Field Oceanography

PHY 6314 and ENG 9098

CRUISE REPORT

Leg 1 on the CSV ANNE S. PEIRCE

October 06 and 07 2008

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Team 2

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Table of content

INTRODUCTION

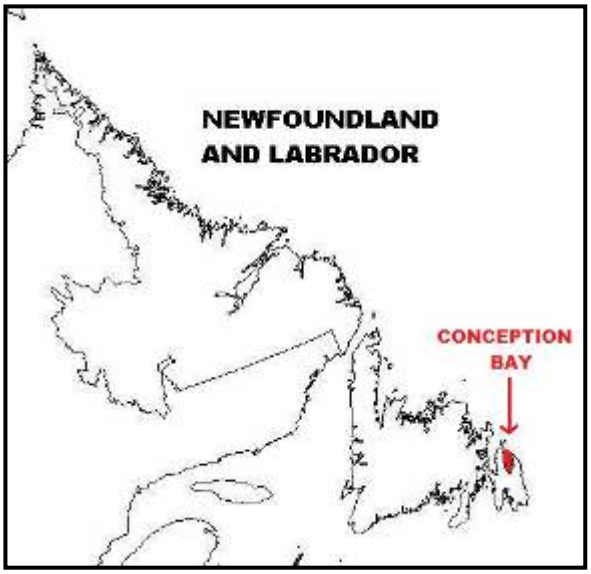


Figure 1, Location of study areas, Conception Bay.

This cruise report presents details of scientific operations, instrument deployments, and data collected over the first one and a half days of a five day scientific cruise in Conception Bay, Newfoundland, from October 6th to 10th, 2008. The cruise was the core element of Field Oceanography P6314, a graduate level course offered by Memorial University of Newfoundland to students from various oceanographic disciplines and engineering. The course is intended to provide hands-on experience in the planning of scientific missions, and in the operation and deployment of a range of oceanographic instruments used in the field today. Students were divided into six teams of three and four. The data presented in this report was jointly collected by teams 1 and 2.

The main area of scientific interest for this cruise was the Bell Island Tickle, located on the eastern side of Conception Bay. Additionally, a large scale survey using CTD (conductivity, temperature, and density) casts were carried out at seven stations throughout the bay. For the first leg the primary focus was on acoustic surveys and CTD casts. Multi-Beam and side scan sonars as well as a ADCP (acoustic doppler current profiler) and echo-sounder transects were carried out both across and along channel using towed bodies. A mooring, consisting of an upward looking ADCP placed on the sea floor, and a chain of thermistors in the water column was deployed on day 2 and recovered by teams 5 and 6 on the last leg of the cruise. A grab sample was also collected on day 2 near the end of the first leg of the cruise.

The report will give a short summary of the daily activities of the scientific teams, the cruise track, and the operations carried out at various stations. An overview of instrumentation used, notes on the data processing and software used on board ship will be followed by a presentation of plots of the raw data with limited or no processing. The report will also present preliminary plans for more detailed scientific analysis.

SCIENTIFIC VESSEL

Figure 2, Anne S. Pierce, MUN research and training vessel

The operation were run from the Anne S. Pierce, owned and operated by The Marine Institute, a division of MUN. The vessel is 29.9 m long and 8 m wide. A large flat deck at the stern of the ship equipped with a sea crane facilitates the scientific operations. The working space inside was spacious and well organized. Even with a high number of students onboard, the working areas were not overcrowded. It is with gratitude that we want to give a special thanks to the Captain of the Anne S. Pierce and is crew for their dedication, enthusiasm and help during the survey. Their professionalism greatly contributed to the success of this scientific mission.

SCIENTIFIC PERSONNEL

Personnel	Function	Dates
Brad deYoung	Chief Scientist Memorial University Newfoundland	06 October 2008
Sam Bentley	Instructor 06 Oct. Chief Scientist 07 Oct. Memorial University Newfoundland	06 -07 October 2008
Ralf Bachmayer	Instructor Memorial University Newfoundland	06 October 2008
Jack Foley	Oceanographic technician	06 -07 October 2008
Renita Aranha	Student Memorial University Newfoundland	06 -07 October 2008
Sara Best	Student Memorial University Newfoundland	06 -07 October 2008
William Fowler	Student Memorial University Newfoundland	06 -07 October 2008
André Roy	Student Memorial University Newfoundland	06 -07 October 2008
Tristan Hauser	Student Memorial University Newfoundland	06 -07 October 2008
Zhimin Ma	Student Memorial University Newfoundland	06 -07 October 2008
David Shea	Student Memorial University Newfoundland	06 -07 October 2008
Ray Roche	Student Memorial University Newfoundland	06 -07 October 2008

SURVEY LOCATIONS AND NARRATIVE

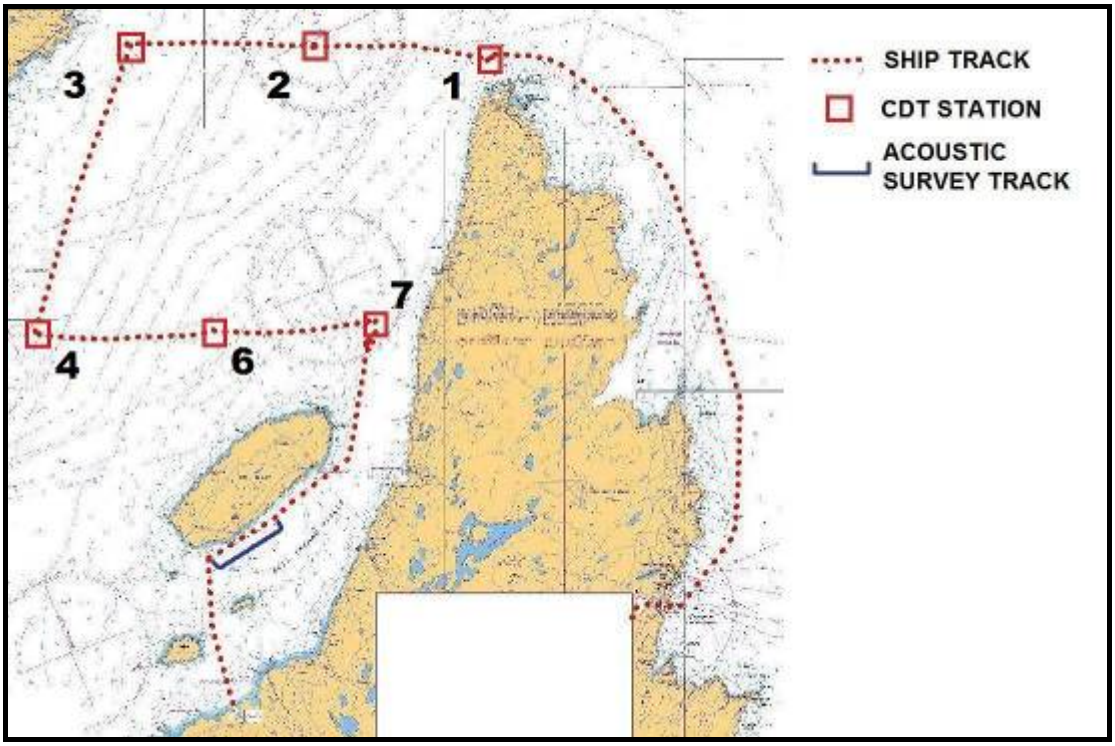


Figure 3, Ship tracks for the Leg 1 of day 1

The first day of this scientific trip began with the gathering of the faculty's instructors and students at the entrance of the MUN University Centre. The first problem encountered was the failed arrival of our planned transportation to the CSV Anne S. Pierce on the south side of St. John's Harbour. Taxis were called in as transportation replacement. Upon our arrival on the vessel, cabins were assigned, breakfast was served and a safety briefing was conducted by the crew. We sailed from St. John's at 9:30 am local time heading for Conception Bay, our study area, which is shown in figure 3. The transit time from St. John's to our first station was used to prepare the different instrumentation that would be used during the mission. The ADCP and thermistor chain mooring were assembled by Jack Foley, our technician, with the help of a few students. Upon arrival to the first station of the large scale CTD survey, instruction was given to the students on the deployment of the Sea Bird CTD and the first cast was executed without any problems. The immediate download of the data showed that all sensors were working properly. The trip continued with the visit of six of the seven planned stations of the CTD large scale survey. Station five, located further into the bay was postponed until

the following day due to time constraints. The transit time between stations was used to download and verify CTD data and to prepare the instruments that were to be used later in the day. The towed sled, combining single beam and multibeam echo-sounder, as well as an ADCP, wasconnected to GPS and laptop controllers. The Edge Tech sidescan was also assembled and prepared for deployment. A problem was encountered during the testing of the controlling software of the BioSonics single beam echo-sounder. After phone calls to the manufacturer, the problem was resolved by using a different laptop controller that had the proper licensing module installed for the controlling software. After the completion of the large scale CTD survey for the day, the sled and the sidescan were deployed for the first acoustic survey line. The line was planned on the western edge of Bell Island Tickle and ran close to the location of a wreck that offered a prime acoustic target for the multibeam and the sidescan. This line of acoustic survey completed operations for the day. The vessel then proceeded for Long Pond Harbour to spend the night.

