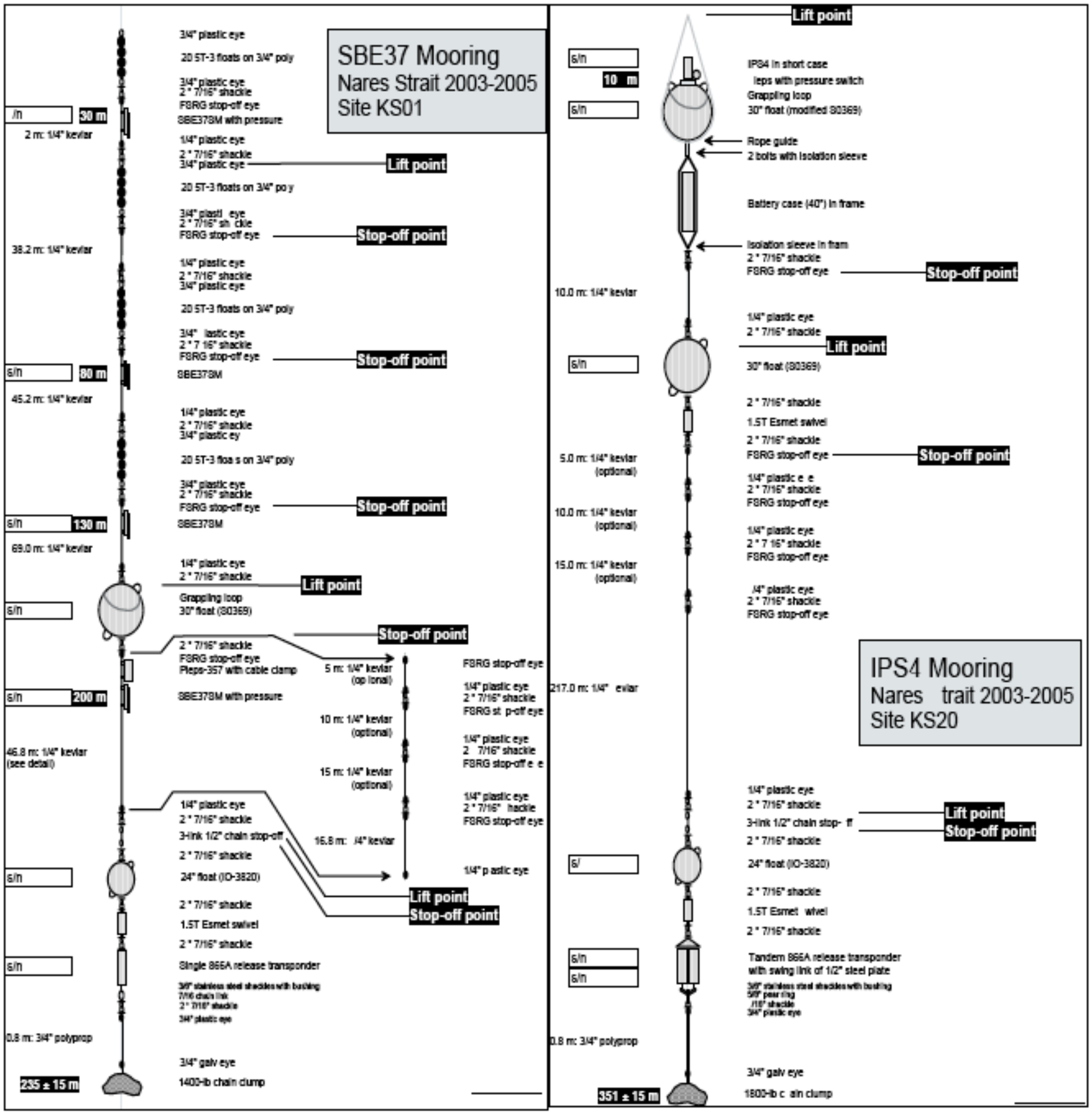
Deployment Method

HLY03-1 was exceptionally lucky with ice conditions in Nares Strait in 2003. The predominant wind direction for the entire cruise was southerly, in consequence of prevailing low pressure in the Beaufort Sea. This prevailing wind has backed ice into eastern Kane Basin, or driven it north all the way to the Lincoln Sea - the freshwater is going the 'wrong' way this year! Over time, heavy ice has leaked northward from Kane basin into eastern Kennedy Channel. However, by the time that this leakage occurred, we had completed al the mooring work in this area. As with all Arctic expeditions, luck (good or bad) plays a significant role in the level of success.

The 18 moorings of the freshwater flux array were deployed during the 48-hour period between the morning of August 4 and that of August 6. The interleaving of rosette casts with moorings at the sites of each temperature-salinity mooring prolonged the overall duration of the mooring activity. Although some pack ice mixed with tabular bergs was encountered within 10 km of Cape Jefferson on the eastern side of Kennedy Channel, we found sufficient ice-free water to stream out the taut-line moorings and use the anchor-last approach at every site. The anchor last approach is safer and much quicker (0.5 hour versus 3 hours) than the anchor-first method. The ADCP moorings are designed for deployment in compact ice and would not have offered challenges even had ice conditions been much worse.

It is worthwhile to note that the deployment of moorings would have required significantly (perhaps 3 times) more time had we encountered ice conditions more typical of Nares Strait in early August. Our efficiency in mooring on this trip should not be viewed as an accomplishment generally achievable in this area.

Soundings at the mooring sites were derived from the Seabeam bottom-mapping sonar, using a profile for sound speed computed from CTD data in central Smith Sound. There are considered accurate to within 2 m. The tidal range imposes a further uncertainty of 2-3 m.



SBE37 and IPS4 Moorings

There is a variety of sources for positioning information on Healy derived from the GPS. Antennas are at various locations on the ship, but none are located where the mooring anchors were dropped at the transom. Also, it is anticipated that anchors will drift up or down channel by distances of approximately 50 m during the 3-minute drop to the seabed, in response to current and to hydrodynamic resistance from the streamed-out mooring. The positions used in the following tables are derived from the Centurian aft GPS receiver/antenna and our referenced to the WGS84 chart datum.

Summary of ADCP Moorings

Mooring Site	CATS name	WH-LR #	WH-LR deployment plan	UTC of 1st ensemble	UTC of drop	Latdeg	LatMin	LonDeg	LonMin	Expected depth (m)	Actual depth (m)	Sonar depth (m)
KS02	Lynx	**3194**	KS02_.whp	00:00 04-Aug-03	17:41 04-Aug-03	80	33.2277	068	52.4657	301	296	293
KS04	Bobcat	**3426**	KS04_.whp	00:00 04-Aug-03	17:03 04-Aug-03	80	32.1242	068	42.8398	352	357	354
KS06	Serval	**3642**	KS06_.whp	00:30 04-Aug-03	16:26 04-Aug-03	80	30.1616	068	27.2399	368	362	359
KS08	Margay	**3653**	KS08_.whp	00:30 04-Aug-03	15:48 04-Aug-03	80	28.2859	068	11.4325	351	350	347
KS10	Kodkod	**3654**	KS10_.whp	01:00 04-Aug-03	14:56 04-Aug-03	80	26.3262	067	55.7786	313	300	297
KS12	Caracal	**3655**	KS12_.whp	01:30 04-Aug-03	15:37 05-Aug-03	80	24.5525	067	40.2551	262	255	252
KS14	Ocelot	**3656**	KS14_.whp	02:00 04-Aug-03	12:22 04-Aug-03	80	23.3054	067	26.7507	155	152	149
KS16	Jaguarund	**3751**	KS16_.whp	03:00 06-Aug-03	11:22 06-Aug-03	80	45.9281	068	48.8179	350	361	358
						Centurian Aft Antenna						
						Datum is WGS84						

Summary of Ice-Profiler Moorings

Mooring Site	CATS name	IPS4 #	WH-LR deployment plan	UTC of drop	Latdeg	LatMin	LonDeg	LonMin	Design depth (m)	Actual depth (m)	Adjust line (m)	Target level (m)	Actual level (m)
KS20	Sabre Tooth	**1034**	IPS4-34 (03KS20).dpl	04:41 06-Aug-03	80	32.0406	068	39.0463	351	342	-10	100	102
KS30	Snow Leopard	**1035**	IPS4-35 (03KS30).dpl	00:05 06-Aug-03	80	26.4158	067	51.1131	307	294	-10	100	98
					Centurian Aft Antenna								
					Datum is WGS84								

Summary of Temperature-Salinity Moorings

Mooring Site	CATS name	SBE37 #	UTC of drop	Latdeg	LatMin	LonDeg	LonMin	Design depth (m)	Actual depth (m)	Adjust line (m)	Target level (m)	Actual level (m)
KS02	Lynx	**2889**	17:41 04-Aug-03	80	33.2277	68	52.4657	301	296	0	300	295
KS04	Bobcat	**2890**	17:03 04-Aug-03	80	32.1242	68	42.8398	352	357	0	351	356
KS06	Serval	**2891**	16:26 04-Aug-03	80	30.1616	68	27.2399	368	362	0	367	361
KS08	Margay	**2892**	15:48 04-Aug-03	80	28.2859	68	11.4325	351	350	0	350	349
KS10	Kodkod	**2893**	14:56 04-Aug-03	80	26.3262	67	55.7786	313	300	0	312	299
KS12	Caracal	**2894**	15:37 05-Aug-03	80	24.5525	67	40.2551	262	255	0	261	254
KS14	Ocelot	**2895**	12:22 04-Aug-03	80	23.3054	67	26.7507	155	152	0	154	151
KS16	Jaguarund	**2896**	11:22 06-Aug-03	80	45.9281	68	48.8179	350	361	0	349	360
KS01	Tiger	**2917**	20:20 04-Aug-03	80	33.4702	068	54.4556	235	234	0	30	30
KS01	Tiger	**2897**	20:20 04-Aug-03	80	33.4702	68	54.4556	235	234	0	80	80
KS01	Tiger	**2909**	20:20 04-Aug-03	80	33.4702	68	54.4556	235	234	0	130	130
KS01	Tiger	**2925**	20:20 04-Aug-03	80	33.4702	68	54.4556	235	234	0	200	200
KS03	Lion	**2918**	22:22 04-Aug-03	80	32.6972	068	47.3071	347	356	10	30	30
KS03	Lion	**2932**	22:22 04-Aug-03	80	32.6972	68	47.3071	347	356	10	80	80
KS03	Lion	**2910**	22:22 04-Aug-03	80	32.6972	68	47.3071	347	356	10	130	130
KS03	Lion	**2926**	22:22 04-Aug-03	80	32.6972	68	47.3071	347	356	10	200	200
KS05	Cheetah	**2919**	00:00 05-Aug-03	80	31.1389	068	34.8083	361	347	-10	30	27
KS05	Cheetah	**2898**	00:00 05-Aug-03	80	31.1389	68	34.8083	361	347	-10	80	77
KS05	Cheetah	**2911**	00:00 05-Aug-03	80	31.1389	68	34.8083	361	347	-10	130	127
KS05	Cheetah	**2927**	00:00 05-Aug-03	80	31.1389	68	34.8083	361	347	-10	200	197
KS07	Panther	**2920**	01:47 05-Aug-03	80	29.3721	068	19.4548	361	377	15	30	32
KS07	Panther	**2899**	01:47 05-Aug-03	80	29.3721	68	19.4548	361	377	15	80	82
KS07	Panther	**2912**	01:47 05-Aug-03	80	29.3721	68	19.4548	361	377	15	130	132
KS07	Panther	**2928**	01:47 05-Aug-03	80	29.3721	68	19.4548	361	377	15	200	202

Mooring Site	CATS name	SBE37 #	UTC of drop	Latdeg	LatMin	LonDeg	LonMin	Design depth (m)	Actual depth (m)	Adjust line (m)	Target level (m)	Actual level (m)
KS09	Leopard	**2921**	03:31 05-Aug-03	80	27.3490	068	3.8391	334	330	-10	30	38
KS09	Leopard	**2900**	03:31 05-Aug-03	80	27.3490	68	3.8391	334	330	-10	80	88
KS09	Leopard	**2913**	03:31 05-Aug-03	80	27.3490	68	3.8391	334	330	-10	130	138
KS09	Leopard	**2929**	03:31 05-Aug-03	80	27.3490	68	3.8391	334	330	-10	200	208
KS11	Puma	**2922**	14:38 05-Aug-03	80	25.6500	067	47.8325	293	288	0	30	26
KS11	Puma	**2901**	14:38 05-Aug-03	80	25.6500	67	47.8325	293	288	0	80	76
KS11	Puma	**2914**	14:38 05-Aug-03	80	25.6500	67	47.8325	293	288	0	130	126
KS11	Puma	**2930**	14:38 05-Aug-03	80	25.6500	67	47.8325	293	288	0	200	196
KS13	Jaguar	**2923**	18:45 05-Aug-03	80	23.8010	067	34.5747	228	219	-10	30	32
KS13	Jaguar	**2902**	18:45 05-Aug-03	80	23.8010	67	34.5747	228	219	-10	80	82
KS13	Jaguar	**2915**	18:45 05-Aug-03	80	23.8010	67	34.5747	228	219	-10	130	132
KS13	Jaguar	**2931**	18:45 05-Aug-03	80	23.8010	67	34.5747	228	219	-10	200	202
KS15	Cougar	**2924**	20:31 05-Aug-03	80	22.5009	067	25.8209	102	109	-10	30	47
KS15	Cougar	**2903**	20:31 05-Aug-03	80	22.5009	67	25.8209	102	109	-10	80	97
KS15	Cougar	**2916**	20:31 05-Aug-03	80	22.5009	67	25.8209	102	109	-10	99	106
						Centurian Aft Antenna						
						Datum is WGS84						

SHALLOW MOORING ARRAY

DEPLOYMENT OF THE PRESSURE-MEASURING ARRAY

Overview by H. Melling

Design of the Array

Flows through Nares Strait will respond to differences in hydrostatic pressure between the Lincoln Sea and Baffin Bay. There will also be a difference in pressure across the strait associated with geostrophic adjustment in the flow. The array of instruments planned for installation in Nares Strait in 2003 included eight pressure recorders at sheltered coastal locations on both sides of the channel between Hall Basin and Smith Sound. These recorders, supplemented by the Canadian, geodetically referenced sea-level gauge at Alert, will delineate the varying pressure field that forces the fluxes of seawater through Nares Strait.

The average difference in pressure between the Lincoln Sea and Baffin Bay is thought to be about 10 mb. The cross-channel pressure difference associated with a barotropic flux of 1 Sv is about 5 mb. Since one centimetre of seawater exerts a pressure of about one millibar, any settling of the mooring into the seabed during deployment must be severely curtailed.

Mooring Description

Stability against settling is achieved by driving a stainless-steel stake into the consolidated sediment several feet beneath the seabed. The stake supports the full weight of the instrument package, thereby minimizing subsidence caused by insufficient bearing strength or creep of the surface sediments and by wave scouring. The mooring is complicated by the need to retrieve it through sea ice in the spring of 2005. The short “fat” package on its support stake is designed to separate into two packages of modest diameter for retrieval through a 10-inch hole in the ice. The pop-up float contains a 457 kHz radio beacon for locating the package beneath the ice.

Deployment Method

The target depth for deployment of the pressure moorings is 20 m, deep enough to reduce the risk from drifting sea ice and bergy bits, yet close enough to the surface to capture most the surface pressure gradient.

The depth and the design of the mooring dictate installation by divers. The design of the mooring requires that the seabed be examined prior to diving operations to find the correct conditions of substrate, bottom slope and visibility.

The seabed inspection and diving were conducted from the Healy’s LCVP (Landing Craft Vehicle Personnel), Healy 3. This aluminum vessel has a broad work deck forward for more than half it length. The gunwale at the bow can be lowered to form a ramp equipped with a ladder. The wheelhouse is heated and accommodates five without crowding. The LCVP is powered by twin diesel engines delivering 600 HP to twin outboard propellers. At times a 6-m (RHIB) rigid-hull inflatable boat, Healy 2, was used to ferry personnel and equipment between Healy and the LCVP work site.

Site Selection

The first phase of site selection involved reconnaissance by helicopter of sites selected using topographic maps of the area, and hydrographic charts in the few coastal locations where soundings were available.

The characteristics of good sites include shelter from ice scour, presence of fine-grained sediment, a range of depth 20-30 m and ease of access by small boat from Healy. There is an additional need for assessment of the ease of access by ski plane operating from the ice in winter. This phase of selection is described elsewhere.

The second phase involved finding a location with the target area with an appropriate depth of water for the instrument and an acceptable bottom slope for dive safety. In many locations in this rugged area, the latter constraint was difficult to meet.

The third phase of selection required visual inspection of the seabed using an under-water video camera and physical inspection of sediment retrieved using a small van Veen grab. Very rocky bottoms and soft alluvial clays must be avoided. The substrate that proved most suitable was a mix of gravel, sand and clay.

Mission 1: Foulke Fjord

2 August 2003: Science participants H. Melling and R. Lindsay

USCGC Healy took up a position several miles north-west of Foulke Fjord. The seas in Smith Sound were choppy, but the LCVP found sheltered waters within the fjord. The site identified from helicopter reconnaissance, behind a promontory cutting halfway across the fjord, proved suitable according to the criteria for ice protection, for depth, for substrate and for visibility. The seabed slope was a little steep, but manageable.

Following the bivalve retrieval operation, the mooring was deployed by two divers in about 20 minutes. Because of the steep slope to the seabed the instrument was positioned at 23-m depth, which was slightly more than intended. This placed the pressure sensor into its over-range, but still above the maximum working depth of 27 m.

Protection from ice at this site was judged to be excellent.

The total operation, including transit, selection, dive preparation and dive time took about 3 hours.

Mission 2: Discovery Harbour

7 August 2003: Science participants H. Melling, P. Kalk and L. Narraway

USCGC Healy came within 2 miles of Breakwater Point in order to launch the LCVP for Discovery Harbour. Waters were calm. The site identified from helicopter reconnaissance, behind Breakwater Spit, was suitable according to the criteria for ice protection, depth, for substrate and for visibility.

Protection from ice at this site was judged to be good.

The mooring was deployed by two divers in about 20 minutes. The total operation, including transit, selection, dive preparation and dive time took about 2 hours.

Mission 3: Off ey Island

10 August 2003: Science participants H. Melling, H. Schaffrin and H. Johnson

USCGC Healy took up a position several miles west of Off ey Island. The seas in Hall Basin were choppy, but the LCVP found some shelter behind Off ey Island. The site identified from helicopter reconnaissance, behind a hook of low land at the eastern end of the island, was suitable according to the criteria for substrate and for visibility, but the seabed was too steep for safe deployment of the divers.

A site between the river delta on the Greenland shore opposite Off ey Island and Cape Mary Cleverly was then examined. The depth and slope of the seabed here were excellent, the protection form ice was acceptable and the seabed appeared to be firm clay suitable for deployment. However, when the divers descended to complete the installation they discovered that the clay was very soft, so that the mooring "spike" could easily be withdrawn from deep in the sediment. An extension pipe was lowered, but this was lost in the murk. The divers ran out of time and returned to the surface with the "spike' in hand.

A site beneath a scree slope on the northwest side of the delta was examined. Here also was soft clay unsuitable for mooring.

We then moved to a location at the end of the hook of land on the eastern side of Off ey Island. The substrate was similar to that at the first location, but the seabed sloped more gently. This site was deemed acceptable, despite relatively poor protection from ice. The existence of a partial barrier of grounded small tabular bergs between the site and Petermann Fjord provided some re-assurance that ice as well and landforms could provide protection to the mooring.

The mooring was deployed by two divers in about 15 minutes.

Protection from ice at this site was judged to be fair.

The total operation, including transit, selection, dive preparation and dive time took about 6 hours.

Mission 4: Scoresby Bay

12 August 2003: Science participants H. Melling, K, Azetsu-Scott, M. Zweng and L. Brown;

USCGC Healy anchored of Cape Malley, about halfway into the bay. Waters were flat calm.

A well-protected site on the southern side of the bay near its head proved sufficiently deep, but carpeted with a thick layer of soft alluvial clay. The substrate at a second location in the southwest corner of the bay was unacceptable for the same reason. A potential site to the south of a rocky point of land reaching into the bay from its western end was too shallow. We then took soundings along a line running directly east from the point, stopping at the 20-m isobath. At this location, the seabed was a mix of clay, coarse gravel and small rocks and apparently suitable for mooring.

Two divers descended, judged that the seabed was acceptable and pounded the mooring spike into place. Meanwhile, final checks on the mooring revealed non-function of the Benthos acoustic transponding release. The stake was buoyed off, and the divers returned to the surface, while a duplicate mooring assembly was delivered by the RHIB from Healy (w/ P. Gamble). The mooring was completed during a quick second dive.

Protection from ice at this site was judged to be fair.

The total operation, including transit, selection, dive preparation and dive time took about 6 hours.

Mission 5: Alexandra Fjord

3 August 2003: Science participants H. Melling, C. Moser, M. O'Brien and R. Macdonald

A first attempt at deployment in Alexandra Fjord was aborted because there was too much ice for safe deployment of the LCVP and divers.

13 August 2003: Science participants H. Melling, J. Ressler and P. Ageeakog

Healy reached the mouth of Alexandra Fjord at noon. The LCVP was launched in choppy seas at about 13:00 to proceed to the proposed deployment site about 5 miles to the southwest. During transit, a weather front passed through. Winds freshened from 15 to almost 15 knots in less than 30 minutes, whipping up 7-foot seas. These precluded not only the mooring operation but also a direct return to the ship. Healy 3 made its way to the north, seeking shelter close behind high land to the north of the fjord until the winds abated. Meanwhile, Healy had taken up a position to the north of Healy 3. The LCVP made a safe return to the ship at about 17:00.

14 August 2003

Healy returned to the same launch position as yesterday. The wind was south-easterly at 15 knots. Weather included fog, low stratus cloud and snow showers. The tour ship Kapitan Klebnikov was nearby.

Following launch at about 08:00, the LCVP made way to the proposed deployment location just north of a rocky islet to the southwest of an un-named island, itself west of Skraeling Island. Inspection by underwater camera revealed the seabed to be a mix of sand and small stones, capable of providing a stable foundation for the pressure-measuring mooring. The depth was 23 m.

After anchoring the LCGP, the deployment proceeded according to plan. After the standard 5-foot steel supporting stake had been driven in with relative ease, a 30-inch extension was passed down to the divers. The extended stake was driven in until the correct length remained projecting above the seafloor..

The mooring was deployed by two divers in about 25 minutes. There was a wait of about an hour until the RHIB arrived to swap out the mooring group and replace it with the clam seekers.

Protection from ice at this site was judged to be good.

The total operation, including transit, selection, dive preparation and dive time took about 4 hours.

Summary of Information on Pressure-Gauge Moorings

Mooring Site	**Foulke Fjord**	**Discovery Harbour**	**Offley Island**	**Scoresby Bay**	**Alexandra Fjord**
CATS name					
Latitude (deg)	78	81	81	79	78
Latitude (min)	17.818	42.371	18.408	54.654	54.309
Longitude (deg)	072	064	061	071	075
Longitude (min)	34.054	47.940	48.824	21.388	48.385
Datum	WGS84	WGS84	WGS84	WGS84	WGS84
Actual depth (ft)	77	61	64	68	76
Actual depth (m)	23.5	18.6	19.5	20.7	23.2
Sensor depth (m)	22.9	18.0	18.9	20.1	22.6
UTC of drop	**01:28 03-Aug-03**	**14:00 07-Aug-03**	**01:34 11-Aug-03**	**20:30 12-Aug-03**	**13:30 14-Aug-03**
DL3PS #	**0001**	**0003**	**0007**	**0004**	**0002**
SBE4 #	None	None	**2475**	**2743**	**2586**
Benthos 867A acoustic release	**0106**	**0108**	**0112**	**0109**	**0111**
Receive	9.0	10.0	13.0	10.5	11.5
Enable	I	K	J	L	I
Release	J	L	K	M	J
Range from transponder (m)	028, 029, 030	134, 137, 139	35, 27	26, 31	31, 32, 32
Set time to utc	Yes	Yes	Yes	Yes	Yes
Release ON	Yes	Yes	Yes	Yes	Yes
Pieps ON	Yes	Yes	Yes	Yes	Yes
Anti-fouling plugs in place	n/a	n/a	Yes	Yes	Yes
Sensor full scale pressure (psi)	45	45	100	45	45
Full-scale depth (m)	20.9	20.9	58.8	20.9	20.9
Max depth with over-range	27.1	27.1	72.6	27.1	27.1

SHIP MOUNTED ACOUSTIC DOPPLER CURRENT PROFILING

PRELIMINARY REPORT ON ADCP DATA COLLECTION

Andreas Münchow
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Aug. 15, 2003

1. Introduction

The USCGC Healy contains two separate and independent hull-mounted acoustic Doppler current profiler systems. The systems are a 75 kHz phased array (Ocean Surveyor) and a regular 4-beam 153 kHz transducer (BroadBand). Each system is mounted in its own well that is filled with anti-freeze solution and is separated from the water by an acoustic window. Both systems collected data continuously, but only the 75 kHz system was operational. Excessive mechanical and/or electromagnetic noise reduced both water tracking range and data quality below acceptable levels. Thus I here refer to the 75 KHz system only. I will prepare a separate report on the 153 kHz BroadBand system before Oct. 2003.

2. Data Streams

The 75 kHz Ocean Surveyor (OS75) was run via VMDAS under Windows-2000 Professional and controls input and output data streams. VMDAS receives

OS75 single ping data via serial port COM7 (.ENR file on output),
Gyro heading data via serial port COM7 (.ENR file on output),
P-code (aft) GPS data via serial port COM8 (.N1R file on output), and
Ashtech navigational and attitude data via serial port COM9 (.N2R file on output)

The aft P-code GPS system is distinct from the bridge P-code GPS system. VMDAS generates 10 different output files that merge and average data from the three input streams in varying ways. A .LOG file contains both direct commands send to the OS75 on start-up as well as all subsequent error messages. Throughout HLY-03-01 we monitored this file hourly and stopped data collection when its size increased to above ~50K rebooting the computer and starting a new data collection cycle. The most frequent error messages were

[date,time]: NMEA [RPH] communication time out
[date,time]: NMEA [RPH] Error writing to raw data file

indicating that VMDAS does not receive the Ashtech data. Generally, the Ashtech dropped out intermittently for a few minutes every day. A second, previously reported "NMEA [RPH] serial buffer full" error message (Flagg, pers. Comm.) occurred only rarely after we moved VMDAS into a high-priority mode within the Windows-2000-Professinal operating system. Additional data recording problems were minimized after we changed the primary data recording drive from the network's F:\ to the local D:\RDI drive and disappeared almost completely after we stopped recording to the (secondary) network F:\ drive.

Curiously, data collection became compromised many days at about 07:45 UTC at a time that the ship's network performed backup services. The problem becomes evident when averaged files (.STA and .LTA) are not updated on the local drive. A subsequent failure involves the display of navigational data within VMDAS. The final and terminal failure is a freeze-up of the computer that also stops data collection. We generally stopped data collection and rebooted the computer at the first sign of trouble and thus prevented any loss of data. We did not observe this failure when we turned off the network as a drive (F:\) to which data is written during data collection. A perhaps more stable data transfer to the science network is a timed copy of files at hourly or daily intervals.

The main ADCP problems appear to be software rather than hardware related. Microsoft Windows and its network provide an unstable platform environment for data collection. A single, stripped down, stand-alone CPU with dedicated serial inputs may remedy many ADCP data collection. The ADCP data collection CPU should NOT be used for ANY other processes besides data collection.

3. Performance

The OS75 performed well during the cruise when run NarrowBand mode using 15-m vertical bins and 10-m blanking. All data except those in file os044 were collected with this setup. The water profiling range varied from more than 600-m to less than 200-m depending on the presence of scatters in the water column. The OS75 tracked the bottom without any problems down to 900-1100-m. Ship speeds below 15 kts had little effect on the systems performance and an optimum ship speed in waters may be 12-14 kts. Once the third engine operates (irrespectively of speed), however, the additional vibrations degrade the OS75 substantially. The same applies to active ice-breaking when little useful data are returned at any ship speed.

Overall, the ship provided a very stable platform in all seas encountered, but the instrument was not used to its full potential during this expedition. Most of the data are severely biased by strong and spatially variable tidal currents. Ship speeds in ice-free waters were generally well below 12 kts to provide concurrent SeaBeam data that required ship speeds of about 8 kts. The spatial-temporal coverage of ADCP profiles was also limited by ship tracks that were set without consideration of ADCP operations. As a result it will be difficult if not impossible to remove the dominant tidal currents from much of the record.

Preliminary processing of the bottom tracking and navigational data indicates that the installation is not perfectly level in the vertical, that is, the nominal 30 degree vertical beam orientations are not correct. While this is not a problem when the ship's velocity vector is determined via bottom tracking, it introduces O(0.1 m/s) errors as a function of the ship's heading if GPS data is used to remove the ship's motion from the velocity estimates. A careful misalignment calibration in the vertical planes is needed to accurately determine the deviation of the instrument from its nominal 30 degree vertical beam angle.

4. Watchstanders

A dedicated team of watchstanders monitored both ADCPs and SeaBeam data collection at all times. These were

0730-1530 (1030-1830UTC)	Helen Johnson	Lauren Brown
1530-2330 (1830-0230UTC)	Melissa Zweng	Robert McCarthy
2330-0730 (0230-1030UTC)	Helga Schaffrin	Elinor Keith

Their tireless efforts ensured an almost gap-free, high-quality ADCP record.

5. List of files

All file names start with HLY-03-01xxx_yyyyyy.zzz or HLY-03-01xxxxx_yyyyyy.zzz where xxx or xxxxx are numerical file designation for a single configuration that may consist of yyyyyy separate files, and zzz is the file extension, e.g., ENR for single-ping raw, N1R for P-code GPS, and N2R for Ashtech GPS data. All times are UTC, longitudes are in decimal degrees West, and latitudes are in decimal degrees North.

