Cruise Report C3O/IPY 2009-07

Pacific Region Vessel CCGS *Sir Wilfrid Laurier*

IPY·API International Polar Year Année polaire internationale 2007·2008

DATE: **FROM:** 31 August 2009 **TO:** 6 September 2009

SCIENCE CRUISE NUMBER: 2009-07 **SHIP'S PATROL NUMBER:**

CHIEF SCIENTIST: Svein Vagle

INTRODUCTION/PROGRAM BACKGROUND:

The Canada Three Oceans project "C3O" is part of Canada's contribution to International Polar Year research efforts. The focus of this collaboration between government institutes and universities is to study impacts of climate variability on the sub-arctic and Arctic water circulation and on the associated ecosystems.

CRUISE OBJECTIVES:

Main cruise objective was the recovery of C3O moorings and hydrographic measurements in Bellot Strait. If time permited: opportunistic hydrographic sampling in Prince Regent Inlet, Franklin Strait, Larsen Sound, Victoria Strait and Queen Maud Gulf.

In addition to recovery and search for scientific moorings, shipboard data collection included physical, biological, and geochemical sampling:

- Profiles of water temperature and salinity were obtained with CTD probes,
- Additional sensors on the CTD profiler collected in situ data on phyto plankton concentrations (fluorometer), optical clarity (transmissometer) and dissolved oxygen,
- A rosette was used with the CTD to obtain water samples from discrete depths for salinity probe calibrations,
- bio-acoustic backscatter data were collected with towed transducers, from a 150 kHz Acoustic Doppler Current Profiler (ADCP) and a dual-frequency (50 and 200 kHz) backscatter sonar deployed over the side of the ship at all science stations,
- continuous underway sampling of near-surface seawater temperature, salinity, fluorescence, oxygen, and nitrogen,

DAYS ALLOCATED: 8 **DAYS OF OPERATION:** 7

SCIENTIFIC PERSONNEL: Five people flew into Taloyoak on August 29. Initial plan was to be picked up on that day, but they ended up staying there until August 31 before being picked up by a small boat from the ship.

Two additional members of the science team (Melling and Lindsay) joined the ship at Fort Ross on September 2nd. All members of science team departed the ship on September 6th in Taloyoak.

Name	Tasks	Affiliation	from	To
Svein Vagle	Bio-acoustics/Underway surface water analysis	DFO-IOS	Taloyoak	Taloyoak
Robert Fudge	CTD	DFO-NCAARE	Taloyoak	Taloyoak
Mike Dempsey	CTD / mooring recovery	DFO-IOS	Taloyoak	Taloyoak
Tung Bui	Documentary film maker	Global TV	Taloyoak	Taloyoak
Wayne Seibol	Film crew	Global TV	Taloyoak	Taloyoak
Humfrey Melling	Mooring search	DFO-IOS	Fort Ross	Taloyoak
Ron Lindsay	Mooring search	DFO-IOS	Fort Ross	Taloyoak

SUMMARY of RESULTS:

During the stops at 10 science stations, the following science tasks were completed

- 10 CTD/Rosette casts,
- 10 150 kHz ADCP/dual-frequency backscatter deployments.

Underway data collection included

- continuous monitoring of surface water properties both with electronic sensors and by sampling at discrete intervals from the seawater loop (for salinity samples) in the main lab on board,
- and meteorological data from the ship.

Recovery of BC2, biogeochemistry mooring. Acoustical backscatter data from an upward looking sonar on the mooring are scientifically very interesting, showing fish and zooplankton all year, plus the formation and breakup of ice as a local Polynya appears and disappears throughout the winter months.

Mooring BC1 was also located, but failed to release from its anchor. Dragging was also unsuccessful and parts of the mooring was later found by hydrographers on Fox Island. A pressure sensor still attached to the mooring line indicated that the mooring let go around June 12th, 2009. After a thorough acoustic search westward through Bellot Strait, mooring HM1 was located approximately 6nm west of the deployment location. Releases did not function properly and dragging was unsuccessful. The mooring is sitting close to shore in approximately 35 m water depth. Sidescan sonar sweeps of the area, by hydrographers onboard the ship, did indicate the presence of floatation in the water column. Position of the recognizable target is 71N58.25 095W03.96. It should be possible to recover the mooring in the future using a small ROV to snag the floatation.

