# Joint Ocean Ice Study (JOIS) 2006
# Cruise Report


## Report on the Oceanographic Research Conducted aboard the *CCGS Louis S. St-Laurent,* July 20 to October 2, 2006

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## 1. OVERVIEW

The research work for the Joint Ocean Ice Study (JOIS), on board the CCGS Louis S St. Laurent, was carried out over four consecutive legs this year from July 20 to October 2. JOIS-2006 involves the collaboration of Fisheries and Oceans Canada researchers with colleagues primarily from Japan and the U.S. This program forms an important Canadian contribution to international climate research programs, and serves as a springboard to the International Polar Year (IPY). JOIS-2006 is an observationally-driven program with the study area of the four components extending along the ship track from Dartmouth to Resolute (Leg 1), Resolute to Kugluktuk (Leg 2), across the southern Canada Basin, including the Beaufort Shelf (Leg 3) and across northern Baffin Bay (Leg 4). Emphasis is on the study of the effects of climate variability and the interconnectivity between the Pacific and Atlantic Oceans through the Canadian Arctic Archipelago.

The most complex component, described as Leg 3 below, combines two ongoing programs: the Joint Western Arctic Climate Study (JWACS), a collaboration with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) scientists; and the Beaufort Gyre Exploration Project (BGEP), a collaboration with Woods Hole Oceanographic Institution scientists. Leg 3 also includes ancillary programs carried out by researchers from the Ocean University of China and the International Arctic Research Center in Fairbanks Alaska. In addition researchers from Natural Resources Canada were aboard the *CCGS Louis S. St- Laurent* to test equipment and acquire seismic data for claiming the continental margins beyond the 200 nautical mile limit as required by the United Nations Convention on the Law of the Sea (UNCLOS). Research questions seek to:

- Understand the impacts of global change on the physical environment and corresponding biological responses by tracking and linking decadal scale perturbations in the Arctic atmosphere (e.g. Arctic Oscillation and Beaufort Gyre) to interannual basin-scale changes in freshwater content, water mass properties, water mass distribution, ocean circulation and biota distribution.
- Understand the impacts of global change on sea ice and other fresh water products by utilizing a suite of stable isotopes and geochemical markers to quantify freshwater components and investigate water mass pathways.
- Investigate physical processes such as thermohaline intrusions, ventilation, boundary currents and tidal effects on nutrient fluxes.

The Leg 1 component is a DFO and JAMSTEC collaboration to investigate variability in Arctic Ocean outflow. The Leg 2 component is a DFO program to investigate water mass properties and biological composition of eastern and western Archipelago waters. The Leg 4 component is a DFO and US collaboration to investigate variability of physical and geochemical water mass properties in the Baffin Bay region, downstream of Nares Strait. The mooring recovery component of the US-Canada Nares Strait project was conducted from the *CCGS Henry Larsen.* Leg 1 and Leg 4 are contributions to the international Arctic-Subarctic Ocean Fluxes Study.

## 2. CRUISE SUMMARY

This science season onboard the *CCGS Louis S St-Laurent* was quite extensive with successful programs on all four legs. The equipment worked well, ice conditions except in the southwest Beaufort Sea were generally easier than usual and there were no major problems with the weather, particularly fortunate for our work out in Baffin Bay on Leg 4. The only major shortcoming was on leg 3 where delays to the program added up to 10.5 days of the original 42 day program. The impact of this accumulated delay is discussed in a section below.

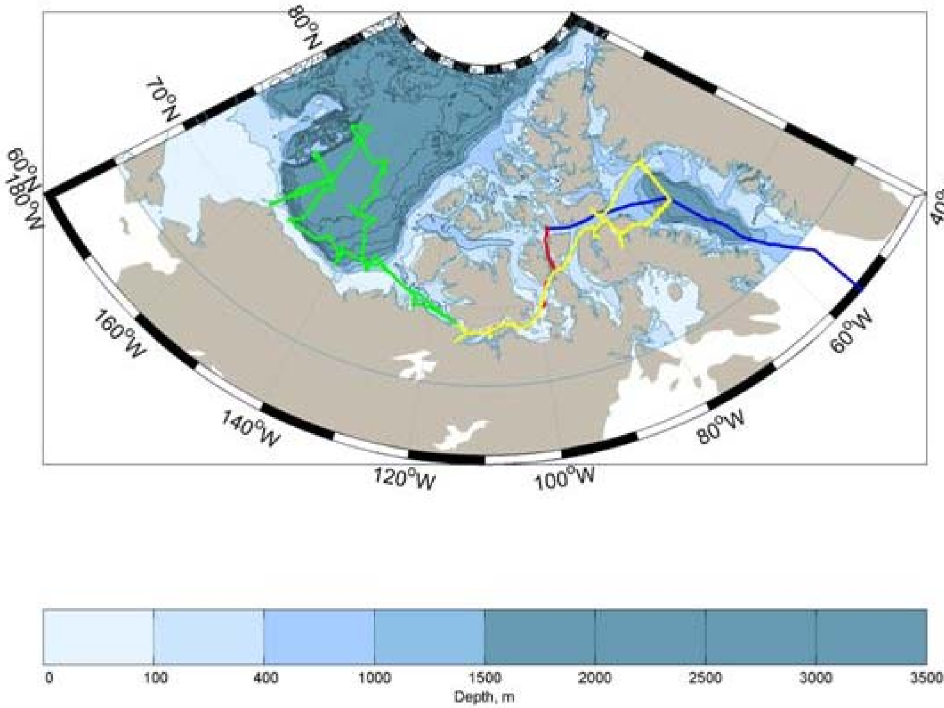


**Figure 1. The cruise track with each leg, 1 to 4, coloured blue, red, green and yellow respectively.**

Full explanations of the science activities are in the sections below, but in brief there were no major problems with data collection. The CTD/Rosette system had minor problems with leaking connectors and Niskin bottles not closing. The XCTD system worked well, even with deployments through ice filled waters. Most of the zooplankton net tows (typically two casts to 100m) and the light transmission casts with the PRR were performed during the Rosette casts, which was an efficient use of time. There were problems in maintaining suitable working temperatures in the lab areas for the oxygen and salinity analyses but apart from this all on-board analysis systems worked well.

The mooring operations were completed successfully. Two of the six moorings did come up under the ice, however with patience they were found and recovered. The moored profilers had all climbed their scheduled distances for the year except the for the CABOS profiler which unfortunately was incorrectly ballasted and meant the profiler did not have the ability to profile below the pycnocline.

The ice buoy deployments were completed but suffered due lack of time. Planned deployment locations had to be adjusted until thick enough ice could be found. The first ITP deployed unfortunately had problems with communication between the profiler and the surface buoy and has not been transmitting, perhaps not collecting data. We had already left the site due to time constraints and so were not able to recover the buoy. A recovery operation of a buoy deployed last year was attempted later in the cruise but it proved to be a good lesson on what equipment is needed for successful recoveries in future years.

Ice observation was a new addition to the program this year. Two ice observers from IARC made hourly observations from the bridge recording ice, weather, water conditions such as the extent of the green colored water in the southeast Beaufort and ice algae in the west. Their primary purpose, to install 6 GPS buoys on the ice, worked well. The on-ice measurements of thickness were not as successful due to both lack of many opportunities to get out onto the ice, and the device to measure the thickness electronically could not be made to work reducing measurements to single points with the ice-auger.

The seismic program was able to test their sled, find the weaknesses in the system, make repairs as needed and attempt to collect data from along the cruise track in areas of interest. Towing periods were preferably long to reduce the number of deployments and recoveries with the ship's cranes. The merging of the seismic and Rosette/Mooring programs worked best when the tows could be carried out overnight between the rosette stations (12 hours at 5knts) with day time dedicated to mooring and buoy operations.

Two wildlife observers stood watches daily above the bridge to record bird and mammal sightings. Their observations were important both for ecological study and to adjust scienctific activity as needed to prevent disturbing the marine mammals.

## 3. PROGRAM COMPONENTS

### Leg 1: Halifax to Resolute (July 20-July 28)

*Program Objectives*: As a Japan/Canada contribution to the international Arctic and Sub-arctic Ocean Fluxes (ASOF) program, continue the "Freshwater Watch" initiated in 2002.

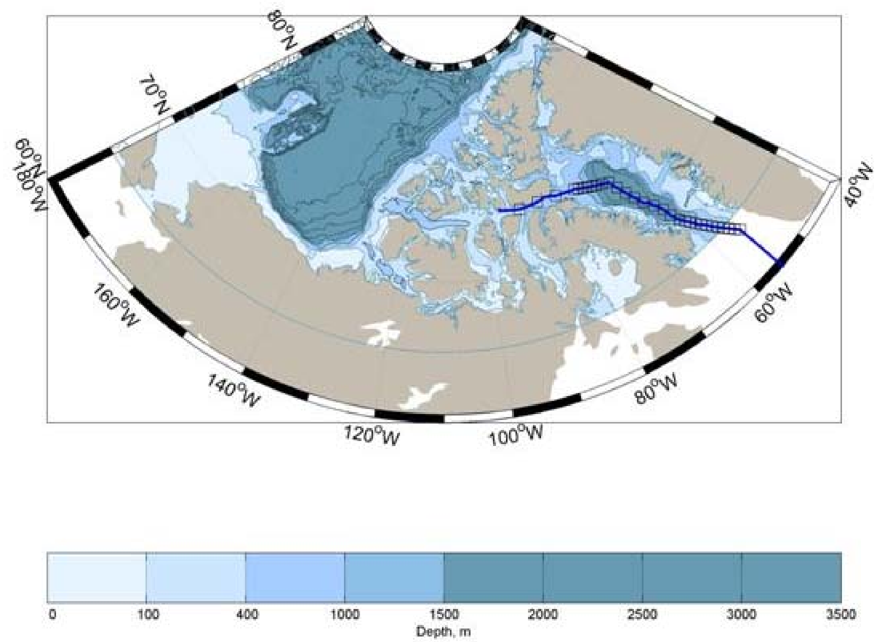


**Figure 2. XCTD casts performed on Leg 1.**

Measurements:

- 30 XCTD Casts typically to 1100m depth
- 1 test Rosette cast

**Leg 2: Resolute to Kugluktuk (July 28-Aug 5)**

*Program Objectives*: Embark core scientific personnel for laboratory set-up.

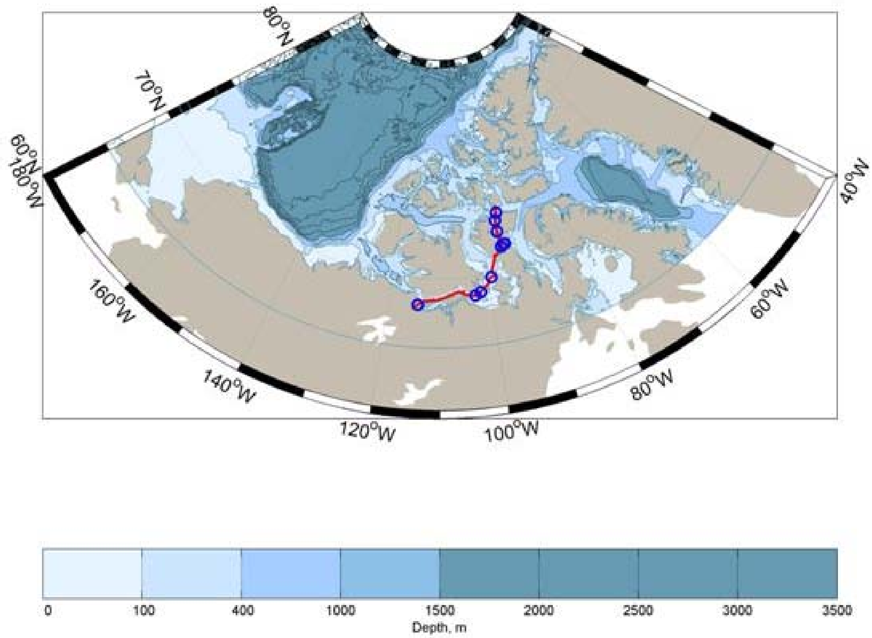


**Figure 3. Rosette/CTD casts on Leg 2**

Measurements:

- 10 Rosette Casts
- 72 Water Samples for properties: Salinity, Nutrients, Barium, O18, and Bacteria
- 84 Drift Bottles
- River water samples from the Kugaryuak River
- Seismic package tow-handling test

**Leg 3: Kugluktuk to Kugluktuk ( Aug 5-Sept 14)**

*Program Objectives:* Embark remaining science team in Kugluktuk. Achieve the combined objectives of the JOIS program as described above.