	Start of file					End of file			
xxx	N	Date	Time	Lat.	Long.	Date	Time	Lat.	Long.
001	2614	20030721	12:45	47.56559	52.67932	20030721	17:06	48.35559	52.58321
002	3856	20030721	17:07	48.35802	52.58322	20030721	21:24	49.49766	52.58313
003	15731	20030721	21:25	49.50294	52.58316	20030722	17:22	54.15986	53.62524
004	442	20030722	17:50	54.15951	53.62360	20030722	18:24	54.28205	53.66132
005	12941	20030722	18:30	54.28270	53.66155	20030723	11:29	58.33990	54.79229
006	6802	20030723	11:30	58.34304	54.79329	20030723	19:07	60.20654	55.28862
007	6284	20030723	19:28	60.20838	55.28880	20030724	2:27	62.15104	55.56337
008	4796	20030724	2:39	62.20158	55.57060	20030724	7:59	63.73242	55.79994
009	4116	20030724	8:02	63.74517	55.80199	20030724	13:19	65.30084	55.99990
010	4752	20030724	13:27	65.30181	55.99985	20030724	19:09	66.95110	56.00008

xxxxx	N	Date	Time	Lat.	Long.	Date	Time	Lat.	Long.
os001	11214	20030724	19:18	66.97982	55.99990	20030725	7:46	70.51912	57.49936
os002	602	20030725	7:58	70.57709	57.55606	20030725	8:38	70.76336	57.73950
os003	6727	20030725	8:39	70.76565	57.74187	20030725	17:18	72.21100	61.19906
os004	7567	20030725	17:20	72.21254	61.21403	20030726	1:44	72.74875	66.98460
os005	18930	20030726	1:50	72.74903	66.99637	20030726	23:01	72.63833	69.34088
os006	7218	20030726	23:48	72.63299	69.46340	20030727	7:49	72.55171	71.36336
os007	11	20030727	7:49	72.55158	71.36464	20030727	7:50	72.55114	71.36908
os008	3658	20030727	7:54	72.54884	71.39668	20030727	13:53	72.41004	73.17503
os009	13340	20030727	14:00	72.40585	73.20967	20030728	7:52	72.49244	70.97118
os010	135	20030728	7:53	72.49308	70.97494	20030728	8:03	72.50625	71.05600
os011	3332	20030728	8:04	72.50817	71.06759	20030728	12:56	72.67528	73.11263
os012	7633	20030728	16:18	72.68455	73.10138	20030729	4:02	72.75072	72.41721
os013	17515	20030729	4:37	72.74989	72.41205	20030730	4:08	72.60424	70.37753
os014	2991	20030730	4:08	72.60461	70.37484	20030730	7:28	72.91213	68.05395
os015	23918	20030730	7:33	72.91260	68.05034	20030731	10:07	75.00109	66.98710

os016	8116	20030731	12:11	75.00344	66.99065	20030731	22:35	75.90225	67.01836
os017	8562	20030731	22:36	75.90190	67.01925	20030801	9:01	76.07922	70.28147
os018	17566	20030801	9:06	76.07963	70.27975	20030802	7:17	76.95346	72.64362
os019	22879	20030802	7:24	76.97481	72.67781	20030803	10:30	78.33389	74.79550
os020	10961	20030803	11:07	78.33357	74.81812	20030803	23:46	79.48189	71.89564
os021	6390	20030803	23:54	79.49553	71.83634	20030804	7:15	80.51923	68.93549
os022	3718	20030804	7:25	80.53894	68.93442	20030804	11:38	80.40329	67.46243
os023	5708	20030804	11:38	80.40301	67.46324	20030804	18:07	80.55524	68.92558
os024	1583	20030804	18:08	80.55600	68.92338	20030804	19:54	80.55028	68.90497
os025	10011	20030804	19:54	80.55070	68.90504	20030805	7:20	80.54407	68.57036
os026	21281	20030805	7:39	80.54304	68.56230	20030806	7:20	80.76631	67.80462
os027	3191	20030806	8:02	80.76632	67.80314	20030806	11:34	80.76712	67.80251
os028	67	20030806	11:45	80.76910	67.78835	20030806	11:50	80.76968	67.78283
os029	17764	20030806	11:50	80.76970	67.78261	20030807	7:34	81.25810	64.04878
os030	2588	20030807	7:36	81.25834	64.04860	20030807	10:29	81.59307	64.18024
os031	1275	20030807	10:29	81.59463	64.18516	20030807	12:03	81.69113	64.53305
os032	15167	20030807	12:15	81.68852	64.54021	20030808	7:02	82.21631	60.21456
os033	20097	20030808	7:49	82.18775	60.39557	20030809	10:59	81.96040	60.86006
os034	16794	20030809	11:07	81.95517	60.82317	20030810	8:06	81.63189	62.93713
os039	18903	20030810	8:19	81.61712	63.00574	20030811	7:38	81.28267	62.40205
os040	12860	20030811	7:47	81.28349	62.40214	20030812	0:58	81.06546	65.82467
os041	1950	20030812	1:02	81.05815	65.84431	20030812	3:16	80.76300	67.37278
os042	3564	20030812	3:16	80.76276	67.37378	20030812	7:32	80.42391	68.56672
os043	5687	20030812	7:36	80.41897	68.56911	20030812	14:04	79.93959	71.05898
os044	13389	20030812	14:18	79.93946	71.05696	20030813	5:10	79.94334	71.03226
os045	36601	20030813	5:10	79.94368	71.02563	20030814	21:52	78.74312	73.99891
os046	3931	20030814	22:05	78.70112	73.98505	20030815	2:27	78.29403	74.43985
os047	8026	20030815	2:28	78.29281	74.42562	20030815	11:56	76.84819	71.88895*

(*) This file is still recording at the time of this writing (Aug.-15-2003, 11:57 UTC)

BIVALVE RETRIEVAL

COLLECTION OF BIVALVES

Overview

Bivalves grow by accreting shell material at the outer edge of their shells in much the same way as tree rings form at the outer edge of the stem of a living tree. Because the bivalve growth period is sharply delineated by the productivity cycle, the shells tend to form annual growth rings throughout their lives which may extend from 10 years to over 50 years. The shells are made predominantly of calcium carbonate which contains oxygen atoms drawn from carbonate dissolved in seawater. Since the dissolved carbonate is in equilibrium with the seawater, the oxygen isotopic composition of the accreting shell reflects the isotopic composition of seawater. In turn, the oxygen isotopic composition of seawater is directly related to the amount of freshwater from runoff contained in the seawater. Together, these facts suggest that bivalve shells may provide proxy records of runoff composition of seawater for periods from 10 years to more than 50 years. In addition to the direct record of freshwater in the shells, there may also be other records contained in shell's composition especially of elements that replace calcium. For example, barium can help to delineate the source of fresh water whereas cadmium can give information on the strength of nutrient cycling.

Our objective in this project is to collect sufficient bivalves from Nares Strait to evaluate the potential of these to deliver proxy records of ocean processes at decadal scales. From among the collected bivalves, we will select the best candidates for detailed analyses. From selected shells, micro samples will be taken in cross section across the growth rings and analysed for stable isotopes and elements at OSU. Records from these analyses will be examined for coherence among bivalves and for relationships to major forcing of the system (e.g., the Arctic Oscillation or the North Atlantic Oscillation).

Approach to Sampling and Site Selection

In order to produce records of upper ocean processes, we planned to collect bivalves residing between 5 and 30 m in the water column, preferably in locations away from major local sources (e.g., river estuaries) and in places exposed to water flowing through Nares Strait both on the Greenland and Ellesmere sides of the channel. Based on previous discussions with biologists who have collected clams in the Arctic, we (Robie Macdonald and Mary O'Brien) planned to use divers as our main method of collection with a small grab sampler as a supplementary/backup device. We also developed a hydraulic excavator (stinger) following a design used by commercial divers to collecting clams. This system included a pump driven by a two stroke engine plus about 100m of hosing to reach the seabed.

Prior to collecting samples, a helicopter survey was conducted along a 10 – 20 nautical mile stretch of coastline to select sites with high potential for bivalves. Three criteria were kept in mind while conducting this search: 1) Sites that were away from intense local runoff; 2) Sites that appeared to have appropriate benthic habitat (soft sediments, protected from ice scour or grounded ice) and a range of depths appropriate for diving (5-30m) and 3) Sites that could be safely sampled by divers operating from a small boat (protected from wind, waves or other hazards). Although up to 10 target sites were identified for some locations, time constraints limited us to sampling only at the most promising site. Once a site was selected, we went to it in a landing craft (LCBP) and conducted a preliminary, small-scale survey using a small submersible camera with colour TV monitor output. This technique allowed us to evaluate the benthic habitat and we were usually able to identify clear evidence of the presence of living bivalves through their siphons and/or shells. Because the bivalve sites had much the same requirements as the pressure mooring deployment sites (soft sediment, protection from ice scour), and because the latter were customarily done first, we usually were assured that bivalves could be collected at the site. In fact, we always found clams at the sites we had chosen.

Mission 1: Littelton Island (78 22.2N 072 51.0W)

2 August 2003

Diving was conducted in a small, protected channel on the outside of Littelton Island. This was the first dive and involved a steep learning curve for everyone. The camera survey suggested that we had a very productive site, 20' deep with a lot of kelp, brittle stars and lots of evidence of siphons and clam shells. Divers entered the water in teams of two and were able to work in the water for a period of about 20 minutes. Three dives were conducted. We attempted to use the hydraulic excavator with limited success, finding it cumbersome and very noisy on the LCBP thus hindering communication with the divers. Knives were also used to dig the mud but the turbid water produced by this endeavor limited success. In the end, we succeeded in collecting a single large bivalve (probably Astarte).

Mission 2: Bellot Island (81 42.81N 64 55.0W)

Sampling was conducted in a small, protected embayment with a relatively gentle bottom slope on the east side of Bellot Island. The preliminary survey by the pressure mooring team had established the presence of clams and our towed camera revealed both siphons and shells on a muddy bottom free of macro algae. Here we were able to collect a number of bivalves between the depths of 44' and 90' using divers and the dredge. Noteworthy among the clams collected at this site were a number of large Hiatellas (4-5cm) but we also obtained a few large Astarte-like clams (3-5 cm). We attempted to use the stinger with 100' of hose at this site but had great difficulty in removing kinks in the hose, which had developed during the dive operations at Littelton Island, and assessing on deck whether or not water was flowing through the hose. We abandoned its use, resorting once again to hand excavation of sediments with the knives.

Mission 3: Off ey Island (81 18.9 N 61 50.0W)

A single, 4cm Hiatella was recovered from a depth of 63' by the pressure mooring group using the small dredge.

Mission 4. Scoresby Bay (79 55.80N 71 7.0W)

The helicopter survey prior to sampling revealed an exposed coastline with grounded ice in many places and evidence of scour in the shallows. The western portions of Scoresby Bay were ruled out due to several large inflowing rivers. We selected a relatively steep beach face that appeared to be essentially a continuation of the talus slope of a ridge extending along the north side of Scoresby just inside Cape M'Clintock. Once on site with the landing craft, we used the dredge and camera to find a location that had mud and some hint of clams. The small colour monitor did not function and was replaced by a smaller black and white monitor. Although the B&W monitor was helpful for assuring the presence of bivalves, the colour monitor was much better for identifying life on the bottom the sea. The divers had developed a new technique for sampling at this site which included a large fabricated scoop and a plastic pail. Once at the bottom, they sought evidence of clams and then filled the bucket with mud to be sorted on the landing craft. This technique recovered some of our best bivalves. We obtained several Astarte-like clams up to 5 cm in breadth and a couple of Hiatellas which, although broken, should provide usable sections of shells.

The first attempt to collect material at this site was abandoned due to high winds and waves. From the charts and helicopter surveys we selected a promising site just to the southwest of Cairn Island. Again using the scoop and bucket technique, we recovered material from 22' and 65' during two dives (paired divers). The camera survey revealed much evidence of clam shells and a mixed sandy/rocky bottom;

however, it was difficult to see evidence of siphon tubes in the black and white monitor. We collected numerous Astarte-like bivalves both by divers and the dredge; however these were mostly very small and there was evidence of bottom scour by ice. The sediments here were organic-rich and it seemed to be a very favourable location for benthos with the exception of the exposure to ice scour which probably explains the abundance of numerous, relatively young clams. Noteworthy among our collections was a large Mya truncata (5cm) collected during the last dive at this site.

Summary and Conclusions

We succeeded in collecting about 10-15 bivalves of possibly 3-4 species that are large enough to provide material to evaluate whether climate records are stored in shells from this region. The depth and geographic ranges are sufficient to allow us opportunities for comparisons between regions and an evaluation of the effects of stratification. The helicopter surveys were very helpful in focusing on promising locations and avoiding shores that were too steep, had grounded ice or showed evidence of scour. In no case did we see any evidence of shells from the air, but we routinely found bivalves and evidence of bivalves at all sites visited although the population distribution appeared to vary from one location to another (e.g., Hiatellas were common at some locations whereas Astarte-like clams were present at others). The small camera and colour monitor were indispensable for evaluating the bottom before sending divers down to collect material; a colour monitor is also essential because it shows siphons and other features that are very hard to see in black and white. The stinger system, while showing promise as an excavation tool, could not be brought to effective use on this trip. This was mainly due to difficulties in handling the hose which kinked easily in the cold temperatures, stopping the flow of water. Furthermore, the noise of the 2-stroke pump on the deck severely hampered communication both on the launch and between the launch and divers. Techniques and tools developed by the divers themselves much improved our collection efficiencies and we found clams in the mud returned to the surface that would have been very hard to spot by the divers at the bottom. Diving operations included paired divers at difficult sites (currents, waves, macro algae) and single divers with protected sites/muddy bottoms. A dressed-out diver was on standby during all dives and we usually had 4-6 divers on board during the operations. Each dive lasted about 20 minutes by which time the divers were feeling the effects of the cold. Between 2 and 3 dives were conducted at each site and the total time taken for doing this work was between 4 and 7 hours, ship to ship.

Table 1. Brief summary of bivalve collections

Date	Site Name	Lat N	Long W	Station	Depths (ft)	Total Number of clams
08/02/2003	Littelton Island	78° 22.2′	072° 51.0′	CL1	66	1
08/07/2003	Bellot Island	81° 42.81′	064° 55.0′	CL2	44-76	56
08/10/2003	Off ey Island	81° 17.91′	061° 43.93′	CL3	32-63	1
08/12/2003	Scoresby Bay	79° 55.8′	071° 7.0′	CL4	32	14
08/14/2003	Alexandra Fjord, Cairn Island	78° 54.35′	075° 47.16′	CL5	22-73	91

CORING

PISTON CORING AND GRAVITY CORING

By J. Chris Moser

Introduction

Four piston cores were taken in the Western margin of Baffin Bay between 900 and 1400 meters water depth. Two gravity cores were taken in the 800 meter deep channel in the Hall Basin.

A Healy 03-1 Coring Data Summary follows:

HLY0301-01PC (C1)	072 44.993’ N	072 24.736’ W	976 cms	905 meters depth
HLY0301-02PC (C2)	072 39.916’ N	071 59.762’ W	500 cms	1041 meters depth
HLY0301-03PC (C3)	072 34.993’ N	071 25.462’ W	188 cms	1174 meters depth
HLY0301-04PC (C4)	072 31.212’ N	071 00.174’ W	649 cms	1400 meters depth
HLY0301-05GC	081 37.286’ N	063 15.467’ W	372 cms	797 meters depth
HLY0301-06GC (Core Catcher)	081 37.321’ N	063 13.860’ W	1 cm	805 meters depth

Coring personnel included two coring technicians from Oregon State University, Pete Kalk and Chris Moser, and two coring technicians from the University of Rhode Island, Chip Heil and Jason Ressler. Welcome assistance was also provided by Pauloosie Akeeagok, a Nunavut cruise participant from Grise Fiord, Ellesmere Island, Canada.

We would also like to thank Captain Oliver and the crew of the USCGC Healy for their expert assistance and ship handling abilities during all phases of our coring program; especially holding station with the stern into the seas during 30 knot winds when the bow thruster was down and the timely repair of the starboard 04 deck crane. We thank the entire deck crew who operated the starboard cranes at all hours of the day and night.

And lastly, no coring operations could have been possible without the expert, capable assistance of the Healy Marine Science Technicians under the direction of Senior MST Glen Hendrickson --- MST Bridget Cullers, MST Suzanne Scriven, MST Josh Robinson and MST Daniel Ganoa.

We would also like to thank Dr. Kelly Falkner, Chief Scientist of this CATS cruise, for the coring opportunity of a lifetime and Dr. Kate Moran, University of Rhode Island, for her background seismic data and initial proposed locations for piston cores C1, C2, C3 and C4.

Piston Coring

Initial Bathymetric SeaBeam 2000 and Bathy2000 3.5KHz Sub-bottom Survey of Coring Sites in Western Baffin Bay and Data Interpretation

July 26, 2003, Saturday and Sunday, July 27, 2003

The Healy steamed NW and upslope in western Baffin Bay toward proposed core locations. Coring technicians watched 3.5KHz records from SeaBeam 2000 and Knudsen Bathy systems alternately as we traversed Hydro Stations 4, 5 and 6 that ran between Core sites C3 and C4. We decided that the SeaBeam 2000 record was easier to read and interpret with Bathy2000W software for archived data.

We continued monitoring 3.5KHz records until 0430 Hours and plotted waypoints for a SeaBeam 2000 3.5KHz and SeaBeam survey through the four proposed Core Sites C4, C3, C2 and C1 from SE to NW. We decided to steam a survey at ten knots that would initially cover all four coring sites and then run parallel swaths on both the downslope and upslope sides of that initial line. These three parallel swaths would cover about a one hundred nautical mile trackline trending thirty nautical miles NW to SE.

July 28, 2003, Monday

The Healy Bridge agreed to navigate using the SeaBeam display to overlap the three parallel SeaBeam trackline swaths which was very helpful. This extra effort by the Healy crew and Roger Davis, the onboard SeaBeam guru, produced a beautifully complete bathymetric map of the entire coring area. The ship initiated steaming NW on Line 1 for the 3.5KHz / SeaBeam Survey at 0035hrs GMT. We turned and began the SW Line 2 of the survey at 0406hrs GMT downslope of that initial line and finished Line 3 of the Coring Survey at 1045hrs GMT steaming NW .

The preliminary SeaBeam bathymetry data provided by Roger Davis revealed a broad flat, featureless shelf sloping gently from 850 meters depth in the NW near site C1 to 1500 meters depth near site C4 at the SE end of our coring transect.

The coring technicians then reviewed the archived 3.5KHz Bathy2000 data with Bathy2000W software to view a stitched-together continuous depth profile of the sub-bottom. The 3.5KHz sub-bottom record showed a nearly acoustically transparent surface layer 5 – 8 meters thick underlain by a continuous denser, laminar layer that varied in thickness throughout the survey area. Below these two fairly transparent layers was a strong, black 3 meter thick acoustic horizon that varied in depth from 12 – 20 meters below the seafloor. In many places, the 3.5KHz record showed multiple laminar acoustic reflectors up to 40 meters below the seafloor.

Based upon this featureless preliminary SeaBeam data and the laminar 3.5KHz Bathy2000 sub-bottom data, the coring technicians decided to retain the proposed coring sites C1, C2, C3 and C4 as acceptable piston coring locations.

Previous Huntec sub-bottom seismic reflection data provided by Dr. Kate Moran from the Buchan Gulf to the south of our coring area also showed the presence of an upper transparent Tiniktartuq Mud underlain by a thicker Davis Strait Silt. Interspersed within the thick seismic section were overlapping, hard black acoustic reflectors that pinched out downslope, identified as glacial till tongues and suggestive of previous glacial deposition of tills and gravels in these areas and perhaps further north in our coring area as well.

After considering all the available data, the onboard Healy starboard piston core was rigged for a forty-foot length as a precaution against these possible layers of glacial till gravels and glacial erratics.

Piston Coring Operations

July 29, 2003   Tuesday

The starboard piston core was already rigged for forty feet. Began coring operations at 0430hrs GMT at Site C1 in 905 meters of water.

Core C1

HLY0301-01PC (C1)	072 44.993' N	072 24.736' W	976 cms	905 meters depth	
Sec 1	59cms	Sec 2	150cms	Sec 3	150cms
Sec 4	150cms	Sec 5	150cms	Sec 6	150cms
Sec 7	76cms	Sec 8	90cms		

Core C1 tripped at 0456hrs GMT and was recovered at 0550hrs GMT. Pullout tension registered 12,960 lbs. 01PC (C1) recovered eight sections totaling 976 cms of sticky brown mud / clayey silt. Very sticky mud and gravels stuck to the outside of the core barrel for approximately the lower 30 feet. The core cutter was dented and the core apparently bottomed out into glacial tills and gravels. Saved and labeled a sample of the gravels from the outside of the core barrel. During sectioning, there was a 126 cm void in the core between Sections 7 and 8 at the bottom of core. We also noted a rock in the core at the cut between Sections 4 and 5.

We again rigged the starboard piston core for a forty-foot long core.

The ship moved to Site C2 and began coring at 0929hrs GMT in 1041 meters of water.

Core C2

HLY0301-02PC (C2)	072 39.916' N	071 59.762' W	500 cms	1041 meters depth	
Sec 1	50cms	Sec 2	150cms	Sec 3	150cms
Sec 4	150cms				

Core C2 tripped at 0958hrs GMT and was recovered at 1130hrs GMT. Pullout tension registered 18,890 lbs. 02PC (C2) recovered four sections totaling 500cms of sticky brown mud / clayey silt. Very sticky mud/silt and gravels stuck to the outside of the core barrel for approximately the lower 20 feet. The core cutter was dented and the core apparently bottomed out into glacial tills and gravels. Saved and labeled a sample of the gravels from the outside of the core barrel. During sectioning, a well-rounded , stream worn gravel about 8cms in diameter was noted at the top of Section 3 that nearly filled the core liner. There were no obvious voids in the core during sectioning.

We rigged the starboard piston core for a forty foot long core and then ate lunch.

The Healy set up at Site C3 and began coring at 1215hrs in 1180 meters of water.

Core C3

HLY0301-03PC (C3)	072 34.993' N	071 25.462' W	188 cms	1174 meters depth
Sec 1	38cms	Sec 2	150cms	

Core C3 tripped at 1550hrs GMT and was recovered around 1630hrs GMT. Pullout tension registered 12,673 lbs. 03PC (C3) recovered only two sections totaling 188cms of sticky brown mud / clayey silt. Very sticky mud and gravels stuck to the outside of only the lower 10-foot section of core barrel. Again the core cutter was dented and the core apparently bottomed out into glacial tills and gravels. Saved and labeled a sample of the gravels from the outside of the core barrel. There were no obvious voids in the core during sectioning.

The coring group was getting quite tired by now at 1630hrs. We stumbled to bed to sleep for three hours until 1930hrs when we ate set-aside dinners.

July 30, 2003 Wednesday

While the Healy steamed slowly through the night, we rigged the last piston core for Site C4 and began coring at 0026hrs GMT in 1400 meters of water.

Core C4

HLY0301-04PC (C4)	072 31.212' N	071 00.174' W	649 cms	1400 meters depth	
Sec 1	40cms	Sec 2	152cms	Sec 3	151cms
Sec 4	151cms	Sec 5	155cms		

Core C4 tripped at 0107hrs GMT and was recovered around 0150hrs GMT. 04PC (C4) recovered five sections totaling 649 cms of stiff brown mud / clayey silt. Once again, very sticky mud/clayey silt and gravels stuck to the outside of the core barrel for about the lower 20 feet . Again the core cutter was dented and the core apparently bottomed out into glacial tills and gravels. Saved and labeled a sample of the gravels from the outside of the core barrel. There were no obvious voids in the core during sectioning.

Broke down the piston coring equipment until 0730hrs GMT.

Gravity Coring

Initial Bathymetric SeaBeam 2000 and Bathy2000 3.5KHz Sub-bottom Survey of Coring Sites in the deepest section of Hall Basin and Data Interpretation

August 8, 2003 Friday

The Healy Bridge again agreed to navigate using the SeaBeam display to overlap SeaBeam trackline swaths which was very helpful. The ship initiated steaming SW on Line 1 for the 3.5KHz / SeaBeam Survey at 1800hrs GMT. After four hours of bathymetric data we finally found the 800 meter depth channel within the Hall Basin that had been suggested by earlier hydrographic sounding charts and finished the survey at 2350hrs GMT. The preliminary SeaBeam bathymetry data provided by Roger Davis revealed a broad U-shaped channel just over 800 meters deep trending NE – SW through the western portion of the Hall Basin.

The coring technicians then reviewed the archived 3.5KHz Bathy2000 data with Bathy2000W software to view the continuous depth profile of the sub-bottom. The 3.5KHz sub-bottom record within the deep Hall Basin Channel showed a horizontal, transparent surface layer 5 – 10 meters thick underlain by multiple laminar acoustic reflectors up to 25 meters thick.

Based upon this flat channel bathymetry and the horizontal bedding in the sub-bottom records, the coring technicians decided to gravity core the thalweg of the channel below 800 meters depth.

Gravity Coring Operations

August 11, 2003 Monday

The coring technicians had earlier rigged a 12-foot long gravity core on the starboard side. We placed a cloth sock in the core catcher to help retain any sandy sediments. At 1400hrs GMT the Healy deck crew and MSTs transferred the gravity core from the 02 Deck to the starboard A-frame and trawl wire using the 04 Deck Crane.

We began gravity coring for HLY0301-05GC in the Hall Basin Area at 1442hrs GMT in 797 meters water depth.

Core 05GC

HLY0301-05GC	081 37.286' N	063 15.467' W	372 cms	797 meters depth	
Sec 1	10cms	Sec 2	60cms	Sec 3	151cms
Sec 4	151cms				

We rigged the 12KHz pinger 50 meters above the core. Core 05GC was lowered at 60 m/min and stopped 100 meters above the bottom for several minutes to settle out. The core was then lowered into the bottom at 60 meters/minute wire speed. Pullout tension registered 2,790 lbs. After pullout the core was hauled in at 60 m/min. The entire outside of the twelve-foot long core barrel was smeared in mud. Core 05GC recovered 372 cms of brown clayey silt with the core penetration stopped only by the core weight. The core slightly over-penetrated and we recovered the top 10cm (Section 1) by carefully prying the core mud from the inside of the metal stub at the bottom of the core weight and preserving it stratigraphically intact within two red core end caps. There were no obvious voids in the core during sectioning. There were no gravels apparent in the mud from the outside of the core barrel.

It should be noted that HLY0301-05GC gravity core represents the highest latitude core ever taken by the Oregon State University NORCOR group and we appreciate the opportunity.

We stayed on station and again rigged the gravity core for another longer ~ 20 foot core. As we were preparing to transfer the gravity core, the 04 Deck level crane developed a hydraulic leak. After only two hours, the Healy deck crew had repaired the blown O-ring seal, and we were ready to deploy.

At 1942hrs GMT we took gravity core HLY0301-06GC near the same site but with a longer 20 foot PVC barrel.

Core 06GC

HLY0301-06GC	081 37.321' N	063 13.860' W	1 cm	805 meters depth
				(Core Catcher)
Sec 1	1cm (Core Catcher Sample)			

We again rigged the core catcher with a cloth sock for possible sandy sediments. The 12KHz pinger was placed 50 meters above the core, and we lowered the core to within 150 meters of the bottom and stopped several minutes to let the line settle out. This time we lowered the core into the bottom at 70 m/min wire speed and registered a good pullout tension of 2,976lbs. During core recovery at 480 meters of wire out, it was noticed that the winch had a bad wrap and wire was let back out to correct the bad wrap. Recovered the core at 60m/min wire speed. PVC core barrel had ~15 feet of mud smear on the outside and clear water running out of the core catcher upon recovery. Core catcher fingers were not inverted and cloth sock was still visible at recovery. There was no mud in the core cutter, but the core catcher and cloth sock were intact. After opening, the core only had a very small amount of mud caught in the cloth sock above the core catcher. At least half (ten feet) of the inner wall of the core pipe was smeared with mud as well. There was not any mud on the upper ~ 5 feet of the core pipe or on any of the core weight or fins. Gravity core 06GC appears to have stuck upright in the mud, pulled out with a reasonable tension and somehow been flushed nearly clean of mud on the way back to the surface - all this without inverting the stainless steel core catcher fingers.

(As a side note of scientific serendipity: After further exhaustive inquiry and debate it appears that the only "reasonable scientific explanation" for mud smear on the outside of the 06GC core barrel and only clear water inside the barrel is that we re-cored the same hole. With tongue in cheek, we would like to commend the crew of the USCGC Healy on their excellent ship handling abilities and station keeping prowess in order to accomplish this feat. To my knowledge, this is the first documented case of this coring phenomenon ever recorded in the annals of the Journal of Irreproducible Results. --- CM)

ONBOARD CORE ANALYSES

Bulk Density Samples and Vane Shear

Jason Ressler, University of Rhode Island, performed other tests on the piston cores (01PC, 02PC, 03PC and 04PC) and gravity core (05GC) while aboard the ship included sampling for bulk density and vane shear. This was done by extracting constant volume sub-samples and using the Torque Watch, respectively. Tests were performed at gross intervals at the bottom of each core section and also at the sediment water interface.

Vane sheer tests will give a first indication of the shear strength and thus stress history of the sediment - i.e. glaciated or non-glaciated.

Because cores are susceptible to desiccation and most liners are actually permeable, bulk density measurements are done for quality assurance. The volume of each bulk density sub-sample was approximately 7.7 cc. Voids created during this process were plugged with Styrofoam, and this data will be used as a check against the gamma-attenuated, bulk density data measured by the Multi-Sensor Track back in the lab.

In addition, the overburden stress on the sediment can be derived from the bulk density data. The relationship between stress and shear strength will give a viewpoint of the cores with respect to age.

NOTE: Constant volume samples taken for bulk density were taken off center <u>in the working half of the core at the bottom of each core section and also at the core top</u>. The vane sheer tests were done on the centerline at the bottom of each core section, which will be cut when the core is split.

A Sampling Table of bulk density and vane shear

Core ID	Section	Depth in Sec. (cm)	Depth in Core (cm)	Bulk Density	Vane Sheer (oz*in)*
HLY0301-01PC	1	0	0	X	1.5
HLY0301-01PC	1	58	58	X	7.5
HLY0301-01PC	2	150	208	X	9.5
HLY0301-01PC	3	150	358	X	7
HLY0301-01PC	4	150	508	X	8
HLY0301-01PC	5	150	658**	X	5
HLY0301-01PC	6	150	808**	X	14.5
HLY0301-01PC	7	76	884**	X	6
HLY0301-01PC	8	90	974**	X	9
HLY0301-02PC	1	50	50	X	2
HLY0301-02PC	2	150	200	X	6
HLY0301-02PC	3	150	350	X	15
HLY0301-02PC	4	150	500	X	20
HLY0301-03PC	1	38	38	X	1
HLY0301-03PC	2	150	188	X	9.5
HLY0301-04PC	1	0	0	X	NA***
HLY0301-04PC	1	40.5	40.5	X	1.5
HLY0301-04PC	2	151.5	192	X	7
HLY0301-04PC	3	151.5	343.5	X	12.5
HLY0301-04PC	4	150.5	494	X	15.5
HLY0301-04PC	5	155	649	X	7.5
HLY0301-05GC	1	0	0	X	NA***
HLY0301-05GC	1	10	10	X	2.5
HLY0301-05GC	2	60	70	X	1.5
HLY0301-05GC	3	151	221	X	1.5
HLY0301-05GC	4	150.5	371.5	X	1.5

HLY0301-06GC No tests performed on recovered sediment.

* Torque Watch reading. Data must be converted to shear strength.