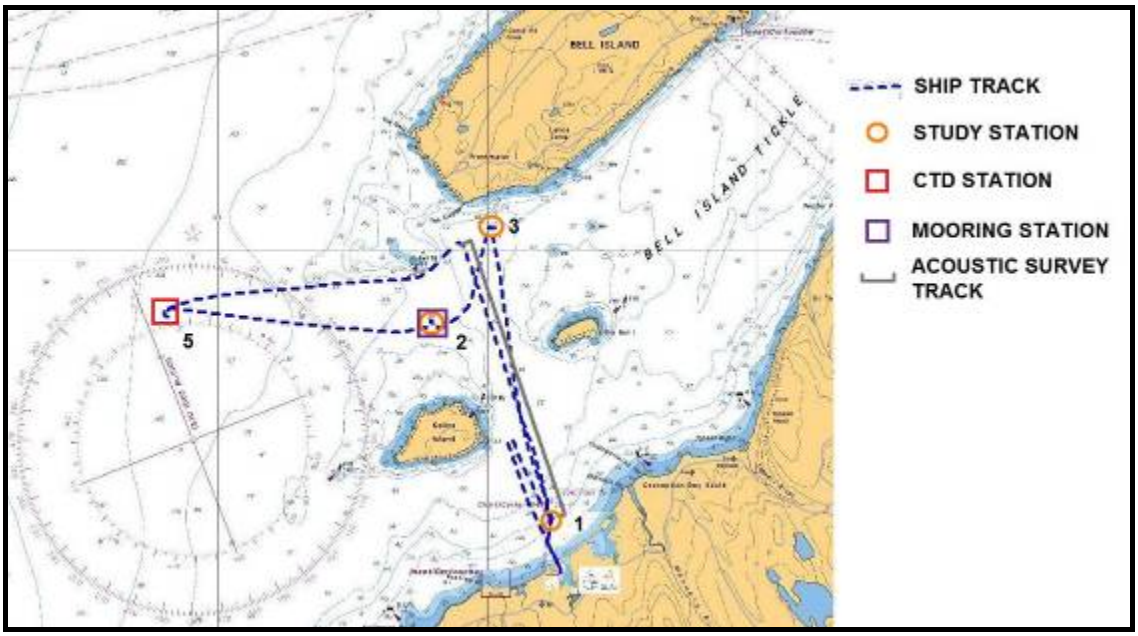


Figure 4, Ship tracks for day 2 of the leg 1

On the second day, the vessel left Long Pond at approximately 8:30 am local time. The cruise track for day 2 is shown in figure 4. A planning meeting took place to review the program of the day and instructions were relayed to the captain. Difficulties were

encountered for the deployment of the Chirp sub-bottom profiler. It was discovered that an accumulation of rust in the holding bracket delayed the installation. A decision was made to deploy the instrument later during the mission. The operation began with the deployment of the CTD on the first station of the Bell Island Tickle study area. After the CTD cast, an acoustic transect across channel was run with the sled. The ship then preceded to the last large scale CTD station, number 5 which was missed on the previous day. After the completion of that task the Anne S. Pierce steamed to the mooring station. Upon arrival, the mooring containing an upward pointing ADCP and a chain of thermistors was deployed without any problems. A GPS fix was taken on location with a handheld E-trex Garmin receiver. The location was also marked with small yellow buoys. We then conducted another CTD cast at the same station known as S2 of the Bell Island Tickle study area. The ship then went to station number S3 of the study areas to perform a CTD and a bottom grab. It was planned to use the capstan on the stern of the ship to lower the grab but it was not working. We had to use the crane instead and its use limited the depth that we could reach. Therefore the grab at station S3 had to be cancelled. Due to time consideration after completion of the CTD at station S3 it was decided to skip station S4 and to return to station S1 to perform a bottom grab. This grab was successful. That marks the end of the leg 1 of the survey. The Anne S. Pierce returned to Long Pond Harbour for student crew change.

SUMMARY OF WORK ACCOMPLISED

No. of Deployments	Type of Operation
7	Large scale CTD survey cast
3	Bell island Tickle CTD survey cast
2	Tows of the hydro-acoustic sled including ADCP, single beam and multibeam echo-sounder.
1	Sidescan sonar tow
1	Bottom grab samples
1	Moored ADCP with thermistor chain

INSTRUMENTATION

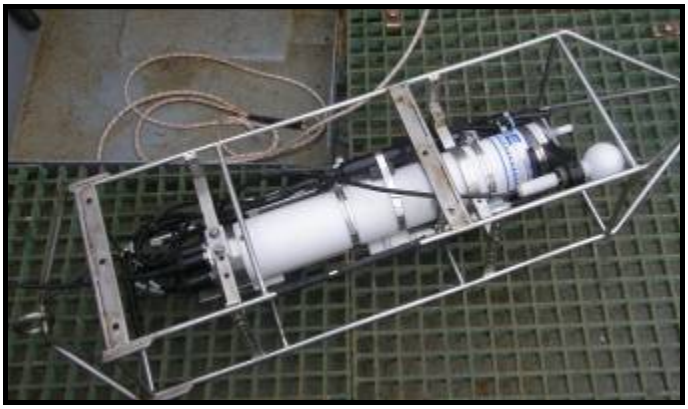


Figure 5, CTD from Sea-Bird Electronics, Inc.

CTD

For the Measurements of conductivity, temperature and density of the water column.

THE MUN HYDRO-ACOUSTIC SLED

ADCP

Measurement of the velocity of oceanic current through the water column.

DELTA T MULTIBEAM SONAR

Instrument for the measurement of the depth. This multibeam echo-sounder will measure a swath of a width of 3.5 times the depth under the transducer for every ping.

BIOSONIC SINGLEBEAM SONAR

Depth measurement and water column data.

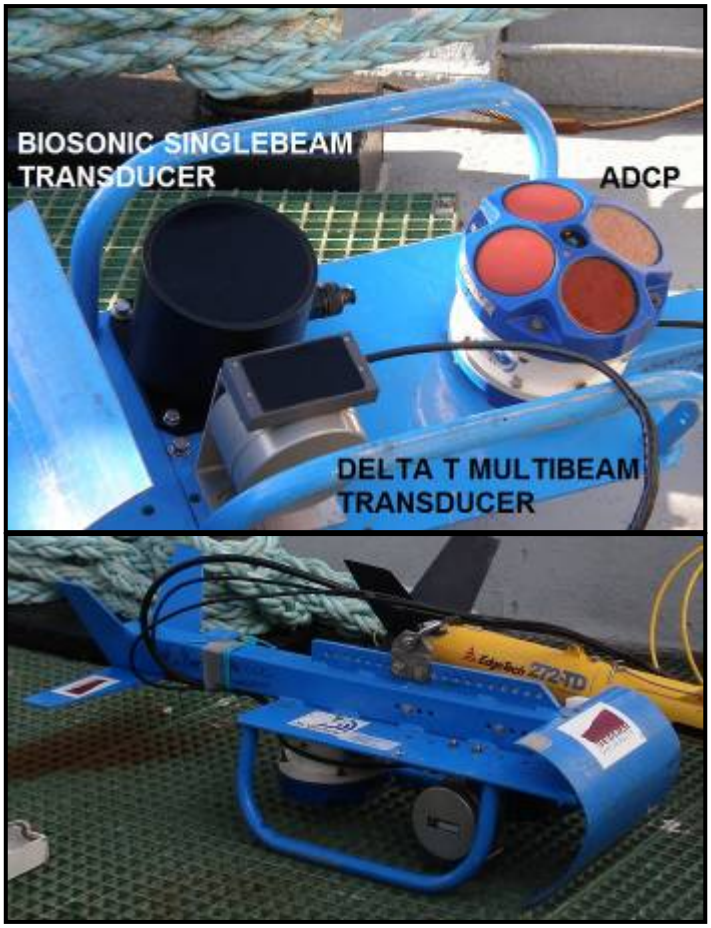
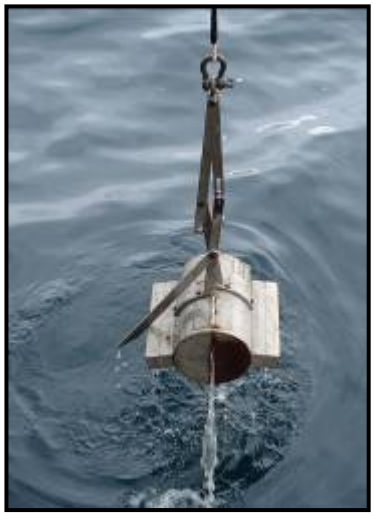


Figure 6, The Mun hydro-acoustic sled.

SIDESCAN SONAR

Figure 7, The Edge Tech 272-TD sidescan sonar

For the production of seafloor imaging interpreted from the backscatter intensity.