Distance Covered: 8300km

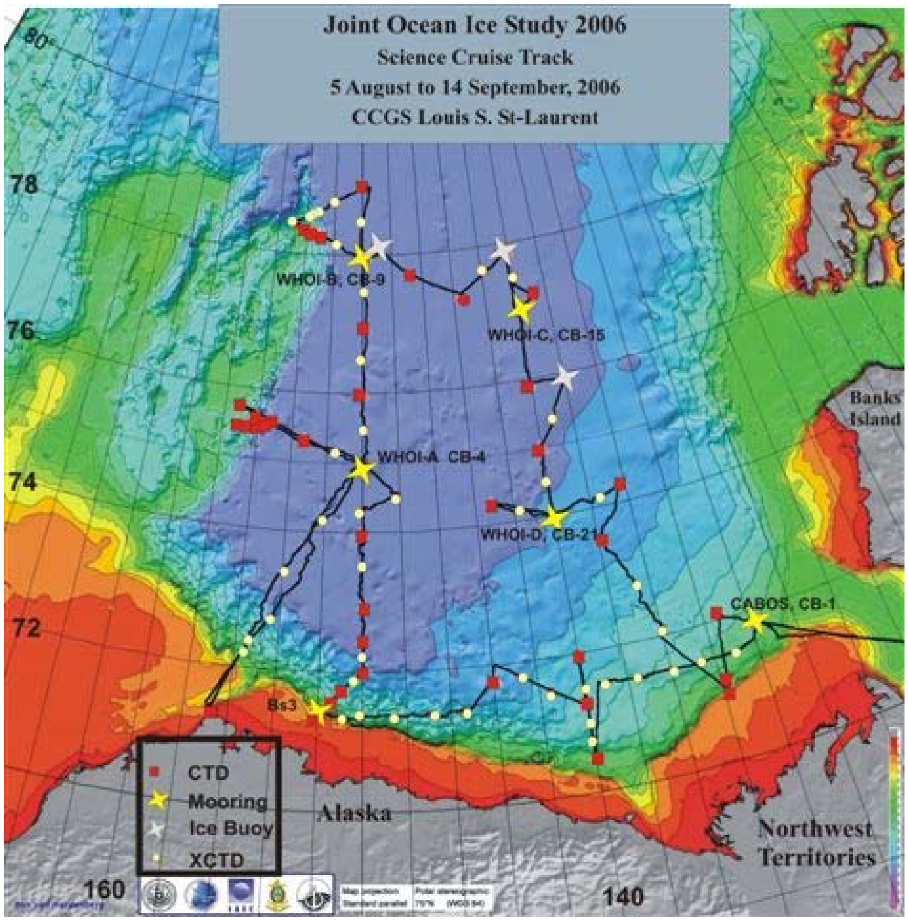


**Figure 4. Rosette, XCTD, Mooring an Buoy locations on Leg 3**

Measurements:

- 75 CTD/Rosette Casts typically full ocean depth
- 1223 Water Samples
  At all stations: Salinity, Oxygen, Nutrients, Barium, O-18, Bacteria, Alkalinity, Chlorophyll-a, C-13
  At selected stations: ChloroFluoroCarbons, Helium, Tritium, I-129, Cs-137, Particulate Organic Carbon, Total Suspended Sediments, Ammonium, Dissolved Inorganic Carbon
- 51 PRR/MCTD Casts (Profiling Reflectance and Radiometer together with a compact CTD), typically to 100m depth, at selected Rosette stations
- 3 PRR/MCTD Casts performed at ice stations, through the ice to 120m depth
- 55 XCTD Casts typically to 1100m depth
- 33 Vertical Net Casts, typically to 100m depth, at selected Rosette stations

- 106 Drift Bottles
- 6 Mooring Recoveries (4 deep basin, 1 slope and 1 shelf mooring)
- 5 Mooring Deployments (4 deep basin and 1 slope mooring)
- 3 Ice Buoy deployment sites
  2 sites each with a single Ice Tethered Profiler (ITP)
  1 multi-buoy site with an ITP, an Ice Mass Balance Buoy, an Ice Heat-Flux Buoy, all surrounded by a ring of 6 GPS Buoys.
- Ice Observations
  Hourly visual observations from bridge
  Opportunistic aerial observations during flights
  4 on-ice surveys with limited results
- Seismic Package Towing
  Tests conducted to observe performance and durability of equipment in ice and to assess data quality with respect to equipment performance, ship noise and ocean floor composition.
  Data collection along cruise-track as possible
  Test of ship's new 12-kHz echo sounder
- Underway data collection of ship's meteorological and depth sensors

**Leg 4: Kugluktuk to Pond Inlet (Sept 14 – Oct 2)**

*Program Objectives:* Conduct hydrographic survey to measure water properties in northern Baffin Bay and across southern Smith Sound.

Distance Covered: 4600km

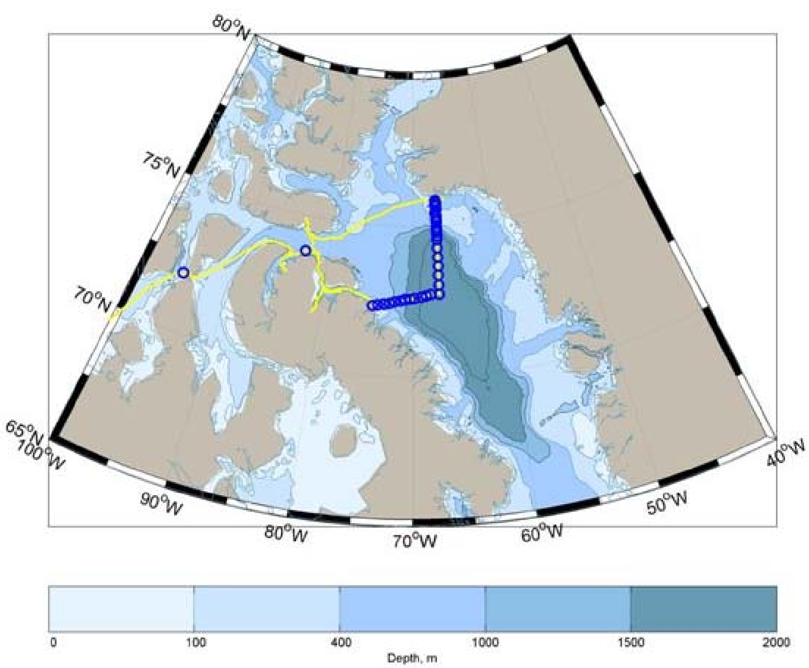


**Figure 5. Rosette/CTD casts on Leg 4**

Measurements:

- 38 CTD/Rosette Casts typically full ocean depth
- 510 Water Samples
  At all stations: Salinity, Oxygen, Nutrients, Barium, O-18, Bacteria, Alkalinity
  At selected stations: ChloroFluoroCarbons, Ammonium, Dissolved Inorganic Carbon
- 50 Drift Bottles
- 2 River water samples from the Coppermine River
- Observations and measurements of surface topography ripple formations in Bathurst Inlet

## 4. PROGRAM DESCRIPTION

### 4.1 Rosette/CTD Casts

**Figure 6. Rosette deployment.**

Rosette casts were taken with a Seabird SBE911+ CTD, equipped with dual temperature sensors, dual conductivity sensors, SBE43 oxygen probe, transmissometer, pumped fluorometer, bottom contact warning device and an altimeter. A second oxygen probe and transmissometer were added for part of the cruise. The rosette water sampler, SBE32, was configured with 24 10-liter Niskin bottles to take chemistry samples: Salinity, Dissolved Oxygen, Nitrate (NO3), Silicate (SiO4), Phosphate (PO4), Freon (11, 12, 113 and carbon-tetrachloride), Chlorophyll-a (filtered at 0.7 um with chlorophyll-a and phaeopigment values for each), Alkalinity, Oxygen-18 isotope (O18), Barium, and Bacteria. On selected casts we sampled Cesium-137, Iodine-129, Helium, Tritium, Particulate Organic Carbon (TOC), Dissolved Inorganic Carbon (DIC), Carbon-13 isotope (C-13), Ammonium and Total Suspended Solids (TSS).

For a typical cast, the CTD was powered on while still on the deck. The rosette package was lowered to 10m, the sensor pumps turned on and the package soaked for 3 minutes to equilibrate the oxygen sensor. The package was then raised to just below the surface and then lowered at 60m/minute to within 15m of the ocean floor. After closing the first bottle at the bottom of the cast, the package was raised at 60m/minute then slowed to 30m/minute for the upper 400m. Bottles were closed on the upcast without changing the ascent speed with the thought that this will capture water with a uniform vertical offset (approximately 1 m) instead of stopping the package for bottle closures which can result in variable 0 to 5m offsets, depending on the flow dynamics around the bottles. The bottle flushing around a stopped package is thought to be dependant on the ship rock and relative drift, which are both less favorable for bottle flushing when a ship is in ice.

In the upper 400m, the sample depths were chosen to match a set of salinity values. During the downcast, the depths of the salinity values were noted so that on the upcast the bottle could be closed at the pre-determined depths. The 113 CTD/Rosette cast location are listed in the appendix.

**Figure 7. Watch for icebergs**


**Figure 8. Nes Sutherland samples the rosette. (photo Jiao)**

Sampling took place immediately after each cast in the heated rosette room. The order of sampling was fixed, based on sampling water most susceptible to temporal changes first.

Dissolved Oxygen, Nutrients, Salinity, Freons, Alkalinity, and Ammonium were measured in laboratories on board. All other samples were prepared and stored for analysis on shore. Real-time analysis was critical for oxygen and ammonium and important for the others due to the higher accuracy achieved from the methods used with fresh samples. Analysis at sea also allows time to respond to problems with equipment or sampling methods that may only be noticed after looking at results.

**Figure 9. Michiyo Kawai measures alkalinity**

**Figure 10. Mary Steel measures dissolved oxygen**

**Figure 11. Hugh Maclean hangs a Niksin bottle on the foredeck net wire.**

While the ship's propulsion system was down we carried out CTD casts from the foredeck. The bubbler system was operational and could sweep ice out of the way as needed. We made section over the path of the ship drift over the Northwind Ridge with high spatial resolution. The equipment used was an internally recording SBE19 CTD configured with pumped temperature, conductivity and oxygen. The CTD was used on non-conducting wire and water samples were taken with 5L and 1.7L Niskin bottles attached to the wire and closed using weighted messengers.

The CTD/Rosette system had problems with two of the three oxygen sensors, but the third performed well throughout the cruise. CTD connectors had problems again with seawater leaks which we hope to change to wet-pluggable connectors next year. There were a few problems with Niskin bottles not closing due to the accumulation of grease in the pylon latches. Alternating between the primary and backup pylon to clean the removed pylon, improved the situation.

### 4.2 Vertical Net Tows (Leg 3)

Zooplankton sampling was performed using a modified Bongo net system. Two large bongo hoops were fitted with coarse mesh nets of 150µm and 236µm. A second set of smaller hoops were fitted perpendicular to the large hoops. These smaller hoops were fitted with finer 53µm mesh nets. The four nets were fitted with unidirectional flowmeters which measure the amount of water flowing through the hoops. Between cast the nets were stored on the foredeck in a box, built by the ship specifically to accommodate the bongo net. The vertical net tows were all to 100m.

Figure 12.  Zooplankton nets

Figure 13.  Helen Drost preserves zooplankton samples

Two casts to 100m were performed per station to collect enough samples for identification, DNA analysis and biomass measurements.  The samples from the first cast were preserved in formalin with the 53µm samples combined to form one sample.  From the second cast, the samples from the 236µm and combined 53µm nets were preserved in 100% ethanol, and the 150µm sample was washed with 4% ammonium formate and dried at 50$^{o}$C for 24 hours.  33 casts were performed at 14 stations.  Locations are listed in the appendix.

## 4.3  Light measurements (Leg 3)

Jiuxin Shi and Yutian Jiao, OUC (excerpts from report)

The physical and ecological profile in the upper ocean (above 150 m) are being observed in order to understand heating process in marginal ice zone and open water in the Arctic Ocean. Physical (temperature and salinity), optical (radiance, irradiance and turbidity), chemical (nutrient) and biological (phytoplankton) data were collected to find their connection in different regions, ice conditions, and heating status.