** Depths not adjusted for unseen voids in core.

*** Sediment contains too much water to perform test.

Magnetic Susceptibility Measurements

Magnetic susceptibility is a non-destructive measurement of the magnetic concentration of the sediment. Because of its simplicity and rapid measurement time, it's commonly measured shipboard to identify lithologic variations and correlate neighboring sediment records. Susceptibility can be useful for identifying possible sediment sources and, when coupled with other mineral magnetic measurements, it can be a useful climate proxy. For instance, glacial/interglacial cycles have been identified in susceptibility records from lacustrine, marine and terrestrial sediments. The climatic and environmental conditions associated with glacial and interglacial periods have a distinct impact on the depositional environment by altering such things as sediment type and/or depositional process. The Canadian Arctic Archipelago is particularly sensitive to glacial/interglacial transitions as well as short-term climate oscillations. As a result, the sediments found in Baffin Bay and Hall Basin should provide useful information about the effects of glaciation on drainage and circulation in this area as well as the timing of shorter scale climate changes.

Methods

After allowing the cores to equilibrate to room temperature, Chip Heil, Graduate School of Oceanography at the University of Rhode Island, measured the magnetic susceptibility at 2-cm intervals using a 125mm diameter Bartington M.S.2.C loop sensor.

Preliminary Results

BAFFIN BAY

Figure 1 shows magnetic susceptibility for the four piston cores taken on the shelf and slope of Baffin Island (HLY0301 –01PC, HLY0301 –02PC, HLY0301 –03PC, and HLY0301 –04PC). Sedimentation rates decrease down slope along a southwest trending transect; core 01PC (the western-most, shallowest site) having the highest sedimentation rate and core 04PC (the eastern-most, deepest site) having the lowest sedimentation rate. The four cores correlate well based on magnetic susceptibility (Figure 1). From these correlations, it appears that 02PC recovered the most complete portion of the upper unit while core 01PC recovered the oldest sediment. It is important to note that the data for core 01PC has been edited to remove voids. Voids were interpreted from near zero susceptibility values (voids found in section 5 at 10-28 cm and 42-128 cm as well as section 6 at 46-90 cm). There appears to be 2 distinct sediment regimes; the upper unit is characterized by lower susceptibility values while the lower unit has higher, more variable magnetic susceptibility values. The low susceptibility unit is probably the Holocene unit identified as Tinktartuq mud in Huntec seismic records from the Buchan Gulf. The lower unit of high susceptibility values likely correlates with the glacial Davis Strait silts identified in the same Huntec records of the Buchan Gulf. These interpretations agree well with seismic data obtained shipboard prior to coring in which a more acoustically reflective layer (Davis Strait silts) was overlain by a more acoustically transparent unit (Tiniktartuq mud). There are also several sharp peaks in magnetic susceptibility in the lower unit (glacial) and at the transition from between the two units. The relative size and spacing of these peaks suggest the possibility of Heinrich events. However, resolution of this possibility requires more detailed measurements including age constraints.

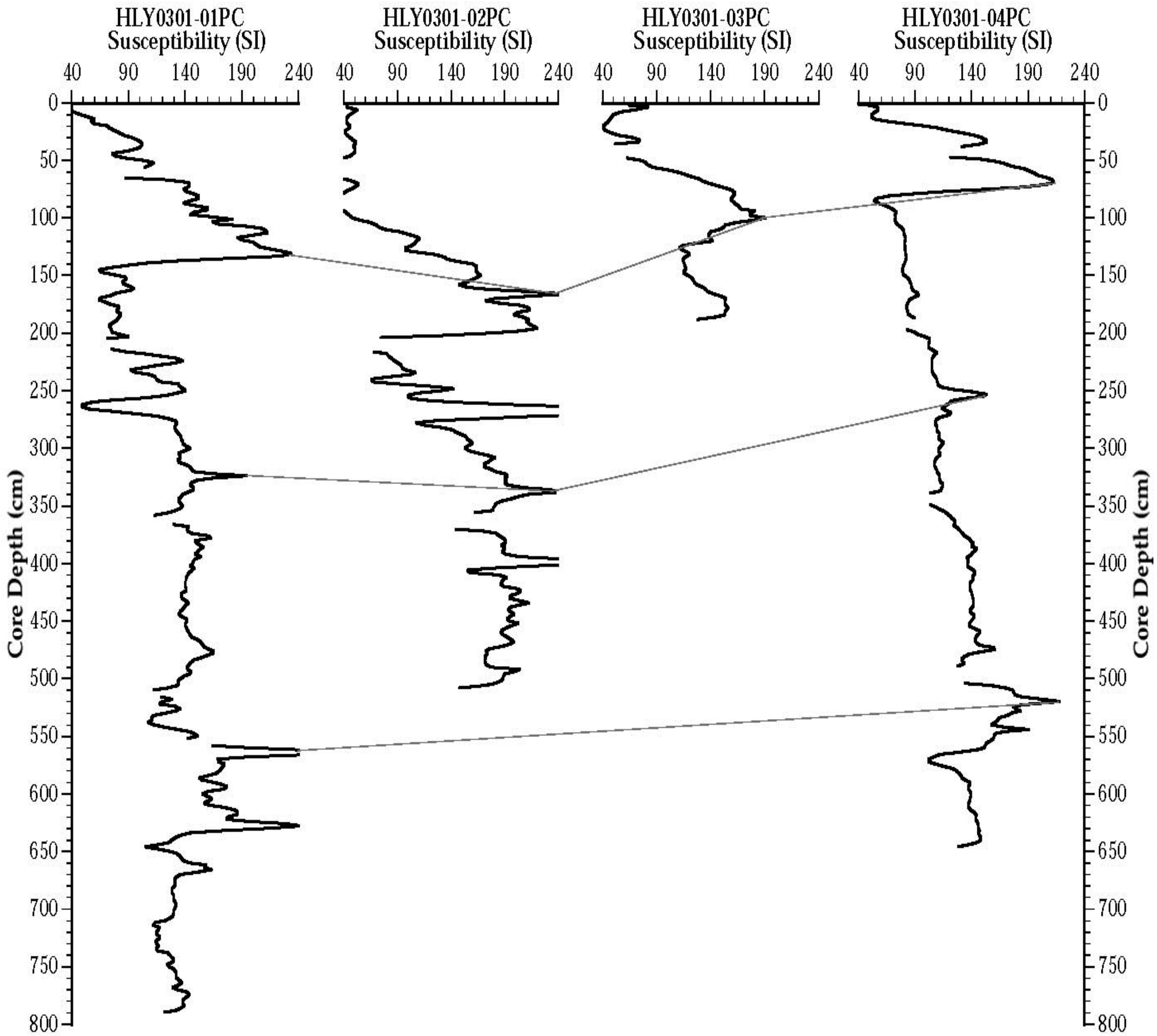


Figure 1. Magnetic susceptibility for Baffin Bay piston cores HLY0301-01PC, -02PC, -03PC, and -04PC showing post-glacial Holocene upper unit (most prominent in 02PC) over glacial unit.

HALL BASIN

Magnetic susceptibility for gravity core HLY0301 –05GC is shown in Figure 2. The data shows high amplitude variability in the upper ~2.5 m of the core, while the lower ~1.5 m shows lower values with smaller amplitude variability. The upper unit appears to have some cyclic variability possibly associated with shorter-scale climate change.

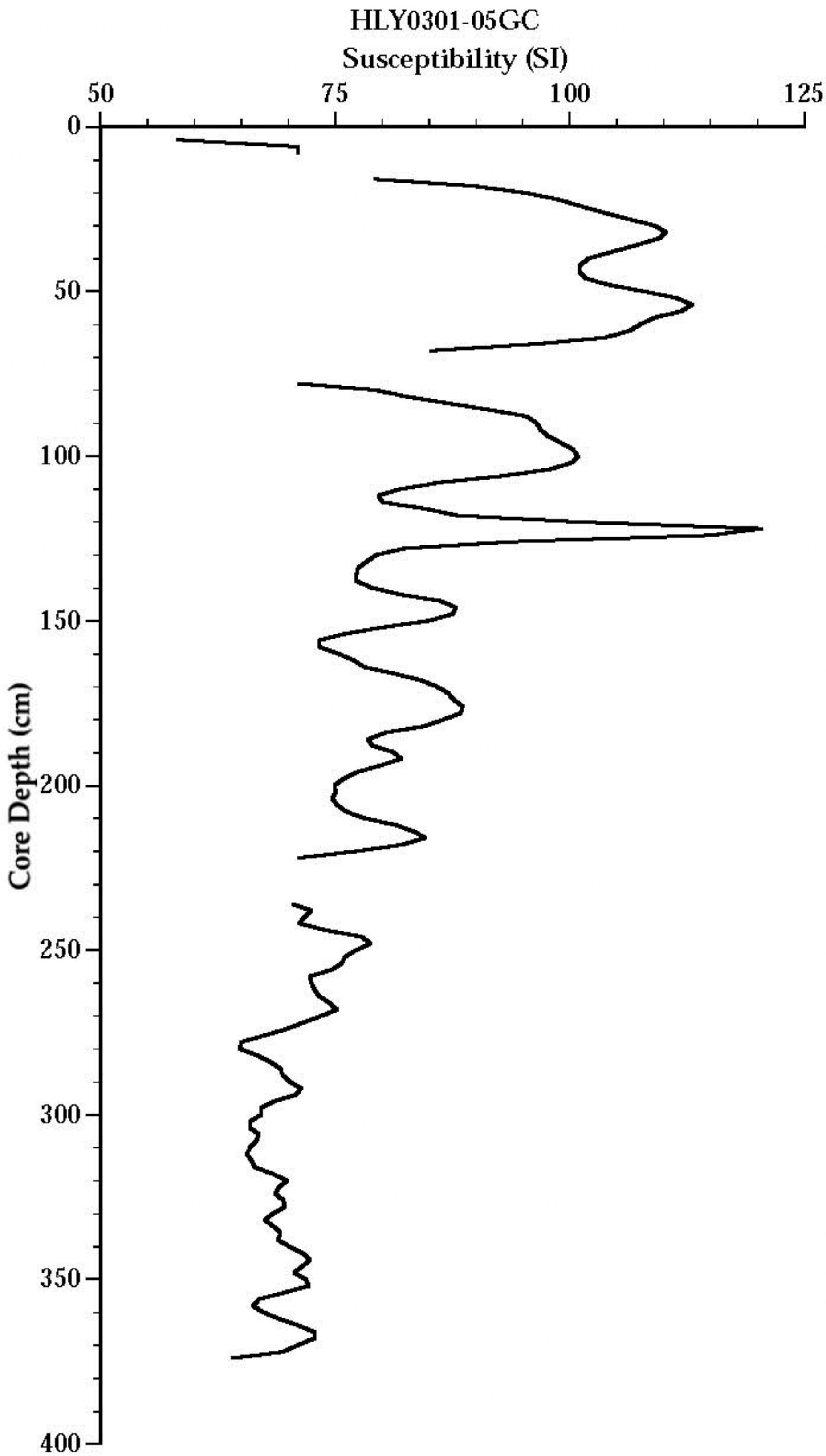


Figure 2. Magnetic susceptibility for Hall Basin gravity core HLY0301-05GC.

RECOMMENDATION FOR GRAVITY CORING ABOARD USCGC HEALY

An Alternative Giant Coring Method

The giant gravity corer cradle holding the giant gravity corer on the USCGC Healy is mounted on the 02 Deck of the ship far above the water and the starboard A-frame block from which the giant gravity corer is deployed. The starboard crane located even higher on the 04 Deck level is needed to move the corer from its cradle on the 02 Deck to a position under the starboard A-frame block for launching into the sea. Moving the giant gravity corer from its cradle to the final lowering position is a cumbersome process requiring a crane operator, a bosun, and several tag line handlers. In heavy seas and high winds, this whole process becomes a dangerous operation in which the corer becomes a giant "pendulum" because the crane lifting point is so high in the air – jib out and boom up.

On coring cruises when the piston corer is not used, the giant gravity corer could be placed in the jumbo piston corer cradle which is bolted to the main deck under the starboard A-frame. This would eliminate entirely the need for the starboard 04 deck crane to move the giant gravity corer into position.

The only modification to the jumbo piston corer cradle would be the addition of a one half inch thick steel plate inside the bottom of the cradle to hold the smaller giant gravity corer. The steel plate would have to be circular with a diameter of 19-1/2 inches and with a seven inch wide slot cut in it to match the slot in the side of the core cradle. The slot would extend from the circular edge of the plate to a point 13 inches in toward the center. This plate would then need to be bolted in place to prevent movement.

The only drawback to using the jumbo piston corer cradle as a giant gravity corer cradle is that the coring technician would have to lie on the main deck in order to attach the core liner, lifting clamp, etc. in place. Care would have to be taken on cores longer than 12 feet so that the core tube would not be snapped off in heavy seas.

SEABEAM MAPPING

SEABEAM 2112 PERFORMANCE

Roger Davis
Hawaii Mapping Research Group
University of Hawaii
(July 21 to August 16, 2003)

Healy's SeaBeam 2112 multibeam swath mapping system was operated continuously over the duration of Healy-0301 with the exception of three time periods as described below where significant outages occurred due to system malfunction. There were various other minor outages due to deliberate shutdown to avoid acoustic interference with conflicting science activities. All times noted below are GMT.

The first major outage was caused by a hard disk drive failure within the 2112 system on July 22 at 05:30. The system was temporarily restarted using the same disk drive, but repeated errors later in the day ultimately forced a replacement of the drive. Inadequate documentation on software reconfiguration of the replacement drive caused the outage to be substantially larger in duration than it should have been. The 2112 was returned to operation around 18:00 of the same day, and improved documentation on the reconfiguration procedure was generated and inserted into the maintenance manuals.

The second substantial outage occurred on August 6 between 16:30 and 22:50. The system stopped logging data despite giving the appearance of operating normally. Ultimately Healy's ETs were called in and reseated a few ribbon cable connectors inside the 2112 chassis that appeared to be loose. The problems did not recur for several days.

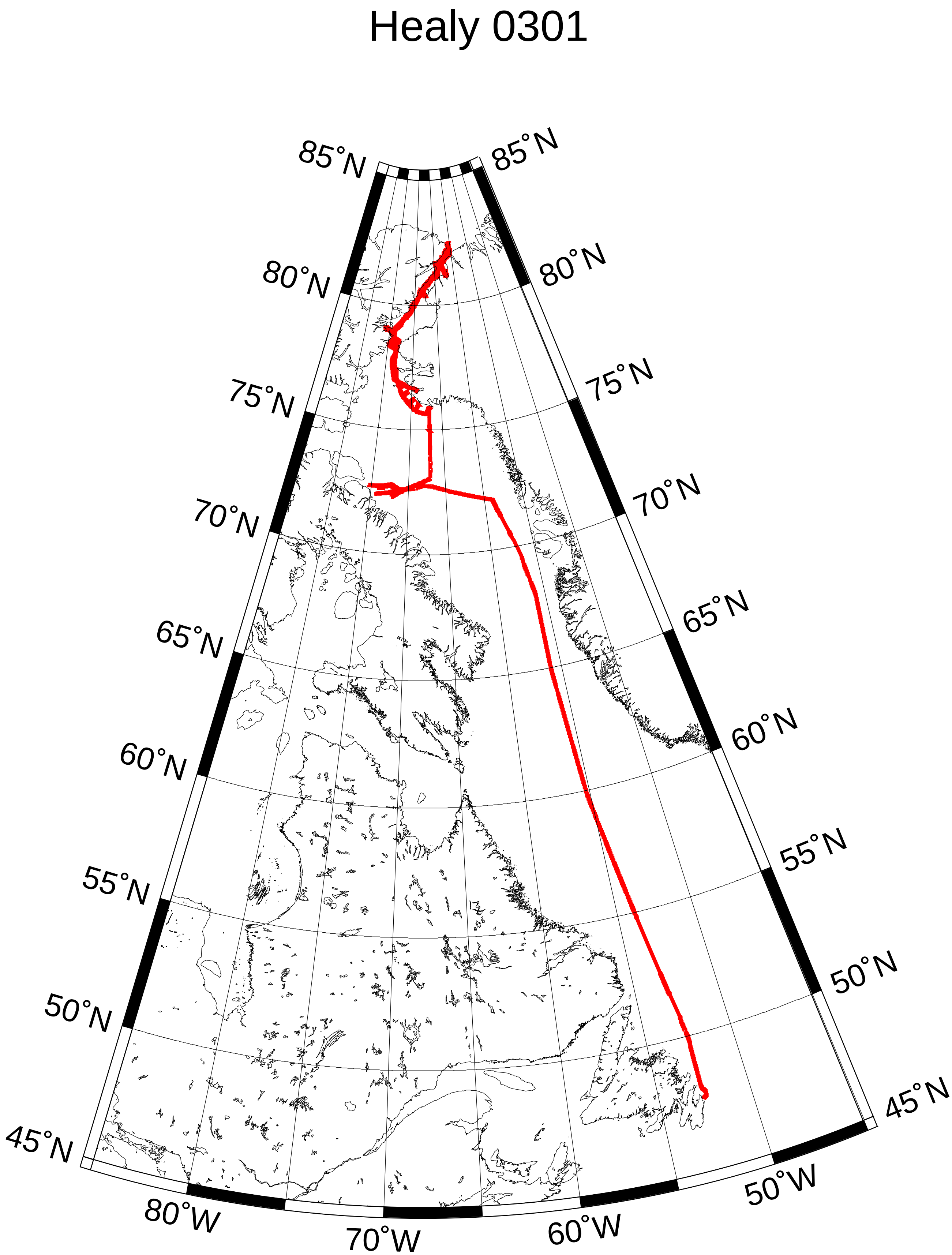
The third and final major outage occurred at 04:30 on August 11. Again the system stopped logging data while appearing to function normally. Multiple restarts (including power cycling) failed to fix the problem. Ultimately the magneto-optical system disk was swapped out (more on a whim than on any substantial evidence of failure) and the system began working again. It was noticed that one of the DSP boards was displaying an unusual LED pattern which may or may not indicate a hardware failure.

The second and third outages as described above appear similar in nature, may be related, and ultimately may be indicative of an ongoing problem that has not yet been solved.

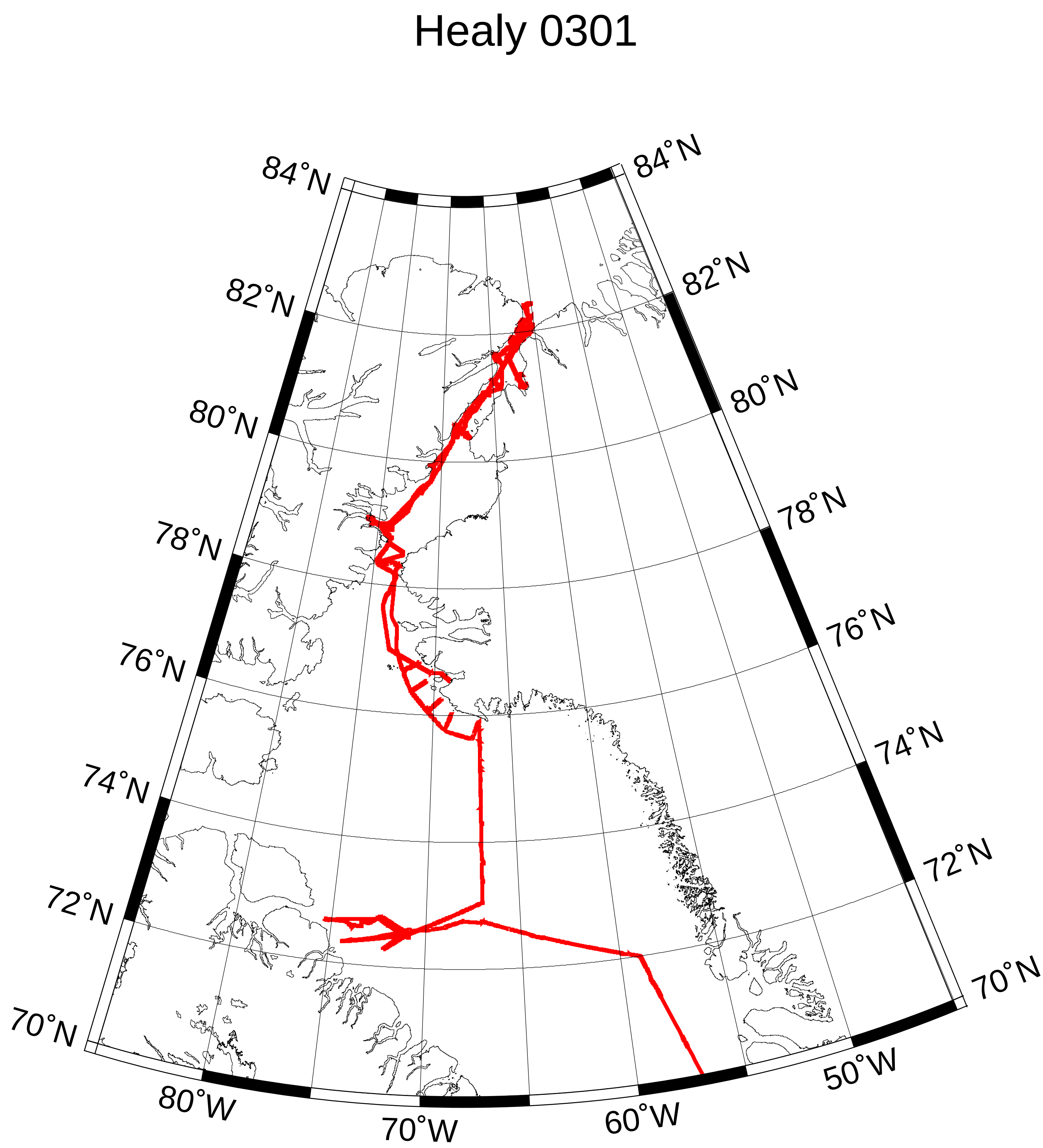
Bathymetric data quality appeared reasonable for the most part when the system was operational. The 2112 normally delivered between 55 beams (shallow water) and 100 (beams) deeper water under most conditions. It chronically returns noisy data along the track centerline and usually has along-track artifacts on both port and starboard sides (more pronounced to port) near the swath edges which appear as a narrow, shallow gully. Peculiar data were returned around 18:50 on July 23 where some system aberration resulted in the generation of a series of across-track ridges alternating between port and starboard. This happened along a near-north heading and may be related to VRU problems.

Sidescan imagery required extensive angle-varying gain correction, providing useful data in some areas. Most of the surveyed terrain was relatively featureless, with the more interesting imagery occurring generally within the Nares Strait region**.**

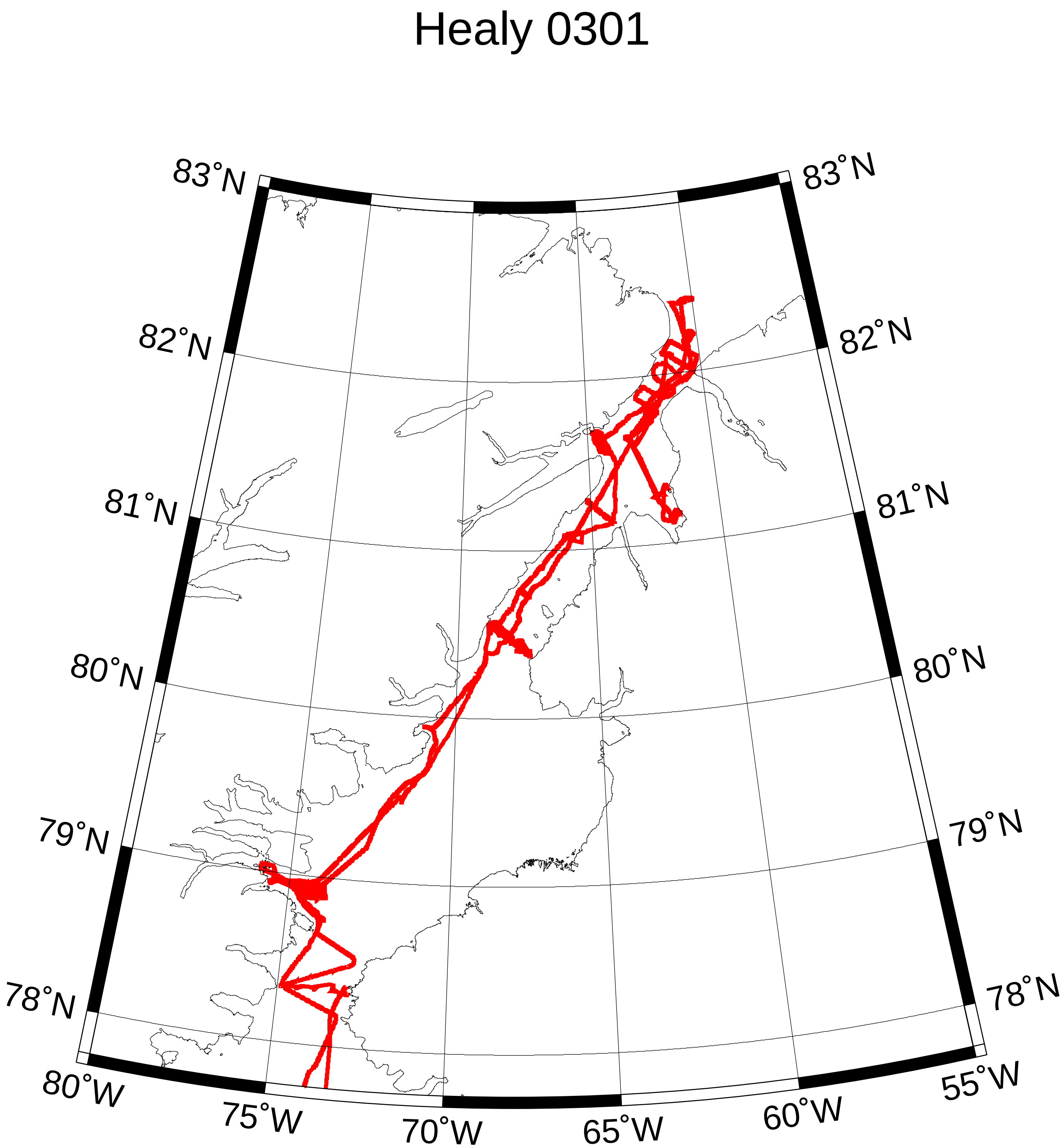
See the following 3 pages for geographic coverage.



Entire cruise track.



Expanded cruise track of working region.



Expanded cruise track in Nares Strait.

SCIENCE AVIATION

SUMMARY OF SCIENCE MISSIONS BY HELICOPTER

By John Simpkins III
COAS
Oregon State University

Helicopter Specifications

The Healy carries two HH-65B Short Range Recovery (SRR) helicopters. A product of the Aerospatiale Helicopter Corporation, these twin engine, 4-blade foldable main rotor aircraft are designed for short range search and rescue operations. These helicopters are equipped with dual flight controls augmented by an Automatic Flight Control System (AFCS), search radar, advanced navigation systems, retractable skis and a 600 pound capacity rescue hoist. The maximum unrestricted gross weight of the helicopter is 8,900 pounds. This allows a maximum load of about 2,250 pounds consisting of crew, cargo and fuel (maximum of 1,800 pounds.) Average cruising speed is about 120 knots. Average fuel burn rate is about 600 pounds/hour. The useful range is determined by the fuel/cargo distribution.

Mission 1: Eastern Smith Sound

2 August 2003, 06:50 – 08:40 ADST

Objectives

Reconnaissance of sites proposed for the collection of clams and for the deployment of long-term moorings for the measurement of sea level.

Good sites to collect clams include general characteristics of appropriate benthic habitat, the remoteness of the site from local influences and, for the small-boat dive operations, the likelihood of good working conditions at the site on the day in question. Habitat considerations include shelter from ice scour, the presence of fine-grained sediment (mud), and supply of organic matter from biological productivity this latter being assessed from observations of, for example, macrophytic algae in the shallows or clamshells on beaches, or the presence in the region of benthic feeders such as walrus, bearded seals and diving ducks. To record the large scale signals in Nares Strait we are adopting two strategies to minimise local influences; 1) we avoid sites near major inflowing rivers and 2) we propose to collect clams from water depths below the surface layer but within the range of depths where much of the freshwater transport is likely to occur in Nares Strait (5 – 30 m). Suitable sites for pressure-recorder moorings should have characteristics similar to those favouring clams (soft sediment, little chance of ice scour). However, the importance of shelter from ice is much higher than for the clam work. The required depth for mooring deployment is 20 m. Additionally there is a need for ease of access by ski plane operating from the ice in winter.

Aircraft

6519

Flight Crew

LT Greg Matyas, LT Gary Naus and AVT2 John Maghupoy

Observers

Humfrey Melling and Robie Macdonald

Route

The aircraft flew north from Healy towards Foulke Fjord, completed a circuit of the fjord, circled Littleton Island and continued northeast to Cape Hatherton. Turning back, we examined the coastline south past Cape Alexander before returning to Healy.

Assessment

Nine sites were logged as having high potential for the clam work. Most promising was the narrow channel between Littleton Island and a small unnamed island to the north. The waters surrounding islets to the south of the mouth of Foulke Fjord were the secondary interest.

The region immediately behind a rocky spine that cuts halfway across Foulke Fjord from the south was selected for the pressure-recorder mooring.

Photographs

No digital photographs taken

Mission 2: Alexandra Fjord

3 August 2003, 11:00 – 13:00 ADST

Objectives

Reconnaissance of sites proposed for the collection of clams and for the deployment of long-term moorings for the measurement of sea level.

Aircraft

6521

Flight Crew

LT Damon Williams and AMT1 Raymond O'dell

Observers

Yves Sivret and Jay Simpkins

Route

The aircraft left Healy off Cape Isabella in western Smith Sound and flew north to Pin Island and west to Alexandra Fjord. It skirted the steep terrain on the northern side of the fjord, circled the group of islets in the centre and completed a reconnaissance of the southern shore from west of the camp during the return flight to Healy.

Assessment

The shores of Alexandra Fjord showed little promise for either purpose because of steep slopes, rocky beaches or local rivers.

The un-named islands west of Skraeling Island revealed potential for both clam collection and as shelter from ice. Soundings on a chart from the Canadian Hydrographic Service confirmed the presence of water of suitable depth in this area.

Photographs
The photo titles indicate major features depicted. There are 4 small unnamed islands west of Skraeling Island. They are identified in the photos as Cairn, 5m, 3m & 15m (east to west) using the only notations found on the existing chart of the fjord.

Mission 3: Western Kane Basin
3 August 2003, morning

Objectives

Ice reconnaissance for the transit north to Kennedy Channel. A secondary objective was the identification of potential clam and mooring sites in bays along the western side of Kane Basin, time permitting. The preferred location for this reconnaissance was Scoresby Bay.

Aircraft
6519

Flight Crew
LCDR Robert Young, LT Greg Matyas and AMT1 Trevin Dabney

Observers
Yves Sivret and OPS-LT Darryl Peloquin

Route
The flight proceeded north from Healy near the Bache Peninsula. Wind and poor visibility prevented the aircraft from proceeding as far as Scoresby Bay. A brief photo-reconnaissance of the smaller Maury Bay was completed before the aircraft turned back south.