PETERSEN GRAB

A gravity bin taking a sample of the surface sediments on the sea floor.

Figure 8, Petersen grab being recovered

MOORED ADCP

A moored ADCP and a chain of thermistors for the static measurement of current velocity and water column temperature at a given location.

Figure 9 Deployment of the ADCP mooring

CHRONOLOGY OF EVENTS

Dates / Time	Event
October 6th, 2008 11:40 UTC	Leave St. John's Harbor. En route for CTD Station 1
12:43 UTC	Built ADCP mooring on aft deck.
13:39 UTC	ADCP mooring ready to deploy. Prepared for CTD Station 1. Ship steaming off Cape St. Francis
13:55 UTC	Team 1 took Large Scale CTD sampling at Station 1.Coordinates were 47 49.319N and 52 48.101W.
14:03 UTC	CTD was cast at a depth of 136m. Wave conditions were good.
14:13 UTC	CTD was recovered.
14:22 UTC	Ship steamed to Station 2. Ship speed was approximately 6.7 knots.
15:01 UTC	Team 2 took Large Scale CTD sampling at Station 2. Coordinates were 47 49.600N and 52 55.800W. CTD was deployed and cast to a depth of 194m.
15:13 UTC	CTD was recovered. Wave conditions were choppy with 1m waves and slight amounts of wind.
15:59 UTC	Team 1 took Large Scale CTD sampling at Station 3. Coordinates were 47 49.769N 53 03.251 W. CTD was deployed and cast to a depth of 80m.
16:04 UTC	CTD was recovered. Wave conditions were a little choppy.
16:00 UTC	Finished lunch. Set up the Mun sled with ADCP, ΔT and Bio Sonic transducer. Set up side scan for tow.
16:25 UTC	Ship steamed to Station 4. The ship speed was approximately 10.8knots. Prepared sides-scan sonar, ring net and tow fish ADCP.
17:02 UTC	Team 2 took Large Scale CTD sampling at Station 4. Coordinates were 47 41.541 N 53 07.086 W. CTD was deployed and cast to a depth of 135m.
17:11 UTC	CTD was recovered. Wave conditions were a little choppy.
17:17 UTC	Software glitch in BioSonics. Trouble-shot by Brad and Ralf.
17:41 UTC	Team 2 took Large Scale CTD sampling at Station 6. Coordinates were 47 41.665 N 52 59.765 W. CTD was deployed and cast to a depth of 120m.
17:49 UTC	CTD was recovered. Sea conditions were choppy.
18:18 UTC	Large Scale CTD sampling at Station 7. Coordinates were 47 41.997 N 52 53.019 W. CTD was deployed and cast to a depth of 120m.
18:26 UTC	CTD was recovered. Sea conditions were choppy.
19:07 UTC	Approached Bell Island Tickle
19:17 UTC	Towfish was place in water along the port side. Began steaming with ADCP, echo-sounder and multi-beam in tow.
19:23 UTC	Started ADCP.
19:26 UTC	Sidescan for Towline 1 was placed in water.(aft)
19:33 UTC	Saw view of ship wreck on the starboard side. *N.B: Another track line should be made.

20:01 UTC	Stopped data acquiring for the day. The coordinates were 47 35.187N and 52 59.997W.
20:02 UTC	Recovered instruments.
October 7th, 2008 10:30 UTC	Had a group meeting to discuss the day's work.
11:43 UTC	CTD was cast along the tickle at station S1 at the start of cross section transect line. The coordinates were 47 31.642N and 52 58.830W. The depth of the cast was 18m.
11:46 UTC	CTD was recovered. Sea conditions were calm.
11:54 UTC	Across Channel Transect ADCP Tow fish placed in water.
11:55 UTC	Transect start location was between 20-80m depth at coordinates 47 31.833 and 52 58.916W. Towfish recording Multi-beam sonar, echo-sounder and ADCP. Speed approximately 4.8 knots for the towfish.
12:38 UTC	End of Across Channel Transect. The coordinates were 47 35.055N and 53 00.422W.
12:42 UTC	Steamed to Large Scale CTD Station 5.
13:13 UTC	Large Scale CTD sampling at Station 5. Coordinates were 47 34.258N and 53 05.894W. CTD was deployed and cast to a depth of 120m.
13:22 UTC	CTD was recovered. Wave conditions were calm. Began steaming to mooring ADCP location and CTD station S2.
13:49 UTC	ADCP mooring deployed. The coordinates of the ADCP were 47 56.841N and 53 01.747W. The coordinates of the float were 47 56.810N and 53 01.691W.
13:58 UTC	CTD at station S2 was deployed and cast at a depth of 30m. The coordinates were 47 34.079N and 53 00.989W.
14:02 UTC	CTD was recovered. The
14:04 UTC	Ship steamed to station S3. Capstan broke, decided to use crane for the grab sample.
14:17 UTC	Grab sample to be taken was aborted. It was decided to take a CTD sample instead, making it new S3 location.
14:23 UTC	CTD was deployed and cast a depth of 45m. The coordinates were 47 35.275N and 52 59.919W.
14:25 UTC	CTD was recovered.
14:26 UTC	Ship steamed for Long Pond. Lunch time. CTD station S4 postponed due to time considerations.
14:51 UTC	Deployed grab sample at coordinates 47 31.644N and 52 58.802W. Grab sample cast depth of 25m. The grab sample obtained fine silt and mud. Photographs were taken. Same suggests that this would be a good area to deploy ADV. End of day 2. Head back to port.

DATA PROCESSING AND SOFTWARE

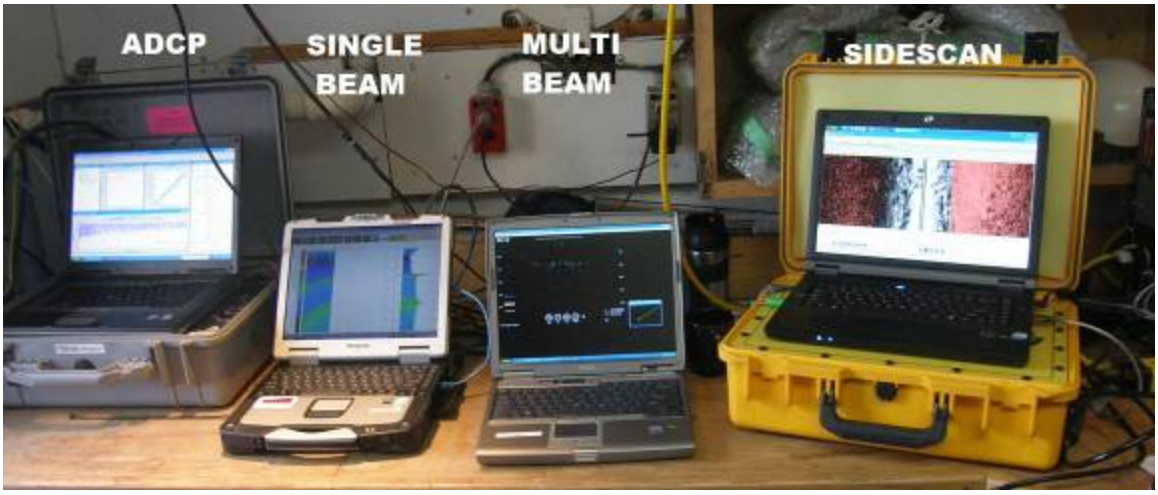


Figure 10 Laptops controlling the various survey instruments

SEATERM
Software used to download the data from the Sea-Bird CTD's cast.

WINRIVER II
Software used to collect the data from the ADCP.

VISUAL AQUISITION 5
Software used to collect the data from the Bio Sonic single beam echo-sounder.

MATLAB 9
Software used for the processing and display of the Thermistors, ACDP and CTD data.

DELTA T MULTIBEAM SONAR 1.01.71
Software used for acquisition and playback of the Delta t multibeam echo-sounder.

HIPS SIPS 6.1
This commercial software was used to display the sidescan data

GLOBAL MAPPER 9.0
This commercial software was used for the productions of maps and the presentation of the navigation data.

PRELIMINARY RESULTS

CTD

Large scale CTD survey

The following are the results from the large scale CTD survey executed on the first two days of the mission. Most of the profiles are fairly similar. The mix layer reaches a depth of ~ 40 m for most casts, with the exception being Station 2 shown in green in figure 11 where the thermocline is located at ~ 25 m, this may warrant further analysis. This station is the most exposed to the open ocean and to the Labrador current. We can also mention that the survey followed a few successive days of high winds; this would have a mixing effect on the water column. Station 4 shown in magenta is also noteworthy, as it appears to exhibit a higher degree of stratification in the upper water column, with a visible step like behavior. Station 4 is located on the western side of Conception Bay and thus less exposed to the Westerly winds. A few outliers can be noted in the salinity profiles shown in figure 12, these data points should be removed prior to further analyses.