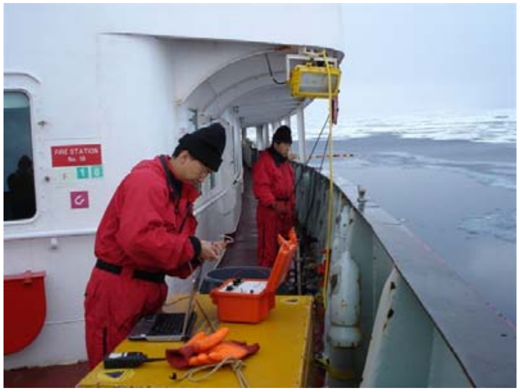

Figure 14.  PRR preparations

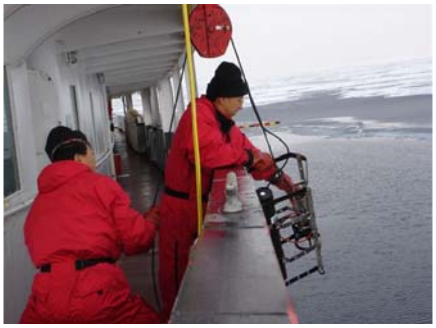

Figure 15.  PRR deployment

A high resolution Profiling Reflectance and Radiometer (PRR, 18 wavelengths at 313-875 nm) including profiler PRR800 (downwelling irradiance and upwelling radiance sensors) and surface sensor PRR810 (downwelling irradiance sensors) was used for optical observations in this cruise. A Compact-CTD (MCTD) with chlorophyll and turbidity sensors was used to collected reference data for the optical studies. PRR800 and MCTD were mounted on a frame and were lowered to about 100 m from ship at the side facing to the sun (or at any side when the sun is invisible). PRR810 was set up near the deployment location to observe the downwelling irradiance at surface for reference. PRR/MCTD profiling casts were conducted at most CTD/Rosette stations when light, open water and time were suitable. The sampling frequency of PRR800/810 is 5Hz and for MCTD is 10Hz. The deployment usually took 20 minutes and was conducted simultaneously with CTD/Rosette cast. Totally 51 casts were finished in this cruise.

4 kinds of samples for optical analysis were obtained by filtering a water sample: a film (diameter 47mm, aperture 0.7μm) for detritus (particulate), two films (25mm, 0.7μm; one in tinfoil, one in plastic box) for phytoplankton and a bottle of 100 mL water filtered through 0.2μm film for gelbstoff (yellow matter).Water samples at depth of 5 m, 20m and chlorophyll maximum were collected from Niskin bottles after CTD/rosette was on deck (referred as Phyto in the rosette sampling log). 82 films for detritus (particulate), 85*2 films for phytoplankton and 85 bottles filtered water samples for gelbstoff (yellow matter) were collected by filtering water samples at 29 CTD/Rosette stations. All the samples were kept in an icebox in the -20°C freezer at ship.

Surface sensor PRR810 was mounted at port side of foredeck to observe downwelling irradiance during August 14 and 26. Totally 178 hours data were recorded. The sampling interval was set as 60 seconds.

At ice floe, MCTD and PRR800 were lowered to the depth about 120 m successively in an ice hole. RR800 was sent into the ice hole by an under-ice frame to measure the irradiance and radiance under ice. Surface sensor PRR810 was mounted at ice surface to observe downwelling irradiance during PRR800 deployment. Above observations were conducted at 3 ice floes. Totally, 3 MCTD profiling casts, 1 PRR profiling cast, and 3 PRR under-ice observations were finished at 3 ice stations.

The location of these casts are listed in the appendix.

## 4.4 XCTD Casts (Legs 1, 2 and 3)

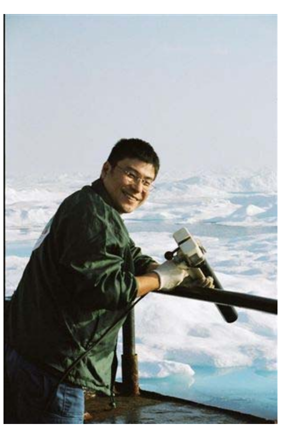

**Figure 16. Shigeto Nishino holds XCTD launcher**

XCTD (eXpendable Conductivity Temperature Depth) probes provided quick water profiles between more time intensive CTD casts. The probes were provided by JAMSTEC (Type XCTD-1 made by Tsurumi Seiki) and WHOI (Type XCTD-3). The probes were deployed from the stern of the ship, falling freely through the water and measuring temperature and conductivity every 0.15 m from the surface to 1100 m. Data were transmitted to the ship during the freefall by a thin conducting wire extending from the XCTD to an onboard computer. To prevent sea ice from cutting the wire of the XCTD, the ship slowed to 12 knots for the deployment in open water areas and completely stopped in heavy ice areas. It took 5 minutes for the XCTD to descend from the surface to 1100m.

According to the manufacturer's nominal specifications, the range and accuracy of parameters measured by the XCTD are as follows;

| Parameter | Range | Accuracy |
|---|---|---|
| Conductivity | 0 ~ 60 [mS/cm] | +/- 0.03 [mS/cm] |
| Temperature | -2 ~ 35 [deg-C] | +/- 0.02 [deg-C] |
| Depth | 0 ~ 1000 [m] | 5 [m] or 2 [%] (either of them is major) |

In this cruise, 30 XCTDs were launched into the Baffin Bay and 56 into the Canada Basin. Only 1 XCTD (Cast No. 38) failed to obtain the data which recorded anomalous values of temperature and conductivity. Locations are listed in the appendix.

**4.5 Moorings (Leg 3)**

Mooring operations were performed from the ship's foredeck using the starboard A-frame and WHOI provided LEBUS winch. Typical recovery procedure was to confirm the mooring's location at the mooring site, determine the ship's drift, open an ice free area and recover the mooring. New this year was the ability to attach the acoustic release deck unit into the ship's transducer. This means the surveys and release commands could all be performed from inside the forward lab. A rosette cast was performed at the site to help with calibration of the mooring's CTD. The set up for the mooring operation typically began in the morning with the actual release/deployment starting late morning. Three or more survey positions were obtained to pinpoint the mooring's location. The ship then broke ice for 1 to 2 hours over the mooring region, taking into account the predicted ice drift. After creating an ice free area over the given location the bridge would signal the deck team to release the mooring. The top float, only 50m below the surface, would appear within 30 seconds of being released. The float was hooked using the foredeck crane, brought on board and the line brought through the A-frame for recovery.

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Figure 17. The bridge during mooring operations

**Figure 18. Mooring recovery**

WHOI moorings A, B, C , D and BS-3, and the University of Alaska Fairbanks' CABOS mooring were put into the water August 2005, each carrying a profiling CTD and current meter ( McLane Moored Profiler, MMP) except for BS-3 which only has a CTD. These moorings were recovered, and except for the BS-3 mooring, were serviced and redeployed. Buoy locations are listed in the appendix.

The mooring operations were completed successfully. The difficulty of working in ice covered waters means there is the chance the mooring will come up under the ice. Two of the six moorings did come up under the ice, however with patience they were found and recovered. In the first case the mooring was recovered by bringing in the bottom set of floats first and retrieving the top float imbedded under multi-year ice last. The latter mooring's top float just took a little while to work its way to the surface and then was caught the standard way. Resulting design modifications for next year will have a transponder below the top float to will allow easy ranging before and after release. New this year was the option to connect the release's acoustic deck unit to the ship's sounder allowing communication to the releases from the ship's forward lab. The only difficulty is that bubbles under the hull from the bubbler and thrusters interfere with the communication. Thus timing the mooring release with ship position and ice cover takes more care. The moored profilers had all climbed their scheduled distances for the year except the for the CABOS profiler which unfortunately was incorrectly ballasted and meant the profiler did not have the ability to profile below the pycnocline.

### 4.6 Buoys (Leg 3)

Buoys were set up at three sites this year along the northern range of our study area. There sites were chosen for ice thickness (over 3m), protective ridging and location. The northwest buoy is likely to stay fairly stationary in the centre of the sea-ice gyre while the northeast set will likely drift southwest through the Canada Basin. There is an ice-tethered profiler (ITP) at each of the buoy sites. The northeast buoy site has additional buoys installed: ice mass balance buoy (IMBB), an Arctic Ocean Heat Flux (AOHF) buoy, and 6 GPS buoys in a 20nm radius ring around the other three.

**Figure 19. Buoy preparations**

**Figure 20. Profiler being deployed**

The buoys were all deployed using helicopter assistance to and from the ice. To install the ITPs, a hole was drilled; a gantry system set over the hole to assist in the lowering of the underwater portion of the buoy and positioning of the surface part; and then the gantry was removed. One of the two ITP/IMBBs deployed in 2005 was not far off the cruise track and a recovery was attempted. The attempt showed that different gear would be needed to successfully recover the buoy, in particular a gantry system that could be set up in a melt pond which may typically form around the buoy.

A couple setbacks were encountered during deployments: The first deployment was into a floe that contained a void which unfortunately trapped the anchor before it could be pulled back out. The anchor was cut off and the line brought in. A new termination and anchor were needed before it could be redeployed. The second try at this northwest corner was worse. The installation went well, but only after we left the site was it determined the profiler was not communicating with the buoy. There is a chance the profiler is working and saving data to memory although it is slim. The AOHF buoy also had a problem. It had the wrong startup information for the ADCP. An attempt was made to return to the site and correct the information however, due to the drifting ice, we were not able to find the buoy with the limited amount of time available.
Buoy deployment locations are listed in the Appendix.

## 4.7 Ice Observations (Leg 3)

Jennifer Hutchings, IARC (excerpts from report)

Ice observations recording during the cruise will provide detailed information for the interpretation of satellite imagery of the ice pack. Our objective was to identify the major sea ice zones in the Beaufort Sea and determine the types and state of ice in these zones. This information will be used to support a joint drifting-buoy, RADARSAT SAR and field campaign to investigate sea ice dynamics in the Beaufort Sea during winter 2006 to spring 2007. The project, “Sea ice tide-inertial interaction: Observations and Modeling” is funded by the National Science Foundation, with PIs Jenny Hutchings and Bill Hibler. The observations from this cruise will also support a field project “Detailed investigation of the dynamic component of the sea ice mass balance” during spring 2007, with PIs

Jenny Hutchings, Jackie Richter-Menge and Cathy Geiger. We anticipate that the observations will be useful for investigating the evolution of the ice cover over this summer.

The cruise occurred over the time of minimum ice extent, providing a snapshot of ice conditions at the end of the 2006 melt season.

**GPS Buoy Deployment**

The prime objective of our project, deployment of a GPS buoy ice deformation array, was successfully completed. This buoy array will monitor pack ice strain rate of a 20mile region about a central autonomous buoy site, with 10 minute frequency.

***Observations from Bridge: Methodology***

Every hour, while the ship was steaming and light conditions allowed, an observation of ice conditions was recorded. Each observation was made from the bridge, and unless the weather was unusually foul the observer gauged ice coverage from the monkey island. Photos were taken to compliment observations, and are available on request from Jennifer Hutchings. Please contact Jennifer Hutchings should you wish to use the ice observations

***Aerial Ice Observations***

At various times during the cruise we had the opportunity to observe the ice cover from helicopter. In flying conditions when visibility was good, and the helicopter could travel at an altitude of 2000 feet, these flights were very helpful in extrapolating ship based observations to the wider field. During flights, notes were taken of ice coverage, distribution of types and state of melt. Photographs were taken as a record of ice conditions. In the compact region of pack ice above 76N, a handheld GPS with data logger was used to record the positions of leads and cracks along track. The orientation of these features was also recorded. This information will be used to support development of fracture models of pack ice.

***Observations taken on ice stations***

Transects of ice thickness, snow depth and melt pond depth can provide additional information about ice conditions that is not possible to gauge with shipboard methods. We had two objectives for ice station work: (1) to determine the mean level ice thickness and variability at point locations during the cruise, and (2) to investigate surface melt conditions in support of the albedo model development of Don Perovich, and to provide information about the progress of this summers melt.  The most important component of our ice station work was to compliment the deployment of a cluster of six ice drifting buoys that will monitor ice deformation (the IARC GPS drifters) around an Ice Mass Balance Buoy (in collaboration with Cold Regions Research and Engineering Laboratory) that will monitor the thermodynamic evolution of the multi-year ice in the center of the buoys array.

## 4.8  Seismic array tows (Leg 3)

The primary objective of the seismic program was to test the air-gun seismic array’s performance on the *CCGS Louis S St-Laurent* in the variable ice conditions of the

Canada Basin. If data collection was possible, the secondary objective was to collect as much seismic data along the most useful portions of the pre-established cruise track. These portions were broken into priority lines 1 through 5. The primary objective was completed and short portions of the priority lines were collected. The quality of the data may not be suitable for the final UNCLOS report however its indication of the sediment depth may be useful in planning future seismic surveys.

The tow-sled operations were staged on the quarterdeck and lab space was made in the AVGAS hold. The sled held three air-guns and was lowered just off the stern of the ship into approximately 10m of water. The hydrophone array, protected in a long clear plastic hose, was trailed off behind the sled. A compressor on the boat deck fed the airguns, which fired approximately every 20 seconds. The data from the sled and hydrophone array were fed to the lab computers in real time.

**Figure 21. The tow sled being deployed.**

**Figure 22. The burst of bubbles from the airguns.**

Towing periods were preferably long to reduce the number of deployments and recoveries with the ship's cranes. The merging of the seismic and Rosette/Mooring programs worked best when the tows could be carried out overnight between the rosette stations (12 hours at 5knts) with day time dedicated to mooring and buoy operations. This of course was only reasonable to do in mild ice conditions and after the system had been through a few test tows.