Assessment
No firm decisions on sites for clam collection or mooring could be made from information gathered on this sortie.

Photographs
The photo titles indicate major features depicted.

Mission 4: Kane Basin
3 August 2003, 21:30

Objectives
Ice reconnaissance for the transit north to Kennedy Channel and ice conditions in southern Kennedy Channel.

Aircraft
6521

Flight Crew
LT Damon Williams, LT Gary Naus and AVTC Lorion Ledkins

Observers
Yves Sivret and Robert McCarthy

Route
The flight was intended to proceed north from Healy toward southern Kennedy Channel. A problem with the deicing system was indicated and the aircraft returned to the ship shortly after departure.

Assessment
None made**.**

Photographs
No digital photographs taken

Mission 5: Western Kennedy Channel
4 August 2003, morning

Objectives
Reconnaissance of sites proposed for the collection of clams and for the deployment of long-term moorings for the measurement of sea level.

Aircraft
6521

Flight Crew
LCDR Robert Young, LT Gary Naus and AMT1 Raymond O'dell

Observers
Robie Macdonald and Gerhardt Behrens

Route
The flight left Healy near Cape Lawrence and proceeded northeast along the western side of Kennedy Channel to Cape Defosse. The aircraft returned via the same route.

Assessment
No firm decisions on sites for clam collection or mooring could be made from information gathered on this sortie. Most of the shoreline was steep and directly exposed to ice drift in the main channel. There were numerous instances of grounded ice and even ice still frozen in place to the bottom. The several embayments that showed some promise for clam habitat were in close proximity to an inflowing river and the aerial reconnaissance was helpful in identifying ice scour in most of these embayments.

Photographs
The photo titles indicate major features depicted.

Mission 6: Southern Kennedy Channel
5 August 2003, 17:30 – 21:00 ADST

Objectives
Reconnaissance of sites proposed for the collection of clams and for the deployment of long-term moorings for the measurement of sea level. Reconnaissance of sites suggested for the deployment of

automatic weather stations for measuring airflow in Nares Strait. Reconnaissance of sites for the shore camp needed to support this project during aircraft operations in the late winter of 2005 and 2007.

The characteristics of good anemometer sites includes low elevations, absence of local steep topography, good exposure to dominant north-east and south-west winds and access by ski plane (land or sea ice) in winter. The characteristics of good sites for a base are many and varied. We worked with a subset of criteria that included proximity to the main mooring line in southern Kennedy Channel, shelter from prevailing winds, terrain suitable for landing ski and wheel aircraft close to where materials could be delivered to the beach by landing craft.

Aircraft
6519

Flight Crew
LT Greg Matyas, LT Damon Williams and AVT2 John Maghupoy

Observers
Humfrey Melling and Ed Hudson

Route
The flight proceeded north from Healy near Cape Jefferson, completing over-flights of Crozier, Franklin and Hans Islands before turning eastward to the mouth of Alakratiak Fjord. From here, we followed the coast south-east to Cape Jefferson and south partway to Cape Madison before returning to the ship.

Assessment
Crozier Island rises about 200 m from the sea and is surrounded by cliffs on all sides. The top, appearing flat from a distance, has significant relief and is strewn with large rocks. The top is the only place for an anemometer and the local terrain makes this location unsuitable for measuring regional winds. It could only be reached by helicopter.

Franklin Island is larger, about the same height and is somewhat flatter on top. The western end is slightly lower. A Twin Otter might possibly land on top in winter, if there is enough snow to smooth the rocky surface. The general meteorological assessment is the same as for Crozier Island.

Hans Island is roughly dome-shaped and has about half the elevation. A new Danish flag fluttered at the peak. The island is shear sided at the water line except at the northwest, where it might be possible to travel up from the sea ice in winter. However, access from the ice might be difficult, owing to extreme pile-ups of ice rubble created by the crushing of drifting floes against the cliffs. Rubble remained piled to a height of about 10 m along much of the northern cliff at the time of this survey. Hans Island has an excellent position in the centre of the channel. This advantage might over-ride the problems of access (helicopter probably required) and of steep local terrain of airflow.

Alakratiak Fjord is very shallow at the mouth, no more than a few metres as the seabed could be seen over a wide area. A spit obstructed much of the opening. There were many small floes grounded on the foreshore. The cliffs were soft, crumbling sandstone, with little evidence of vegetation above or below the water. The water deepened abruptly some distance behind the spit, but this area was spotted with small bergs calved from glaciers further up the fjord. This site was judged a poor prospect for clams and unsuitable for the deployment of the pressure-recording mooring.

There is a valley with two rivers at 81° 07'N just south of Cape Resser that might be suitable for a winter camp. There is a delta allowing convenient access to the beach. Extensive raised deltaic benches of fine soils offer good potential for aircraft access. The high land of Cape Resser offers protection from northerly winds.

The un-named arrow bay just south of Cape Independence is very steep-sided , with unstable slopes of scree making it unsuitable for a mooring site.

An even better prospect for a winter camp is a valley harbouring three rivers that enters the northern half of Lafayette Bay at 80° 57'N. There is a delta allowing convenient access to the beach. Extensive raised deltaic benches of fine soils offer good potential for aircraft access. The high land of Cape Independence offers shelter from northerly winds, high land to the south provides shelter in that direction, and Crozier Island is a buffer to the west. There is a broad area of raised beach beneath the cliffs to the south of the valley, extending to 80° 24.5'N.

The area south of Cape Jefferson is low lying with gentle slopes and many small lakes, bays, isthmus and peninsulas. Although there are areas where aircraft could land and where barges could be beached. The complexity of the terrain probably precludes these activities within a reasonable distance on one another. The landscape also offers very little shelter.

However, for this reason this area is probably ideal for the sitting of an automatic weather station. It has excellent exposure to winds from the sector south-east to north. Exposure deteriorates towards the north-east, but terrain rises only slowing in this direction. The area offers plenty of landing sites for aircraft.

The near-shore has potential for the collection of clams.

Photographs

The photo titles indicate major features depicted.

Mission 7: Northern Kennedy Channel and Hall Basin

6 August 2003, 13:45 – 15:20 ADST

Objectives

Tactical ice support to Healy for a planned oceanographic section at Cape Bryan. Reconnaissance of sites proposed for the collection of clams and for the deployment of long-term moorings for the measurement of sea level. Reconnaissance of sites suggested for the deployment of automatic weather stations for measuring airflow in Nares Strait.

Aircraft

6519

Flight Crew

LT Gary Naus and AVT2 John Maghupoy

Observers

Humfrey Melling and Lee Narraway

Route

The aircraft flew north-east from a location near 81°N toward Cape Bryan. On completing reconnaissance of Hannah island at the mouth of Bessels Fjord and of Joe Island, we continued north-east to Off ey Island at the mouth of Petermann Fjord. The next way point was Discovery Harbour, from where the aircraft flew south-west along the western side of Kennedy Channel to reach Healy near Cape Defosse.

Assessment

The channel between Hannah Island and the mainland was very shallow (1-2 m). The deeper water behind the shallows was littered with many small bergs. The location was judged unsuitable for mooring a pressure-recorder.

Joe Island is dome shaped like Hans Island and about the same size. Its elevation is a little lower, and a steep walk-up may exist from the south-west. Ice rubble may be a problem here also in winter if the island must be reached from an aircraft landing on adjacent sea ice. A helicopter is probably required. The island is at the side of the channel, which fact makes Hans Island the preferred of the two sites.

Off ey Island has an elevation of about 150 m. It has steep cliffs on the west and north sides but slopes gently to the east, permitting easy access to the summit from the sea ice. The land to the North and East is high (350 m) but not steep. Off ey Island could be suitable for an automatic weather station. There is a curving rocky spine at the east end of the island. This shelters a steep beach that could accommodate a pressure-recorder mooring. The seabed is darker at depth, perhaps indicating good clam habitat. However, a river that enters the bay from Greenland may compromise the value of this site for the present study.

Polaris Bay lay to our north as we crossed to Discovery Harbour. The valley behind the bay is about 15 km wide and the land behind rises gently to about 350 m. The beach of Polaris Bay offers some advantages as an anemometer site with excellent exposure to the southwest.

Bellot Island, which shelters Discovery Harbour, is almost 700 m high. The are tow spits projecting to the east north-east. The more northerly is rocky with high elevation and steep shores. The other, terminating at Breakwater Point, is low lying. The latter offers excellent shelter from ice. It is highly rated as a site for a pressure-recorder mooring and for the collection of clams.

Cape Baird marks the northern end of the Judge Daly Promontory. It steps up from the sea in two slopes. Atop the first is a bench at about 60 m above sea level. This has excellent exposure to the northeast , since it projects far out into Hall Basin. Although our flight path precluded close inspection, it is likely that a Twin Otter could land on this bench for the installation of surface weather station.

There is a broad river delta south of Cape Defosse. This has acceptable exposure to the south, and possibly to the north, where a valley stretches to the shores of Lady Franklin Bay. Landing of a fixed-wing aircraft on the frozen delta in winter is probably practical.

Photographs

No digital photographs taken

Mission 8: Eastern Robeson Channel and Petermann Fjord

9 August 2003, 21:30 – 23:00 ADST

Objectives

Reconnaissance of Arctic Ocean ice edge in the Lincoln Sea. Location of a suitable ice floe in which to hove to the ship for helo repairs and debarkation of the science party and crew to the ice was the primary objective. Satellite photos showed a particularly large floe on the western half of the channel.

Aircraft

6519

Flight Crew

LT Greg Matyas, LT Damon Williams and AVTC Lorion Ledkins
Yves Sivret and Glen Hendrickson

Route

The flight was meant to follow the ice edge at the Lincoln Sea. Winds rose from 25 to 35 gusting to 45 kts as the aircraft prepared for take-off. The captain aborted the mission in the interest of safety.

Assessment

None made.

Photographs

No digital photographs taken

Mission 9: Eastern Robeson Channel and Petermann Fjord

9 August 2003, 21:30 – 23:00 ADST

Objectives

Reconnaissance of Off ey Island and Petermann Fjord as tactical support for operations in ice at these locations. Off ey Island is proposed for the deployment of a mooring for the measurement of sea level. Geochemical stations will be occupied in Petermann Fjord to determine the geochemical signature of glacial meltwater input into Nares Strait.

Aircraft

6521

Flight Crew

LT Greg Matyas, LT Damon Williams and AVTC Lorion Ledkins

Observers

Dave Huntley and Glen Hendrickson

Route

The flight left Healy near Newman Bay (Robeson Channel) and proceeded south along the Polaris Promontory Cape Tyson. After an examination of ice conditions at Off ey Island, the aircraft flew up Petermann Fjord to the terminus of the glacier. It returned via the same route.

Assessment

Ice conditions are suitable for small-boat work with divers near Off ey Island, and for travel of Healy to the terminus of the Petermann Glacier.

Photographs

The photo titles indicate major features depicted.

Mission 10: Eastern Robeson Channel and Petermann Fjord

12 August 2003, ADST

Objectives

Reconnaissance of Scoresby Sound, Maury Bay and Joiner Bay for location of a suitable bivalve retrieval site.

Aircraft

6519

Flight Crew

LCDR Robert Young, Lt Gary Naus and AMT1 Raymond O'dell

Observers

Robie Macdonald and Mary O'Brien

Route

The flight left Healy at anchor in Scoresby Sound and proceeded northwest to the shoreline of the sound. It then followed the shoreline to the south through to Maury Bay and then north to Joiner Bay, back into Scoresby Sound and into its western reaches, then back to the ship.

Assessment

The shorelines in Maury Bay and Joiner Bay are extremely rugged, many of them essentially a continuation of above-water talus slopes. Furthermore there was much evidence of grounded ice and bottom fast ice right against the shore. There were virtually no protected embayments along the coast and some regions to the south of Scoresby Bay were turbid due to local inflow and would likely provide difficult conditions to dive in. All of the region comprising the western part of Scoresby Bay was deemed a favorable habitat for clams due to the large silt supply; nevertheless, the proximity of inflows from a large drainage basin to this part of the bay ruled the region out as a favorable place for clams to record large-scale records of freshwater composition in Nares Strait. Accordingly, a south-facing shore at the northern entrance to the Sound was selected as being the best one available for bivalve retrieval even though it appeared to provide poor benthic habitat. While not exposed directly to Nares Strait, this site appears to be in close communication with the Strait. Furthermore, it is reasonably protected from the ice and wind making small boat ops reasonable especially given the relatively calm conditions occurring on this day. Finally, the small boat could work at this site while the Healy remained at anchor thus potentially saving the time that would be required to move the ship.

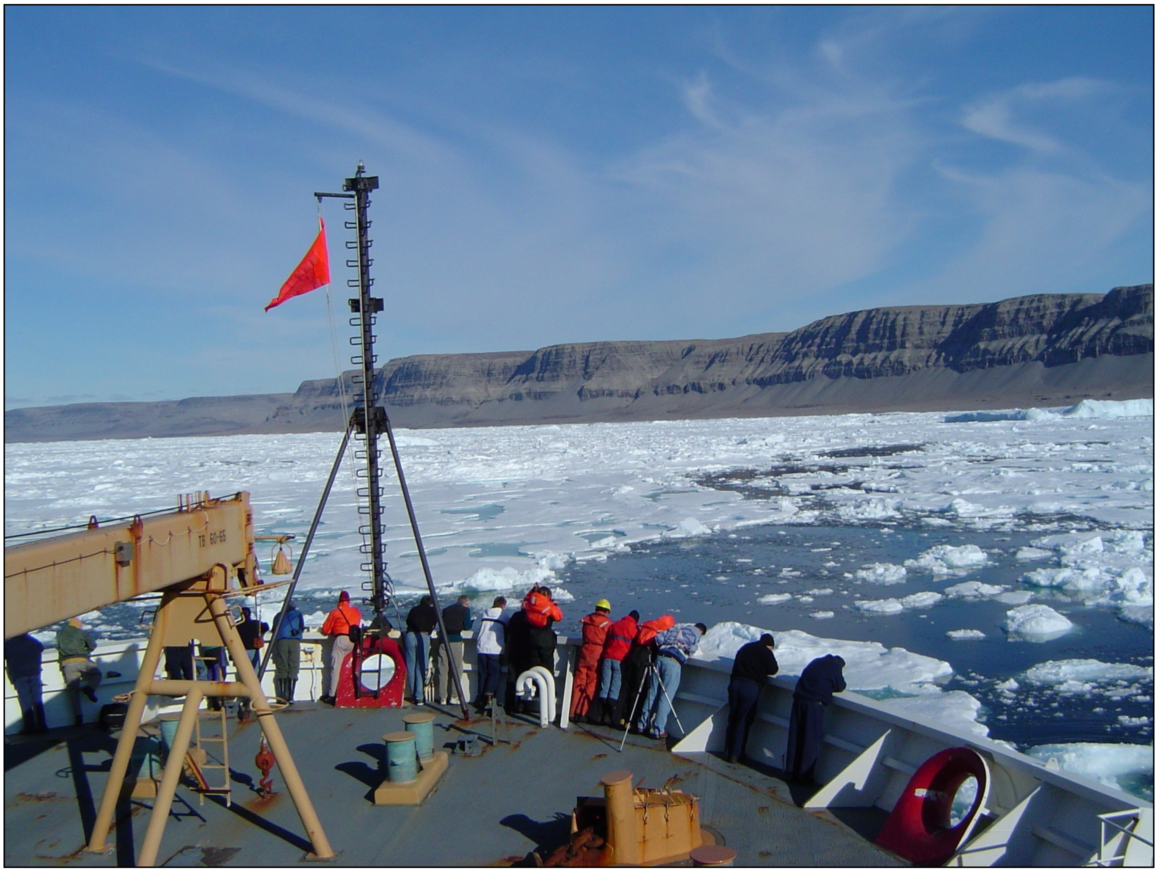
Photographs

No digital photographs taken

Document reviewed by:

Humfrey Melling
Robie Macdonald
Jay SimpkinsEd Hudson

ICE IMAGERY



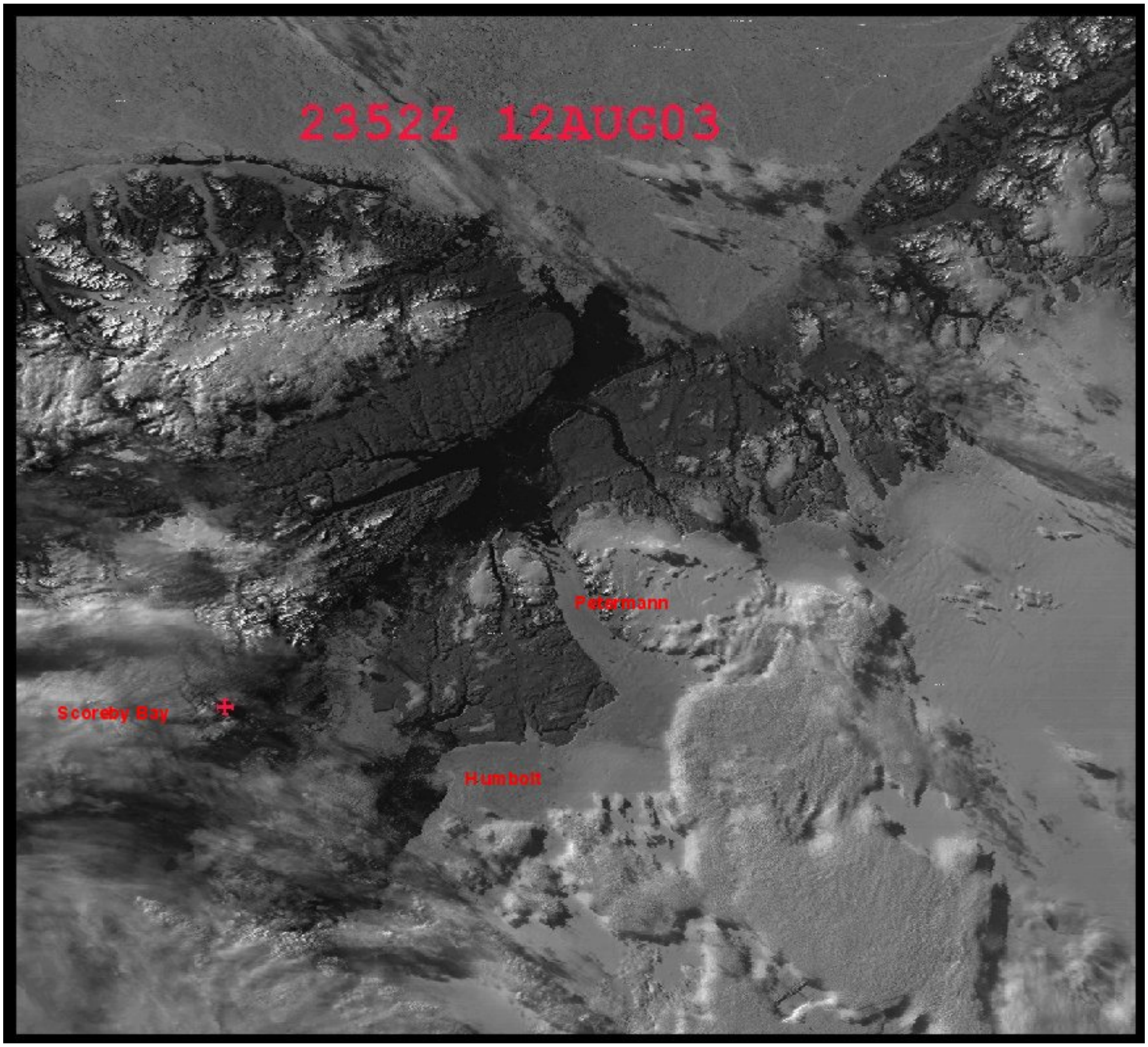
ICE SERVICES SPECIALIST REPORT

Yves Sivret
Canadian Ice Services

During Cats Healy 2003, ice conditions were more favorable than normal in all areas covered. See accompanying ice median charts for 30 July and 13 August (1971-2000 data) and regional charts for 28 July and 11 August. Bergy water was encountered through Baffin Bay and into Smith Sound. During the northward transit into Nares Strait, an open pack of old and first year ice prevented a small boat operation into Alexandra Fjord. Otherwise, ice conditions did not cause significant scientific work delays or cancellations. Bergy water condition prevailed over the extreme western section of Kane Basin. A small band of mostly old ice was encountered on the Greenland side of Kennedy Channel then mostly bergy water conditions into Hall Basin, Lady Franklin, Robeson Channel and into the Lincoln sea as far north as 8226N. There were the occasional small areas of very open drift of old ice in Robeson Channel, Hall Basin and the approaches to Petermann Glacier.

During our transit south, higher concentrations of mostly old ice were encountered in Kennedy Channel and into Northeastern Kane Basin. Afterward, bergy water condition in western Kane Basin, Alexandra Fjord and into Thule.

The latest ice information was received on a daily basis via Inmarsat and Iridium. Imagery consisted of Radarsat (Canadian Ice service and NIC), NOAA and OLS received on the ship's Terascan system. On occasions, MODIS and enhanced NOAA imagery was received from CIS.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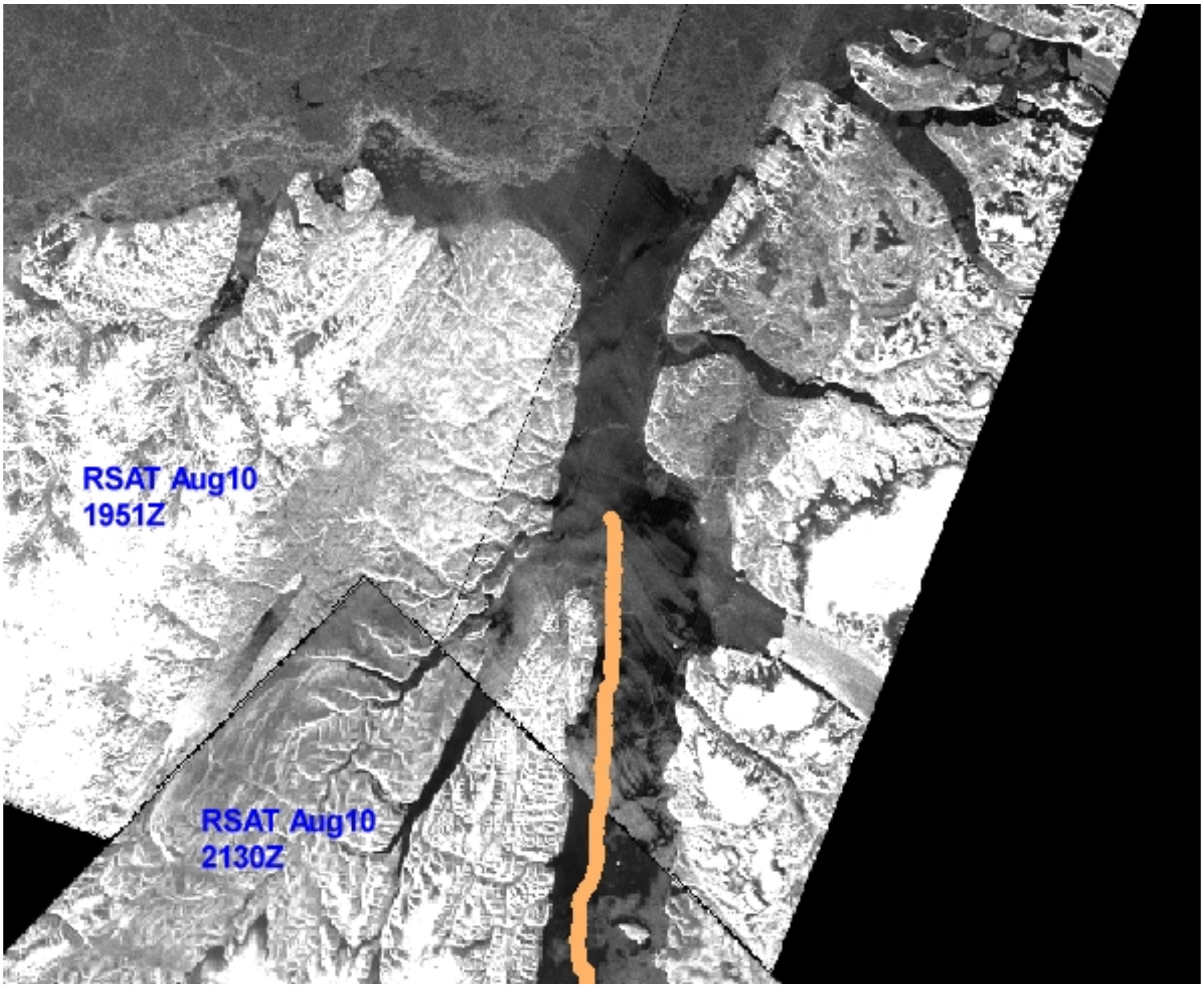
Petermann
Scoreby Bay
Humbolt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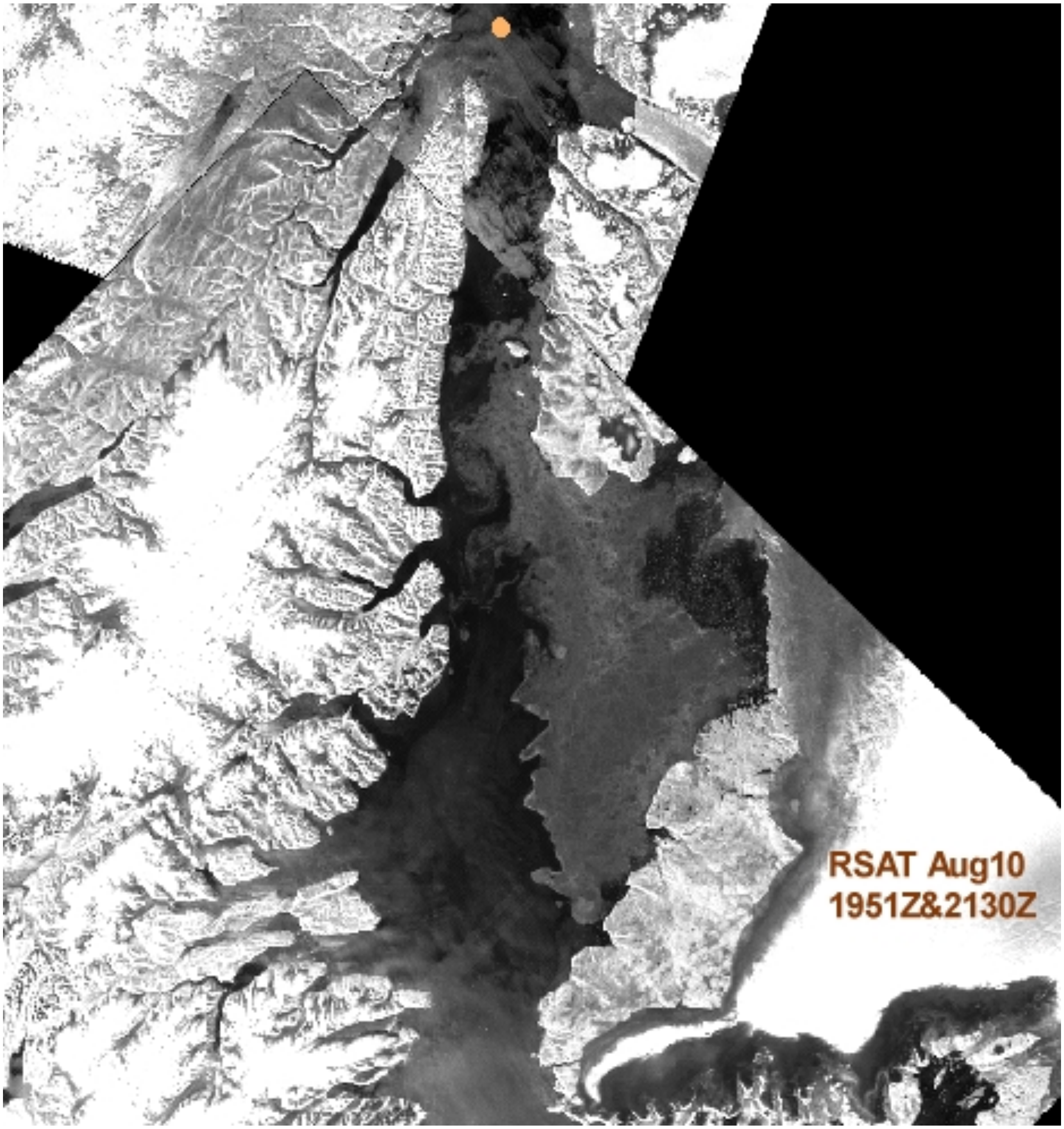
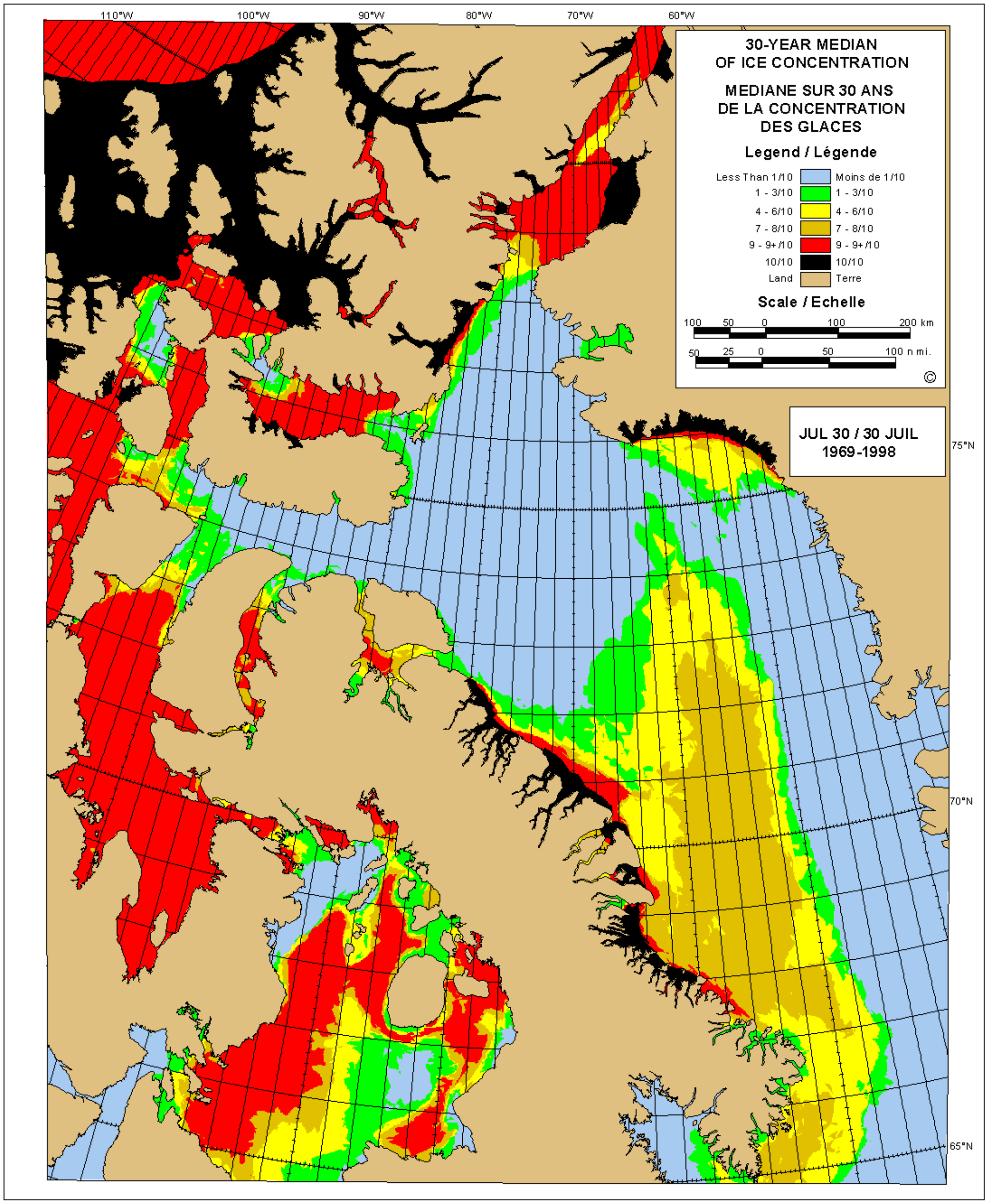
1951Z
RSAT Aug10
2130Z