There were no signs of mooring HM2 around the deployment location and in areas east and west of the deployment site. However, a more thorough acoustic search for this mooring is desirable.

AREAS OF OPERATION:

James Ross Strait, Franklin Strait, Bellot Strait, Prince Regent Inlet.

The map below (Figure 1) shows the science stations and deployment locations of scientific moorings. A list of science station locations, dates and activities is included in appendix 1.

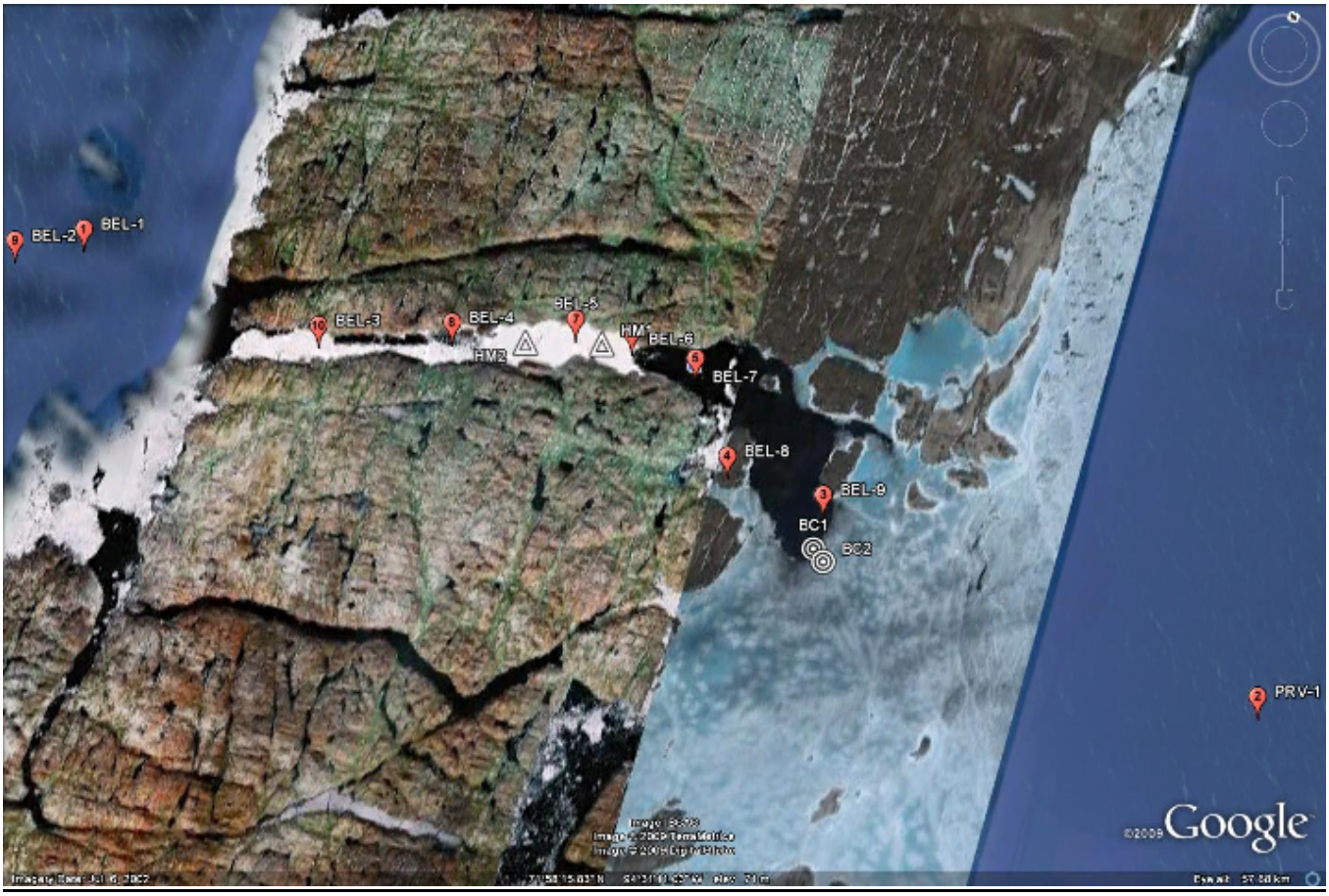


Figure 1. Map showing science stations (red drops), biogeochemical mooring locations (BC1 and BC2), and deployment locations of ADCP moorings (HM1 and HM2).