### 4.9 Mammal and bird observations (Leg 3)

Two wildlife observers stood watches daily above the bridge to record bird and mammal sightings. These sightings will be collated and mapped to indicate unique feeding areas. The oceanographic conditions of these regions will be examined to identify whether special bathymetric or other physical processes can explain aggregation behaviour. The observers stood three two-hour watches daily unless there were seismic operations. During seismic operations, night or day, the observers were on constant watch in order to report any marine mammals in the vicinity which would require the air-gun firing to stop. Additionally, the observers were there to report any disturbance of the marine mammals due to science activity so that we could modify our activity or ship track as needed.

**Figure 23. Wildlife observer, Ian Green takes a coffee break.**

### 4.10 Drift-Bottle deployments (Legs 2-4)

This is simple science at its best. Numbered bottles with messages inside were tossed over the side, typically with each CTD cast. In two years we expect to start hearing back as people find these bottles washed up on shore. From the returned information, the starting and ending positions, probable route and a maximum transit time can be determined.

**Figure 24. Message and bottle shown by Kristina Brown and Michiyo Kawai**

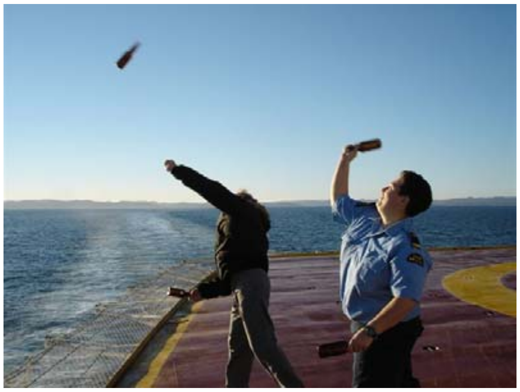

**Figure 25. Drifter deployment by Michele Dubois and Catherine Lacombe**

### 4.11 Opportunistic Study

River samples from Kugaryuak and Coppermine Rivers

The fresh river water flowing into the archipelago has a geo-chemical signature. Taking samples from the river allows us to measure these signatures. This year, we had the opportunity to measure both the Kugaryuak and Coppermine Rivers.

Land ripples in Bathurst Inlet

During the transit through Coronation Gulf, a side trip was made for observations of an interesting area previously visited in 1997. The land 'ripples' or 'ropey rocks' (Eddy Carmack) were present on all the islands in the vicinity. Observations included photos, measurements of the wave length and height, rock composition and size, and lichen and plant collection. Prior research by Wes Blake in the 1960's of this area says the interesting features are raised gravel beaches. This is consistent with our observations.

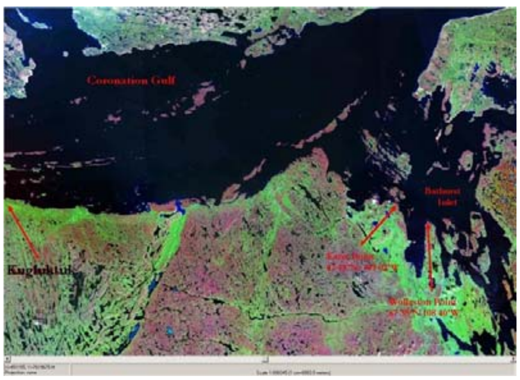


**Figure 26. Map showing areas of Bathurst Inlet with Ripples.**

**Figure 27. Example of the ripples.**

## 5. COMMENTS ON OPERATION

### 5.1 Ice conditions

The unusual ice conditions this year began with the easy passage through the Canadian Archipelago especially in Larsen Sound south to Victoria Strait. The past two years this section has been landfast ice at the end of July requiring much effort on the part of the first ship through each year (Louis S St-Laurent in 2004 and the Oden in 2005). The station plan had been to sample through Bellot Strait during Leg2, but due to mobile ice packed into the strait by winds we changed the station locations to measure the western end, in and outside of the strait in addition to the periodic stations along the cruise track.

The Canada Basin ice conditions were as expected in the southeast, providing good testing ground for the seismic tow sled in ice. To the west, along the 150W line the ice was quite thick. Interestingly the heavy ice was limited to the southern (up to approximately 74degN) region. Between 75 and 76degN we encountered open water, extending from the west and progressively opening farther to the east during the month so that on our return south along 140degW we went across the same band of open water. The ice analysis charts below show the change from the start to the end of Leg 3 in the Canada Basin. The melt at 75degN is quite pronounced. For comparison a 2004 ice analysis chart is also shown below.

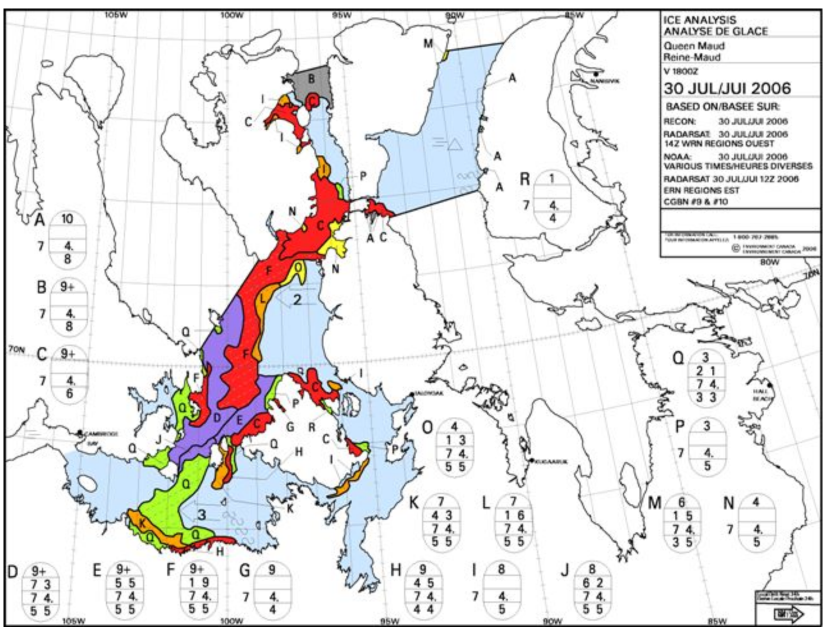


**Figure 28. Ice concentration with many areas of open water in the North-West Passage on Leg 2.**

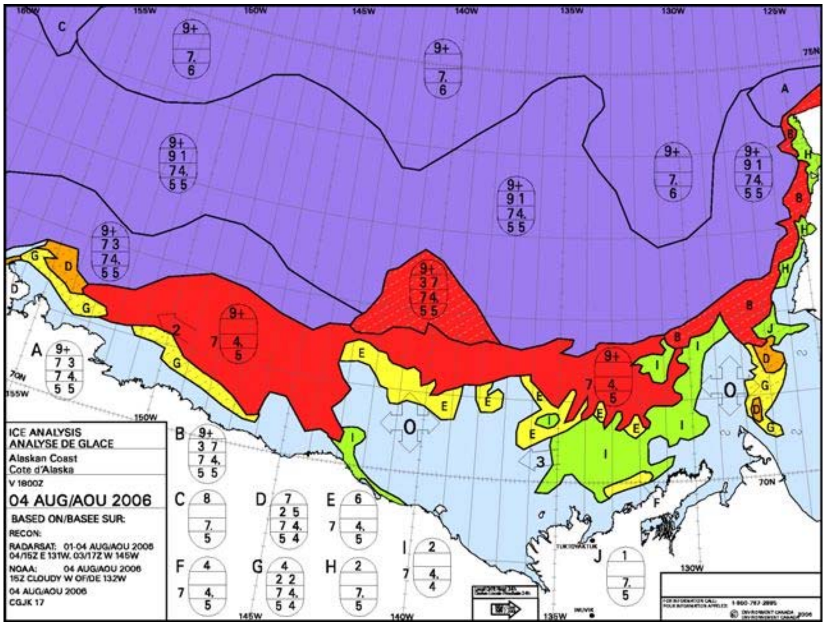


**Figure 29. Ice concentration at the start of Leg 3**

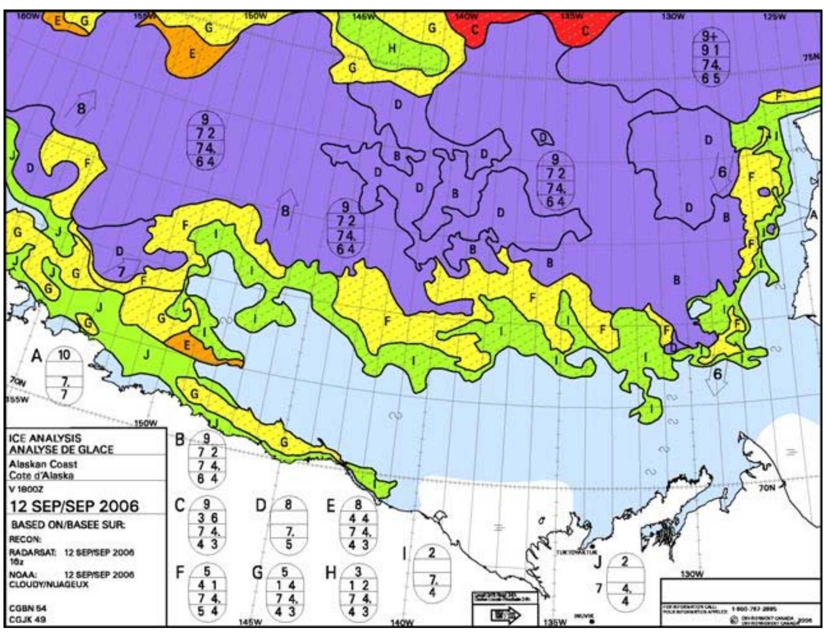


**Figure 30. Ice concentration at the end of Leg 3**

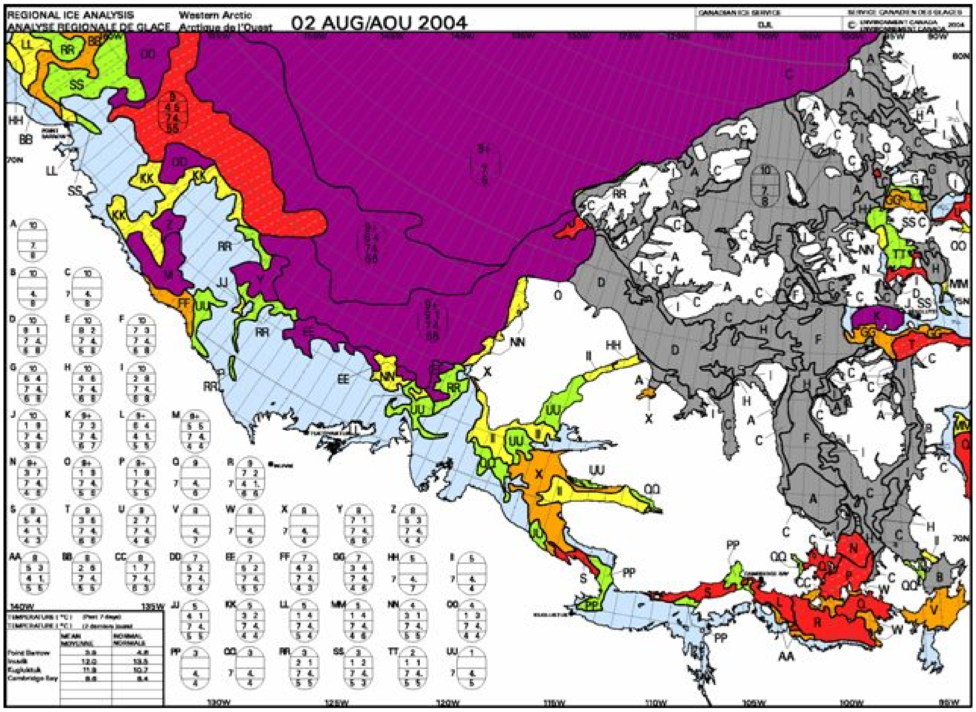


**Figure 31. Ice concentration in 2004 shows landfast ice through Larsen Sound.**

## 5.2 Planned activities that were not completed

The loss of ship time during Leg 3 impacted the number of rosette casts and mooring and buoy operations. The 42 day program was reduced by 10.5 days due to a change in flight time due to flight availability (2 days), repairs to the ship's propulsion system (4.5 days) and two medical evacuations (4 days).

The accumulated delays put quite a lot of pressure on science and crew to maximize the remaining time. Captain McNeill's support and assistance with juggling the order and timing of operations to take into account ice, weather, daylight, equipment and personnel was much appreciated. The officers and crew were very helpful working long days, sometimes in difficult weather to get as much science done as possible. We were fortunate that in both 2005 and 2006 the ship was able to make the repairs while at sea.

## 5.3 Improvements completed for 2006

The 2004 and 2005 science programs produced "wish lists" for the continued improvement of the ship's science capability. The ship has done an impressive job of addressing all of these requests. Some highlighted outcomes are:

- For CTD work there is a dedicated winch with 5000m of new conducting wire. This year brought the addition of an instrumented sheave with integrated displays for the CTD and winch operators, the bridge and the main lab.