RSAT Aug10
1951Z&2130Z

Environment Canada Environnement Canada

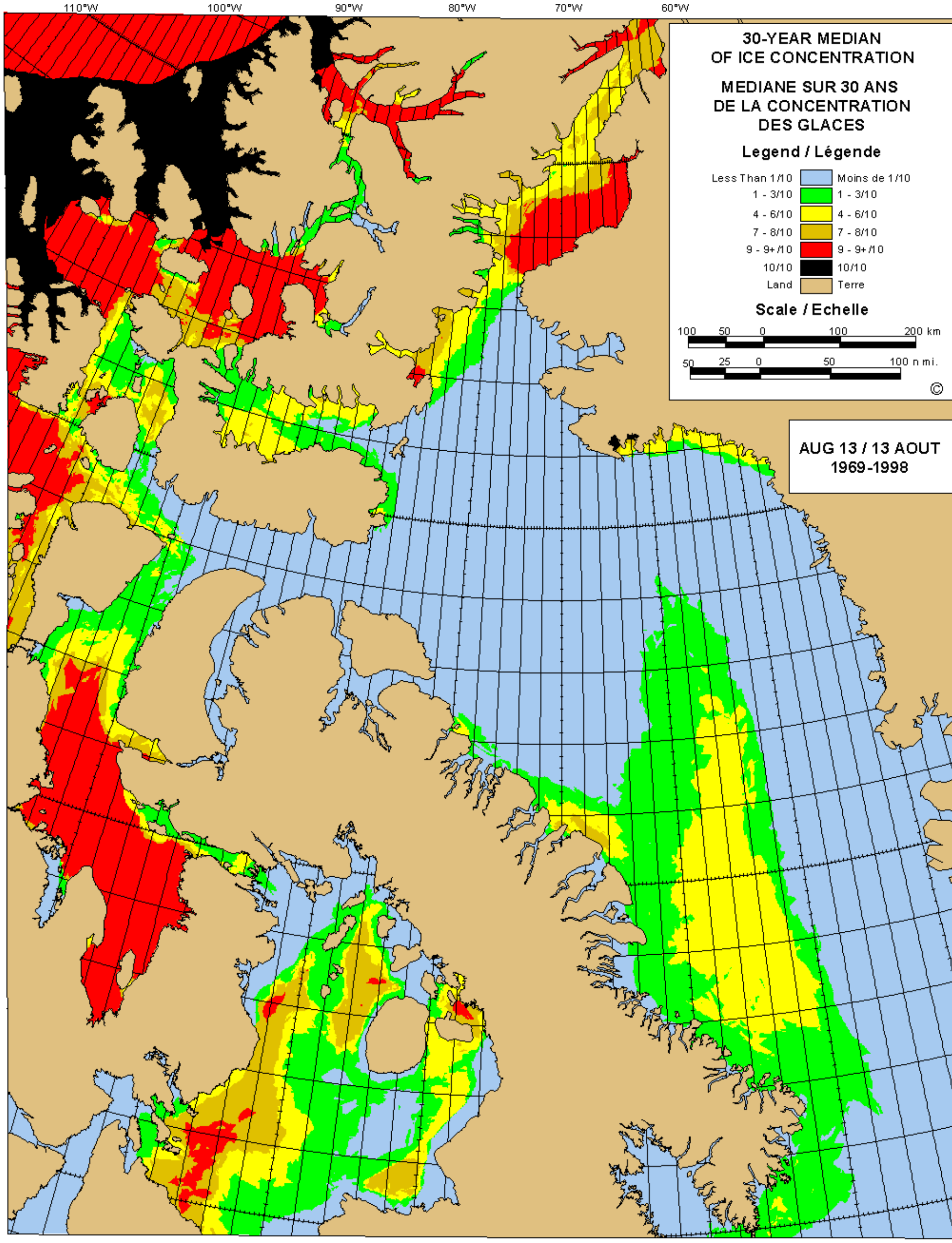
Canadian Ice Service
Service canadien des glaces



Canada

Environment Canada Environnement Canada

Canadian Ice Service
Service canadien des glaces



Canada

REGIONAL ICE ANALYSIS / ANALYSE REGIONALE DE GLACE — Eastern Arctic / Arctique de l'Est

11 AUG/AOU 2003

CANADIAN ICE SERVICE — SERVICE CANADIEN DES GLACES — RO

TEMPERATURE (°C) (Past 7 days) / TEMPERATURE (°C) (7 derniers jours)	MEAN MOYENNE	NORMAL NORMALE
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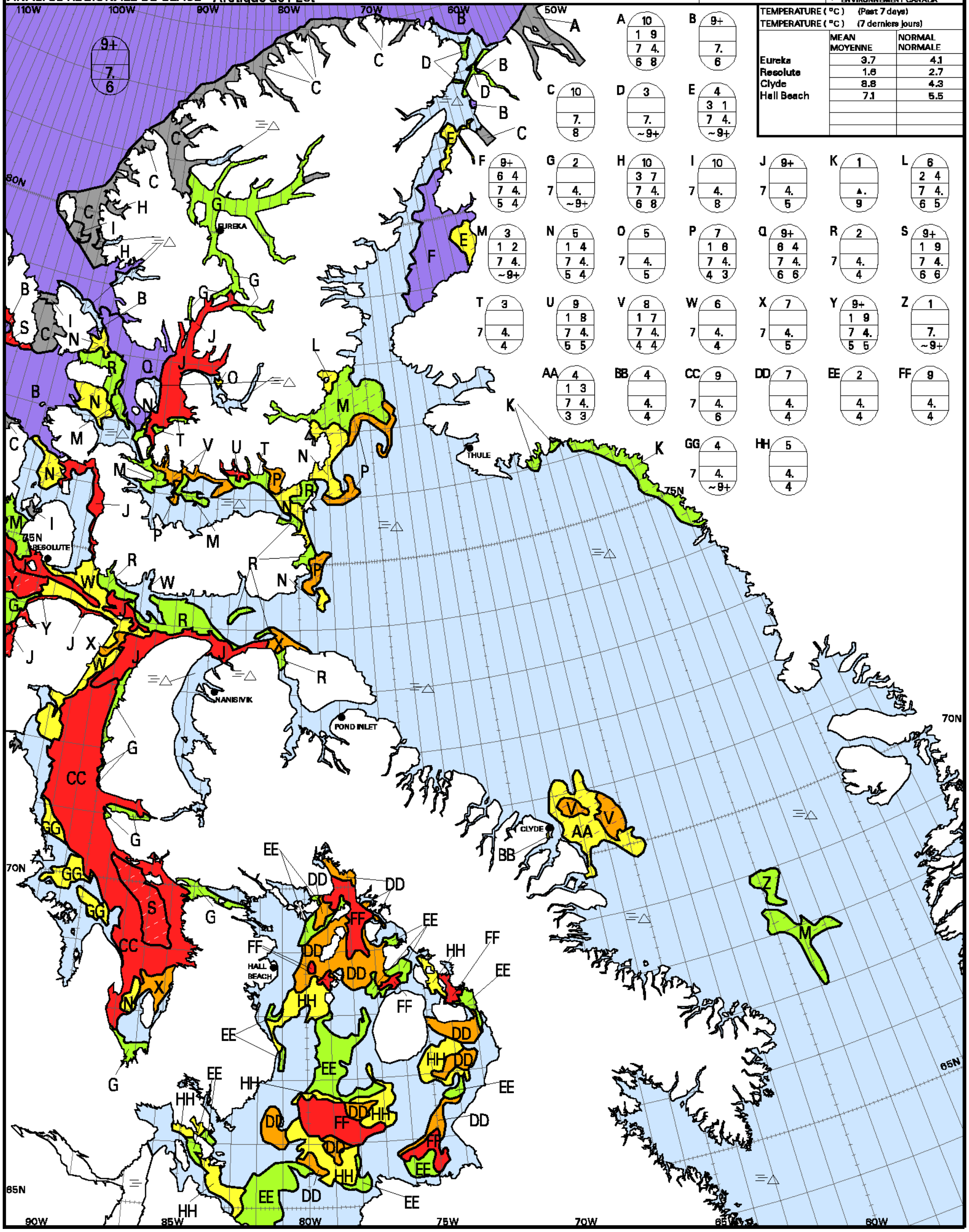
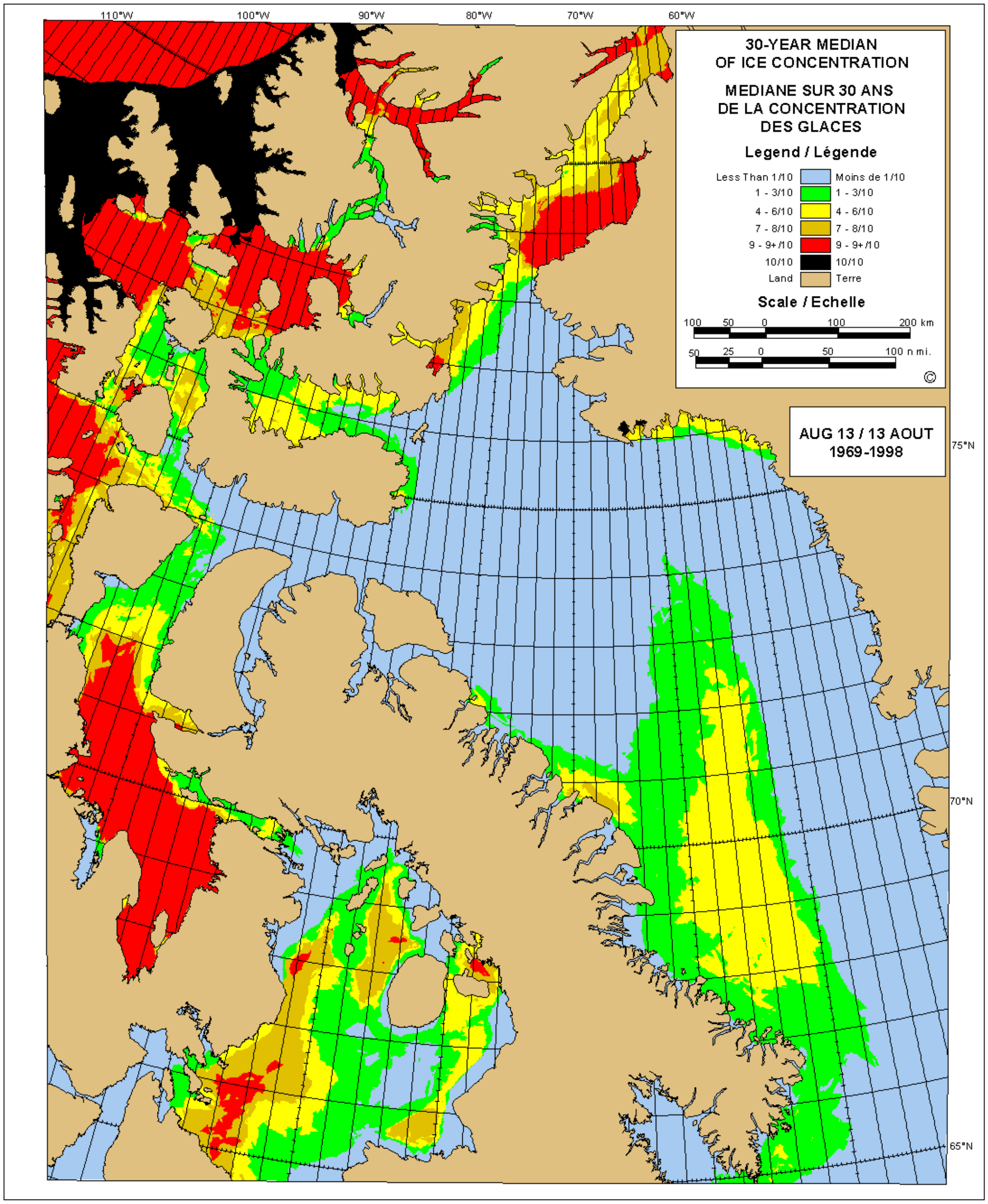
Resolute	1.6	2.7
Clyde	8.8	4.3
Hall Beach	7.1	5.5

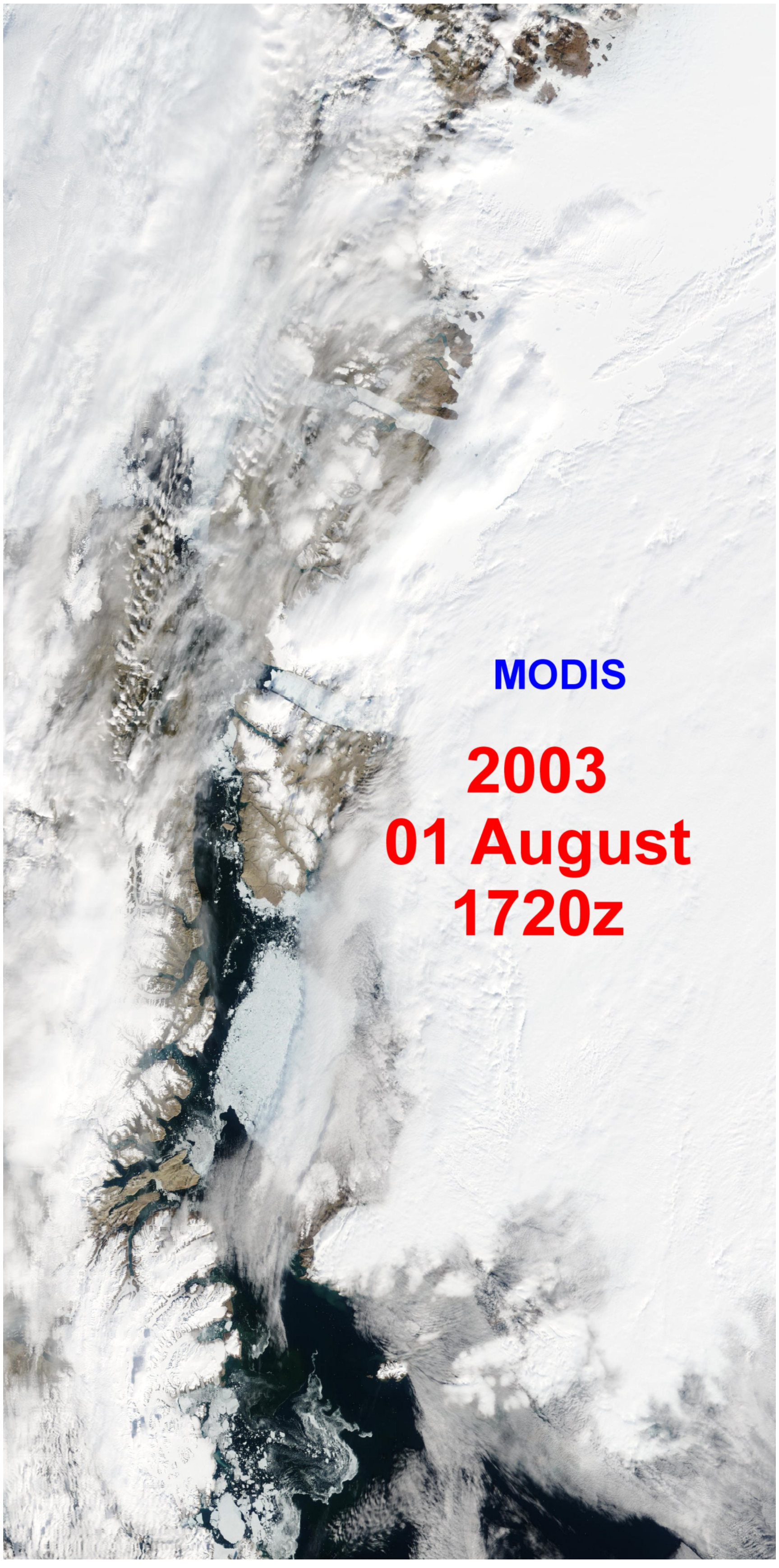


Environment Canada / Environnement Canada

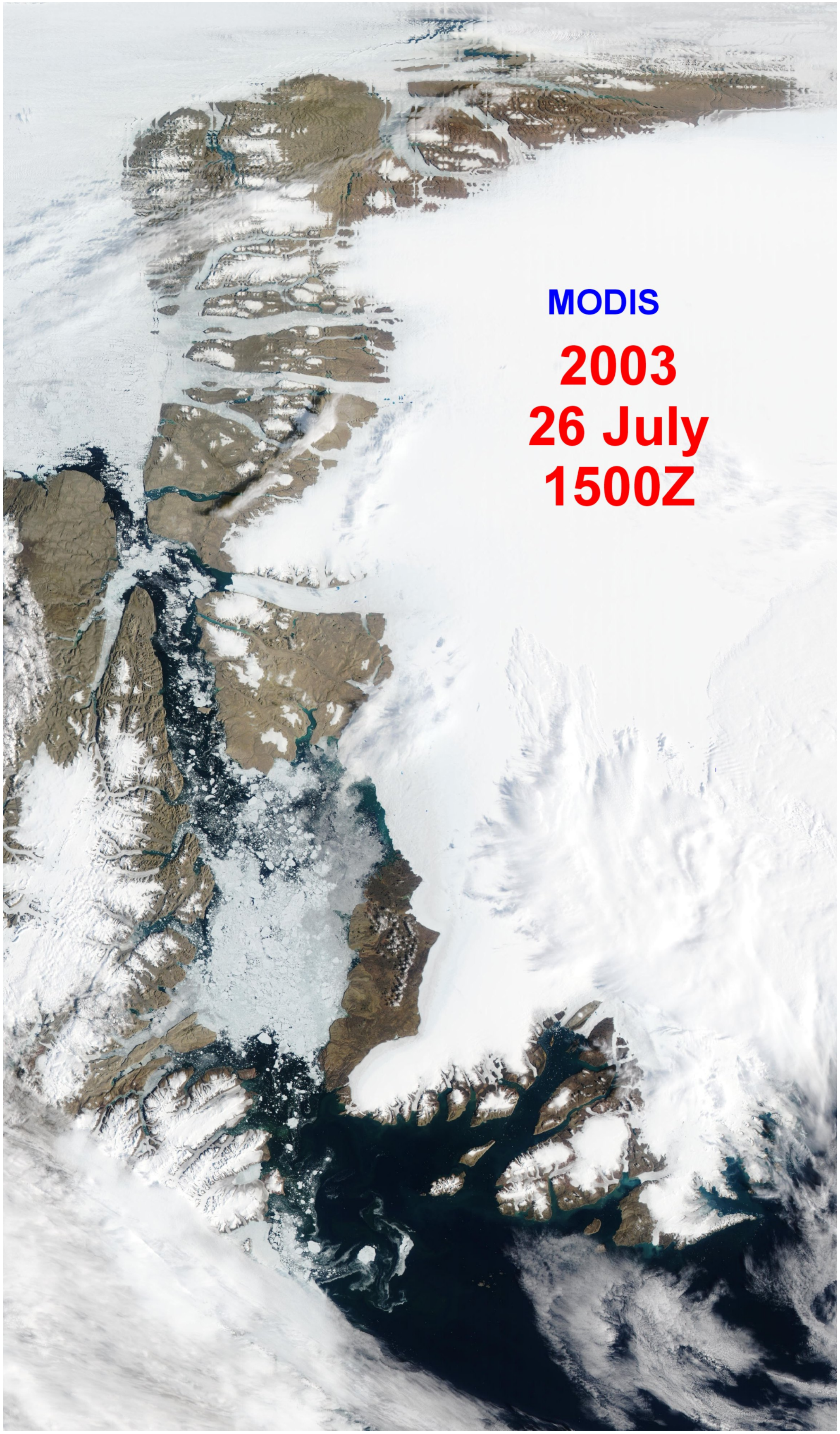
Canadian Ice Service
Service canadien des glaces



Canada



MODIS
2003
01 August
1720z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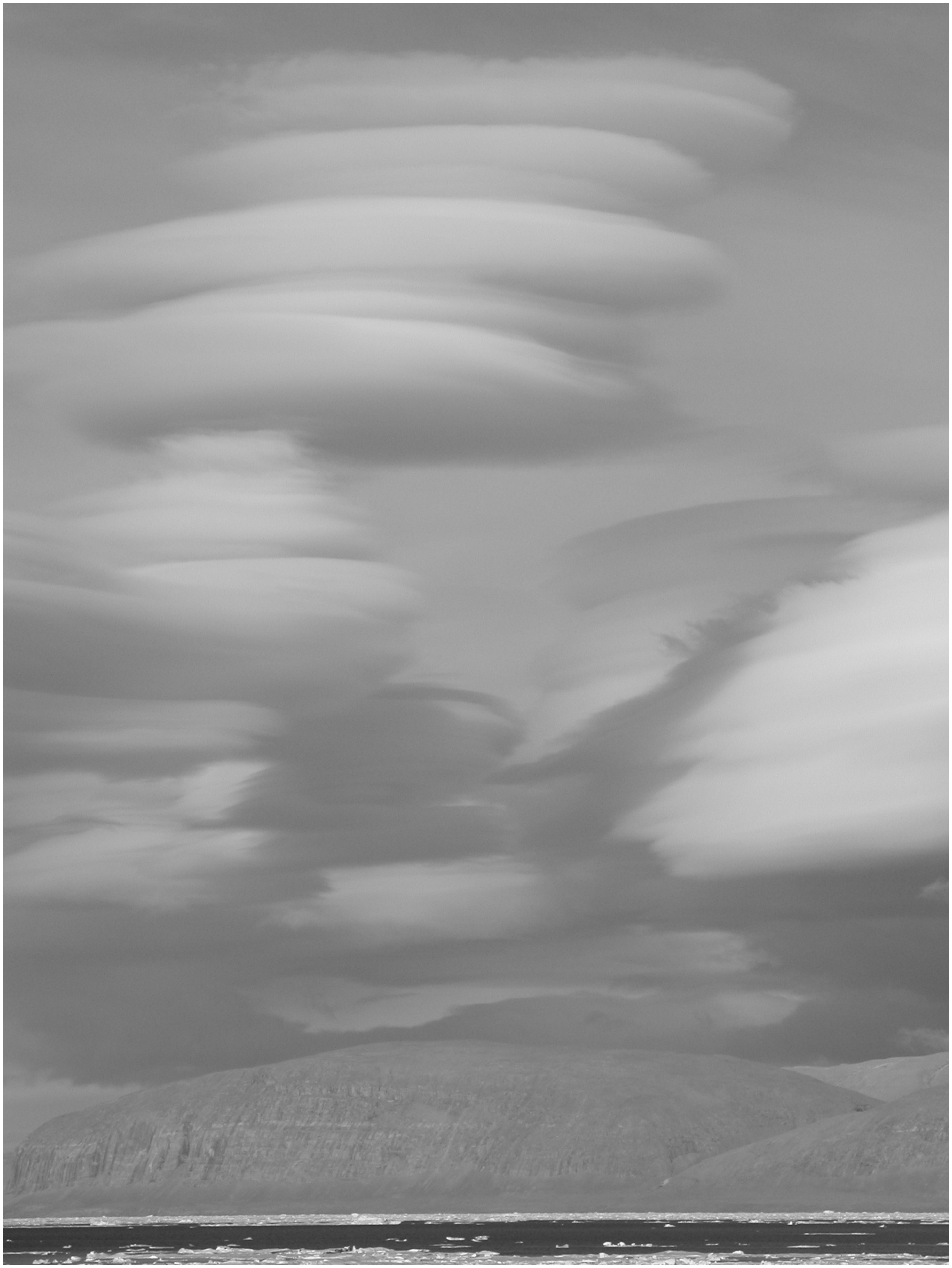
26 July
1500Z

WEATHER



Weather - *Canadian Archipelago Throughflow Study (CATS)*

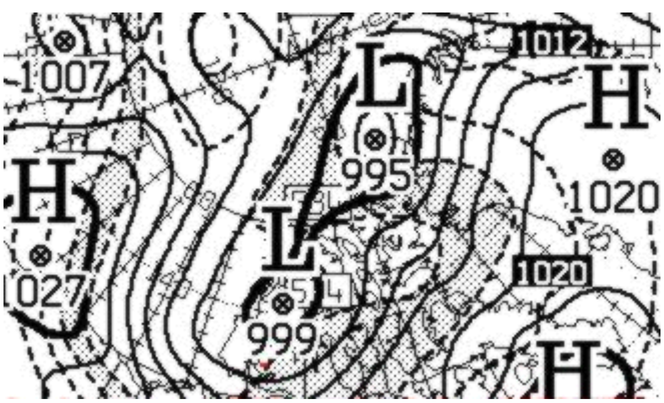
Ed Hudson, meteorologist
Prairie Aviation and Arctic Weather Centre
Meteorological Service of Canada

Background

The Prairie Aviation and Arctic Weather Centre (PAAWC) does the marine, aviation, and public weather forecasting for Nunavut and the Northwest Territories. I personally have been forecasting for the arctic for 30 plus years. I am the lead marine forecaster for the Centre and was the principle author for a just completed aviation weather handbook for Nunavut and the Arctic.

Overview

CATS Healy 2003 gave me the opportunity to see the marine and aviation perspective of the weather across Baffin Bay and the waterway between Ellesmere Island and Greenland. It afforded me an opportunity to share what knowledge I had about the weather of the area with others. The voyage on the Healy additionally allowed me to see what and how weather information is acquired and briefed "operationally" by ship personnel in support of vessel, small boat, science, and aviation activities. The voyage gave me an opportunity to acquire and put to use / check out the utility of web products for real time use in onsite weather forecasting for the CATS 2003 science area. I got to experience first hand the effect of weather on ship and science activities and the impact of forecasts on planning activities. I note that "external" weather information is acquired from the web via InMarSat except north of about 80N where InMarSat no longer functions and Iridium must be used. Timing of weather briefings on the ship, web access times, and the speed of the web down loads meant that new material was routinely 'out there' at the time of the weather briefings. When external weather material such as surface and upper air analyses, prognostic charts, wind depiction charts, and weather observations were not available / had become dated, one had only the observations of what was around them and what information one could infer from the DMSP and NOAA polar orbiter satellite imagery acquired in real time onboard via a Sea Space Tera Scan system for weather forecasting and briefing. Fortunately , access to at least a few charts always occurred.



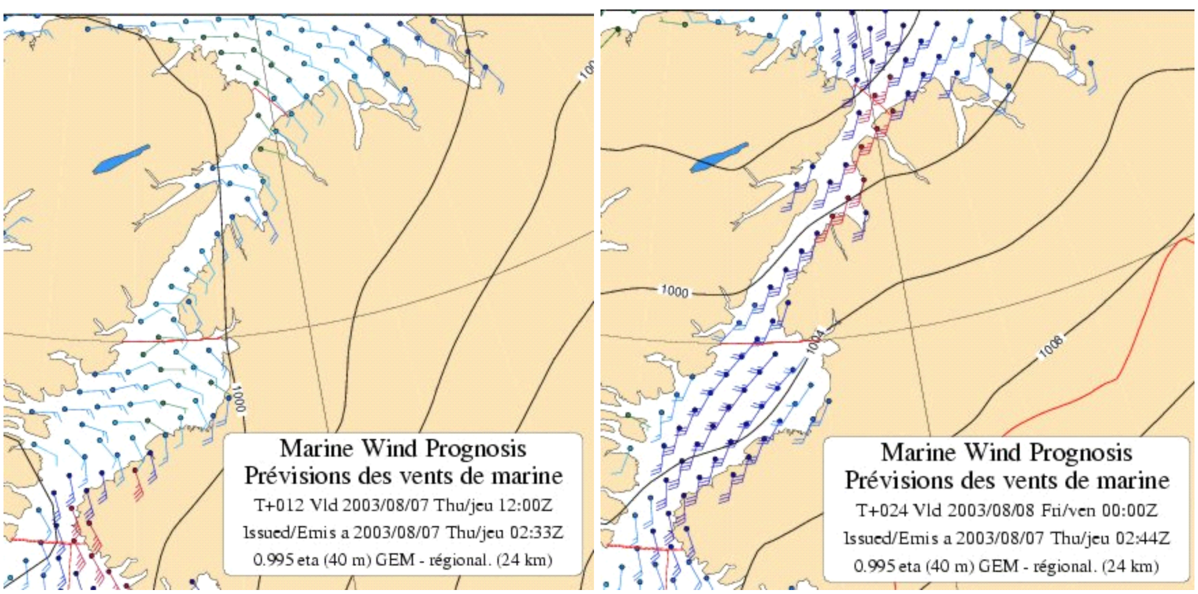
Sample section of prog chart accessed from the MSC web site: 24 hour panel for 8 August 0000 UTC from 7 August 0000 UTC set of progs.

Weather overview

The dominant wind direction throughout the CATS Healy 2003 science period was southerly and these winds were routinely 20 knots or more and at times gale to storm force strength. That said, during mooring day (5 August) winds were light and skies were sunny. A shift from light easterly winds to gale strength southerly winds the evening of 7 August while the Healy was in Kennedy Channel was well handled by prog charts. 13 August. the sudden shift and strengthening of winds from moderate easterly winds to winds to 50 knots while small boat operations were occurring in the Alexandra Fiord area was not well handled by prog charts. The winds settled down within 2 hours. In both the 7 August and 13 August cases, a cold front looks like the trigger for the strong winds.

Pre-voyage Activities

- arranged for "Kane" wind visualizations out to 72 hours to be produced at the PAAWC. The charts are 3 hourly out to 48 hours and then 12 hourly out to 120 hours. Visualizations out to 48 hours at 6 hourly increments were ported to Canadian Ice Service for remote access by Canadian Ice Service specialists. The following are sections of the wind visualizations. Subjectively, the wind visualizations were 5 to 10 knots light when they depicted winds 15 knots or more.