FIELDWORK:

Science activities aboard the CCGS Sir Wilfrid Laurier for this leg of the program can be separated into three distinct parts:

1. Search for four scientific moorings and recovery of one of these:
   - BC 2 mooring was located straight away and was easily recovered by the competent ship's crew. Mooring BC1 was also located, but it turned out that the acoustic releases had major corrosion problems and the mooring let go on or around June 12th, 2009. The two releases are still on the sea floor at the location of deployment, while the floatation and some of the scientific instruments were found by hydrographers on a beach on Fox Island in Bellot Strait. No lines were cut, but shackles were gone and the main instrument packages were gone.
   - Mooring HM1 was finally located acoustically approximately 8nm west of the deployment location and in only 30 m of water. However, the releases did not let go and even after several dragging attempts, the mooring was not recovered.
   - Mooring HM2, which was deployed in 2008 as a replacement mooring for HM1 was never heard from.

2. CTD/rosette stations and deployment of ADCP/dual-frequency acoustic backscatter package over the side of the ship while on station. The captain and his officers on the bridge did a magnificent job keeping the ship on station during the casts, under very difficult conditions with shallow water and strong currents.

3. Data were collected continuously from the salt-water loop on the ship from Taloyoak, north to Prince Regent Inlet and back to Taloyoak. This system was left running on the ship and collected a very nice data set during leg 3 and all the way back to Victoria. With a bit of help from members of the ship's crew it was possible to collect data to characterize the surface water (temperature, salinity, fluorescence, oxygen and nitrogen) all the way from Victoria to Prince Regent Inlet and back to Victoria.

Shipboard labs

During this leg only the main laboratory was used to collect samples and electronic sensor data from the seawater loop.
The aft laboratory was used by hydrographers and the two containers were only used for storage.

SUCCESSES AND PROBLEMS [SCIENTIFIC]:

All of the onboard science instrumentation worked as intended and provided scientifically valuable data, and will help to combine biological findings with measurements of the physical characteristics of the ocean.

Only one of the four scientific moorings was recovered. The second biogeochemical mooring was lost presumably because the attachment points between the acoustic releases and the rest of the mooring failed around June 12, 2009. This hypothesis is based on the fact that the two releases (exactly the same type, model number and age) used on the recovered biogeochemical mooring failed on deck shortly after recovery.

None of the Acoustic Doppler Current Profiler (ADCP) moorings deployed inside Bellot Strait for measurements of the flow field through the strait were recovered. The hypothesis is that the currents in the strait are much stronger than allowed for in the design of the moorings, allowing the moorings to move significant distances from the deployment sites.

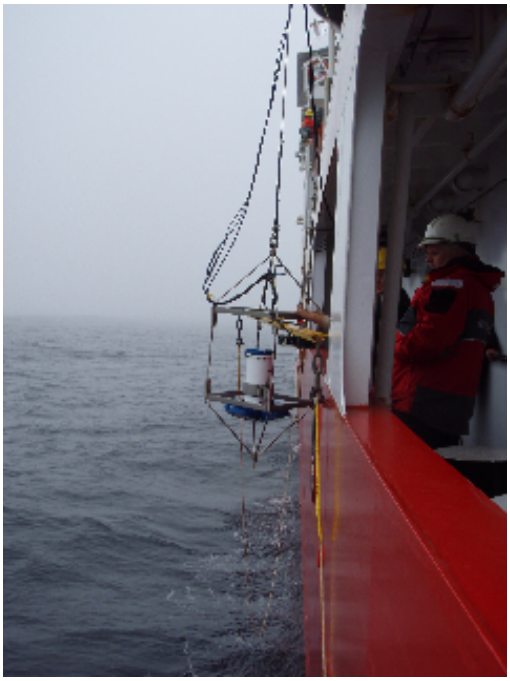
CTD/rosette system

A Seabird SBE-9 profiling CTD was used with a custom built compact 24-bottle rosette water sampler. The CTD was equipped with the standard suite of pressure, temperature and conductivity sensors, and additional external sensors: a fluorometer to measure chlorophyll-a concentrations, a transmissometer to measure water clarity, a dissolved oxygen probe, and an acoustic altimeter to get accurate height above the bottom.