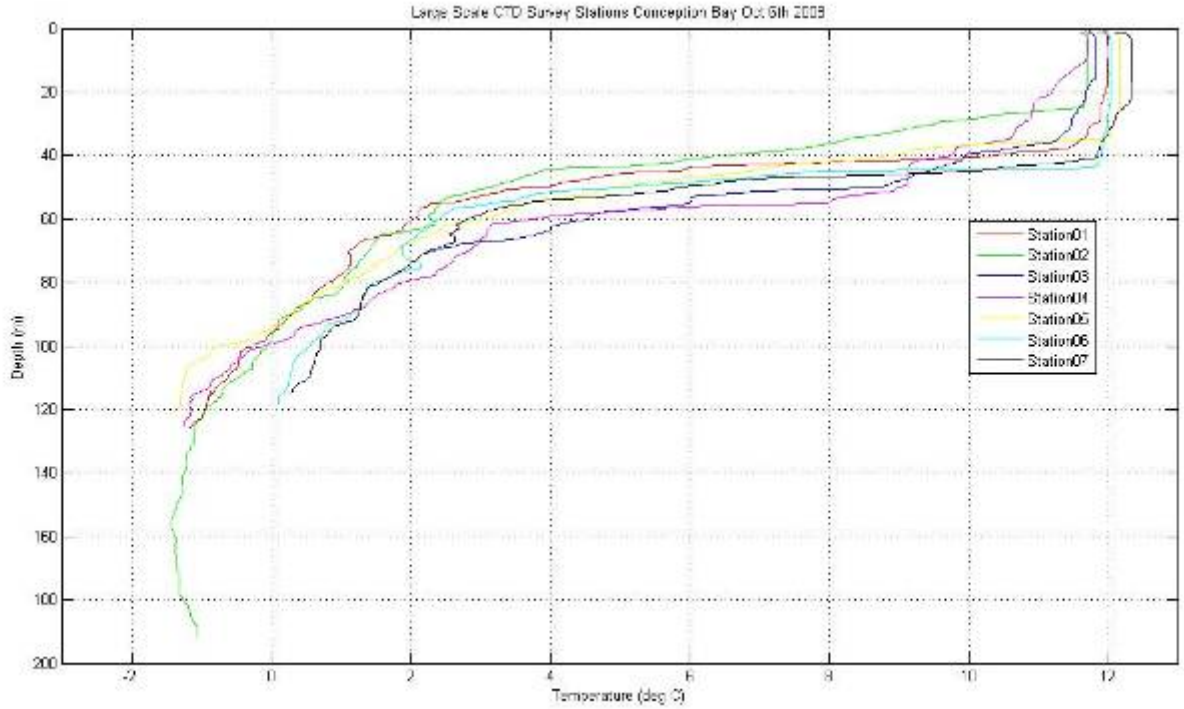


Figure 11, Temperature measurement for each station of the large scale CTD survey