Kane wind visualization charts: sections of 12 and 24 hour forecast panels from 7August 0000 UTC model run.

During voyage activities

- alerted onboard Coast Guard Marine Science Technicians to MSC's web page / products on the web page which I felt would be useful for their weather briefings (http://weatheroffice.ec.gc.ca)
- alerted the pilots to the aviation link on the MSC web site
- provided the pilots materials from the aviation weather handbook for Pond Inlet, Grise Fiord, Resolute, and Cambridge Bay
- Accessed the MSC web site daily and downloaded prog charts and wind visualizations

- Provided weather consultation / opinion on an ad hoc basis to the MST's, the lead science persons Kelly Falkner and Humfrey Melling, CIS Ice Specialist Yves Sivret, and the ship captain starting about day 3 of the cruise, provided a weather briefing at the daily science meeting. The weather briefings evolved from verbal to a structured projection presentation – latest surface analysis, surface prog charts, and finally Kane wind depiction charts out to 48 hours.
- given opportunity on 2 occasions to present a weather briefing at the ship captain's evening meeting. The evening weather brief is a function done by the Coast Guard Marine Science Technicians.
- routinely accessed the Tera Scan system and posted imagery for viewing. During the last week, saved softcopy of sample Tera Scan acquired imagery

For consideration for such science missions on the Healy

- if there is a Canadian Ice Service ice specialist onboard, arrange for him to do weather observations at whatever synoptic or intermediate synoptic hours that occur during his duty day. On CATS Healy – 2003, there were occasions during which an MST was not available to do a weather observation and hence no weather observation was done.
- set up a mapping area on the Tera Scan system that corresponds to the science study area and map all passes that cover say 60% of the area. Such mapping facilitates looping and hence tracking of cloud movement and cloud expansion and contraction
- stand alone data files for true wind, atmospheric air pressure and air temperature that includes ship position
- display and save Tera Scan imagery on a daily basis
- on specialty products such as the Kane visualizations, label a few key sits on the base map

Items that I will investigate / pursue / do

- meteorology of the 13 August wind event
- sample verification of the Kane wind visualization charts
- smaller file size for wind visualization graphics
- restructuring of the PAAWC arctic wind visualization areas / level of detail
- creation of prog chart quilts by area for the arctic and their placement on the web
- ftp site for forecast products for the arctic
- date / time labeling at top of all charts / images on the http://weatheroffice.ec.gc.ca web site. Web access at high latitudes can be painfully slow and it is frustrating to download a full image only to find that it is an old image. Date/ time stamping at the top facilitates acquiring only the top arctic section of an image and doing a print screen rather than waiting for the complete image to download.

Filed Friday 15 August by Ed Hudson

INUIT PERSPECTIVE

Pauloosie Akeeagok on Grise Fiord on right

LETTER FROM PAULOOSIE AKEEAGOK

Nunavut Research Institute

My name is Pauloosie Akeeagok, and I am from Grise Fiord, Nunavut. This summer, I had the opportunity to take part in a scientific program in the Canadian Archipelagos, between Ellesmere Island and Greenland. There were 35 scientists from both Canada and the United States, studying the waters from Baffin Bay to the Lincoln Sea. They researched ocean currents, mapped the sea floor, sampled sediments and collected clams to increase their understanding of climate history and fresh water flows in the Arctic.

After seeing a posting on the bulletin board in the Hamlet of Grise Fiord for a summer job opportunity to work with the scientific expedition, I submitted my name and was accepted to participate and represent my people, territory, and culture. I communicated with Kelly Falkner, chief scientist, and Humfrey Melling, co chief scientist for several weeks prior to sailing and joined the scientific team in St. Johns, Newfoundland. I was excited to set sail. This was an opportunity of a lifetime to learn about the projects that are going on in the lands where my ancestors have lived in for thousands of years. Not only did I represent Inuit, I also was a field assistant throughout the voyage and played a huge part in observing the activities. This gave me the chance to learn first hand what scientists do in our area, and also how to use scientific instruments such as the CTD-rosette system. This takes 24, 10 liter Niskin (water) bottles down to the ocean and retrieves samples at certain depths. Then it measures the conductivity, temperature, and depth.

On the first couple of days, I was getting oriented to the ship and the people I was going to be working with for 4 weeks. I occasionally felt lost and needed some guidance to find things to do. I had time to meet new people both from the science party and the crew of the ship. This was when the scientist were getting their equipment ready for their 4 week projects.

I participated in the coring of the seabed. The information that we collected from the coring will help us learn more about the climate history of the Arctic through a number of tests such as looking at the magnetic susceptibility (indicates how much magnetic material is in the samples). This was one of the most interesting tasks I had throughout the whole expedition since I was fully part of the coring team. Also, since climate change is affecting the Arctic vastly, it was good to learn their theories, and the analysis they will do once they return to the south.

Throughout the whole project, there were several things that I found quite disturbing. The first was how much garbage the USCGC Healy ship throws away in the Arctic Ocean. I was taught by my parents and the elders that if there's enough room to bring what you brought, there's enough room to bring garbage back to where you received it. There, it would be disposed of properly instead of just dumping it into the ocean. If ships continue to come north and dump their garbage, our beautiful Arctic ocean will be contaminated. This is of great significance to us, the Inuit, as most of the traditional food we eat comes from the ocean.

Secondly, what disturbed me a lot was when we were enjoying the great meals they served on the 12th of August and someone from the crew of the USCGC Healy announced through the loud speaker that they were allowing "anyone" to go out and fish for Arctic char. I was stunned to hear the ship announce the fishing free-for-all without any fishing license or permits from the Department of Fisheries and Oceans (DFO). When I enquired about whether or not they had a license, the response was, "Are you going to arrest us now?" I feel that expeditions into Nunavut should be aware of the restrictions and guidelines contained in the Nunavut Land Claims Agreement. These guidelines are the result of years of hard work and negotiations by the passionate Inuit political leaders. After going to Nunavut Sivuniksavut and studying our history, I am now aware of how the outside world came north and did what ever they wanted to do up here, and how that can no longer continue.

Throughout the Canadian Archipelago Throughflow Study (CATS) project, I have realized the need for communication between the scientists and the Inuit. While growing up in Grise Fiord, Nunavut, I have seen scientific teams come and go. Questions always arose once they left. "What do they do up in the Arctic where we (Inuit) live?"

With me being on the project, it gave the chance to contribute in a lot of ways, such as: giving Inuktitut words every day to the scientific team for them to communicate with Inuit in the future expeditions and giving power point presentations about Inuit history to both the scientific team and the crew of the ship. This gave them a better understanding of what Inuit went through; the loss and regaining of power, independence and control of their own lives and future. These presentations helped me realize where Inuit fit in the world. After hearing comments and feedback from the crew and scientific team, I realized they had great respect for our people and an interest in learning more about who we are.

In conclusion, I would like to thank Kelly Falkner and Humfrey Melling for giving me the chance to participate, help out and learn what they do in the beautiful oceans of the north. I would like to congratulate the scientific team on their success and hope the best for their future voyages. This has been a once in a lifetime experience that I will never forget. I hope that future scientific projects in Nunavut will continue to share and exchange knowledge with the Inuit.

Pauloosie Akeeagok

Chief Scientist's Notes Regarding Inuit Participation

K. Kenison Falkner
16 September 2003

During the last week of the cruise, I requested that Pauloosie Akeeagok write a 1 to 2 page summary of his experiences on board the Healy to include in this cruise report. The previous 2 pages constitute his response to my request that he turned in to me on August 13, 2003. I was pleased to receive his thoughtful input. We responded to a few of the issues that he raised while we were still on board the ship because I felt that it was important to be proactive and respectful of his viewpoints.

On August 14, we called Pauloosie to the Captain's conference room to discuss overboard dumping of wastes and the fishing incident. Present were the Captain, the Executive Officer, Humfrey Melling and myself. We first assured Pauloosie that our meeting with him was not in any form a reprimand. We told him that we appreciated both the positive and negative observations in his report. He was on board, in part, to sensitize us to issues of which we might otherwise be unaware and had done his job well.

Pauloosie had expressed general concern about dumping wastes over the side. The executive officer informed Pauloosie that the ship was following international marine pollution protocols. Under those protocols, food waste is permitted to be put overboard when greater than 3 nautical miles away from the coast and materials of the cardboard category can be put overboard at greater than 25 nautical miles. The ship was otherwise incinerating or retaining non-burnables in a bin on decks or in other hazardous waste containers. Pauloosie was told that the international protocols (MARPOL Treaty) can be found via the web (i.e. http://www.epa.gov/OWOW/OCPD/marpol.html) if he or other members of the Nunavut community wished to view the specifics. Pauloosie asked a few additional questions which the Captain answered.

We then we discussed the fishing incident. The Captain began the discussion by apologizing for the making the call to fish. He also said that he was intending to write a letter to the Nunavut Research Institute formally apologizing for the incident. He also expressed commitment to ensure that proper licenses be obtained in the future before allowing any crew members to put their rods in the water. (A copy of that letter sent on August 16 from Thule follows these notes.)

In wrapping up our discussion, Pauloosie reiterated that I might want to be aware for future missions, during which people like himself might participate, that he felt a bit "lost" at the beginning. Unfortunately he was beset by motion sickness soon after we set sail, which is most definitely a "lonely" experience. He was unable to participate in the initial briefings given by the ship to the science party as a result. I did arrange with the nurse on board to provide him with Scopolamine patches to get him through this rough stage.

Several people in the science party, and Lee Narraway in particular, made special efforts right from the beginning to interact and include Pauloosie in activities. Lee helped Pauloosie to organize some Inuktitut lessons for our daily science meeting, which helped him to become more integrated into that gathering. Upon his own accord, he volunteered to make a presentation to interested people on the ship regarding the founding of Nunavut. It was so well done that he was asked to give it a second night to the folks who had been on watch the first time. He claimed he was very nervous in speaking to the group but he managed to overcome his nerves. While Pauloosie contributed to many of the science activities, he seemed to find his stride in participating in the coring activities. He both learned a lot and made substantial contributions to that program. I thank Chris Moser for being an inclusive and apt team leader for the coring operation.

Commanding Officer
USCGC Healy (WAGB-20)
FPO AP 96667-3918

15 August 2003

Mary Ellen Thomas
Nunavut Research Institute
Box 1720
Iqaluit, Nunavut
X0A 0H0 Canada

Dear Ms Thomas,

As the Commanding Officer, I wish to offer my apology for an incident that occurred onboard my ship during our recent oceanographic cruise in Nares Strait. We operated in the region from late July through mid-August of this year, supporting a scientific research mission for Dr. Kelly Falkner of Oregon State University. We had onboard the ship as a member of the embarked science party Mr. Pauloosie Akeeagok, a student from Nunavut Sivuniksavat College in Ottawa, Canada. He was aboard to assist with science evolutions, provide feedback to the Nunavut Research Institute on the cruise, and help us better understand the Arctic region by providing his own insight into the native way of life in the Arctic.

On 12 August we were anchored in Scoresby Bay, Ellesmere Island conducting diving operations in support of the science mission. While anchored in the bay I gave permission for members of my crew to try fishing off the fantail of the ship. There were a number of crewmembers who took advantage of this opportunity and tried their hand fishing, but without any luck. Mr. Akeeagok, who has an admirable sensitivity for the beauty and resources of the entire Arctic region, expressed his concern for the fishing as no member of the ship's crew had a license for fishing within the waters of Nunavut. I had allowed the fishing as an opportunity for members of my crew to have a diversion from the rigors of a four and a half month long deployment away from home and had not considered the need for a local fishing license.

Mr. Akeeagok, through his enthusiastic talks about living in Nunavut and passionate concern for the Arctic environment, has helped me better understand the many challenges Nunavut faces trying to manage the resources of the region. For future science missions that bring HEALY back into the waters of Nunavut, I will certainly ensure we respect the resources of the region and obtain the proper licenses before allowing any members of the crew to fish.

Please accept my apology and distribute as you deem appropriate.

Sincerely,

D. K. Oliver

D. K. OLIVER
Commanding Officer
USCGC HEALY (WAGB-20)

PHOTOJOURNALISM

PHOTO-JOURNALIST SUMMARY

Lee Narraway
15 August 2003

While on board the Healy, I photographed the science team at work, the ship operations, landscapes, seascapes, weather conditions and limited wildlife. I was able to take photos during a helicopter reconnaissance flight and on small boat operations with the mooring and clamming crews. An enjoyable afternoon was spent on Bellot Island, photographing the dive ops from shore and the land itself.

I helped with the CTD rosette samples, cooked pizza on crew morale night, decorated a birthday cake for Peter Gamble and another cake for the ship's crew on Coast Guard Day. I helped with the daily Inuktitut lesson and taught an "Improve Your Photography" course. This was attended by the science group as well as the ship's crew. It has been rewarding for me to see the improvement in the photographs taken during this voyage.

When I return home, I will be submitting photos and related stories to magazines.

Note: Lee is a regular contributor to "Above and Beyond" and "Up North" flight magazines as well as other venues for spectacular photography of the North and its people..

Fisheries and Oceans / Pêches et Océans

MEMORANDUM   NOTE DE SERVICE

To / À
Lee Narraway
RR 1
White Lake, Ontario K0A 3L0

From / De
Humfrey Melling
Institute of Ocean Sciences
Box 6000 Sidney BC V8L 4B2

Security Classification - Classification de sécurité
UNCLASSIFIED

Our file - Notre référence

Your File - Votre référence

Date
23 June 2003

Subject / Object **VOYAGE ON THE USCGC HEALY, 20 JULY - 17 AUGUST 2003**

Lee:

This is a summary of understanding regarding roles and responsibilities during the cruise of the USCGC Healy to Nares Strait this summer.

The costs of your travel (transport and accommodation) from your home near Ottawa to St John's on July 19 and of your return travel from Albany, New York to Ottawa on August 17 will be paid by Fisheries and Oceans Canada. There will be no charge to you for room and board (shared cabin) on the USCGC Healy from 19 July to 16 August and no charge for travel with the scientific team via US Air National Guard transport plane from Thule to Schenectady on 16 August. All other expenses will be your responsibility.

We have invited you to join the expedition in anticipation that you can promote public awareness of our scientific work. We understand that you have at present you have no firm commitment for acceptance of stories that you may produce from this trip. However, we are confident that your photographic and journalistic skills, coupled with your contacts in the publishing world, place you in an excellent position to succeed in this objective.

We will make no claim on the income that you generate from this expedition. However, we would like to have access to some of your photographs, upon specific agreement, for non-copyright applications such as scientific talks and conference posters. If we have interest in copyright use of your work, we will be willing to purchase such rights..

We will have others on board ship with a role to play in scientific out-reach. In particular, the US National Science Foundation is sponsoring two teachers on the ship, who will post written material and photographs of our activities daily to a web site. They look forward to having your professional opinions on their content. The scientific team will also write short articles about the project for scientific news publications, such as the newsletters of Canadian and US scientific societies – which clearly don't reach your audience.

We very much look forward to you joining us on what should prove to be an exciting science mission.

Please provide comments on this draft. We can revise and add to the content until it clearly describes our mutual interests. I am getting excited about the trip.

Humfrey

Canada

THE WEBSITE

UPKEEP OF THE CANADIAN ARCHIPELAGO THROUGHFLOW STUDY WEBSITE: http://newark.cms.udel.edu/~cats/

Lauren Brown and Andreas Münchow
University of Delaware
15 August 2003

1. Introduction

The daily creation, update and maintenance of the Canadian Archipelago Throughflow Study website includes the formatting and uploading of all HTML text files as well as pictures and figures. I worked on a daily basis with two teachers, Gerhard Behrens and Robert McCarthy, who were responsible for writing the logs. Once they had passed the information to me, I put the text into HTML format and place them on the local network. From the local network I was able to upload these files to a remote server in Newark, Delaware where they were available for public viewing.

2. Method

At the beginning of the cruise, I used the Inmarsat Internet connectivity to upload the files via Safe FTP. When we were north of 79 degrees latitude, we had to use the 2400 baud Iridium system to connect to the internet. I was using the Putty Safe FTP client to upload the files. The problem with this client was that each individual file to be uploaded had to be entered by hand. Not only was there not a way to queue the files and check back on their progress, the process was time consuming and was not readily available for my use due to other operational needs (ice observation, weather charts, satellite imagery, etc.). After several unsuccessful and tedious attempts to get data off the ship using the Windows command line with varied problems (permissions, protocols and mutual handshakes between different computer and communication systems), we finally settled on the BulletProof FTP client as a means to upload the files with minimal problems involved. This system worked well after University of Delaware systems administrator, Randy Rokosz, switched a Safe FTP server to a less secure FTP server.

3. List of Daily website entries

Daily Logs

Please select a name below to see the individual log.
Bob McCarthy | Gerhard Behrens | Andreas Münchow

Log August-15-2003
Report Card for CATS
Last day on the ship. Since I am a teacher, it must be time for a report card... **More**

Log August-14-2003
The Strongest Fictitious Force "Around"
We are fortunate to have a meteorologist on the Healy with us. So much of the research plans depend... **More**

Log August-13-2003
Dive, XBT! Dive!
Two days ago I mentioned that I took 3 CTD casts on the small boat just to feel useful... **More**

Log August-12-2003
I'm Happy!
A helo ride, breaking through ice, an excursion on the Healy 3 small boat, tasted an iceberg... **More**

Log August-11-2003
Walking on the land
Gerhard Behrens and I were privileged to accompany Drs. Humfrey Melling and Helen Johnson on a small boat excursion... **More**

Log August-10-2003
Morale night
Last night was "morale night" on the Healy. Each Saturday night, a different unit helps... **More**

Log August-9-2003
What color would you be?
Last night, after our daily science meeting in the conference room, we were treated to a video... **More**

Log August-8-2003
No more "ball and chain"
The Challenger Expedition was the first "Oceanographic cruise". Their sole mission was to... **More**

Log August-7-2003
Back for clams
The six heroes are back in the water today; first to place another bottom secured... **More**

Log August-6-2003
Ride of a lifetime
This heading could pertain to this entire research cruise; the scenery and breaking through ice... **More**

Log August-5-2003
Message on a float
Yesterday and today the scientists and crew were deploying acoustic current meters... **More**

Log August-4-2003
We're here!
Today we started to place the expensive moorings in the water... **More**

Log August-3-2003
A three ring circus
It's Sunday, but as I wrote last week, it is a regular workday for the scientists and much of the Healy Crew... **More**

Log August-2-2003
Who wants to go swimming?
The ocean water temperature is 2.75oC, which is about 37oF... **More**

Log August-1-2003
Electricity to the rescue
Before I went off on the optics tangent, I was explaining about the coring operation... **More**

Log July-31-2003
Cameras
Last night Lee Narraway gave a talk on photography... **More**

Log July-30-2003
Celebrity
Lee Narraway is on the deck! Lee Narraway is on the deck! Quick get your... **More**

Log July-29-2003
Coring equilibrium
Late last night and all day today the science crew spent piston-coring... **More**

Log July-28-2003
Relaxing and working
Yesterday we saw land for the first time since we left St. John's Harbor... **More**

Log July-27-2003
The sound of water
I was talking with Dave Huntley this morning, about the instrumentation that will be thrown overboard... **More**

Log July-26-2003
Water testing begins
While I'm waiting for the cups to return, my thoughts are in France, this being the penultimate day... **More**

Log July-25-2003
Getting ready to collect important data
During the last few days, the scientists, the lab technicians, the mechanical specialists, and the Coast Guard... **More**

Log July-24-2003
Labrador Sea
Today we passed into the Arctic Circle (Latitude 66 degrees, 40 minutes North), and we continue... **More**

Log July-23-2003
Water, water everywhere
"Water, water everywhere, but not a drop to drink." This is one of those places... **More**

Log July-22-2003
Steaming north
This is our second day of "steaming" north... **More**

Log July-21-2003
First day at sea
On a more serious side, today we were instructed on the procedures to follow for real emergencies: general emergency, collisions... **More**

Log July-20-2003
Leaving St. John's, Newfoundland
The scientists got themselves ready, too, but not always in the way you might guess... **More**

Log July-18-2003
Arriving from Portland, Oregon
What a long day for us West-coasters. We left our Portland, OR, hotel at 5:00 am, and arrived at the Healy, in St. John's, Newfoundland at midnight... **More**

Log July-17-2003
Loading more gear in Newfoundland
After the *Healy* finished her 18 hour stop at a gas station in St. John's taking on 600,000 gallons of fuel, she ... **More**

Log July-16-2003
Nerveous anticipation
I'm not on the Healy in the middle of Baffin Bay, nor am I on the ship in the St. John's harbor. I am ... **More**

Log July-15-2003
Questions from Delaware
Tracey from Delaware send me the following questions today. Several crew members ask me similar questions, so ... **More**

Log July-13-2003
Crossing the Gulfstream
All sensors went wild today as we are approached the northern extension of the Gulfstream. After sailing for 4 days in warm and salty sub-tropical waters a drop in... **More**

Log July-12-2003
Preparing for Nares Strait moorings
Over 40 brand-new University of Delaware ocean instruments arrived on the *Healy* when she was loaded in Seattle. We have never opened the boxes ... **More**

Log July-11-2003
Passing through the Bermuda Triangle
On our way to St. John's we are passing through the infamous Bermuda Triangle between Bermuda, Florida, and Puerto Rico ... **More**

Log July-09-2003
Letting a balloon go off Puerto Rico
Today Kevin let go of a balloon height into the atmosphere for a vertical profile of the temperature and humidity ... **More**

Log July-06-2003
Walking the town and beaches of Curacao
On our Sunday hike through Curacao Dave and I encountered an unexpected memorial. It was hidden away near the beach a few yards from... **More**

Log July-05-2003
Settling in
David Huntley and Andreas Münchow arrived on the *Healy* in Curacao of the Netherland's Antilles. The *Healy* had just arrived via the Panama Canal... **More**

Date	Topic Synopsis for Daily Log
July 16	Anticipation and last minute preparations
July 18	Description of travel from Portland to St. John's
July 19	Scientists' preparation for leaving, including enjoying St. John's
July 20	More on scientists preparations while anchored in St. John's
July 21	Description of crew briefing and leaving; first impressions of life on the ship
July 22	Steaming…ship details, size and accommodations
July 23	Water evaporation system on the ship
July 24	Why the Arctic? How CATS meets Science Inquiry model Finished short bio on each science crew member
July 25	Preparing for first station: skill of organization
July 26	Ship's sewage; meticulous collection of water samples from rosette
July 27	Protocol for getting water and preparing samples for storage or analysis
July 28	Sunday: relaxation for crew; work for scientists US-Canada-Coast Guard cooperation
July 29	Helicopter operations to Pond Inlet
July 30	Piston Coring operations
Aug 1	Icebergs underway
Aug 2	Checking your work, having backup data sources, careful data collection
Aug 3	A Four Ring Circus: rosettes, helo ops, mooring, clams
Aug 4	ADCP mooring process
Aug 5	CT mooring process
Aug 6	Helicopter ride up Ellesmere Island's coast
Aug 7	Inuit History and culture
Aug 8	Interdisciplinary cruise: fields in oceanography
Aug 9	Life on Land: mammals, insects, plants, fish
Aug 10	Sunday: what everyone would be doing in their other life
Aug 11	Boat ops: 6 hours on the water in Healy 3
Aug 12	A packing list for CATS 2003-Whew!!
Aug 13	Mammals in the sea: whales, narwhal, seals, walrus
Aug 14	Life skills of a scientist
Aug 15	Trip summary

Date	Topic Summary for Fun Facts Page
July 25	Eating on the Healy…a cornucopia
July 27	Ship's vocabulary…words you gotta know!
July 29	Helicopter facts
July 30	Hotel Healy: rules for being a good guest
Aug 1	Iceberg facts
Aug 5	Sea Ice facts
Aug 7	Life in Grise Fiord
Aug 11	Number One: life as chief scientist
Aug 13	ARTic…art from the crew

Daily Log summary, Bob McCarthy

July 20: Last day in St. John's and hiking up Signal Hill, plus a little history about Signal Hill.

July 21: Definition of a knot, problem to calculate the earth's circumference, and ship procedures

July 22: How fog is formed, answer to circumference of the earth, and new problem about ship's fuel capacity.

July 23: First iceberg sighting, and calculation of amount of freshwater it contained. Also how the ship makes freshwater from seawater.

July 24: Wind generating waves; time, strength, or fetch limited, and Labrador current evidence from ADCP.

July 25: Decorating Styrofoam cups, definition of pressure, and calculation of hydrostatic pressure.

July 26: Definition of power and calculations involving the stationary bike trainers. Also showed the results of 242 atmospheres of pressure can do to Styrofoam cups.

July 27: Acoustic releases, and how they work and why two are better than one

July 28: Thank you note to everybody involved, and my first of the remaining nights working the 15:30-23:30 shift watching computers.

July 29: How piston cores work, and rotational equilibrium and torque calculations.

July 30: About Lee Narraway, and how fog bows are produced.

July 31: Lee Narraway's talk about taking better pictures, and how cameras work.

August 1: How Chip and Jason use electricity in a coil of wire to set up a magnetic field so they can analyze their core samples.

August 2: Diving into the frigid waters and how regulators work.

August 3: The dive heroes, and why the pressure sensors are needed to help the physical oceanographers determine the driving forces for the flow through Nares Straight.

August 4: Finally arriving at the mooring line in Nares Straight, and breaking through ice, and what controls the strength of the ice.

August 5: Messages placed on the floats for the moorings, and why the moorings are an important contribution to this research cruise.

August 6: My helicopter ride, and how helicopters create lift.

August 7: The purpose for diving for clams, and calculating the dive time based on the depth the diver is at.

August 8: Sea Beam mapping the oceans versus the old way the Challenger used.

August 9: How light is transmitted through the water column, and how plants that depend on light for life are adapted to receive the most available light reaching them.

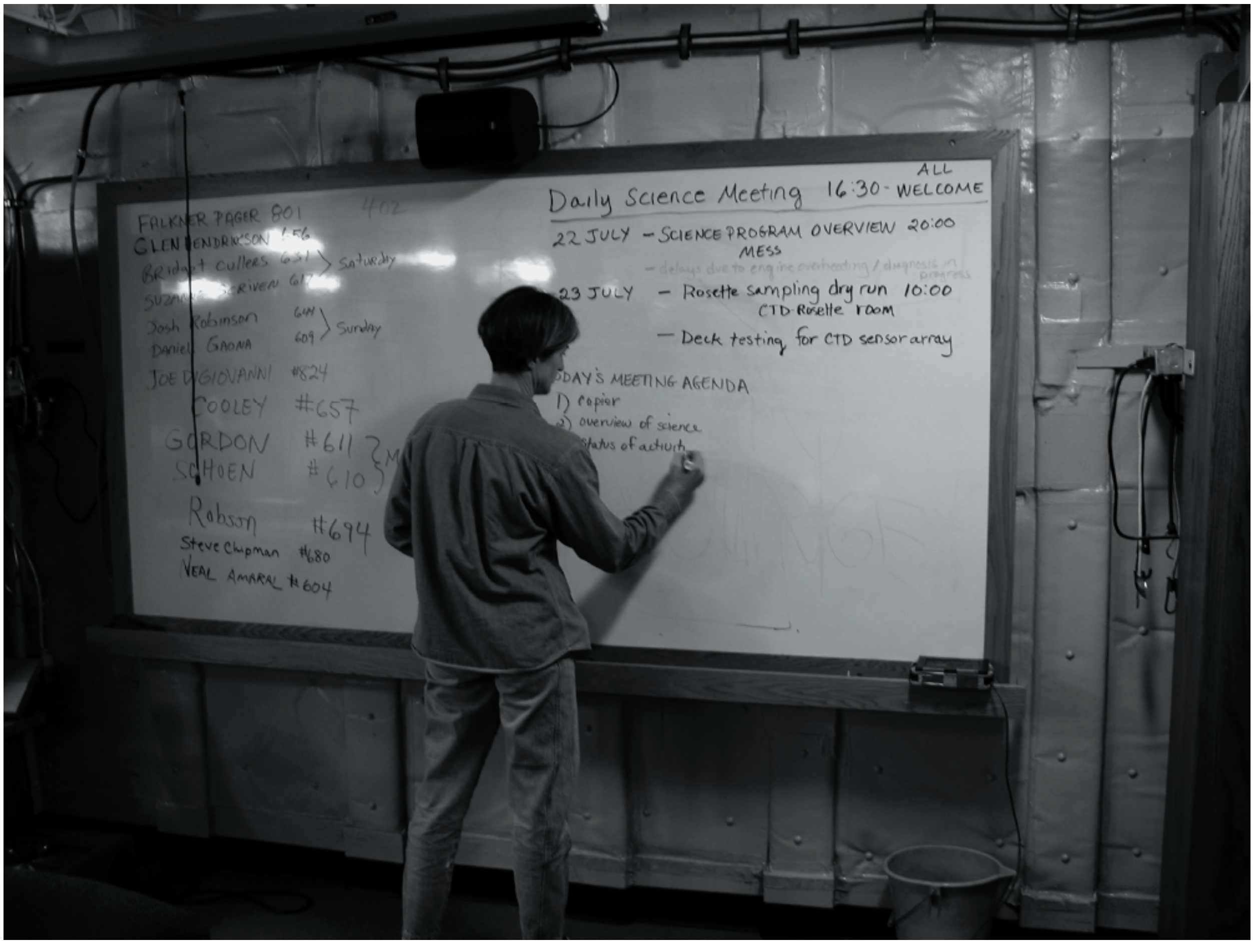
August 10: Morale night

August 11: Gerhard's and my small boat excursion to Off ey Island.

August 12: Lauren and Melissa's small boat excursion to Scoresby Bay

August 13: Stokes's Law, and how that is used to determine the depth on an XBT cast.

CHIEF SCIENTIST LOG



CHIEF SCIENTIST'S LOG

16July03

Arrived 11:55 pm at St. John's airport. Connections were smooth although short (45 min) between Newark and Halifax. Continental did not recognize Canjet and so did not check my luggage through to St. John's. In Halifax I had to go through customs, retrieve my baggage and walk to the other end of the airport to check in with Canjet. I then had to proceed back through security. Fortunately there was enough time to do this and I made the flight with all my baggage. It was hot and muggy in St. John's.