The 24-bottle rosette system was equipped with a Seabird Carousel pylon to remotely trigger the 10-litre sample bottles. An SBE-11 deck unit was used with Seasave software to acquire real-time data from the CTD and to close the bottles at depths selected before and/or during the cast. The deck unit included a NMEA board to automatically add GPS position into the header of the data file. This system worked very well during the trip. Only water used to calibrate the salinity sensors were collected at the 10 science stations.

ADCP/Backscatter sonar

A 150 kHz Teledyne RDI Acoustic Doppler Current Profiler (ADCP) was mounted in a stainless steel frame and lowered over the side when stopped at each science station. In addition to the ADCP the frame was equipped with two transducers (50 and 200 kHz) connected to transmit and receive electronics and software in the aft laboratory on the ship. This package was the first to be deployed at each science station and the last to be recovered again. Data from these instruments give current profiles below the ship to a maximum depth of 500 m and a measure of plankton layers in the water column down to approximately 200 m.



Drift bottles

As part of a project started in 2000, 14 drift bottles, each containing a message with serial number and reporting contact information, were launched at selected locations along the ship's track. The drop locations are logged, and when finds are reported this provides information on ocean surface drift trajectories. A website is maintained at IOS to document all drops and finds, and map the results.

PROBLEMS [SHIP'S EQUIPMENT/OPERATIONS/PLATFORM SUITABILITY]:

The pickup of the science party in Taloyoak was delayed, at the last minute, by two days due to SWL icebreaking duties in Victoria Strait. The science party arrived in Taloyoak with no hotel reservations. Fortunately there were available beds in the only hotel in town the first night. It could have gotten serious the second night when the hotel was fully booked. Fortunately for us, the hotel management, managed to open the permanently closed old hotel to give us a place to stay for the night.

While in Bellot Strait the ship's crew was dealing with three operations simultaneously: science, hydrography, and servicing of navigational aids. This combined with the fact that the ship was missing an experienced member of the deck crew, limited what operations could take place at any given time, and slowed down the science program on the trip.

SUCCESSES [SHIP]:

The professional handling of the ship and small boats by the officers and crew on the ship in strong current conditions, and close to shore, was paramount in getting the science stations completed, and in the recovery, dragging, and search for the four moorings.

DAYS LOST DUE TO WEATHER:

The weather cooperated during the trip.

DELAYS [OTHER THAN WEATHER]:

Two days delay in joining the ship in Taloyoak due to last minute ice-breaking duties.

SAFETY CONCERNS:

No safety concerns were reported.

SUMMARY/FINAL COMMENTS:

We want to express our heartfelt thanks to the officers and crew of the Sir Wilfrid Laurier for their help in making this cruise a success. Many hours were spent assisting with the operation of science gear, and in technical assistance with a variety of different projects. Thank you for your willing and eager support, for your patience in dealing with the challenges we presented, all the effort put into trying to recover the lost mooring, and for the warm welcome we received during our stay on board.

Appendix 1 Science Stations

Explanation of listed tasks:
-ADCP is the down-looking 150 kHz Acoustic Doppler Current Profiler and associated dual frequency (50/200 kHz) backscatter sonar system,
-CTDR is the CTD/Rosette electronic profiling and water sampling instrumentation deployed to 5 m above the seafloor.
-DB is drift bottles; deployed in pairs.

Station Name	Date	Start (MDT)	Lat. North (deg)	Lat (min)	Long. West (deg)	Long (min)	Science Tasks
Taloyoak	8/31/2009	08:30					Joined the ship
BEL-1	9/1/2009	12:54	71	56.957	95	25.211	ADCP, CTDR , DB
PRV-1	9/2/2009	22:13	71	55.105	93	35.144	ADCP, CTDR, DB
BEL-9	9/4/2009	10:15	71	57.454	94	16.055	ADCP, CTDR, DB
BEL-8	9/4/2009	13:43	71	57.807	94	25.040	ADCP, CTDR, DB
BEL-7	9/4/2009	19:53	72	00.155	94	29.933	ADCP, CTDR, DB
BEL-6	9/4/2009	20:48	72	00.481	94	35.984	ADCP, CTDR, DB
BEL-6	9/4/2009	21:17	72	00.504	94	35.908	ADCP, CTDR
BEL-5	9/4/2009	22:03	72	00.338	94	41.376	ADCP, CTDR, DB
BEL-4	9/4/2009	23:10	71	59.234	94	51.884	ADCP, CTDR
BEL-2	9/5/2009	07:24	71	57.544	95	13.040	ADCP, CTDR, DB
BEL-3	9/5/2009	08:34	71	58.488	95	02.684	ADCP, CTDR
Taloyoak	9/6/2009						End of oceanographic science program