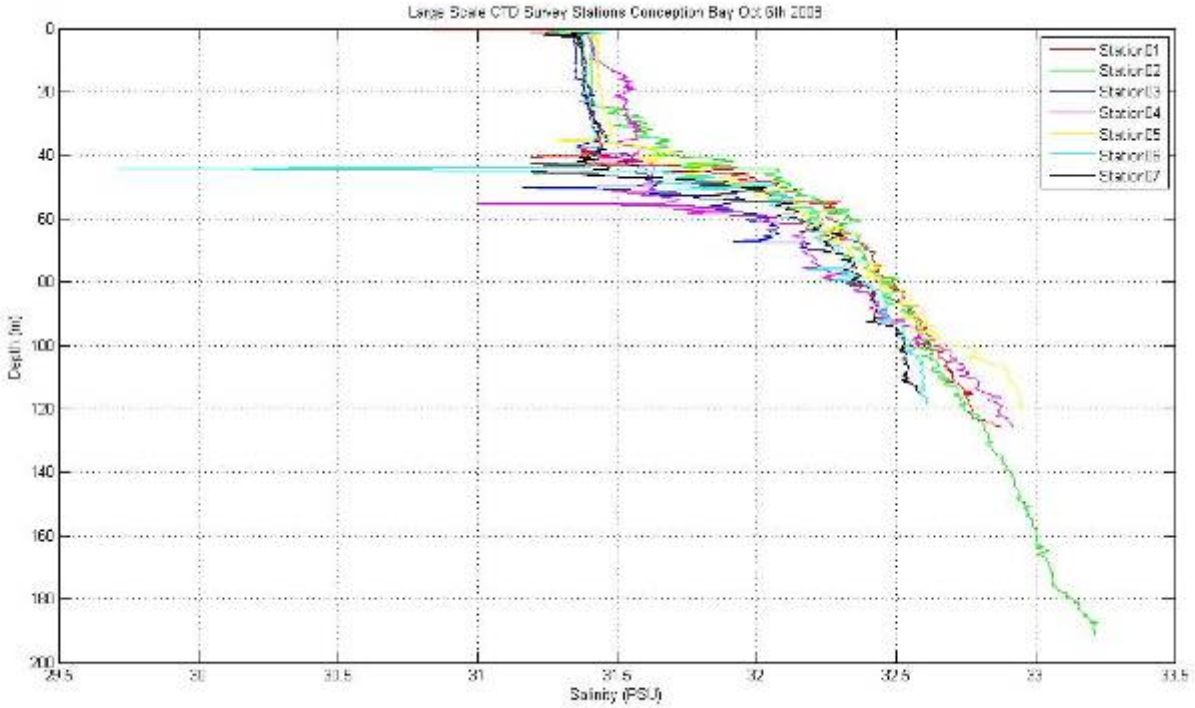


Figure 12, Salinity measurement for each station of the large scale CTD survey

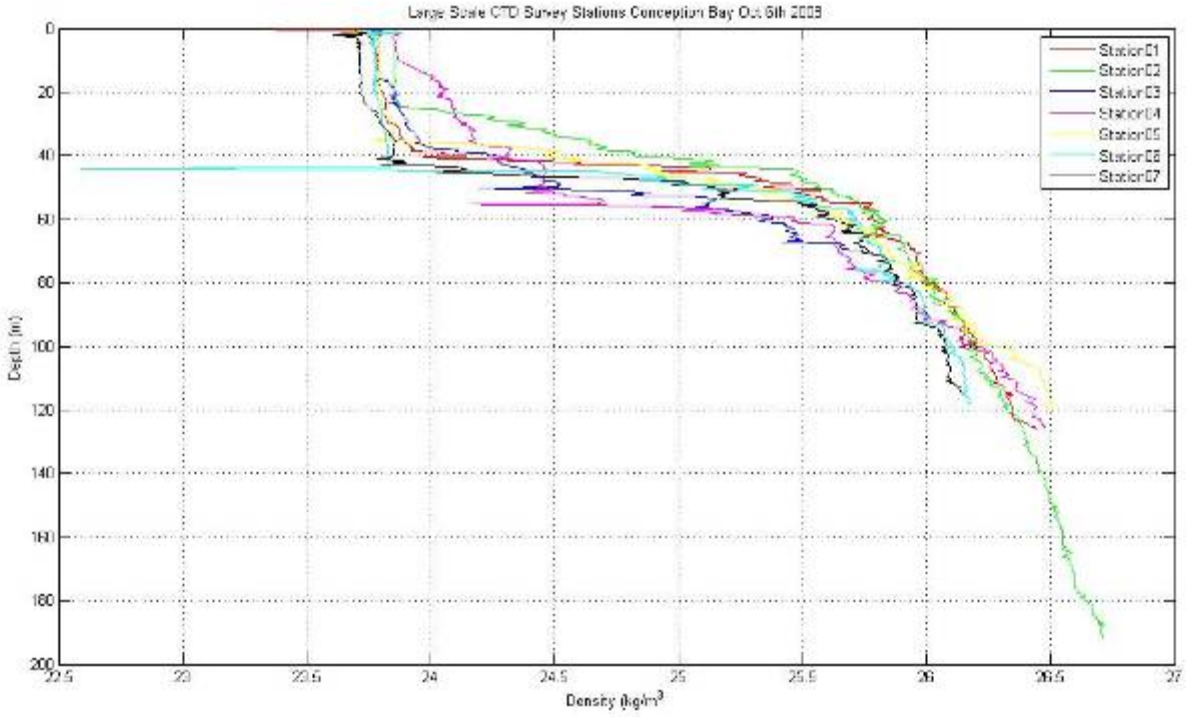


Figure 13, Density measurement for each station of the large scale CTD survey

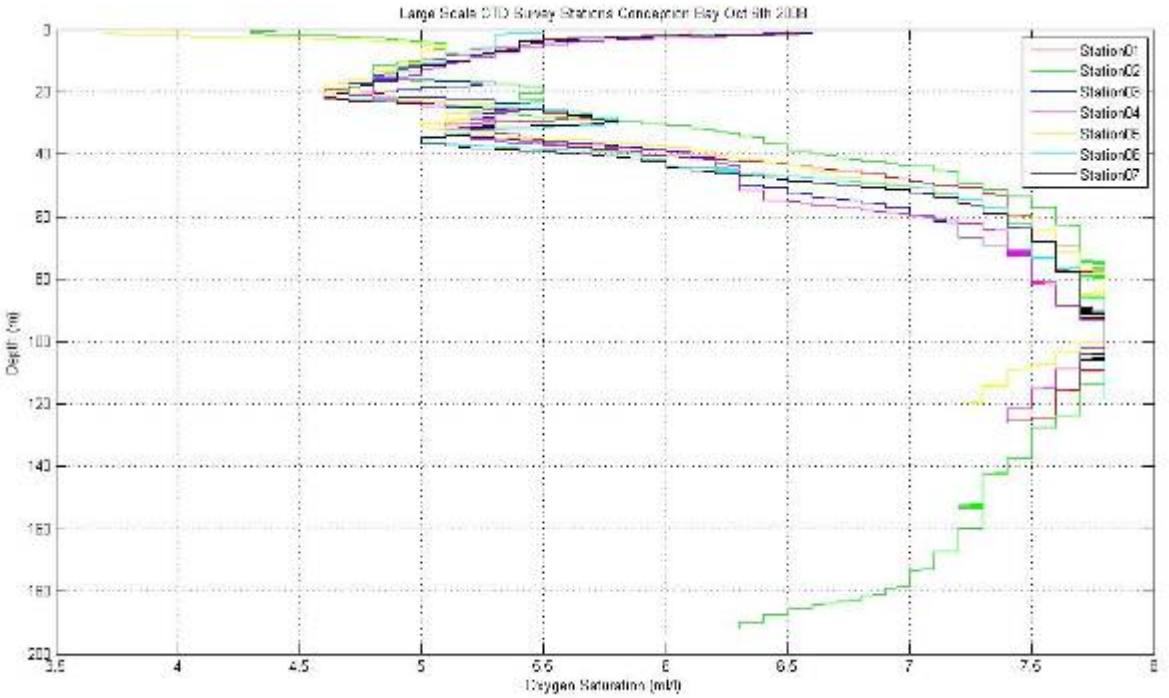


Figure 14, Oxygen saturation measurement for each station of the large scale CTD survey

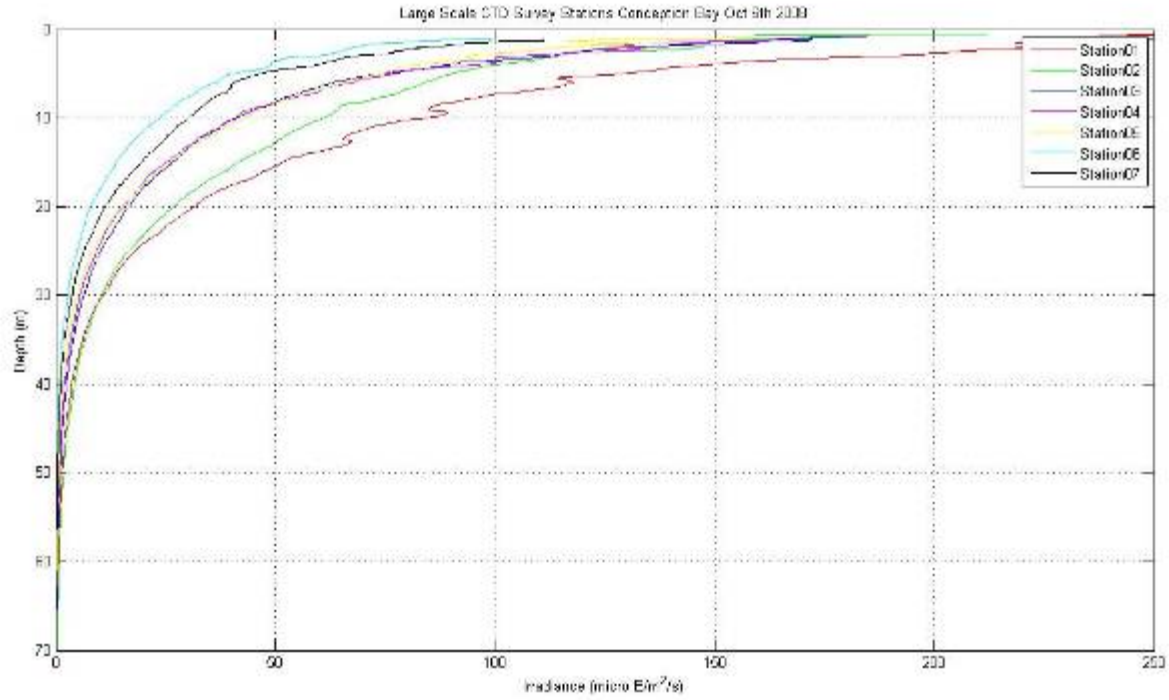


Figure 15, Irradiance measurement for each station of the large scale CTD survey

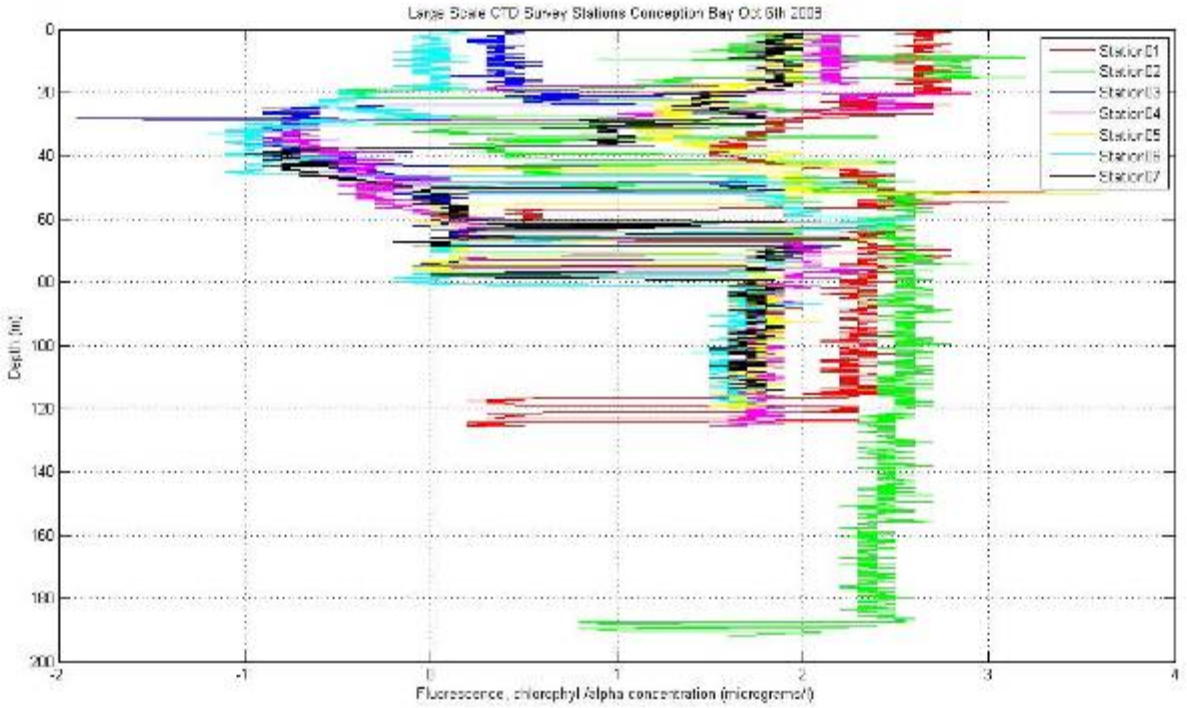


Figure 16, Fluorescence measurement for each station of the large scale CTD survey