17July03

Took cab to Irving Pier fueling dock on the south side of St. John's harbor. The security gate was locked when the cab drove up but some young Coast Guard fellows were leaving and I slipped in. Upon boarding the ship, I was stopped on the quarterdeck and asked who I was. When I gave my name I was told that no berthing was available for the science party until July 19. Upon producing the e-mail from XO Bill Rall indicating that my stateroom as chief scientist was ready for my arrival, I was allowed to pass. Although off-duty, EM2 Ben Garrett graciously offered to haul my bag up to my stateroom. He was reluctant to give me his name but he did mention "Garrett". I tracked down his full name later in order to give him a token of appreciation. I spent much of the day setting up in my stateroom and assuring that our gear that the Canadian Coast Guard was sheparding got put on board in a sensible place. All gear was accounted for and secured from the weather by late afternoon. The MST's, Dave Huntley and Andreas Muenchow all assisted in that activity. The Executive Officer (XO) Bill Rall arranged for a call to Atlantis International (the husbanding agent used by OSU) and let them know that shipments to the Healy would be accepted. I received calls from the CBC radio folks and agreed to give an interview the next morning at 7 am. The XO volunteered that I could make use of the 2 liberty vans hired by the ship while in port. I worked out a plan based on everyone's itineraries to retrieve folks from the airport over the next few days using the vans when they weren't otherwise booked. I hadn't anticipated this option but it proved to be expedient and much appreciated. I was warned that berthing for the incoming science party while in port would be temporary in part since there were extra folks remaining on board to take care of the generator repair and other such things. That evening Dave Huntley, Dale Chayes, Don, Andreas Muenchow, Kevin (of Peter Minnet's group) and myself had a nice dinner at Milou's in St. John's. I used Dave's cell phone to call my husband. I told him of my safe arrival and to call my chief technician because I needed the software code for my Microsoft package and a few other things. Chi returned the call while we were in the restaurant. She relayed what I needed and found my Arctic Crossing certificate, which she intends to bring along with her. Dramatic thunder-shower activity occurred during the night.

18July03

Another uncharacteristically hot humid day in St. John's that started off rainy. At 7 am Andreas and I arrived at the brow to discover that a cab that had been sent for us from CBC had waited from 6:30 to 6:50 am and then taken off. The driver never exited the vehicle. CBC called the quarterdeck while we were standing there and they sent another cab. Someone met us at the door and brought us to the studio where we broadcast a 5-minute live interview. Afterwards, I returned a call from the CBC television people. We agreed to an interview at noon. Joe Digiovanni then networked my computer and I attempted to send messages to folks back home informing them that we were at Pier 17. Just after lunch, Monica Kidd and a cameraman from CBC TV showed up and interviewed Andreas and I on the bridge and helo deck. I then took off for town, bought steel-toed boots, books for the kids, some cereal and went to the post office and took care of my e-mail home account from there. On the way back to the ship I ran into Dennis Bogle, the principal of the school in Grise Fiord and we agreed to meet for dinner at the Indian restaurant. He was in town to attend a wedding of two of his teachers. I ran into the ship's liberty van on the way back to the ship and they took me to a grocery store where I picked up a few items. When I arrived back at the ship, the captain informed me of the ship's wetting-down ceremony to take place at the

Crow's Nest in St. John's that evening. Five of the officers and crew were promoted and by tradition put on a party with drinks and eats for the ship's crew. I also learned that our gear from Atlantis International arrived and I checked that it was all accounted for. When I headed into town to meet Dennis, Andreas and Dave and I crossed paths and we went for dinner together. After dinner, we parted with Dennis and went to the Crow's Nest where I met a large number of the Healy crew. At 10:30 pm, I headed back to the ship to accompany the liberty van to the airport to pick up scientists coming in. When I arrived at the ship, both vans had already set off for the airport. I then had a cab called and arrived just in advance of folks coming in. The first flight had been delayed but eventually Humfrey, Ron, Chi, Pete K., Chris, Dale and Jay arrived. Ed Hudson was at the airport to greet Humfrey so I met him and his wife there. Jay's bag did not arrive so he filed a report and left his keys with Air Canada for customs. The vans went back to the ship with all but Chi right about when Joe and Scott arrived. We then waited for the van to return and pick us up. Although berthing arrangements were temporary for most, everyone settled into their staterooms ok.

19July03

I awoke early and found several folks had managed to muster for breakfast. I met with people in the science conference room at 12 noon to go over some ship rules and help get people going on science gear set-up. I continued to try to get e-mail off board without much success initially either through INMARSAT or Iridium systems. I spent considerable time working out lab space allotment. Fortunately everyone is being good natured about accommodating each others needs. We confirmed that Humfrey's air shipment arrived and was all accounted for. Midday I went to the airport in the liberty van to pick up Kumiko, Lee, Dave Forcucci and Helga. I determined that Helga had missed her connection but managed to identify and collect Kumiko, Lee and Dave. We brought them back to the ship and got them to their staterooms. Chip and Jason managed to get to the ship on their own via taxi. Humfrey arranged with Ed Hudson to pick up Pauloosie at the airport. Dave went to retrieve the UDel girls, Melissa, Lauren and Elinor as well as Helga and Helen and Pete G. It took two liberty van trips. Melissa was missing her baggage so filed a report. John Harris made it to the ship on his own (I never did get a copy of his itinerary). In the meanwhile we worked on tracking Jay's bag by borrowing the ship's cell phones. The officers on board were very helpful in allowing me to borrow their phones for such. Upon arrival, Pauloosie informed me that he left his passport in Grise Fiord and that he needed to acquire some financial assistance paperwork for school via fax. Humfrey and I told him that we would sleep on it and come up with solutions in a day or so.

20July03

I called a science meeting just after breakfast (10 am) and updated the new arrivals on ship's rules. Dennis Bogle and Pauloosie came in together. Melissa received her baggage in the morning. We created a sign up list for people requesting lap top connections and gave it to Joe to begin working on. After meeting we dispersed to science spaces and continued to work on set-up. I located the sound system for Scott and Chi to use in the climate control chamber. I requested that the climate control chamber, freezer and fridge be turned on. I was informed that they would not be turned on until we were underway. Since we have nearly 5 days before beginning science operations, this is actually ok. There was some concern that this need had not been expressed to the ship ahead of time. I had discussed it with the marine science officer but I had not put it in the cruise planning form. I came close to losing my temper on this. Ed Hudson and Yves Sivret showed up and were shown their accommodations. I discussed the passport situation with Humfrey and XO Rall. We came up with a plan to have Dale Chayes hand-carry Pauloosie's passport to Thule. I called Pauloosie's parents to explain the hand off situation for the passport. They assured me that they would follow through and send it to Dale in New York. I left Dale with contact info for Pauloosie's parents. I discussed the fax situation with IT1 Steve Chipman. This was virtually impossible from the ship while in port and so I determined that Pauloosie would work with Digiovanni and use other electronic means to accomplish his financial aid paperwork. Pauloosie in the meanwhile was in town with Dennis Bogle. Jay received his bag. After having to traipse back to the airport to retrieve his baggage keys, his situation was finally resolved. At 2 pm, IT1 Chipman distributed pagers for the science party who were onboard. A seawater coolant line in the backup generator room broke sending a flood into the athwartships passageway on the 03(?) level. Humfrey and I happened to spot the water leaking through the doorway grill and notified Coast Guard personnel. Unfortunately St. John's has yet to put a sewage treatment plant on line and so the harbor water isn't very clean. It was a messy unexpected job for a host of Coast Guard folks who toiled diligently and got the situation under control. I ended up with just enough time at the end of the day to eat on the ship and then get off for a walk up to Signal Hill with Ed Hudson and Humfrey Melling. From the top of the hill we could see the Canadian Coast Guard ship Hudson making her way into the narrows. We also went around to Quide Vide Harbor and made it back to the ship in time to watch the Hudson tie up behind the Healy at Pier 17. Kumiko had invited Allyn Clarke and several other BIO folks on board. We all met up on the helo deck and chatted briefly and then I turned in.

21July03

Up at 6 am to exercise with Gerhard, Robert, Joe and Lee. Breakfast at 7 and science meeting at 8. Also did laundry. Some of the remaining scientists received their pagers. I told scientists not to go on fantail or folksail because lines were being laid out. The anticipated pilot boat didn't show at 9am. They initially rescheduled for 1:30 pm and we requested a waiver to exit the harbor unaccompanied. They got back to us and got us out on a 10 am departure. About two hours later we took on the second helo that had been at the airport for convenience of conducting flight practice while we had been in port. At noon we had a ship's briefing. Pauloosie did not attend due to seasickness. I had already informed the ship's nurse that she might expect him to show up in sickbay but when I saw her before the briefing, I requested that she bring the patch to his room. We then went through an abandon ship and man overboard drill. In conversing with Chris and then the URI guys I also learned that the URI folks hadn't been able to look at the seismics in the targeted region of the coring off Bylot Island. I requested that they attempt to communicate with Kate regarding the best available information for the area that we would attempt to core in. I learned of plans for the deck space by the mooring group by happenstance and so called a meeting with Humfrey to establish better communications. We called the coring folks in and discussed plans for the deck. There appeared to be no problem in proceeding with the mooring layout as intended. Humfrey agreed to keep me better informed in aid of my coordination duties. I went to the captain's cabin for the first of regular evening briefings. Glen H. gave the weather and I learned of plans from the officers regarding ship activities. We have three engines running and are doing about 18 kts. I gave Coast Guard folks a heads up on testing the acoustic releases and deck testing the CTD-rosette unit with all sensors and pumps running. Earlier in the day, the science party and MST's determined that the best way to test the releases was to mount them on a CTD rosette frame, lower them and query them using a hydrophone from the fantail in groups of 7. Not all could be queried simultaneously due to frequency overlaps. (For the shallow -rated pressure sensors, we would lower the frame aft and query them from a small boat away from the vessel.) I asked to get a clarification on the voice communications available to the science party on board. They could not give me a clear answer and elected to do some homework and get back to me. They gave me a copy of the St. John's Express article that consisted of an interview of Humfrey Melling. It started off with a quite condemning paragraph quoting Humfrey. He remarked upon how ugly the ship is! When Humfrey was informed of it, he was quite chagrined by the hand of the media.

22July03

I woke early and exercised again with Gerhard, Robert and Lee. Weather continues to be good. Today I began a daily meeting routine of attending the officers' call to quarters at 12:25 pm in the officers' lounge, followed by the general call to quarters on the helo deck at 12:30 pm. At 4:30 pm, I hold a science meeting in the science lounge. At 6:30 pm, I attend the Captain's briefing (that was held in the officers' lounge throughout the bulk of the cruise). The event of this day was to learn that 7 custom made cables that were ordered through RDI had not made their way into the ADCP boxes. Humfrey had tested and approved of the prototype and that is the only one on board. Initial calls to RDI by Dave Huntley didn't reveal the whereabouts of the cables. This is a show-stopper. Earlier in the day, Humfrey plotted up the stations using my cruise planning spreadsheet. We discovered large errors in the coring locations and I requested the URI folks to give me updated coordinates. By the end of the day, they produced revised coordinates. Everyone is very busy setting up gear in the lab spaces. Jay mounted ZAPS and is helping the mooring group. We conducted a daily science meeting in the science conference room. (These meetings occurred all but 1 day on the ship for the duration of the cruise., I started the practice of passing around a roster sheet for folks to initial to indicate their presence on the vessel. I tape this to the bulkhead and ENS Cooley picks it up. I asked Ed Hudson to start a quote of the day duty. I started it off with reading the quote from Humfrey in the Express and a quote of Dave Forcucci "There is no accountability on this ship" and Andreas's radio interview comment taken out of context that "…In fact I think all of physics is trivial". The MST's (primarily Glen Hendrickson) and MSO (Neal Amaral) "briefed" the science party in the science lounge. Around mid-day we suddenly went dead in the water and had a power outage. At the captain's briefing I learned that valves on the supply side of seawater cooling systems for the main engines had been inadvertently shut off and the engines were tripped by overheating conditions. Earlier in the day the captain had called me to apologize for the snafu. I told him that I didn't view the situation as something they had done "to us". He felt differently and made it clear that mistakes such as that were unacceptable. We explained the situation with the cables at the captain's briefing to the officers. Humfrey began accompanying me to the briefings. I was given a double-sided 1-page set of instructions for making phone calls. The sheet included information on costs. Later (8 pm) I gave a 20-minute overview of our project to the ship's crew and officers in the galley. I estimate that 50 people attended including about 10 of the science party. In addition to summarizing the science program, I invited folks to decorate styrofoam cups. I introduced the teachers and Lee and Pauloosie. It went quite well and folks lingered and talked to the available science party for quite some time after. I suggested that one of our party (Humfrey) quoted in the press for his denigrating remarks on the ship's appearance would like to wear the WAGB cap since it stood for "What a Gorgeous Boat".

23 July03

I didn't awake early today but managed to slip my exercise in during breakfast time. Early in the day, we learned that the cables were in fact at RDI and that they were intending to send them to us in Pond Inlet. We suggested that they send someone with them to make sure that they got through customs in Canada and ideally accompany them all the way to Pond Inlet. Networking is nearly completed for all of the science party. E-mail bounce backs are a common problem. Joe D. is working on trying to solve that issue. At the moment my connections seem to be working. We deck tested the CTD-rosette and things appear to be in working order for all sensors. With Andreas and Roger Davis, a schedule of watch standers was devised to begin tomorrow morning. Melissa, Helga, Helen, Dave, Lauren and Elinor are all involved. There was some confusion on the teachers' part regarding their role in the technicalities of posting web entries and editing the existing material. They were instructed to focus primarily on producing the primary material and to compile a list of edits for someone else to implement. One of the undergraduates from UDel, Lauren, with occasional help from Joe Dogiovanni took on the responsibility of tidying up the teachers' input, rendering it into html and posting it. This proved to be a highly fruitful division of labor. We were fortunate to have Lauren on board because she wasn't originally scheduled to sail with us. Ed Hudson gave the quotes of the day in good humor and I asked him to give the science party a daily weather briefing. He gives a lively presentation! and has a knack for finding the humor in most any situation without being mean. Pauloosie (with encouragement and assistance from Lee) announced that he would be giving us a few Inuktitut words per day as part of the science meeting.

24Jul03
Andreas and Robie both expressed interest in thermosalinograph data. I had not expected to be in so much open water and had not planned on making extensive use of the system but they pointed out that we were crossing major frontal features on our track that would be worth recording. We made provisions to archive the sensor data. Robie instituted a watch standing for taking surface samples from the thermosalinograph system. The watch standers integrated this into their routine. Robie gave a clams presentation to interested folks in the science and ship's crews. This was well received and the ensuing discussion raised a number of worthy practical and scientific issues. (Note: From this time forward, I found it extremely difficult to find time to type in notes on a daily basis. Because I was traveling all over the ship, I ended up carrying my notebook with me and scratching notes when I could. The subsequent notes are digitized forms of these notes. I must apologize to cruise participants for failing to record a number of important events. I suppose I should get with the palm pilot generation.) I happily managed to purchase some espresso type coffee from the JavaHut for the first time today (and most days after). Ahhh, the creature comforts to titrate this hectic pace. Pauloosie has followed through on his promise to teach us some Inuktitut at the science meeting. Yves Sivret, our Canadian Ice Technician, is giving reports at the science meeting when there is interesting news to relate.

25-26Jul03
Dave Forcucci gave me a copy of the XCTD deployment plan and as he warned me yesterday, indeed I failed to deploy some of them intended for Davis St. and south. Arghhhhh. I missed taking notes in this period due to intensive CTD-rosette operations. Much of what occurred can be gleaned from the CTD-rosette hydrography section of the cruise. I note that Humfrey, Robie and I generally shared oversight of the rosette casts. Andreas, Melissa, Helga and Helen also contributed substantially when not on watch for other activities. The MST's were generally quite dedicated in readying the rosette for deployment and running the winch. Ultimately they spent many long hours troubleshooting the equipment as well. Dave Forcucci had to drop out of the ADCP/Seabeam watch and Joe Digiovanni volunteered to pitch in. Robert McCarthy also ended up being a significant contributor to that mission. Pete Gamble had a birthday on July 26. His was the only birthday of the science party that occurred during the mission. Lee Narraway made a spectacular cake for him with help from the kitchen staff. This was served to him with the appropriate song at dinner. While he wished to have no recognition, we couldn't help but honor the birthday of the oldest person on the ship! Hail to Pete the Elder. The science party reports that the damage control folks have been extremely helpful with respect to their requests for fabricating parts to aid with the camera operation for the clams, the shallow mooring anchoring system and other items. Pete Gamble has been helpful to the DC folks in repairing some of their machinery before he made use of it. I asked that folks let me know of such requests in advance and be sure and thank ship personnel for any help rendered. I also encouraged science party personnel to write up their recognition of meritorious service and cc supervisors when appropriate. Pauloosie volunteered to give a presentation on the founding of Nunavut sometime in the next few days. Chris Moser aptly ran one of the science meetings on my behalf. I learned via e-mail that our plan for placing all preliminary hydrographic data on the public drive did not sit well with the co-PI in charge of CFC data and so made an arrangement that only I be able to have access to the merged CFC data.

27Jul03
The grueling CTD-rosette operation ended and we set a course for the Seabeam and sub bottom profiler operation to run overnight. We hope to send both helos into Pond inlet tomorrow for the cables. In anticipation that the teachers might ride, they attended a helo safety brief and the helo brief on the bridge. We've been on board for a week and common science spaces were in need of cleaning and trash disposal is an issue. I decided to clean the common spaces (clean the heads, sweep the labs) and Joe and Jay pitched in. Ed Hudson volunteered to roundup a team of scientists for incineration training that included the teachers and the younger coring team. Although they became certified, the incinerator was down so

often that in the end we simply brought trash to the incinerator room and burnables were taken care of for us by Coast Guard folks.

28Jul03

We successfully ran a pattern over the shelf using Seabeam and the sub bottom profiler to survey the coring area. No dramatic contraindications for coring appeared although there is a trough between stations 3 and 4 that we will avoid. The first helo had a switch malfunction and had to return to the ship. The second was used instead to take 4 Coast Guard folks to Pond Inlet. This meant that the teachers did not get a chance to ride. One of the Coast Guard personnel unfortunately had to return home for his mother's funeral. The other helo operators met Eric Hawes of RDI and retrieved the 7 cables from him. I got these from the helo deck once they arrived and brought them to Ron Lindsay who confirmed that they were what we needed. Crisis averted! An intensive piston coring effort began. Pauloosie pitched in with the coring and was extremely helpful through the entire process. I kept watch on the team throughout the process to be sure that we weren't pushing the fatigue limits. Thoughts of losing the equipment were a bit nerve-wracking as the wind speed picked up to over 30 kts at intervals. Fortunately ship station keeping seems to be improving as our demands increase. I received the following message from Andreas:

> *Kelly,*
>
> *Both our original proposal and the justification to use the Healy for the present expedition called for specifically designed ADCP/CTD surveys to investigate the spatial and temporal variability of currents in northern Baffin Bay and Nares Strait. Please note that the present operations do NOT contribute to this goal in any way. It is a very common misconception that transit lines and ship tracks designed for other operations (like the current 19 hour SeaBeam survey) will yield physically meaningful ADCP velocity observations. I feel that this misconception may prevent us from achieving some of the science goals of our proposal.*
>
> *In order to conduct physically meaningful ADCP surveys I will need 3 days of dedicated survey time that I want to allocate as follows:*
>
> *1. ~24 hours of transect repetitions in Smith Sound to resolve both semi-diurnal (~50 cm/s) and diurnal (15 cm/s) tidal currents to get a snapshot of the subtidal spatial variability of the outflow from Kane Basin;*
>
> *2. ~24 hours of transect repetitions in southern Kennedy Channel to resolve tidal currents and get a snapshot of spatial variability of the outflow from Kennedy Channel; and*
>
> *3. ~24 hours of transect repetition in northern Kennedy Channel to resolve tidal currents and get a snapshot of spatial variability of the outflow from Hall Basin.*
>
> *Each of the above channels is about 25 nm wide, hence a crossing at 10-12 kts may take 3 hours. I am planning to take a single (internally recording) CTD cast over the center (and endpoints, time permitting) of the channel during each of 6 crossings to extend thermosalinograph observations from the surface into the water column.*
>
> *I furthermore advocate ship tracks that cross topographic features and would like to be included in the planning of survey and transit lines. This will allow me to optimize ADCP sampling strategies that may contribute to meaningful ADCP/CTD surveys.*
>
> *andreas*

P.S.: I would not make this request without knowing that we have a functional ADCP with a bottom tracking range exceeding 900-m and a water tracking range approaching 500-m. No other ship with these capabilities has ever been in this area and we ought to take better advantage of it than we are doing right now.

29Jul03

Coring continued through to about 1:30 pm. At that point the coring team was clearly fatigued and so we took a break until 7 pm. The bow thruster was further tested and a blown fuse discovered. Upon talking with andreas in the night, the captain ordered us on a cross shelf course while we bided time for the coring break. The galley put up dinners for 6 scientists. Deck work for coring began again at 8 pm under very calm conditions. Winds were extremely light. Station keeping by the ship was excellent. Andreas approached me about wasting time on further deep Baffin bay ctd-rosette surveys. He's convinced that the stations in the deep basin are a waste of time and that all the variability is at the slope. He views the deep stations on the ns line to be excessive and come at the expense of his ADCP time. I countered that data for the deep part of Baffin bay was very limited. He is concerned that his interests are being marginalized. I suggested that we focus efforts for ADCP work further north in conjunction with the mooring work and that Humphrey, he and I meet for planning purposes after the ns-ctd-rosette line was completed. Jay, Dave, Helen and Helga, under the guidance of Pete gamble and Humphrey, having been working extremely hard to assemble the moorings. Folks like marry, Ed, Lee and Pauloosie have pitched in with some of the line work. The main team managed to complete preparations of the ADCP moorings. Scott continued work on the salinometer; we had a minor malfunction with the flushing mechanism that I managed to fix. Joe, dale and john finished analyses and assembly of data for merger into the main data spreadsheet. Mary and chi worked hard on getting the ctd-rosette data in shape to view the sections. Somewhat miraculously, this was nearly completed, when we all turned in for the night. Rob, marry and I viewed the sensor sections using ocean data view. I spoke to the group about having a discussion regarding local hydrography for everybody's benefit. (unfortunately this never happened since the science party became too busy to incorporate such an evening activity.) At the captain's brief I learned that a major (large) fuse was blown in the bow thruster. Attempts to obtain a replacement part by the time we reach Thule on the way north were not successful. Attempts to arrange for a helicopter switch replacement apparently were successful and we will try and pick that up on the way in. Lee Narraway gave a well-received presentation on improving photographic techniques to all interested in the science lounge.

30Jul-3Aug03

This is another period in which **things** got too hectic for much note taking. Pauloosie made a Powerpoint presentation on the founding of Nunavut to the ship's party that was so well received that he gave a command performance the following night. It allowed those who were on watch the previous time and myself to hear it and I concur that it was excellent. One of the ship's crew asked how old Pauloosie was and then commented that he knew no other 18 year old who could have given such a wonderful presentation regarding the history of his people and culture. The CTD-rosette operation was intensive once again. We did note an interesting bottom boundary layer that as far as we know has yet to be described for deep Baffin Bay. Andreas produced a plot of available data for Baffin Bay that illustrates that this layer had not been sampled but once or twice previously. We attempted to use the internally recording CTD to supplement station spacing over the shelf but needed to sort out some data recording issues for the instrument. As we neared the end of the line, Andreas, Humfrey and I met to discuss how best to use the time as we passed near Thule. Since the Coast Guard needed to fly in for helo parts, it seemed we did need to loiter in the region. Andreas designed an ADCP-oriented survey designed to check for the presence of a northward flowing freshwater coastal current along the coast near Thule. This entailed CTD drops at the end of cross-shelf spokes. Some of these were accomplished with the internally recording CTD but it proved to be preferable to use the CTD-rosette package since the data real-time, quality was better and the sensor array better. The helo parts were successfully retrieved during this timeframe. The CTD-rosette water samplers used the time to catch up on analyses. Joe Digiovanni set up space on a public drive for us to exchange data. This proved to be extremely useful. Helen Johnson was designated the science party morale leader. A set of briefs regarding the use of the small boat and divers was conducted. We then headed north to complete a hydro section across Smith Sound. Fortunately ice was minimal there expediting our section. We then made our first attempt at retrieving clams and deploying a shallow pressure sensor using divers on the eastern side of Smith Sound. A big clam was retrieved and the mooring was deployed. We adjusted our approach based on this experience. We made a helo based reconnaissance of Alexandra Fiord and things looked good to go for doing dive ops there. In fact when we arrived the ice had moved in making small boat ops impossible. Not knowing when and if the ice would clear, we made the decision to head north to the main mooring array. Given the transit times, it made sense to lay out a track that involved crossing the channel at the sight of the main array twice to do Seabeam/ADCP surveying. The initial pass with Seabeam would be useful for checking target mooring site depths. August 4 was Coast Guard Day celebrating the founding of the US Coast Guard. Lee Narraway made another terrific sheet cake in honor of the occasion. The crew was on holiday routine and the cake was shared at dinner on the 4th. I asked the science party to look after cleaning up. Joe Jennings valiantly took care of cleaning shared science heads. Our Inuktitut word for the day means iceberg and phonetically sounded like "pick-a-lu-yuk". Rob Macdonald pointed out that my call for cleaning provided the perfect mnemonic. During this period, Lee Narraway ran one of the science meetings on my behalf.

4Aug03

I awoke at about 6:30am and noted that we were headed for ice to the eastern side of Kennedy Channel towards Cape Jefferson. This ice was a conglomeration of multi-year and first year ice pans with scattered bergs and slowed us down considerably. Upon entering the ice, Seabeam data drops out. Toward the very eastern part of the targeted section (KS15) the water is clear of ice. The captain and master chief were driving in the loft conning station for the first time on the mission. We reached the target station (KS15) in about 120 m of water and only 1.3 nm from the land. Seabeam recorded well once again in the open stretch. Andreas came in to report a strong current at the ice edge. He didn't know whether what he was seeing was real or an artifact and was agitated. At about 7:15am, the captain descended from the loft con and we discussed how to proceed. Given the relatively long transit time to break the ice in the channel, it appears most expedient to forgo the transit back across for the ADCP/Seabeam survey and to begin the deployment at this end of the line. Moreover the deck folks and the MST''s and the scientists were standing by to be ready to go at 8:00 just after breakfast. The captain gave the orders and I went down to the galley for juice and oatmeal. Upon finishing was approached by Andreas who asked to speak to me in private. We went to the chief scientist's conference room and he once again expressed frustration with not being included in the decision making process (i.e. not taking the Seabeam/ADCP track back across channel). He also expressed consternation at not knowing whether the phenomenon of a 2 kt apparent current that he observed in the ice was an artifact or real. He was wondering if the cross channel wind gradient is driving an across channel flow. He mentioned that the strength of this apparent current matched that observed off Pt. Conception. He implied that a return transit would have allowed him to determine whether these observations were real or not. I told him that we needed to take advantage of the available weather/ice conditions to accomplish our main priority of getting the moorings in. We agreed that he would keep an eye on the ADCP as we transited back of the area while deploying the moorings. That transit, albeit punctuated, should serve as a test of how persistent the observed phenomena are. I told him I would try work harder to keep him better informed of decisions that needed to be made. Finally I noted that I had observed momentary differences between speed over ground and way speed of up to 3 kts when we were breaking ridged ice. This would suggest that the ADCP data might be prone to artifacts while breaking ice and I would continue to try and evaluate that in relation to his observations.

We began the mooring deployment with the ADCP style moorings at KS14. Conditions were such that we were able to do anchor last deployments for all of the moorings although the exact approach to do this depended upon the wind and local ice situation. We decided to deploy all the ADCP moorings first as they were laid out on the deck and ready to go. KS12 was located in the middle of thick ice and after a few hours of difficult going we abandoned that station and continued to KS10, which was in open water. While the ship was negotiating the ice, we took advantage of the time to do testing of the Kevlar line. I remained on the bridge for most of the mooring deployment operation in order to hand record the time and locations and depths when the moorings were cut away based on the aft A-frame camera monitor. The ship watch standers were ordered to mark depth and position for the moorings. I also took time and position readings from the ship's VMS (voyage management system) and the depths from Seabeam based on the centerline readout on the screen located on the bridge. I felt it necessary to remain on the bridge because early on I noticed and corrected incorrect positions entered into the VMS for the moorings and answered questions at the change of the watch regarding science operations. Ship handling during these deployments was quite challenging due to conspiring wind and ice. We had to be careful not to let ice drift down on the line paid out because it would have severed the mooring. We generally wanted to make way slowly and pay equipment out so that when we arrive on station the anchor was placed in the water and the securing line cut away. Maintaining headway required a minimal 2 kts. Much above that put too much tension on the lines for the deck crew to handle the manually deployed sections. The various ship operators rose to the occasion with different approaches.

At one point, the VMS position was overlaid by a navigational window for ship driver purposes and so I switched to recording from the GPS system next to the ship's log computer. At the time I was told that it was echoing the VMS though in fact it didn't. This is the system that the ship's watch standers were using to record events. I then noted when both system readouts were available that the positions appeared to be different. When I tried to find out why, a confusing discussion of antenna offsets ensued. What I eventually found out was that the VMS uses the p-code GPS and has an offset correction to account for the distance from the antenna to the bridge. It also is referenced to Datum NAD27 (US version). The other GPS uses Y-code and a different antenna. Andreas was also recording positions from the science GPS's and depths from the ADCP. His times were based on someone from the fantail door next to the computer room relaying to him that the moorings had been cut away. (Eventually we compiled all of this information into a single spreadsheet.) To get around the system switch in my notes, I gave the VMS times I recorded to the master chief and he extracted the exact positions from the VMS logs for me. I also corresponded with Dale Chayes regarding this topic. He recommended for accuracy using the aft science system GPS and noted that the AICC had recommended that a study be conducted to determine the exact offsets and compile this information for the ship. I learned from the Captain that someone from Lamont was due to sail the next leg to address this issue and the synching of ship and science data streams.

Seabeam centerline readout was somewhat problematic because it tended to drop out while we were on station. It took careful watching to extract reliable readings. Not all watch standers were aware of this. In these shallow straits we had the ADCP as a backup.

When we completed all but KS12, we proceeded to the eastern most part of the section in order to conduct a CTD-rosette cast followed by the conductivity-temp-depth moorings.

Humfrey had to change the position of KS01 because from the initial Seabeam survey we had learned that it occurred in waters too shallow. Roger worked with Humfrey to find a spot on the 235 m isobath. At about 5:30pm ship time, the first of the CTD moorings went into the water. At KS05, the deck unit failed in the CTD-rosette. We brought the unit in for trouble-shooting near midnight and proceeded to complete mooring.

5Aug03

Reinitializing the CTD-rosette computer allowed communications to be reestablished with the deck unit and a successful CTD-cast was made. At KS11, the CTD-rosette deck unit blew a fuse and so a cast was not made. The trouble was determined to a malfunctioning CTD and so the replacement unit was swapped in and configuration files changed. In the meanwhile we proceeded to deploy KS11 CTD-mooring and proceeded to deploy KS12 that had been missed on the way over. Ice conditions were somewhat improved and both the science and ship crews benefited from experience. They were able to deploy the mooring anchor last in a very short stretch of open water. By noon we were back to KS11 and managed to conduct a successful CTD-rosette cast with the replacement CTD. Andreas noted that deeper salinities (34.62) at this station and the preceding one match Baffin Bay deep water. We discussed whether the change in sensors might affect things but later determined the salinity fields from the sensors to be reliable based on the bottle salinities. This is exciting because no one has observed properties matching Baffin Bay deep water within the strait before although people have speculated that sporadic overflows from Nares St. would explain Baffin Bay deepwater properties.