- A new deepwater sounder with automated data collection. This is a significant improvement to the 2005 method of hand lowering a transducer over the side to take a point measurement for depth! The new system is configured to allow the mooring acoustic release deck units to attach to the transducer from the forward lab, easing mooring operations considerably.

- A new rosette sampling lab.

- There is now a computer data collection system that records and integrates underway measurements (currently meteorological, navigational and depth)

- Improved local area network system with drops to the science workspaces and many of the cabins used by the science group in addition to new computer work area in the ship's board room.

- Improvements to the foredeck starboard crane to ease with mooring operations

## 6. ACKNOWLEDGMENTS

The science team would like to thank the Coast Guard for their support and particularly the Captains and Crew of the *CCGS Louis S. St-Laurent*. Once again we have seen the accomplished and dedicated crew successfully handle problems as small as filling in a door gap to as large as fixing the ship's propulsion system. The care with which the ship is kept a comfortable and productive place to work is much appreciated. We'd also like to thank the Canadian Ice Service for their assistance with ice images and weather information as well as the helicopter pilots and mechanics for their valuable help with ice observations and transport. Thanks go to the *CCGS Sir Wilfrid Laurier* for transporting much or our equipment back to Victoria after the completion of Leg 3. Vera Williams' help with Danish clearance was crucial to our Leg 4 program. Importantly, we'd like to acknowledge DFO, NSF and JAMSTEC for their continued backing of this program.

## APPENDIX A: Participants

**Leg 1** Jane Eert, IOS
Borden Chapman, NRCan
Ryan Pike, NRCan

**Leg 2** Marty Bergmann, FWI
Eddy Carmack, IOS
Sarah Zimmermann, IOS
Jane Eert, IOS
Borden Chapman, NRCan
Ryan Pike, NRCan

**Leg 3**

| | |
|---|---|
| Sarah Zimmermann | IOS |
| Mary Steel | IOS |
| Linda White | IOS |
| Nes Sutherland | IOS |
| Michiyo Kawai | IOS |
| Kristina Brown | IOS |
| Jane Eert | IOS |
| Michael Dempsey | IOS |
| Jennifer Jackson | UBC |
| Hugh Maclean | IOS |
| Helen Drost | IOS |
| Shigeto Nishino | JAMSTEC |
| Richard Krishfield | WHOI |
| William Ostrom | WHOI |
| Kris Newhall | WHOI |
| Jennifer Hutchings | IARC |
| Patrick McKeown | IARC |
| Abigail Spieler | Lamont Doherty Earth Observatory |
| Juxin Shi | Ocean U. China |
| Yutian Jiao | Ocean U. China |
| Borden Chapman | NRCan |
| Thomas Funk | Denmark |
| Ryan Pike | NRCan Student |
| Joe Manning | DFO/Maritime |
| Joe Illasiak | NRCan |
| Ian Green | NRCan |

Leg 4 Sarah Zimmermann, IOS
Michiyo Kawai, IOS
Mary Steel, IOS
Nes Sutherland, IOS
Kristina Brown, IOS

Helen Drost, IOS
Vera Williams, FWI

**Participating Investigators on Shore**

| | Name | Affiliation | Program |
|---|---|---|---|
| Leg 1-4 | Fiona McLaughlin | IOS | CTD and chemistry |
| Leg 1-4 | Eddy Carmack | IOS | CTD and chemistry |
| Leg 3 | Andrey Proshutinsky | WHOI | WHOI moorings |
| Leg 1-3 | Koji Shimada | JAMSTEC | XCTD |
| Leg 2-4 | Chris Guay | OSU | Barium samples |
| Leg 2-4 | Bill Li | BIO | Bacteria samples |
| Leg 3 | John Smith | BIO | Cs-137 and I-129 samples |
| Leg 3 | Bob Newton | LDEO | Helium and Tritium samples |
| Leg 3 | Jinping Zhao | OUC | Light absorption in seawater |
| Leg 3 | Russ Hopcroft | UAF | Zooplankton net tows |
| Leg 3 | John Nelson | UVic/DFO | Zooplankton net tows |
| Leg 3 | Igor Polyakov | IARC | CABOS mooring |
| Leg 3 | Rob Chadwell | IARC | CABOS mooring technician |
| Leg 3 | Robert Pickart | WHOI | BS-3 mooring |
| Leg 3 | Ruth Jackson | NRCan | Seismic |
| Leg 4 | Kelly Falkner | OSU | CTD and chemistry |
| Leg 4 | Humfrey Melling | IOS | CTD and chemistry |

Affiliation Abbreviation

| | |
|---|---|
| BIO | Bedford Institute of Oceanography, NS |
| DFO | Department of Fisheries and Oceans, Canada |
| IARC | International Arctic Research Center, Alaska |
| IOS | Institute of Ocean Sciences, BC |
| JAMSTEC | Japan Agency for Marine-Earth Science Technology, Japan |
| LDEO | Lamont Doherty Earth Observatory, NY |
| OSU | Oregon State University, OR |
| OUC | Ocean University China |
| NRCan | Natural Resources Canada |
| UAF | University of Alaska Fairbanks, Alaska |
| UBC | Univerisity of British Columbia, BC |
| UVic | University of Victoria, BC |
| WHOI | Woods Hole Oceanographic Institution, Massachusetts |