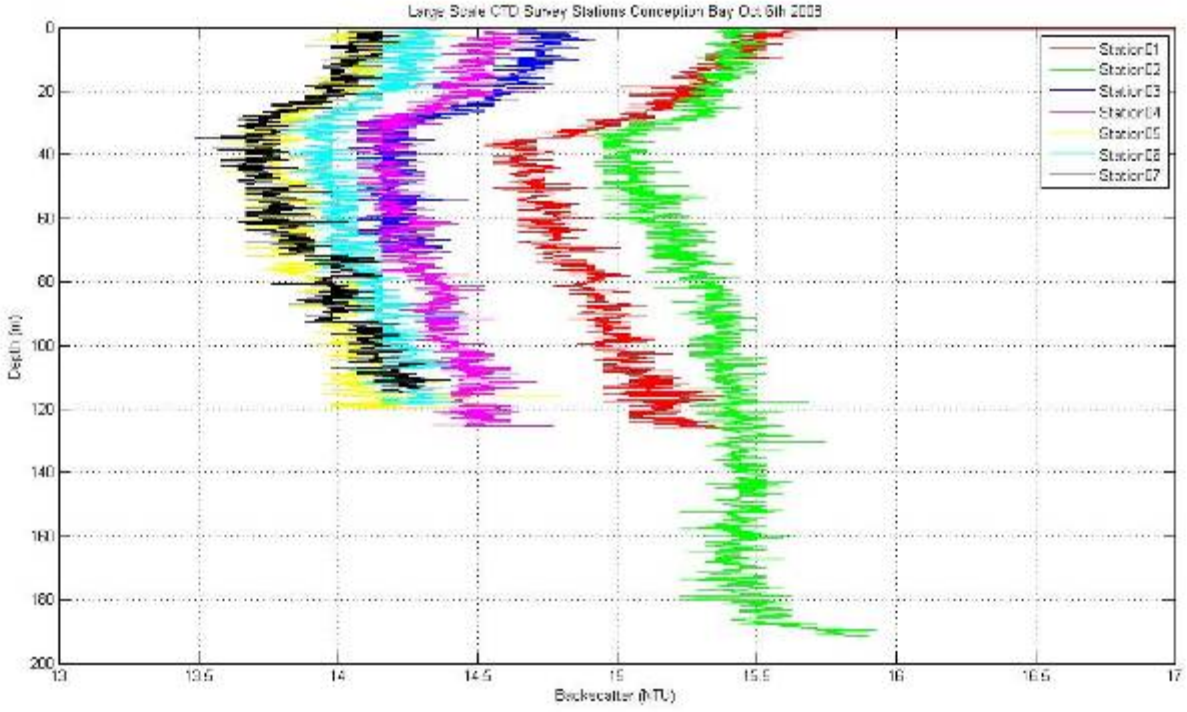


Figure 17, Backscatter measurement for each station of the large scale CTD survey.

Result from Bell Island Tickle CTD survey

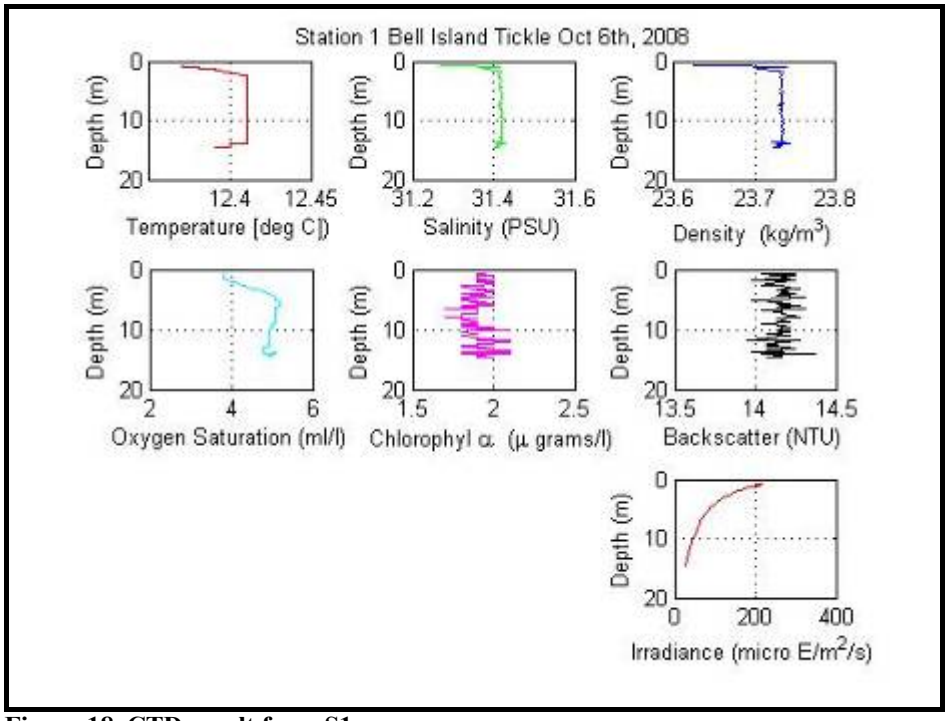


Figure 18, CTD result from S1

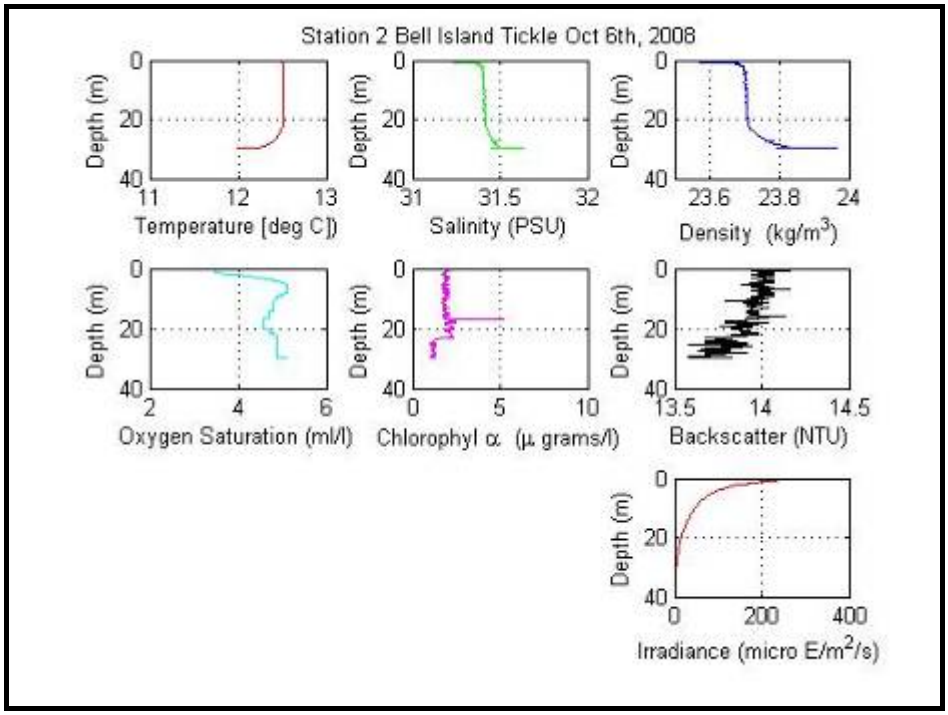


Figure 19, CTD result from S2

SIDESCAN

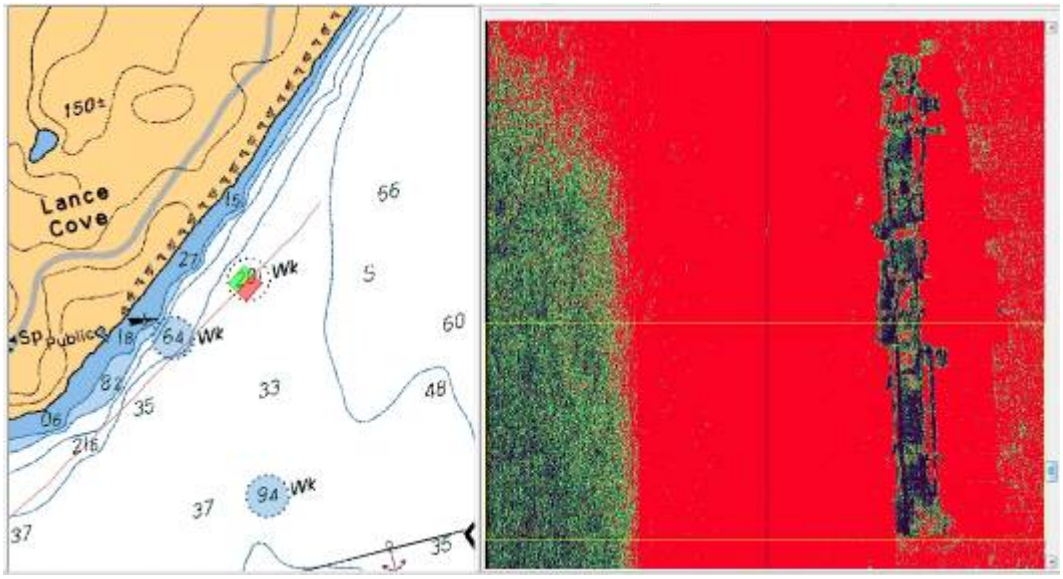


Figure 20, Screen capture from the HIPS/SIPS processing software for sidescan data

The screen capture shown in figure 20 is from the HIPS/SIPS processing software of the sidescan data collected on 06 Oct 2000. In the left window, we can observe the navigation line, shown in red over the nautical chart of the area. In the right window we can observe the backscatter echo. We can note the very obvious return from a wreck identified on the chart. No other specific feature could be identified over this short line. It was also noted that the sidescan did not provide any data at depths greater than 40 m. The tow fish would need to be lowered deeper in the water column to render a better image of the sea floor over the deeper areas.