We continued on through to KS15, which turned out to be located in shallow waters (109 m) impressively close to the coast. The very clear air makes distant land appear deceivingly close. Science and Coast Guard crew alike were treated to quite spectacular scenery during our operations.

After finishing the main array, we launched the helo for recon. Upon the helo return, we proceeded with the last of the main mooring array, which consisted of 2 ice sonars and 1 additional upward looking ADCP. This required some careful sonar work to be sure the targeted sites wouldn't result in tangling with the already deployed moorings. Lee approached me about setting up presentations for the science party members interested in hearing her photography talk and one to be lead by Chi on sketching. I told her I would try and schedule things but unfortunately I never succeeded to do this.

6Aug03

The last of the mooring deployments continued through the wee hours through to about 8:30 in the morning. The exhausted science crew and deck folks took a well-deserved break. We launched the helo again to do ice and clam site reconnaissance with Robie and Gerhard on board and headed north. By about 10 we had them back on board. We decided to head to Discovery Bay to deploy a shallow-pressure sensor mooring and to retrieve clams. The coring group informed me that they had rigged for gravity cores and were eager to conduct gravity coring in the Lincoln Sea or Hall Basin.

7-9August

This is another period in which I didn't take many notes and am relying on memory. We first conducted small boat operations in Discovery Bay. Pete Kalk and Lee Narraway accompanied Humfrey, Robie and Mary for the science party. We ended up needing to launch the rigid hull inflatable boat (RHIB) to ferry gear to the group and so Dave Forcucci also went out on the small boat. Lee spent the majority of the day on shore while the others conducted the science from the boat. When we finished mooring deployment and clam retrieval, we then headed north to do a hydrosection and ADCP surveying in northern Kennedy Channel. We conducted cross channel ADCP/Seabeam surveying as part of this and tried to do helo recon but had fairly high winds. It is interesting to note that our winds on this cruise have been dominantly out of the south. We have had a few frontal systems pass by but southerly winds persist. This was not expected given the climatology and may explain the particular ice conditions we are encountering. (Note: This in fact remained true throughout our expedition!) One of the helos needs to have a strut repaired. We talked about going hove to at the Arctic ice edge in the Lincoln Sea. This would give them the opportunity to put the helo on jacks and for the crew and science party to get out on the ice. The northern CTD-rosette transect across northern Kennedy channel was accomplished. When we approached the Arctic ice pack winds were high enough to result in considerable swell in the brash edge. Unfortunately conditions were not suitable for an ice party and so we headed back down into the strait. It was the science party turn to cook on morale night and under the leadership of Helen, they rose to the occasion in fine form. The galley was transformed into "Science by the Slice Pizza Hut". It seemed as though hundreds of pizzas were made. Fried cheese sticks, "poppers"=jalepenos stuffed with cream cheese and deep fried in a batter(!) and cream pies rounded out the menu. I pitched in to help serve at Helen's request. Festivities were apparently continued with a host of board games for which the crew was invited to science conference room. I should mention that the food quality and choices on the ship have and continue to generate raves from the science party.

10Aug03

After being up much of the night, we've finally located a suitable coring spot. Originally we had targeted 81deg51.552N and 061deg51.132W 798 m based on the Seabeam surveying line done earlier. Upon arrival at that station at 1:30am, the winds were a sustained 35kts with gusting to 40+kts. I chose to head 21 nm south to a location (81 deg 34.6'N, 063 deg 08.0'W) that looked to have deep soundings. Upon arriving there, Seabeam indicated that we were not in the appropriate water depths and then Seabeam crashed. Glenn H. worked on it and eventually it was necessary to rouse Roger who had been up most of the night. We slowed from 8 to 2 kts. Roger optimized the system and we increased speed to 5 kts. We headed toward the west after tracking a parallel line back. The deeper spot on the parallel line looked hummocky on the sub-bottom profiler. Upon heading toward the west, we located the deep plain and Chris Moser reported the following target location: 81deg 37.256 ' N 063deg 14.823' W at about 812 m. We attempted to station keep at this location but with 25-35 kt winds, it was difficult. There was no ice in the vicinity. At 7am I sent the coring folks to eat and joined them. After breakfast I returned to the bridge to suggest that we head into Petermann Glacier for CTD's and follow that by small boat ops at Off ey Island. If conditions permit, we would return to the coring site in Hall Basin after. The captain gave his approval and set up a 3 hr steam to inside the Glacier Fiord. I retired for about three hours at 8:00am. At about 10:30, the bridge called to notify me that we were about 30 minutes to the edge of the glacier floating tongue. Andreas called shortly after that to ask whether I knew that bottom depths exceed 800m. When I arose and went to the bridge, Seabeam depths were in excess of 1000 m. The setting is quite dramatic with very steep cliffs to 2000 m above sea level rising on either side of the Fiord. There is over a mile of relief from cliff top to seafloor! At our closest approach to the tongue, we conducted a deep CTD-rosette cast to about 1000 m. The deepwater column was quite homogenous in dissolved oxygen, fluorometry, temp and salinity. We had crossed over sill-like features at 270 m and 360 m coming into the fiord. Helen and Andreas noted high velocity cores propagating over the sill and down to the deeper water in the fiord. They requested that we yo-yo the CTD over the sill during small boat ops. Andreas presented these findings to the science party at our meeting that evening and explained their intentions for the impromptu yo-yoing experiment to the larger group.

Upon completing the CTD-rosette cast, the Captain had us follow the ice-tongue edge from the center of the channel to the north. We then turned parallel to the coast and "mowed" a pattern to observe the bathymetry. The southern side has a wide shallow fan. An excellent map of the fiord bottom bathymetry was produced. There was no call to quarters as it was Sunday. We had a boat brief at 12:30. I determined that Humfrey, Helen, Gerhard, Bob and Dale should ride and all but Gerhard attended the brief. The decision was made for folks to eat at 17:00 and to launch at 17:30. We adhered to the plan and the boat headed into the bay on the northern side of Off ey Island. The river on the mainland facing the bay has a broad shallow delta. The headland just east of the delta is quite steep and a spectacular example of geology in action. The Greenland Ice Sheet is also visible from this vantage point. The Captain is not comfortable leaving sight of the small boat since we carry the decompression chamber for the divers so we are unable to proceed to the other side of the island to yo-yo the CTD. The first site attempted by the small boat was on too steep a slope to deploy the mooring. The second site was too soft for the mooring stake. Fortunately for Humfrey and the "three divers", the third site was just right. They crossed the Bay to put people off on land to sample the river. All passengers got off the small boat. What must seem like a short time on the small boat feels excruciatingly long for those of us waiting aboard the Healy. It was noted that the bear gun needed to be loaded for future small boat missions.

11Aug03

We reboarded folks at 0:30 am. Andreas had requested that we do a traverse of the so-called sill upon completion of small boat ops. He had worked with Roger and the existing Seabeam data to learn that the entry is more a saddle than a classic sill. He then would like to return to the topographic high to yo-yo for a few hours.

I requested that the bridge figure out how much time it would take to get back to the deep Hall Basin site by about 8 am and then allow Andreas and Helen to use the remaining available time through the night. Unfortunately I did not relay that clearly to Andreas and he labored under the assumption that he had only two hours. He eventually learned from the bridge there was more time (closer to 6 hours), which apparently made it hard for him to schedule the watch standers.

At 8 am we conducted 2 successful CTD-rosette casts in deep Hall Basin that looked very similar to those in deep Petermann Fiord. At 11 pm we started gravity coring with 10 ft of pipe. The first core had a 1500 lb pull out tension and was completely filled with mud. We rigged for a 20 ft core but then the crane experienced a hydraulic fluid leak. The ship's crew got right onto repairing it but weren't optimistic time-budget wise. It turned out to be less a problem than originally envisioned and we were back at coring at 16:30. We got about 15 ft penetration on the 20 ft section but the mud apparently washed out but the fingers of the core-catcher not bent back. During retrieval, the winch wrapped poorly so was paid out and rewound about 50 m. Moreover, at about 20 m to being on board, the wire jumped as the wrap on the far side of the winch momentarily snagged it. It was disappointing to have no mud for the effort. We decided to attribute the empty core barrel to having cored in exactly the same spot as the first core and to blame it on perfect station keeping by the ship. We are now headed south to conduct small boat operations in Scoresby Bay. I tagged Kumiko, Helga, Melissa ad Lauren to accompany Humfrey in Scoresby Bay. I had discussions with the captain, XO and Ops regarding a bit of tweaking to improve communications between us. Folks are now finishing up water sample analyses, packing up the main lab and with Glenn H's help, stowing gear in the hold. A Russian vessel, the Kapitan Khlebnikov, carrying tourists was sighted heading north so we broke our science meeting up a bit early to go have a look at her.

12Aug03

Our intended arrival in Scoresby was delayed a few hours by ice at the mouth. There is absolutely no wind and the seas are flat calm as we head in to anchor. At 10:50 the anchor was let go. The chain is marked in shots (10 fathoms or 60 ft) by white sections. We've let out 6 shots with a big puff of iron powder. Folks ate lunch and then the boat was launched. After the small boat headed out, the helo took off with Rob and Mary to survey Scoresby and further south for clam sites. We used the rigid hull inflatable boat to ferry out Pete Gamble and a new release because the one sent out failed to communicate. Melissa and Lauren returned. The deployment with the new release was successful. The helo recon showed the best clam spot to be at the mouth of Scoresby so we remained at anchor. Mary, Rob, Elinor and Scott went out with for the science party. The divers were eager to make use of a range of elaborate clam retrieval tools that had been fabricated on the ship. Many clams were retrieved. Scoresby Bay was eventually bathed in sunshine and the winds remained low through most of the operation. The setting was absolutely spectacular. The divers continue to impress the scientists as being hard working and effective and having a wonderful can-do attitude. On board, various parts of the cruise report have been assigned and the science party is making headway on a draft.

13Aug03

At 0:30 we recovered the small boat and headed south to Alexandra Fiord. The captain decided upon arrival mid-morning that we wouldn't anchor in the Fiord since soundings were inadequate. We launched the small boat with Mary, Robie, Chris Moser and Humfrey comprising the science party. Winds were about 15kts and skies were overcast. Within 15 minutes of the launch, the skies began to clear and white capped waves were appearing toward the shore. Moments later the coxswain of the small boat radioed that they were getting bounced around. By that time winds were up to 40-50 kts. (Andreas later in the afternoon produced a graph of the ships anemometer that documented the rapidity of these changes.) The coxswain was advised by the Healy to head down wind, get in the lee of the land and hold tight while a plan was made. As I was watching the boat with binoculars, several riders appeared to be airborne as they bounced over sizeable waves. With the large sail that the Healy presents to wind and the currents in the face of very few soundings, our own maneuvering was extremely slow. The small boat made it into the lee of a promontory while we spent the next several hours making the difficult way into the nearby fiord to bring the boat back on board. That fiord opening was studded with rock island and ground bergs adding to the difficulty. I spent much of the time in the loft con keeping visual contact with the small boat. Normally when the small boat is brought alongside the ship, the personnel climb up a rope ladder to get back on the Healy and then the boat is craned onto the ship. Because the winds remained quite high and we risked going aground in the fiord, it was determined that the boat would be raised part way with the crane to where people could get off. What had been a 30 to 45 minute operation was reduced to less than 10 minutes by this approach. Once everybody was back on board and the boat secured, the feeling of relief aboard the Healy was palpable. I spent considerable time discussing the situation with our meteorologist Ed Hudson trying to get a handle on the likelihood of the recurrence of such a wind event. Later, in the galley the captain approached me about trying the operation again the next day since time remained in the schedule to do so. To the best of our ability to determine the source of the sudden wind event, it did not appear likely to recur. I was thankful that the captain had been proactive with his officers and crew in discussing what to do next. From what I heard on the bridge there was sentiment that no more such operations should take place. My asking for a retrial may have met with resistance. I agreed that it would be scientifically optimal to try again. After I informed folks of that plan, I made a much needed retreat to my bunk.

14Aug03

I awoke to find that we had run a Seabeam pattern in the night and that the Kapitan Khlebnikov had appeared early morning and headed into the fiord to debark part of its party for exploring the vicinity of the research station there. They filled the airwaves with their radio chatter. Approximately 12 hours after our failed attempt to do dive ops in Alexandra Fiord we were back at it. In the night the ship had mapped the nearby region via Seabeam. I should note that the ship was driven numerous times to optimize Seabeam coverage by using the readout on the bridge. The officer of the bridge was simply told to overlap the edges of the swaths to the best of their abilities and this worked quite well. The deployment of the mooring and clam retrieval went quite well but took the full day. Upon retrieving folks, it was time to head south to Thule. Andreas requested that we take a zig-zag trajectory for ADCP purposes so that was plotted and we crossed Smith Sound twice on the way home. While this was going on, folks continued to pack and work on their cruise report contributions.

15Aug03

I met with Andreas after breakfast in order to get his feedback on my draft cruise report summary. It relayed largely positive impressions of our accomplishments. What I learned from our lengthy discussion was that he was in fact quite disappointed with aspects of the cruise and in particular my leadership style.

After pondering his statements, I believe he has some valid points and others I disagree with. There wasn't much time remaining so I attempted to take his view into account as I edited my summary words. Later in the morning I met with Robie, Humfrey and Andreas to go over the debrief questions that Lisa Clough had forwarded to me before we set sail. The notes from our discussion of the debrief questions served as the subject of a final meeting with the Captain, Executive Officer, Humfrey and myself later that afternoon. In my opinion it was a fruitful meeting and I have summarized that discussion in the final section of this report. From it stemmed the actions that we took with Pauloosie regarding putting wastes overboard and fishing (see Inuit Participant report) plus a number of recommendations. I remained on my feet for over 50 hours straight trying to complete a draft of the cruise report to leave aboard the vessel and to pack. Many of the science party were able to take advantage of the barge going back and forth for liberty leave in Thule for the evening. With Humfrey's help, I passed mooring location and type information to Operations Officer D. Peloquin who had volunteered to post this to a website designed to serve as a Notice to Mariners for Arctic locations (use navsafety@nima.mil to have info posted at http://pollux.nss.nima.mil). This was newly instituted in March 2003 and we had agreed that it was in the ship's interest to assure that such information was posted properly. (Note: I was informed by D. Peloquin that this was completed 22 Sep 03.)

16Aug03

Just after breakfast, I gave to the captain a copy of our draft cruise report. I also left him a computer memory stick that had been useful in passing planning information back and forth. I received copies of all but the Seabeam science data from Joe Digiovanni who agreed to get the information to Dale Chayes who would be chief scientist on the next leg. With the exception of Joe Digiovanni, Yves Sivret and Dave Huntley who were remaining on board, the science party debarked from the Healy after breakfast using a barge. At shore we were bused up to the airport. (We had been graciously provided bag lunches by the ship upon my request.) We were delayed in departure with the 109th because communications regarding a pallet they needed to take back got crossed. Although we had been ready to depart at 10:00, we didn't board until near noon. We were further delayed after the aircraft returned to the hanger area for oil after taxiing to the runway. Once airborne, the group alternately slept, ate the lunches and amused themselves with reading, word games and composing limericks and the like. When we landed in NY, we were detained on the runway almost an hour waiting for customs. In the customs clearing room we learned that we didn't have the proper paperwork to ship Humfrey's gear back to Canada, however they let that go. They did detain Helen for not having a proper visa. This is a new requirement that is fallout from 9/11. Fortunately a similar situation earlier in the day had occurred so the necessary phone calls were placed and she was released after an hour or so. Foreign nationals would not be allowed to return to the base so our plan of sending Humfrey and Ron off to rent a van and come back for their air cargo was foiled. Instead Chris Moser and I did the deed of renting the van from the Albany airport, getting lost getting back to the base but eventually making it back to pick up Ed, Pete and Humfrey who were waiting with the gear. The others had taken taxis to their hotels and then made their way to a restaurant, the Macaroni Grille, where we had made reservations (via my colleague Bob Collier who has relatives in the area). We proceeded directly there and arrived around 10:20pm. Some folks departed at that point and so we had a round of good-byes. We ordered a bit of food and more wine and decompressed. I discreetly took off my steel-toed boots and long woolen socks to better enjoy the moment. Those who stuck around enjoyed themselves reading limericks composed on the plane. We ended up shutting down the place but the waiters and waitresses were good humored about it. One in particular really got a kick out of seeing his name written in Inuktitut on the paper table covering. It was both satisfying and hard to say good-bye to such a terrific and dedicated group of people.

DEBRIEF NOTES

On August 15, 2003, Kelly Falkner, Humfrey Melling, Dave Forcucci, XO Bill Rall and CO Dan Oliver met to address the following debrief topics. Earlier in the morning, input had been obtained from Andreas Muenchow and Robie Macdonald:

Topics to cover in debrief (modified from Antarctic debrief questions)

1) How were communications with PACAREA (Dave, April, and Phil) and the ship (CO, XO, MSO, MSTC or MST1) before the cruise? Ways to improve?
Communications were facilitated by the on-line planning cruise form and hampered by having the ship go south for the Deep Freeze mission. We had one conference call while the ship was south but I think that the most important communications took place informally on board the ship before she headed south. I had requested the Arctic Survey Boat for our mission and was told by the previous CO that it was unavailable for reasons that remain unclear to me. I believe that it's larger cabin would have better served our purposes than Healy 3 did.

2) Any environmental or permitting areas that arose during the cruise? If yes, how smooth did the process(es) go? From CG side, did the scientists follow procedures to obtain clearances, permits etc. Suggested improvements?
Dave Forcucci was instrumental in sheparding through the clearance requests to Canada, Denmark and Greenland. I thank him for all of his help with that arduous paperwork. Our native participant noted two items of concern to him while on board. In Scoresby Bay, the crew was given permission to fish off the ship. He pointed out in a written summary of his experiences on board that the individuals fishing needed to have licenses. While nothing was caught, we felt it important to be proactive in addressing this issue as a matter of trust under the Nunavut clearance that had been granted. The CO wrote an excellent letter of apology for the incident to the Nunavut licensing agent. Concern was also expressed by our native participant, Pauloosie, about trash going over the side. The CO, XO and myself and co-chief scientists directed Pauloosie to the MarPol convention on the guidelines that were being followed by the ship. The practices were described and his questions answered. We pointed out that if his people had specific concerns, that we certainly would wish to know them. Pauloosie was thanked by the CO for bringing attention to these matters. I could not have asked for a better response to these situations!

3) Logistics/ Cargo- Were the shipments on time? Were special handling requests met? (Frozen things kept frozen, etc.)
Things went well in this regard. I would recommend that science parties shipping gear should be advised to meet the ship earlier rather than later during a port call in order to take care of deliveries.

4) Construction- Was anything built or modified on board? How did that go? Damage Control/ scientist interactions?
We had several items built on board ranging from a work table in the aft staging area, to a davit for the underwater camera to stakes for anchoring the shallow moorings. A positive working relationship was established under the leadership of DCC Schaffner. The scientists were quite happy with the services rendered. Pete Gamble of the science part contributed to maintenance and repair of the DCC machinery.

5) Information Technology- e-mail, computer, Inmarsat, radio support?
a) According to Andreas Muenchow ADCP Windows2000 data recording/operating system unstable; either use Windows XP with RDI software or consider stand alone system to avoid network interruptions (i.e. output to 2 places (1 is a backup) but non-networked. Seabeam is more stable in this regard since it is stand alone.

b) Ashtec feed from bridge for ADCP made independent of bridge operations(?) The discussion on this item was confusing and should be raised again with Andreas Muenchow.
c) Having a networking/data systems specialist (Joe DiGiovanni) on board is absolutely essential. MST's having such responsibilities as collateral duties is not acceptable. The success of science missions hinges on the duties Joe performed. It is also highly desirable that such an individual not have to come up to speed from ground zero for each mission and so assure some continuity in the arrangements for such personnel.

6) Laboratory operations- scientific support for everything from operations to hazmat to familiarity with equipment
We suspect that loss of the considerable experience of someone like senior technician Glenn Hendrickson could spell trouble for future missions. The 5+ years of experience with science operations counts for a lot. Again continuity will be the issue.

7) Laboratory equipment- comments on malfunctions, desires for upgrades, needed new equipment
a) The distilled water system water purity level needs to be addressed.
b) The 150 kHz ADCP is inoperational.
c) CTD-Rosette: The responsibility for water tight connectors, O-rings, checking in with Sea-Bird regarding the unexplained bottle trips needs to be sorted out.
d) Add position/heading to data stream for thermosalinograph.
e) Integrate position/heading etc with met obs (note which bird is being recorded.
f) Work out capability for silencing echosounders on command from working deck
g) Have hand held unit reading out position/depth on the fantail
h) The aft conning station wasn't working well.
i) Gravity coring deck operations were dicey.

SeaBeam specific questions:
A. How much real-time watchstander effort was required?
B. How much ping editing was done in the post processing?

In both cases, who provided the people (CG or scientists?); who was responsible for training the people?

8) Diving support
The science party enthusiastically thanks the divers for their innovative positive contributions to the science program.

9) Science technical services- seawater systems, climate control rooms, winches, etc.
The use of the salinometer in the climate control chamber produced excellent data under extremely stable conditions. It is noisy for the operators though.

10) Small boat ops
Supplement communications with and Iridium phone. Climbing the long ladder into and out of the boat is inherently dangerous. Work out alternate loading strategy.

11) Helo ops
The pilots were competent with good attitudes. Science recon went well. In the perfect world, consider a better bird for science ops.

12) Food service
Absolutely excellent. Only complaint was of too much food for those envisioning svelte physiques!

13) Housing/ janitorial
Streamline check in procedures; Outfit room 404 with desk lamps, towel rack and lower the desks.

14) Safety- particularly deck ops (AICC will probably need to consider both scientist's view of ops, and CG's view of scientists)
Safety conscience level was commendably high. The true hazards on the ship appear to be structural. For example, emergency breathing devices boxes are mounted in hazardous locations. Remove the tripping hazards in the CTD rosette room where people have to circulate. Like-wise consider tripping hazards on the aft working deck.

15) Administrative services
Fine.

16) Medical- For ARVOC includes required suites of physicals
Fine.

17) Travel- As above probably more an ARVOC issue than AICC as we all make our own travel arrangements
Many thanks to the ship for allowing the use of the liberty vans by the science party while in port! This contributed greatly to our in port logistics issues.

18) Ship operators- interactions between bridge and scientists, nightly meetings, etc.
Chief sci and officer of the deck need to be clear about whether exact positioning versus holding a constant wire angle is more important for any given operation. Such information needs to be passed between watches clearly. Once the bow-thruster is fixed, I am certain that operating from the aft conning station will improve communications between science and the vessel operators.

19) Any other comments?
The use of the helo-deck and high-crane for the current mode of gravity coring operations seems inherently more dicey than it need be. Pete Kalk made a recommendation for an alternate mode of operation from the main working deck. Please refer to the final paragraphs of the coring report for details.

20) Plans for next trip if relevant.

Small Boat Hydrography

Station	Date	Time (UTC)	Site Name	Lat deg N	Lat deg W	sample #	depth m	bot salinity	δ18O VSMOW	Ba nM	PO4 µM	NO3+NO2 µM
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-01	1	31.757	-1.88	83.9	NA	NA
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-05	5	31.757	-1.87	61.4	NA	NA
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-10	10	31.804	-1.78	60.7	NA	NA
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-20	20	31.933	-1.73	61.1	NA	NA
Ice near Ft Conger	7-Aug-03	NA	CL2	81.717	64.667	265101	0	NA	-5.80	52.9	NA	NA
Ice near Ft Conger	7-Aug-03	NA	CL2	81.717	64.667	265102	0	NA	-3.92	NA	NA	NA
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-01	1	31.254	-2.67	61.2	NA	NA
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-05	5	31.369	-2.68	61.4	NA	NA
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-10	10	31.378	-2.67	62.9	NA	NA
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-20	20	31.448	-2.61	60.3	NA	NA
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-30	30	31.573	-2.58	60.8	NA	NA
Offley Island	11-Aug-03	evening	CL3	81.315	61.833	265205	1	30.019	-3.45	60.3	0.487	0.226
Offley Island	11-Aug-03	evening	CL3	81.315	61.833	265109	8	30.096	-3.37	60.3	0.502	0.230
Offley Island	11-Aug-03	evening	CL3	81.315	61.833	265110	17	30.484	-3.17	61.1	0.595	0.235
Offley site River	11-Aug-03	evening	CL3	81.315	61.833	265204	0	0.094	-25.58	102.7	0.013	5.699
Offley site River rep	11-Aug-03	evening	CL3	81.315	61.833	265206	0	0.075	-24.72	101.4	NA	NA
Offley Site Melted Ice	11-Aug-03	evening	CL3	81.315	61.833	265103	0	0.018	-25.85	NA	NA	NA
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-01	1	30.823	-2.76	63.1	NA	NA
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-05	5	31.464	-2.38	68.8	NA	NA
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-10	10	31.631	-2.27	61.9	NA	NA
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-20	20	31.894	-2.22	62.1	NA	NA
Scoresby Bay-River	13-Aug-03	evening	CL4	79.930	71.117	265105	0	0.247	-23.40	338.2	NA	NA
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-01	1	31.256	-2.23	56.3	NA	NA
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-05	5	31.260	-2.20	56.0	NA	NA
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-10	10	31.766	-2.02	58.5	NA	NA
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-18	18	32.122	-1.85	58.8	NA	NA

water samples collected using Niskin bottle suspended on nylon rope from small boat; chemical analyses as described for the HLY0301 rosette bottle samples; see cruise report for further details

Small Boat Hydrography

Station	Date	Time (UTC)	Site Name	Lat deg N	Lat deg W	sample #	depth m	Silicic acid µM	NO2 µM	NH4 µM	comments
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-01	1	NA	NA	NA	
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-05	5	NA	NA	NA	
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-10	10	NA	NA	NA	
Littleton Island	3-Aug-03	18:00	CL1	78.370	72.850	CL1-20	20	NA	NA	NA	
Ice near Ft Conger	7-Aug-03	NA	CL2	81.717	64.667	265101	0	NA	NA	NA	H. Melling collected
Ice near Ft Conger	7-Aug-03	NA	CL2	81.717	64.667	265102	0	NA	NA	NA	H. Melling collected
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-01	1	NA	NA	NA	lon wrong in cruise report
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-05	5	NA	NA	NA	lon wrong in cruise report
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-10	10	NA	NA	NA	lon wrong in cruise report
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-20	20	NA	NA	NA	lon wrong in cruise report
Bellot Island	8-Aug-03	17:00	CL2	81.714	64.917	CL2-30	30	NA	NA	NA	lon wrong in cruise report
Offley Island	11-Aug-03	evening	CL3	81.315	61.833	265205	1	1.37	0.013	0.075	
Offley Island	11-Aug-03	evening	CL3	81.315	61.833	265109	8	1.52	0.019	0.068	
Offley Island	11-Aug-03	evening	CL3	81.315	61.833	265110	17	2.35	0.013	0.060	
Offley site River	11-Aug-03	evening	CL3	81.315	61.833	265204	0	3.30	0.010	0.347	Ba filtered 0.4 µm
Offley site River rep	11-Aug-03	evening	CL3	81.315	61.833	265206	0	NA	NA	NA	Ba filtered 0.4 µm
Offley Site Melted Ice	11-Aug-03	evening	CL3	81.315	61.833	265103	0	NA	NA	NA	
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-01	1	NA	NA	NA	
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-05	5	NA	NA	NA	
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-10	10	NA	NA	NA	
Scoresby Bay	13-Aug-03	evening	CL4	79.930	71.117	CL4-20	20	NA	NA	NA	
Scoresby Bay-River	13-Aug-03	evening	CL4	79.930	71.117	265105	0	NA	NA	NA	Ba filtered 0.4 µm
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-01	1	NA	NA	NA	
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-05	5	NA	NA	NA	
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-10	10	NA	NA	NA	
Alexandra Fjord	15-Aug-03	evening	CL5	78.906	75.786	CL5-18	18	NA	NA	NA	

water samples collected using Niskin bottle suspended on nylon rope from small boat; che
rosette bottle samples; see cruise report for further details

Data Processing Notes

Event Date	Person	Date Type	Summary
2010-03-24	*Falkner, Kelly*	BTL	methodology exception
	rosette was stopped to trip bottles for cast 42		
2010-03-24	*Falkner, Kelly*	BTL/Cruise Report	To go online
	BTL file submitted via email as an excel file. CTD to follow, also public.		
2010-04-08	*Falkner, Kelly*	CTD	To go online
2010-08-04	*Berys, Carolina*	BTL/CTD/Cruise Report	Available under 'Preliminary/Unprocessed'
	ArchiveHLY031bottledata.xls bottle file and HLY031CruiseReport092603.pdf cruise report submitted by Jerry Kappa on 2010-03-24 and HLY031CTDO.zip CTD files submitted by Kelly Falkner on 2010-04-08 available under 'Preliminary/Unprocessed', unprocessed by CCHDO.		
2010-09-02	*Muus, Dave*	BTL	Exchange & WOCE format files online

Notes on Healy 0301 Bottle Data Reformatting Sept 2, 2010/dm

1. Original data received as Excel file: ArchiveHLY031bottledata.xls, from Kelly Falkner, OSU, March 24, 2010.
2. Assigned Expocode 32H120030721 Cruise dates July 21 - August 16, 2003 per Cruise Report
3. Used SECT_ID "CAA" (Canadian Arctic Archipelago).
4. All data in volume units converted to mass units using 'convert_per_litre_to_per_kg_exchange.py'.OXYGEN conversion used CTDTMP.Other conversions used 25 deg C. [SILCAT,NITRAT,NITRIT,PHSPHT,CFC-11,CFC-12,CCL4,NH4,BARIUM]TCARBN & ALKALI received as UMOL/KG.
5. Station B01, Cast 2, Bottle 24, 12.3db, OXYGEN flag changed from 2 to 9. Missing value blank on Excel file changed to -999.
6. Many values are blank on the Excel file with Quality Flags 9. Added -999 for missing values.
7. Many CFC-11, CFC12 and CCL4 have apparently good values but blank Quality Flags. Added 2 for missing Quality Flag.
8. Station KS01, Cast 45, Bottles 6. Bottle flag 4, SAMPNO blank in original Excel file, No water samples, deleted Station KS09, Cast 48, Bottles 11 & 12. Bottle flags 9, SAMPNO blank in original Excel file, No water samples, deleted
9. CTDTMP is average of temp1 and temp2. CTDSAL is average of Salinities from CTD 1 and CTD 2; except merged CTDSAL#2 only for Casts 39 - 50, CTDSAL #1 missing.
10. NITRAT is NO2 subtracted from NO3+NO2.
11. DELO18 calibrated with Vienna Standard Mean Ocean Water (VSMOW).