# APPENDIX B: Science Station Locations

## Rosette/CTD Casts

| Leg | Cast # | Station | CAST START TIME (UTC) | Lat Deg (N) | Lat Min (N) | Lon Deg (W) | Lon Min (W) | Water Depth (m) from CTD data | Approx. Cast Depth (m) | Sample #'s |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | PE1 | 7/29/2006 12:41 | 74 | 14.6 | 95 | 23.03 | 211 | 200 | 1-8 |
| 2 | 2 | PE3 | 7/29/2006 17:18 | 73 | 42.8 | 96 | 5.08 | 249 | 235 | 9-15 |
| 2 | 3 | PE5 | 7/29/2006 23:04 | 72 | 55.6 | 96 | 12.43 | 351 | 345 | 16-23 |
| 2 | 4 | Bellot | 7/30/2006 12:52 | 71 | 58.5 | 95 | 1.27 | 229 | 181 | 24-34 |
| 2 | 5 | BE3 | 7/30/2006 17:15 | 71 | 57.4 | 95 | 15.39 | 132 | 125 | 35-41 |
| 2 | 6 | BE3A | 7/30/2006 19:03 | 71 | 49.9 | 96 | 0.83 | 426 | 422 | 42-50 |
| 2 | 7 | 7 | 7/31/2006 12:46 | 69 | 49.3 | 99 | 19.73 | 111 | 106 | 51-55 |
| 2 | 8 | QM1 | 8/2/2006 4:51 | 68 | 52.6 | 101 | 52.01 | 56 | 51 | 56-60 |
| 2 | 9 | QM2 | 8/2/2006 7:47 | 68 | 40 | 103 | 0.4 | 120 | 111 | 61-64 |
| 2 | 10 | CCG1 | 8/4/2006 14:50 | 68 | 6.04 | 114 | 15.71 | 219 | 214 | 65-70 |
| 3 | 11 | AG5 | 8/7/2006 17:58 | 70 | 32.9 | 122 | 54.86 | 645 | 635 | 73-94 |
| 3 | 12 | CABOS | 8/8/2006 19:12 | 71 | 49 | 131 | 46.47 | 1109 | 231 | 95-109 |
| 3 | 13 | CABOS | 8/8/2006 20:55 | 71 | 48.5 | 131 | 46.61 | 1102 | 1089 | 110-133 |
| 3 | 14 | CB28a | 8/10/2006 7:05 | 70 | 29.9 | 139 | 59.95 | 652 | 272 | 134-146 |
| 3 | 15 | CB28a | 8/10/2006 9:01 | 70 | 30.1 | 140 | 0.01 | 657 | 655 | 147-170 |
| 3 | 16 | CB29 | 8/11/2006 1:25 | 71 | 59.9 | 139 | 58.63 | 2674 | 2665 | 171-194 |
| 3 | 17 | CB28bb | 8/11/2006 13:10 | 71 | 14.9 | 140 | 0.28 | 2285 | 2260 | 195-218 |
| 3 | 18 | Sta-A | 8/12/2006 7:32 | 71 | 47.3 | 143 | 56.33 | 3160 | 3146 | 219-242 |
| 3 | 19 | Sta-A | 8/12/2006 13:34 | 71 | 46.7 | 143 | 58.12 | 3167 | 1000 | 243-266 |
| 3 | 20 | BS-3 | 8/13/2006 20:44 | 71 | 23.9 | 152 | 3.11 | 153 | 147 | 267-282 |
| 3 | 21 | BS-3a | 8/13/2006 23:41 | 71 | 19.8 | 152 | 12.64 | 60 | 54 | 283-292 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 22 | BS-3b | 8/14/2006 3:32 | 71 | 32 | 151 | 35.55 | 1283 | 1273 | 293-315 |
| 3 | 23 | BS-3c | 8/14/2006 9:45 | 71 | 43.4 | 151 | 0.01 | 2263 | 205 | 316-321 |
| 3 | 24 | BS-3c | 8/14/2006 10:46 | 71 | 43.7 | 151 | 0.36 | 2263 | 2250 | 322-345 |
| 3 | 25 | BS-3d | 8/14/2006 21:47 | 72 | 1.37 | 150 | 0.08 | 3162 | 3153 | 346-369 |
| 3 | 26 | CB-2a | 8/15/2006 7:56 | 72 | 27.9 | 150 | 0.47 | 3717 | 3708 | 370-393 |
| 3 | 27 | CB2 | 8/15/2006 19:21 | 72 | 57.8 | 149 | 56.25 | 3744 | 3734 | 394-417 |
| 3 | 28 | CB3 | 8/16/2006 12:52 | 73 | 59.7 | 150 | 1.47 | 3823 | 3809 | 418-441 |
| 3 | 29 | CB-5d | 8/18/2006 20:50 | 75 | 44.1 | 157 | 12.49 | 920 | 912 | 442-465 |
| 3 | 30 | CB-5b | 8/19/2006 0:09 | 75 | 35.3 | 156 | 17.05 | 1824 | 1814 | 466-489 |
| 3 | 31 | CB5b1 | 8/19/2006 15:40 | 75 | 32.6 | 156 | 15.83 | 1887 | 800 | ctd only |
| 3 | 32 | CB5b2 | 8/19/2006 21:27 | 75 | 31.4 | 156 | 11.15 | 2025 | 996 | ctd only |
| 3 | 33 | CB5b3 | 8/20/2006 3:00 | 75 | 29.9 | 156 | 11.94 | 2000 | 1000 | ctd only |
| 3 | 34 | CB5b4 | 8/20/2006 9:18 | 75 | 28.6 | 156 | 12.16 | 2118 | 999 | ctd only |
| 3 | 35 | CB5b5 | 8/20/2006 17:22 | 75 | 27.7 | 156 | 16.92 | 1894 | 784 | 490-496 |
| 3 | 36 | aborted rosette cast | | | | | | | | |
| 3 | 37 | CB5b7 | 8/21/2006 11:35 | 75 | 26.4 | 156 | 30.94 | 1330 | 995 | ctd only |
| 3 | 38 | CB5b8 | 8/21/2006 19:20 | 75 | 26.4 | 156 | 41.9 | 1398 | 1013 | 497-505 |
| 3 | 39 | CB5b9 | 8/22/2006 8:35 | 75 | 27.8 | 156 | 58.25 | 1409 | 996 | 506-513 |
| 3 | 40 | CB5b10 | 8/22/2006 19:51 | 75 | 28.6 | 157 | 10.07 | 1386 | 500 | 514-534 |
| 3 | 41 | CB5b11 | 8/23/2006 7:00 | 75 | 27.8 | 157 | 16.04 | 1306 | 999 | ctd only |
| 3 | 42 | CB5b12 | 8/23/2006 12:08 | 75 | 27.4 | 157 | 15.57 | 1326 | 1319 | 536-559 |
| 3 | 43 | CB5a | 8/23/2006 20:55 | 75 | 33.6 | 155 | 34.53 | 3842 | 3832 | 560-583 |
| 3 | 44 | CB5a | 8/23/2006 23:15 | 75 | 33.5 | 155 | 37.3 | 3842 | 50 | 584-588 |
| 3 | 45 | CB-5 | 8/24/2006 4:24 | 75 | 19.2 | 153 | 16.2 | 3840 | 3835 | 589-612 |
| 3 | 46 | CB-4 | 8/24/2006 14:15 | 74 | 59.2 | 150 | 1.95 | 3825 | 3815 | 613-636 |
| 3 | 47 | CB-4 | 8/25/2006 0:36 | 74 | 59.1 | 150 | 3.77 | 3825 | 500 | 637-658 |
| 3 | 48 | Barrow | 8/26/2006 16:50 | 71 | 20.8 | 156 | 51.37 | 53 | 49 | 659-672 |
| 3 | 49 | CB-7 | 8/29/2006 8:19 | 76 | 0.22 | 149 | 59.36 | 3829 | 3820 | 673-696 |
| 3 | 50 | CB-8 | 8/29/2006 | 76 | 57.5 | 149 | 52.96 | 3825 | 3814 | 697-720 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19:19 | | | | | | | |
| 3 | 51 | CB-9 | 8/30/2006 8:01 | 77 | 59 | 149 | 52.26 | 3822 | 1000 | 721-744 |
| 3 | 52 | CB-9 | 8/30/2006 10:46 | 77 | 59 | 149 | 52.22 | 3822 | 3813 | 745-768 |
| 3 | 53 | CB10 | 8/31/2006 5:04 | 78 | 18.1 | 153 | 12.57 | 2455 | 2444 | 769-792 |
| 3 | 54 | CB10a2 | 8/31/2006 9:12 | 78 | 20.6 | 153 | 29.08 | 1907 | 1000 | 793-816 |
| 3 | 55 | CB10a2 | 8/31/2006 11:09 | 78 | 20.6 | 153 | 28.98 | 1907 | 1847 | 817-840 |
| 3 | 56 | CB10a | 8/31/2006 16:11 | 78 | 19.4 | 154 | 4.1 | 1005 | 994 | 841-864 |
| 3 | 57 | CB11 | 9/1/2006 14:08 | 79 | 0.44 | 149 | 59.64 | 3817 | 3808 | 865-888 |
| 3 | 58 | CB12 | 9/3/2006 6:38 | 77 | 42.4 | 146 | 48.67 | 3811 | 1000 | 889-912 |
| 3 | 59 | CB12 | 9/3/2006 8:43 | 77 | 42.6 | 146 | 46.1 | 3811 | 3803 | 913-936 |
| 3 | 60 | CB13 | 9/3/2006 18:20 | 77 | 19.4 | 143 | 30.51 | 3786 | 3777 | 937-960 |
| 3 | 61 | CB16 | 9/4/2006 6:39 | 77 | 55.1 | 140 | 5.15 | 3748 | 3739 | 961-984 |
| 3 | 62 | CB16 | 9/4/2006 11:47 | 77 | 52.5 | 140 | 7.81 | 3743 | 455 | 985-1001 |
| 3 | 63 | CB15 | 9/5/2006 10:45 | 77 | 0.64 | 139 | 52.66 | 3727 | 3717 | 1002-1025 |
| 3 | 64 | CB14a | 9/6/2006 5:37 | 77 | 10.8 | 138 | 52.32 | 3717 | 1000 | 1026-1045 |
| 3 | 65 | CB15 | 9/6/2006 9:41 | 77 | 1.03 | 139 | 56.27 | 3732 | 1000 | 1047-1070 |
| 3 | 66 | CB17 | 9/7/2006 13:23 | 75 | 57.2 | 140 | 5.57 | 3708 | 3698 | 1071-1094 |
| 3 | 67 | CB18 | 9/8/2006 4:01 | 75 | 1.24 | 140 | 1.84 | 3630 | 3628 | 1095-1118 |
| 3 | 68 | CB21 | 9/8/2006 19:56 | 74 | 0.75 | 140 | 7.97 | 3528 | 3518 | 1119-1142 |
| 3 | 69 | CB19 | 9/9/2006 14:50 | 74 | 19.2 | 143 | 10.79 | 3693 | 451 | 1143-1161 |
| 3 | 70 | GF'06 | 9/10/2006 21:44 | 74 | 15.1 | 136 | 14.22 | 3215 | 3206 | 1162-1185 |
| 3 | 71 | CB22 | 9/11/2006 5:49 | 73 | 30.5 | 137 | 50.68 | 3167 | 3158 | 1186-1209 |
| 3 | 72 | CBMED 1 | 9/12/2006 0:11 | 70 | 59.9 | 133 | 45.93 | 136 | 130 | 1210-1223 |
| 3 | 73 | CBMED 2 | 9/12/2006 1:55 | 71 | 7.98 | 133 | 44.07 | 480 | 474 | 1224-1247 |
| 3 | 74 | CB31a | 9/12/2006 8:16 | 72 | 6.18 | 133 | 15.32 | 1772 | 1763 | 1248-1271 |
| 3 | 75 | CABOS | 9/12/2006 16:36 | 71 | 49.7 | 131 | 45.96 | 1115 | 1108 | 1272-1295 |
| 4 | 76 | Bellot | 9/18/2006 19:42 | 71 | 57.4 | 95 | 14.9 | 45 | | ctd only |
| 4 | 77 | LS-1 | 9/21/2006 17:58 | 73 | 51 | 82 | 48.04 | 755 | 750 | 1296-1307 |
| 4 | 78 | BEW-11 | 9/22/2006 | 72 | 20.9 | 74 | 23.96 | 106 | 101 | 1308-1314 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 12:30 | | | | | | | |
| 4 | 79 | BEW-10 | 9/22/2006 15:12 | 72 | 22.9 | 73 | 49.5 | 153 | 148 | 1315-1322 |
| 4 | 80 | BEW-09 | 9/22/2006 17:51 | 72 | 24.9 | 73 | 9.91 | 679 | 674 | ctd only |
| 4 | 81 | BEW-09 | 9/22/2006 19:11 | 72 | 24.5 | 73 | 8.09 | 701 | 695 | 1323-1341 |
| 4 | 82 | BEW-08 | 9/22/2006 22:25 | 72 | 27.1 | 72 | 34.39 | 899 | 892 | 1342-1363 |
| 4 | 83 | BEW-07 | 9/23/2006 2:50 | 72 | 30 | 71 | 59.89 | 1035 | 1028 | 1364-1385 |
| 4 | 84 | BEW-06 | 9/23/2006 7:46 | 72 | 32.4 | 71 | 20.59 | 1214 | 1204 | 1386-1409 |
| 4 | 85 | BEW-05 | 9/23/2006 12:22 | 72 | 35.2 | 70 | 50 | 1471 | 300 | ctd only |
| 4 | 86 | BEW-05 | 9/23/2006 16:41 | 72 | 34.3 | 70 | 49.59 | 1471 | 1464 | 1411-1434 |
| 4 | 87 | BEW-04 | 9/23/2006 23:11 | 72 | 37.5 | 69 | 46.45 | 1833 | 1826 | 1435-1458 |
| 4 | 88 | BEW-04.5 | 9/24/2006 4:35 | 72 | 35.8 | 70 | 16.23 | 1711 | 1702 | ctd only |
| 4 | 89 | BEW-03 | 9/24/2006 8:37 | 72 | 40 | 68 | 59.7 | 2061 | 2052 | 1459-1482 |
| 4 | 90 | BEW-02 | 2006/09/24 16:40 | 72 | 45 | 67 | 57.93 | 2279 | 2273 | 1483-1506 |
| 4 | 91 | BEW-02.5 | 2006/09/24 22:01 | 72 | 42.6 | 68 | 28.37 | 2202 | 2213 | ctd only |
| 4 | 92 | B-01 | 2006/09/25 02:05 | 72 | 45.1 | 67 | 0.07 | 2367 | 2362 | 1507-1530 |
| 4 | 93 | B-01 | 2006/09/25 14:23 | 72 | 45.1 | 67 | 0.35 | 2368 | 2359 | ctd only |
| 4 | 94 | B-01 | 2006/09/25 19:26 | 72 | 44.7 | 67 | 2.4 | 2367 | 150 | 1531-1536 |
| 4 | 95 | BNS-02 | 2006/09/25 22:08 | 73 | 3.03 | 67 | 0.09 | 2366 | 2356 | 1537-1560 |
| 4 | 96 | BNS-03 | 2006/09/26 04:33 | 73 | 22.6 | 67 | 1.32 | 2350 | 2340 | 1561-1584 |
| 4 | 97 | BNS-04 | 2006/09/26 12:11 | 73 | 40.8 | 67 | 0.02 | 2348 | 2320 | 1585-1608 |
| 4 | 98 | BNS-05 | 2006/09/26 19:08 | 73 | 57.9 | 67 | 0.43 | 2238 | 2228 | 1609-1632 |
| 4 | 99 | BNS-06 | 2006/09/27 02:06 | 74 | 16.9 | 67 | 0.41 | 2206 | 2198 | 1633-1656 |
| 4 | 100 | BNS-07 | 2006/09/27 10:09 | 74 | 33 | 66 | 59.83 | 2131 | 2102 | 1657-1680 |
| 4 | 101 | BNS-07.5 | 2006/09/27 15:09 | 74 | 40 | 66 | 59.6 | 2082 | 2074 | ctd only |
| 4 | 102 | BNS-08 | 2006/09/27 18:05 | 74 | 47 | 66 | 59.94 | 1695 | 1688 | 1681-1704 |
| 4 | 103 | BNS-08.5 | 2006/09/27 23:07 | 74 | 52.5 | 67 | 0.05 | 1263 | 1254 | ctd only |
| 4 | 104 | BNS-09 | 2006/09/28 02:08 | 74 | 58 | 67 | 0.04 | 663 | 653 | 1705-1723 |
| 4 | 105 | BNS-10 | 2006/09/28 10:09 | 75 | 8.16 | 66 | 59.52 | 482 | 473 | 1725-1742 |
| 4 | 10 | BNS- | 2006/09/28 | 75 | 13.5 | 66 | 59.84 | 456 | 452 | ctd only |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 10.5 | 17:07 | | | | | | | |
| 4 | 10<br>7 | BNS-11 | 2006/09/28<br>18:25 | 75 | 18.9 | 67 | 0 | 426 | 421 | 1743-1760 |
| 4 | 10<br>8 | BNS-<br>11.5 | 2006/09/28<br>21:37 | 75 | 25 | 67 | 7.69 | 424 | 419 | ctd only |
| 4 | 10<br>9 | BNS-12 | 2006/09/28<br>23:08 | 75 | 32 | 66 | 59.96 | 398 | 392 | 1761-1778 |
| 4 | 11<br>0 | BNS-<br>12.5 | 2006/09/29<br>04:03 | 75 | 38.4 | 67 | 0.3 | 437 | 432 | ctd only |
| 4 | 11<br>1 | BNS-13 | 2006/09/29<br>06:02 | 75 | 41.6 | 67 | 5.61 | 432 | 427 | 1779-1797 |
| 4 | 11<br>2 | BNS-<br>13.5 | 2006/09/29<br>10:03 | 75 | 45.9 | 66 | 59.74 | 383 | 377 | ctd only |
| 4 | 11<br>3 | BNS-14 | 2006/09/29<br>12:04 | 75 | 49.9 | 67 | 2.23 | 124 | 119 | 1798-1805 |

## Mooring and Buoy Sites, all in Leg 3

### WHOI MOORING OPERATIONS

Investigator: Andrey Proshutinsky

| | BS-3 | BGOS-A | BGOS-B | BGOS-C | BGOS-D |
|---|---|---|---|---|---|
| recovery date | 13-Aug-<br>06 | 17-Aug-06 | 30-Aug-06 | 5-Sep-06 | 8-Sep-06 |
| recovery time | 17:53 | 17:55 | 17:50 | 18:05 | 16:14 |
| surveyed latitude | 71<br>23.729' | 75 0.3262' | 77 59.626' | 76 58.2515' | 74 0.1500' |
| surveyed longitude | 152<br>2.154' | 149 53.3997' | 149 57.958' | 139 59.5852' | 139<br>58.9264' |
| depth | 149 | 3825 | 3821 | 3722 | 3510 |
| duration | 372 | 370 | 378 | 375 | 376 |
| | | | | | |
| redeployment date | | 24-Aug-06 | 2-Sep-06 | 6-Sep-06 | 10-Sep-06 |
| redeployment time | | 23:10 | 18:23 | 18:01 | 2:26 |
| drop latitude | | 74 59.945' | 77 59.662' | 76 59.757' | 74 0.018' |
| drop longitude | | 149 59.936' | 149 58.167' | 139 54.321' | 139<br>59.794' |

### WHOI BUOY OPERATIONS

Investigators: Andrey Proshutinsky and John Toole

| | ITP4 | ITP6/IMB/AOFB | ITP5 |
|---|---|---|---|
| deployment date | 3-Sep-06 | 4-Sep-06 | 7-Sep-06 |
| deployment time | 0:00 | 20:00 | 20:00 |
| latitude | 78 7.80' | 77 53.61' | 75 54.69' |
| longitude | 148<br>57.53' | 140 25.2' | 138 4.19' |

## CABOS MOORING

| Investigator | Recovery Depth (m) | Recovery Location | Recovery Time (UTC) | Deployment Depth (m) | Deployment Location | Deployment Time (UTC) |
|---|---|---|---|---|---|---|
| UAF/IARC<br>I. Polyakov | 1112 | 71° 49.676'N<br>131° 45.663'W | 12-Sept 06 1522 (UTC) | 1111 | 71 49.688'N<br>131 45.691'W | 12-Sept 06 2156 (UTC) |