Appendix 2. Weather conditions along the ships track.

Plots of weather parameters along the ships track were constructed from the data submitted by the ship's AVOS automated weather reporting station to the global weather network. The data was downloaded from the internet website http://sailwx.info/shiptrack/researchships.phtml which tracks reporting ship locations and conditions.

The figure below shows the barometric pressure, and the air-, and seawater temperatures along the track in time series plots (Wind speed and direction were not available during the preparation of this report).

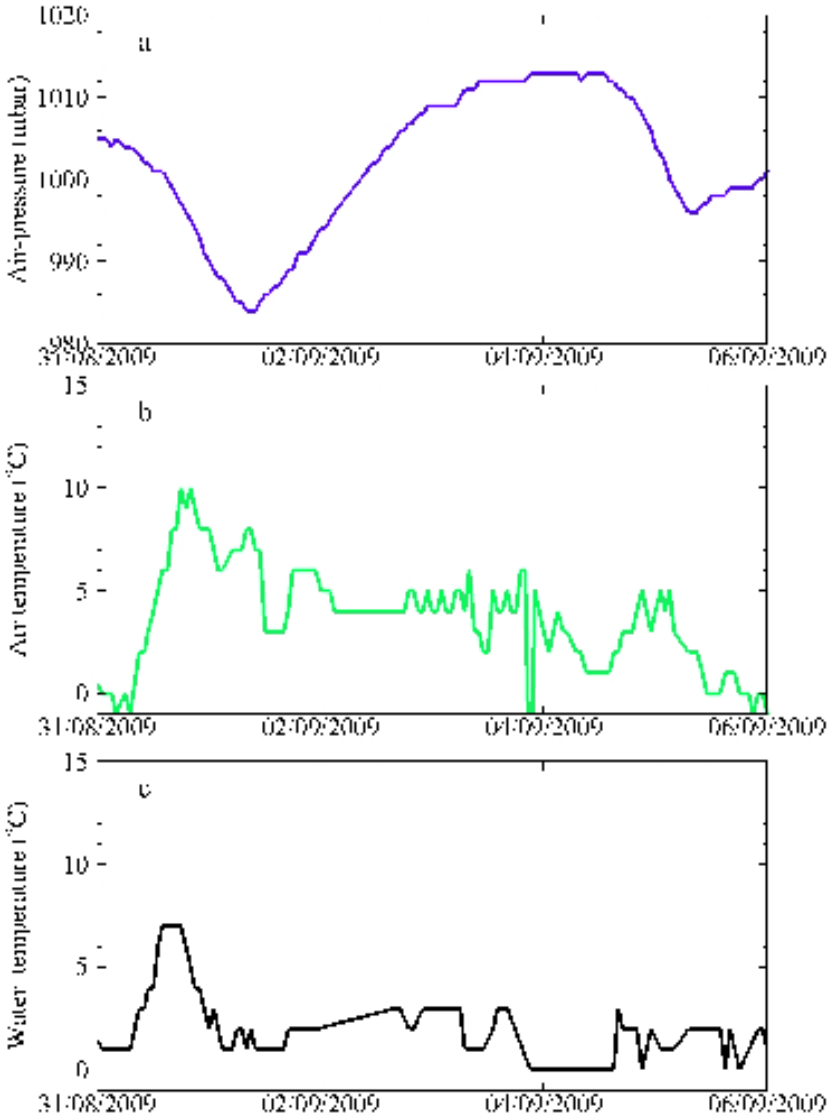


Figure A2-1. Time-series plots of a) barometric pressure, b)air- and, c) water temperature along the track as reported by SWL.

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