MULTIBEAM ECHO-SOUNDER

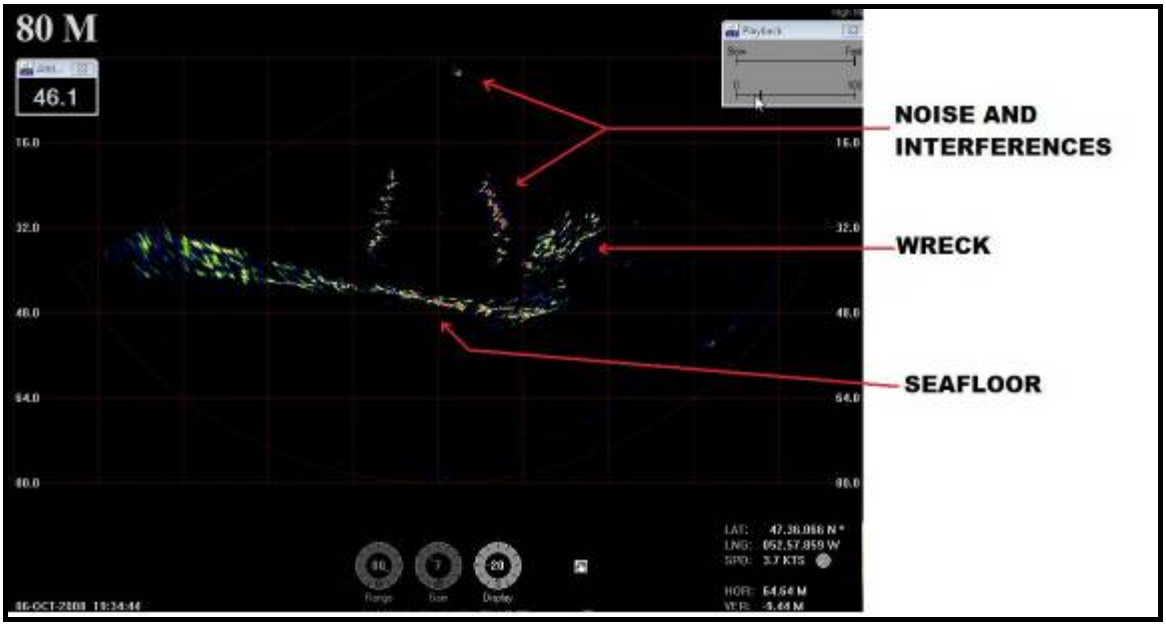


Figure 21, Image from the DELTA T acquisition and playback software.

From the playback we can identify clearly the seafloor from the noise and interference created by the other acoustic instruments used simultaneously. We can also observe a correlation in time for the detection of a known wreck between the multibeam data and the sidescan data. The large amount of noise and interference in the data will complicate the realization of an accurate bathymetric picture.

SINGLE BEAM ECHO-SOUNDER

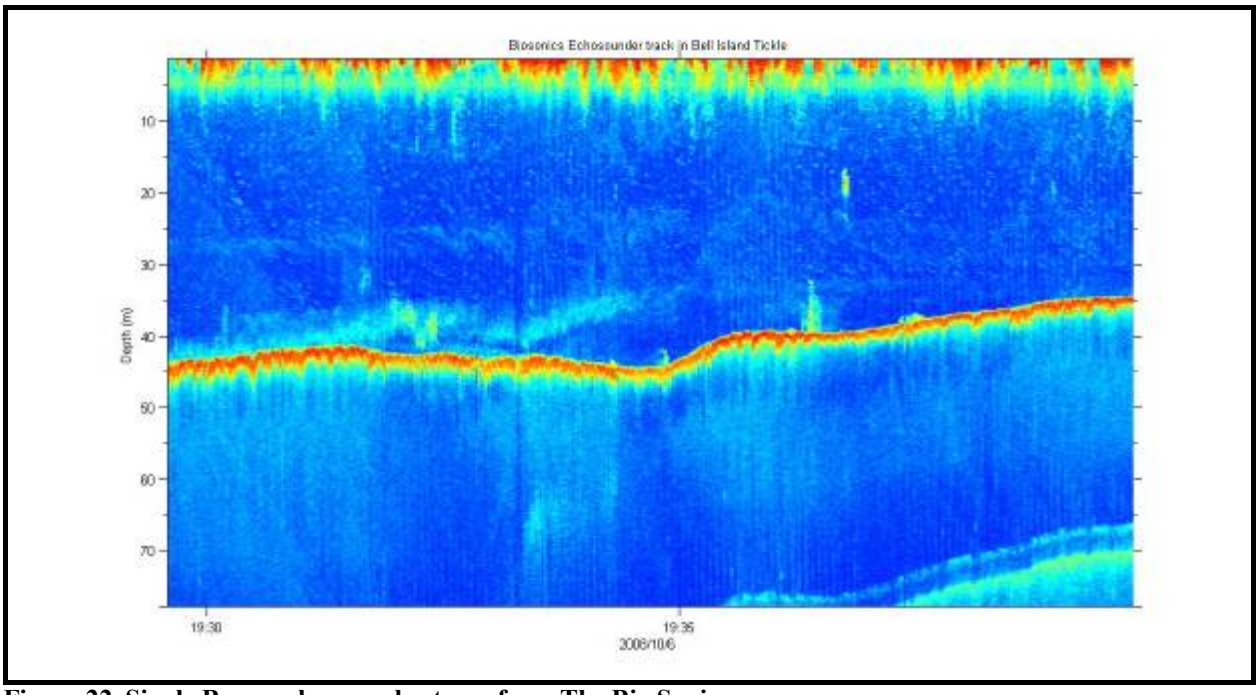


Figure 22, Single Beam echo-sounder trace from The Bio Sonic.

The image above is a sample of from the BioSonics echo-sounder. Possible density layers and some aquatic fauna can be discerned in light blue and orange on the display. The bottom is clearly identified as the sharp orange line in the middle. A noisy environment is also present on the surface layer. A double echo from the bottom can be observed on the lower right corner.

TOWED ADCP

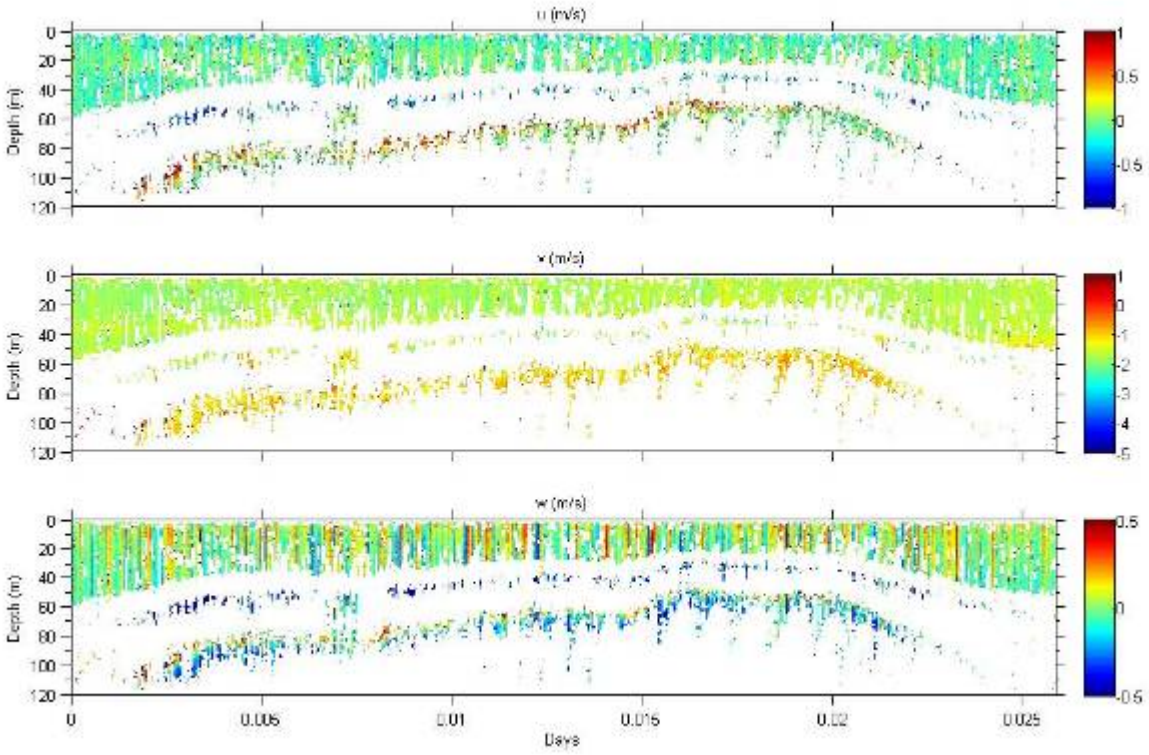


Figure 23 ADCP data from the first towed line on day 1, which ran along the Bell Island Tickle.

Our interpretation of the data would be that the first color band on the top is the useful portion of the data. The second band of color is the bottom and the third band represents what we believe to be a double echo based on the fact that we were not in water deeper then ~ 45 m during this transect on the western side of the Bell Island Tickle. We can also note the white band between the first and second band that represent the dead zone from where no measurement can be interpreted.