## IARC GPS BUOYS

Investigator: Jennifer Hutchings

| | |
|---|---|
| Description | 6 ice drifting GPS buoys were deployed in a 10 mile radius ring about a central site with Ice Tethered Profiler, Ice Mass Balance Buoy and Heat Flux Buoy |
| Deployment date | 4-Sep-06 |
| Buoys at center of array | **ITP6/IMB/AOFB** |
| Latitude, center of array | 77 53.61' |
| Longitude, center of array | 140 25.2' |

XCTD Casts

| Leg | Cast | Mo. | Day | Time (UTC) | Latitude (N ) | Longitude (W) | Water Depth |
|---|---|---|---|---|---|---|---|
| 1 | XCTD-001 | Jul | 25 | 3:46:26 | 64 00.05909 | 055 00.06249 | 1100 |
| 1 | XCTD-002 | Jul | 25 | 5:38:56 | 64 19.91538 | 055 32.71800 | 1052 |
| 1 | XCTD-003 | Jul | 25 | 7:29:31 | 64 39.97037 | 056 04.77969 | 895 |
| 1 | XCTD-004 | Jul | 25 | 9:21:15 | 64 59.94839 | 056 38.01469 | 656 |
| 1 | XCTD-005 | Jul | 25 | 11:08:27 | 65 19.93839 | 057 11.05632 | 609 |
| 1 | XCTD-006 | Jul | 25 | 12:45:37 | 65 40.11051 | 057 43.77794 | 579 |
| 1 | XCTD-007 | Jul | 25 | 14:20:04 | 66 00.63844 | 058 15.21195 | 563 |
| 1 | XCTD-008 | Jul | 25 | 16:19:40 | 66 19.22518 | 058 49.62594 | 628 |
| 1 | XCTD-009 | Jul | 25 | 18:19:41 | 66 39.97017 | 059 21.18740 | 894 |
| 1 | XCTD-010 | Jul | 25 | 20:15:52 | 66 59.90329 | 059 53.85706 | 937 |
| 1 | XCTD-011 | Jul | 25 | 21:59:09 | 67 19.98129 | 060 26.99050 | 1065 |
| 1 | XCTD-012 | Jul | 25 | 23:39:15 | 67 39.90084 | 060 59.63465 | 1517 |
| 1 | XCTD-013 | Jul | 26 | 3:16:00 | 68 20.53747 | 061 41.29247 | 1730 |
| 1 | XCTD-014 | Jul | 26 | 6:51:31 | 69 00.03170 | 061 55.33536 | 1851 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | XCTD-015 | Jul | 26 | 11:01:51 | 69 40.07162 | 062 44.86085 | 1970 |
| 1 | XCTD-016 | Jul | 26 | 15:24:18 | 70 19.99429 | 064 01.62138 | 2077 |
| 1 | XCTD-017 | Jul | 26 | 18:35:21 | 71 00.45358 | 064 45.63422 | 2158 |
| 1 | XCTD-018 | Jul | 26 | 21:37:52 | 71 40.01068 | 065 29.85032 | 2266 |
| 1 | XCTD-019 | Jul | 27 | 0:38:27 | 72 20.13666 | 066 17.42720 | 2330 |
| 1 | XCTD-020 | Jul | 27 | 3:34:38 | 72 59.90472 | 066 58.59420 | 2346 |
| 1 | XCTD-021 | Jul | 27 | 5:34:02 | 73 11.39051 | 068 29.35116 | 2329 |
| 1 | XCTD-022 | Jul | 27 | 7:30:46 | 73 22.45366 | 069 59.40567 | 1686 |
| 1 | XCTD-023 | Jul | 27 | 8:50:36 | 73 29.96047 | 070 59.45223 | 1217 |
| 1 | XCTD-024 | Jul | 27 | 10:09:15 | 73 37.34618 | 071 59.41879 | 1089 |
| 1 | XCTD-025 | Jul | 27 | 11:31:18 | 73 45.13044 | 073 00.01263 | 872 |
| 1 | XCTD-026 | Jul | 27 | 12:48:07 | 73 52.29019 | 074 00.66514 | 836 |
| 1 | XCTD-027 | Jul | 27 | 14:02:59 | 73 59.94211 | 074 59.43836 | 813 |
| 1 | XCTD-028 | Jul | 27 | 19:47:26 | 74 15.19517 | 079 59.43288 | 805 |
| 1 | XCTD-029 | Jul | 28 | 1:35:40 | 74 22.84921 | 084 59.07280 | 540 |
| 1 | XCTD-030 | Jul | 28 | 8:24:01 | 74 19.99498 | 090 00.65023 | 296 |
| 3 | XCTD-031 | Aug | 9 | 4:39:56 | 71 29.54638 | 132 57.88058 | 814 |
| 3 | XCTD-032 | Aug | 9 | 9:04:33 | 71 30.10871 | 134 29.85171 | 1456 |
| 3 | XCTD-033 | Aug | 9 | 13:11:53 | 71 30.31665 | 135 59.95880 | 1803 |
| 3 | XCTD-034 | Aug | 9 | 17:59:06 | 71 30.40713 | 137 30.03089 | 2028 |
| 3 | XCTD-035 | Aug | 9 | 21:37:45 | 71 31.62021 | 138 54.89950 | 2227 |
| 3 | XCTD-036 | Aug | 10 | 11:24:32 | 70 44.97637 | 139 59.96250 | 1464 |
| 3 | XCTD-037 | Aug | 10 | 13:16:05 | 70 59.61902 | 139 59.70010 | 2069 |
| 3 | XCTD-038 | Aug | 10 | 16:12:44 | 71 30.24133 | 139 59.46287 | 2375 |
| 3 | XCTD-039 | Aug | 10 | 16:29:59 | 71 31.17669 | 139 59.46034 | 2390 |
| 3 | XCTD-040 | Aug | 11 | 19:30:52 | 71 32.52082 | 141 29.99713 | 2644 |
| 3 | XCTD-041 | Aug | 11 | 22:26:57 | 71 48.19763 | 142 47.77275 | 2930 |
| 3 | XCTD-042 | Aug | 12 | 20:22:19 | 71 23.52084 | 145 30.14401 | 3137 |
| 3 | XCTD-043 | Aug | 13 | 0:44:10 | 71 22.77983 | 146 59.80011 | 2595 |
| 3 | XCTD-044 | Aug | 13 | 5:18:14 | 71 22.60560 | 148 29.85956 | 3033 |
| 3 | XCTD-045 | Aug | 13 | 10:40:06 | 71 21.95229 | 149 57.93993 | 1535 |
| 3 | XCTD-046 | Aug | 13 | 14:08:48 | 71 21.85000 | 151 00.02000 | 228 |
| 3 | XCTD-047 | Aug | 14 | 1:48:40 | 71 27.47994 | 151 49.14091 | 437 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | XCTD-048 | Aug | 14 | 7:01:00 | 71 37.42447 | 151 13.87624 | 1758 |
| 3 | XCTD-049 | Aug | 14 | 8:28:56 | 71 42.60064 | 151 02.02919 | 2192 |
| 3 | XCTD-050 | Aug | 14 | 15:48:57 | 71 51.92932 | 150 21.24425 | 2723 |
| 3 | XCTD-051 | Aug | 15 | 3:30:06 | 72 14.46498 | 149 58.65550 | 3524 |
| 3 | XCTD-052 | Aug | 16 | 4:57:30 | 73 29.98707 | 150 00.65370 | 3762 |
| 3 | XCTD-053 | Aug | 16 | 20:58:30 | 74 19.57626 | 149 58.93731 | 3775 |
| 3 | XCTD-054 | Aug | 17 | 8:09:05 | 74 32.54416 | 148 06.23021 | 3747 |
| 3 | XCTD-055 | Aug | 18 | 6:16:53 | 75 10.59226 | 151 30.26874 | 3792 |
| 3 | XCTD-056 | Aug | 18 | 16:15:13 | 75 37.50629 | 155 59.06247 | 2395 |
| 3 | XCTD-057 | Aug | 18 | 17:10:48 | 75 40.09598 | 156 21.29090 | 1342 |
| 3 | XCTD-058 | Aug | 26 | 1:21:27 | 72 44.85132 | 154 25.07698 | 3258 |
| 3 | XCTD-059 | Aug | 26 | 5:32:03 | 72 22.27402 | 155 22.43048 | 1673 |
| 3 | XCTD-060 | Aug | 26 | 6:57:28 | 72 12.69914 | 155 34.48440 | 504 |
| 3 | XCTD-061 | Aug | 28 | 1:19:43 | 73 25.16723 | 153 58.05192 | 3802 |
| 3 | XCTD-062 | Aug | 28 | 10:09:12 | 74 10.32263 | 152 04.01695 | 3791 |
| 3 | XCTD-063 | Aug | 29 | 4:03:13 | 75 29.63445 | 149 50.15593 | 3779 |
| 3 | XCTD-064 | Aug | 29 | 15:20:11 | 76 29.95366 | 149 56.35313 | 3777 |
| 3 | XCTD-065 | Aug | 30 | 2:30:36 | 77 29.81870 | 149 56.46348 | 3821 |
| 3 | XCTD-066 | Aug | 31 | 0:13:28 | 78 09.25827 | 151 41.87659 | 3817 |
| 3 | XCTD-067 | Aug | 31 | 3:04:17 | 78 17.06774 | 152 58.61598 | 3177 |
| 3 | XCTD-068 | Aug | 31 | 18:13:44 | 78 21.62837 | 154 16.85562 | 948 |
| 3 | XCTD-069 | Aug | 31 | 19:25:06 | 78 25.11343 | 154 40.52541 | 1541 |
| 3 | XCTD-070 | Sep | 1 | 1:59:12 | 78 27.61926 | 154 48.80664 | 1800 |
| 3 | XCTD-071 | Sep | 1 | 3:23:31 | 78 32.37000 | 153 51.38000 | 2011 |
| 3 | XCTD-072 | Sep | 1 | 4:03:55 | 78 33.59552 | 153 38.36212 | 2516 |
| 3 | XCTD-073 | Sep | 1 | 5:14:22 | 78 37.01673 | 153 13.26478 | 3734 |
| 3 | XCTD-074 | Sep | 1 | 5:18:16 | 78 37.02566 | 153 12.65267 | 3734 |
| 3 | XCTD-075 | Sep | 1 | 7:53:51 | 78 46.02897 | 152 08.92782 | 3814 |
| 3 | XCTD-076 | Sep | 1 | 7:59:27 | 78 46.05215 | 152 08.70849 | 3814 |
| 3 | XCTD-077 | Sep | 2 | 5:20:32 | 78 30.17866 | 150 02.06894 | 3815 |
| 3 | XCTD-078 | Sep | 4 | 1:43:13 | 77 38.67860 | 141 40.81713 | 3764 |
| 3 | XCTD-079 | Sep | 5 | 4:15:27 | 77 30.74784 | 140 02.86162 | 3732 |
| 3 | XCTD-080 | Sep | 8 | 1:31:17 | 75 23.68239 | 139 05.08837 | 3656 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | XCTD-081 | Sep | 8 | 9:45:08 | 74 30.56452 | 140 03.51334 | 3642 |
| 3 | XCTD-082 | Sep | 9 | 18:07:25 | 74 08.50288 | 141 51.08348 | 3642 |
| 3 | XCTD-083 | Sep | 10 | 15:22:06 | 74 09.20121 | 137 26.18150 | 3343 |
| 3 | XCTD-084 | Sep | 10 | 15:25:51 | 74 09.19915 | 137 26.05825 | 3343 |
| 3 | XCTD-085 | Sep | 11 | 13:42:08 | 72 47.57066 | 136 42.73357 | 2721 |
| 3 | XCTD-086 | Sep | 11 | 19:12:07 | 72 06.69329 | 135 56.87119 | 2213 |

PRR Light Transmission Casts

| | | | | Start time | Position | | Deployment | | Water sample |
|---|---|---|---|---|---|---|---|---|---|
| Leg | PRR Profile # | Station | Date | UTC | Lat(N) | Lon(W) | depth (m) | location | (CTD cast #) |
| 3 | 1 | AG5 | 8-Jul | 18:56 | 70 32.96 | 122 54.86 | 100 | 6 | 11 |
| 3 | 2 | CABOS | 8-Aug | 23:31 | 71 48.45 | 131 46.62 | 120 | 2 | 12 |
| 3 | 3 | CB28A | 8-Oct | 8:27 | 70 29.88 | 139 59.92 | 100 | 2 | 13 |
| 3 | 4 | CB29 | 8-Nov | 3:03 | 71 59.90 | 139 58.63 | 100 | 3 | 0 |
| 3 | 5 | CB28BB | 8-Nov | 13:21 | 71 14.88 | 140 00.29 | 110 | 2 | 0 |
| 3 | 6 | STAA | 8-Dec | 11:34 | 71 47.25 | 143 57.41 | 120 | 2 | 18 |
| 3 | 7 | STAAA | 8-Dec | 16:13 | 71 46.02 | 144 00.84 | 80 | 2 | 0 |
| 3 | 8 | BS3 | Aug-13 | 21:21 | 71 23.52 | 152 02.90 | 100 | 2 | 20 |
| 3 | 9 | BS3C | Aug-14 | 12:09 | 71 44.07 | 151 00.65 | 50 | 1 | 24 |
| 3 | 10 | BS3D | Aug-14 | 21:59 | 72 01.58 | 150 00.02 | 100 | 4 | 25 |
| 3 | 11 | BS3DR | Aug-14 | 23:22 | 72 01.66 | 150 00.08 | 120 | 4 | 0 |
| 3 | 12 | CB2A | Aug-15 | 8:15 | 72 27.77 | 150 04.65 | 70 | 4 | 26 |
| 3 | 13 | CB2 | Aug-15 | 19:30 | 72 57.84 | 149 56.26 | 130 | 4 | 27 |
| 3 | 14 | CB3 | Aug-16 | 13:18 | 73 59.35 | 150 01.77 | 120 | 4 | 28 |
| 3 | 15 | CB3R | Aug-16 | 15:02 | 73 58.79 | 150 02.94 | 120 | 4 | 0 |
| 3 | 16 | CB5D | Aug-18 | 21:24 | 75 44.12 | 157 12.55 | 120 | 4 | 29 |
| 3 | 17 | CB5B | Aug-19 | 0:33 | 75 35.26 | 156 17.05 | 120 | 4 | 0 |
| 3 | 18 | CB5BR | Aug-19 | 5:47 | 75 35.10 | 156 15.93 | 80 | 4 | 0 |
| 3 | 19 | CB5BR1 | Aug-19 | 14:28 | 75 32.64 | 156 15.76 | 120 | 3 | 0 |
| 3 | 20 | CB5BR2 | Aug-19 | 19:13 | 75 31.98 | 156 12.46 | 120 | 3 | 0 |
| 3 | 21 | CB5BR3 | Aug-20 | 0:59 | 75 30.09 | 156 11.04 | 120 | 3 | 0 |
| 3 | 22 | CB5BR4 | Aug-20 | 15:01 | 75 27.93 | 156 15.90 | 80 | 3 | 0 |
| 3 | 23 | CB5BR5 | Aug-20 | 17:24 | 75 27.66 | 156 17.11 | 125 | 4 | 0 |
| 3 | 24 | CB5BR6 | Aug-20 | 22:11 | 75 27.99 | 156 19.14 | 120 | 4 | 0 |
| 3 | 25 | CB5BR7 | Aug-21 | 3:51 | 75 27.82 | 156 23.28 | 60 | 3 | 0 |
| 3 | 26 | CB5BR8 | Aug-21 | 17:11 | 75 26.12 | 156 38.93 | 100 | 3 | 0 |
| 3 | 27 | CB5BR9 | Aug-21 | 22:20 | 75 27.07 | 156 44.83 | 130 | 3 | 38 |
| 3 | 28 | CB5BRA | Aug-22 | 16:52 | 75 28.42 | 157 07.10 | 120 | 4 | 0 |
| 3 | 29 | CB5BRB | Aug-23 | 0:15 | 75 28.30 | 157 13.86 | 4 | 3 | 0 |
| 3 | 30 | CB6BRC | Aug-23 | 2:01 | 75 28.30 | 157 13.86 | 50 | 3 | 0 |
| 3 | 31 | CB6BRD | Aug-23 | 2:09 | 75 28.30 | 157 13.86 | 37 | 4 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 32 | CB7BRE | Aug-23 | 15:44 | 75 26.94 | 157 56.17 | 105 | 3 | 42 |
| 3 | 33 | CB5A | Aug-23 | 21:50 | 75 33.65 | 155 35.52 | 80 | 3 | 43 |
| 3 | 34 | CB5 | Aug-24 | 5:01 | 75 19.45 | 153 15.90 | 110 | 3 | 45 |
| 3 | 35 | CB4 | Aug-24 | 16:00 | 74 59.21 | 150 02.87 | 100 | 4 | 46 |
| 3 | 36 | BARROW | Aug-26 | 17:32 | 71 20.73 | 156 51.61 | 50 | 3 | 48 |
| 3 | 37 | CB8 | Aug-29 | 19:40 | 76 57.47 | 149 52.68 | 110 | 3 | 50 |
| 3 | 38 | CB9 | Aug-30 | 12:39 | 77 59.02 | 149 51.81 | 100 | 4 | 52 |
| 3 | 39 | CB10 | Aug-31 | 5:37 | 78 18.82 | 153 12.28 | 50 | 3 | 53 |
| 3 | 40 | CB10A | Aug-31 | 15:47 | 78 19.37 | 154 03.72 | 100 | 3 | 56 |
| 3 | 41 | CB11 | 9-Jan | 17:07 | 79 00.45 | 149 59.61 | 90 | 4 | foredeck |
| 3 | 42 | CB12 | 9-Mar | 6:54 | 77 42.42 | 146 47.46 | 100 | 3 | 59 |
| 3 | 43 | CB13 | 9-Mar | 18:57 | 77 20.42 | 143 29.51 | 45 | 4 | 60 |
| 3 | 44 | CB16 | 9-Apr | 14:25 | 77 52.78 | 140 07.74 | 100 | 4 | 62 |
| 3 | 45 | CB15 | 9-Jun | 18:07 | 76 59.70 | 139 53.64 | 100 | 4 | 0 |
| 3 | 46 | CB17 | 9-Jul | 15:00 | 75 56.98 | 140 03.22 | 100 | 4 | 0 |
| 3 | 47 | CB18 | 9-Aug | 4:49 | 75 00.76 | 140 01.67 | 100 | 3 | 67 |
| 3 | 48 | CB21 | 9-Aug | 20:20 | 74 01.00 | 140 09.62 | 90 | 3 | 68 |
| 3 | 49 | CB19 | 9-Sep | 15:25 | 74 19.07 | 143 10.46 | 15 | 3 | 0 |
| 3 | 50 | GF06 | 9-Oct | 22:09 | 74 14.90 | 136 15.28 | 100 | 3 | 70 |
| 3 | 51 | CABOSR | 9-Dec | 17:40 | 71 49.44 | 131 46.46 | 110 | 4 | 75 |

## PRR On-Ice Casts

| **Cruise** | **Station** | **Date** | **Latitude (N)** | **Longitude (W)** | **Time** |
|---|---|---|---|---|---|
| LSSL2006-18 | ICE1 | Aug-31 | 78 27.41 | 154 47.80 | 21:06-23:45 |
| LSSL2006-18 | ICE2 | 9-Jan | 78 57.77 | 149 28.42 | |
| LSSL2006-18 | ICE3 | 9-Apr | 77 54.77 | 140 22.10 | |

## Vertical Net Tows

| **Leg** | **Net event** | **Station Information** | **Latitude (N)** | **Longitude (W)** | **Date (UTC)** | **Time (UTC)** | **Approx. Cast Depth (m)** | **Approx. Water Depth (m)** | **Notes** |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 1 | CTD cast #8, CABOS Mooring | 71.63 | 131.79 | 8-Aug-06 | 2300 | 100 | 1100 | flow meter #4 (50μm) not working Spilt some of sample 236a Labels dated 09/08/06 should be 08/08/06 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | CTD cast #8, CABOS Mooring | 71.63 | 131.79 | 8-Aug-06 | 2320 | 100 | 1100 | flow meter #4 (50μm) not working |
| 3 | 3 | CTD cast #14, CB-28a | 70.50 | 140.00 | 10-Aug-06 | 745 | 100 | 655 | no ice present Net went under boat on downcast so waited at 100m for ~15mins |
| 3 | 4 | CTD cast #14, CB-28a | 70.50 | 140.00 | 10-Aug-06 | 814 | 100 | 655 | |
| 3 | 5 | CTD cast #18, Station A | 71.79 | 143.94 | 12-Aug-06 | 1038 | 100 | 3300 | start of flow meter changed - estimated at the number listed |
| 3 | 6 | CTD cast #18, Station A | 71.79 | 143.95 | 12-Aug-06 | 1052 | 100 | 3300 | |
| 3 | 7 | CTD cast #18, Station A | 71.79 | 143.95 | 12-Aug-06 | 1109 | 500 | 3300 | Large Mysid in 500m haul (150μm) |
| 3 | 8 | CTD cast #20, BS-3 | 71.39 | 152.05 | 13-Aug-06 | 2146 | 100 | 150 | 1st haul not vertical |
| 3 | 9 | CTD cast #20, BS-3 | 71.33 | 152.21 | 13-Aug-06 | 2203 | 100 | 150 | both hauls abundance of chaetognaths and jelly fish - clogged up mesh |
| 3 | 10 | CTD cast #30, CB-5b1 | 75.56 | 156.25 | 19-Aug-06 | 1057 | 100 | 2026 | ship offline to fix shafts used bubbler to make hole low arrow worms high copepods. |
| 3 | 11 | CTD cast #30, CB-5b1 | 75.55 | 156.27 | 19-Aug-06 | 1112 | 100 | 2026 | 236u put in 40% ethanol - changed to 97% 22 August 2006 |
| 3 | 12 | CTD cast #39, CB-5b9 | 75.47 | 157.00 | 22-Aug-06 | 1144 | 500 | 1409 | |
| 3 | 13 | CTD cast #39, CB-5b9 | 75.47 | 157.00 | 22-Aug-06 | 1214 | 100 | 1409 | |
| 3 | 14 | CTD cast #39, CB-5b9 | 75.47 | 157.00 | 22-Aug-06 | 1227 | 100 | 1409 | |
| 3 | 15 | CTD cast #46, CB-4 | 74.98 | 150.04 | 24-Aug-06 | 1518 | 100 | 3778 | |
| 3 | 16 | CTD cast #46, CB-4 | 74.99 | 150.04 | 24-Aug-06 | 1527 | 100 | 3778 | |
| 3 | 17 | CTD cast #49, CB-7 | 76.00 | 149.99 | 29-Aug-06 | 847 | 30 | 3780 | |
| 3 | 18 | CTD cast #49, CB-7 | 76.00 | 149.98 | 29-Aug-06 | 907 | 30 | 3780 | |
| 3 | 19 | CTD cast #49, CB-7 | 76.00 | 149.97 | 29-Aug-06 | 944 | 100 | 3780 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 20 | CTD cast #49, CB-7 | 76.00 | 149.97 | 29-Aug-06 | 955 | 100 | 3780 | |
| 3 | 21 | CTD cast #52, CB-9 | 77.98 | 149.87 | 30-Aug-06 | 1111 | 100 | 3819 | |
| 3 | 22 | CTD cast #52, CB-9 | 77.98 | 149.87 | 30-Aug-06 | 1123 | 100 | 3819 | biomass left in oven 34 hours |
| 3 | 23 | CTD cast #65, CB-15 | 77.0268333 | 139.9661667 | 6-Sep-06 | 1115 | 100 | 3726 | contaminated |
| 3 | 24 | CTD cast #65, CB-15 | 77.0293333 | 139.9693333 | 6-Sep-06 | 1126 | 100 | 3726 | contaminated |
| 3 | 25 | CTD cast #65, CB-15 | 76.99 | 139.8746667 | 6-Sep-06 | 1946 | 100 | 3726 | redo 23 |
| 3 | 26 | CTD cast #65, CB-15 | 77.9896667 | 139.8745 | 6-Sep-06 | 1955 | 100 | 3726 | redo 24 |
| 3 | 27 | CTD cast #66, CB-17 | 75.9505 | 140.0678333 | 7-Sep-06 | 1511 | 100 | 3705 | |
| 3 | 28 | CTD cast #66, CB-17 | 75.9501667 | 140.0666667 | 7-Sep-06 | 1524 | 106 | 3705 | high wind used bubbler when nets were on the way back up |
| 3 | 29 | CTD cast #67, CB-18 | 75.0116667 | 140.0411667 | 8-Sep-06 | 549 | 100 | 3629 | |
| 3 | 30 | CTD cast #67, CB-18 | 75.0106667 | 140.044 | 8-Sep-06 | 600 | 100 | 3629 | |
| 3 | 31 | CTD cast #68, CB-21 | 74.0251667 | 140.2095 | 8-Sep-06 | 2152 | 100 | 3525 | Ice algae in 53u net? Scraped ice on upcast. 2nd tow cancelled due to wind |
| 3 | 32 | CTD cast #75, CABOS | 71.8188333 | 131.712 | 12-Sep-06 | 1715 | 100 | 1125 | flow meter #3 did not work? |
| 3 | 33 | CTD cast #75, CABOS | 71.828 | 131.7728333 | 12-Sep-06 | 1737 | 100 | 1125 | |