MOORING: ADCP AND THERMISTOR

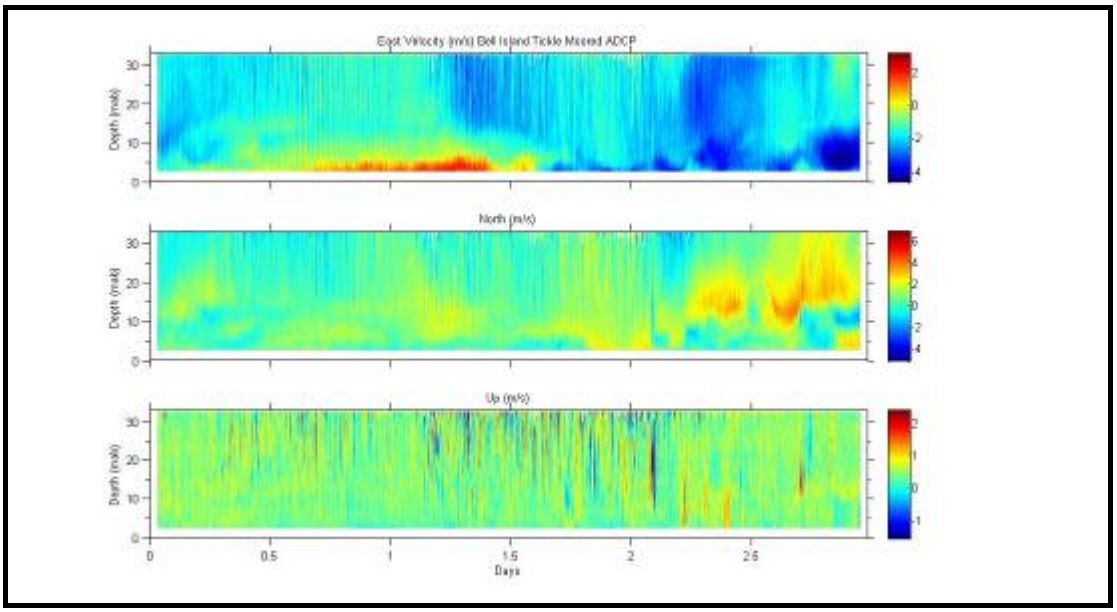


Figure 24, Moored ADCP data

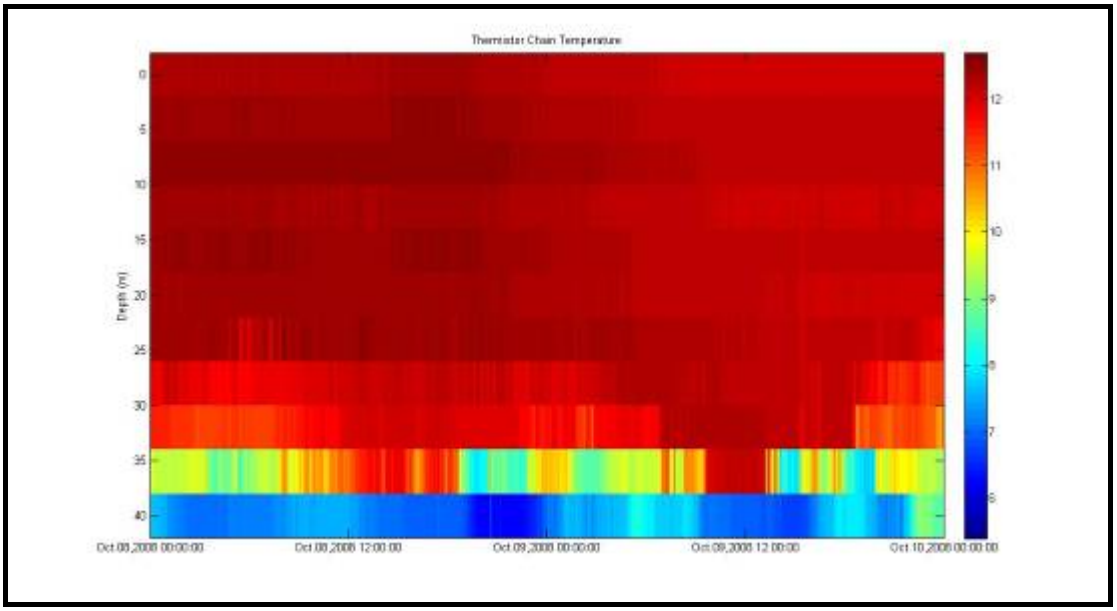


Figure 25, Data from the chain of thermistors

From the combination of the temperature and current measurement we can observe a stratified cold bottom layer with the highest velocity currents mostly in the east/west flow which seems consistent with the location of the mooring near the western mouth of the tickle and a counter clockwise flow around Conception Bay. Would this higher velocity be generated by the density difference of the water layers?

BIOLOGY

Summary of type and number of marine zooplankton collected from vertical plankton net tows throughout the cruise

The following is the list of organisms collected, and the abbreviation used for their names in the tables that follow:

COPE	Copepods
CLAD	Cladoceran
GASL	Gastropod Larvae
CHAE	Chaetognath
LARV	Larvacean
STAL	Starfish Larvae
ECHL	Echinoderm Larvae
JELL	Jelly
CTEN	Ctenophore
SHPL	Shrimp Larvae
PTER	Pteropod
MYSI	Mysid
POLY	Polychaete Larvae
HYPE	Hyperiid
DECA	Decapod
ISO	Isopod

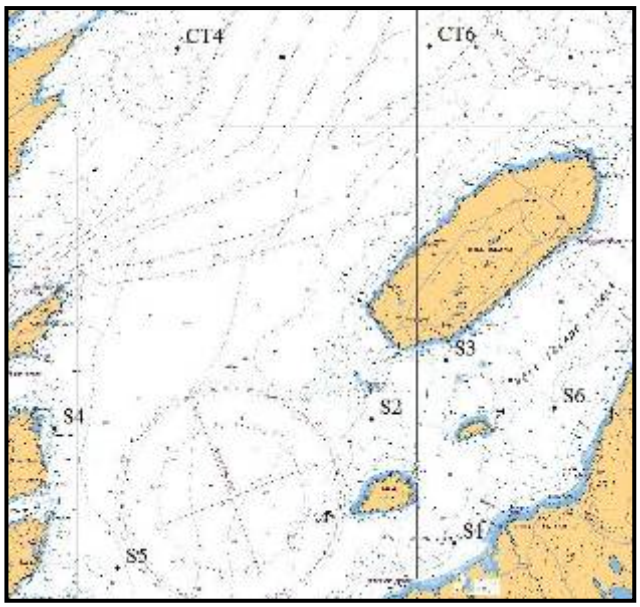


Figure 26, Location of biology stations in Conception Bay.

Site	Latitude	Longitude	Split
CT4	47°41.555N	53°07.016W	1/128
CT6	47°41.600N	52°59.598W	1/256
S1	47°31.709N	52°58.858W	1/128
S2	47°34.186N	53°01.229W	1/128
S3	47°35.221N	52°59.131W	1/128
S4-shallow	47°33.961N	53°10.707W	1/256
S4-deep	47°33.997N	53°10.616W	1/256
S5-shallow	47°31.228N	53°08.767W	1/256
S5-deep	47°31.015N	53°09.081W	1/512
S6-shallow	47°34.418N	52°55.931W	1/256
S6-deep	47°31.015N	53°09.081W	1/256

Table 1: Location of the sites where the plankton nets were deployed and the degree of splitting done for the analyses of each sample

Site	COPE	CLAD	GASL	CHAE	LARV	STAL	ECHL	JELL	CTEN
CT4	981	30	251	16	9	4	13	1	1
CT6	152	281	127	0	9	9	23	2	0
S1	290	59	36	0	5	2	8	2	0
S2	372	136	120	2	16	1	18	8	0
S3	141	178	130	0	6	2	43	5	0
S4-shallow	434	91	57	3	5	3	1	0	0
S4-deep	365	106	146	10	23	4	2	4	0
S5-shallow	211	53	22	1	6	1	7	4	0
S5-deep	242	10	14	6	21	7	1	6	0
S6-shallow	126	182	148	0	2	2	18	1	0
S6-deep	204	194	135	6	4	4	16	1	0

Table 2: A list of the number of Copepods, Cladocerans, Gastropod Larvae, Chaetognath, Larvaceans, Starfish Larvae, Echinoderm Larvae, Jelly and Ctenophores in each sample analyzed

Site	SHPL	PTER	MYSI	POLY	HYPE	DECA	ISOP	TOTAL	COUNT
CT4	2	1	1	1	0	0	0	1311	4388
CT6	0	1	0	0	0	0	0	604	6078
S1	1	1	0	0	1	0	8	413	1059
S2	0	0	0	0	0	1	0	674	6356
S3	0	0	0	0	0	0	0	505	1569
S4-shallow	0	0	0	1	0	0	0	595	1123
S4-deep	0	0	1	0	0	0	0	661	3191
S5-shallow	1	1	0	0	0	0	0	307	1636
S5-deep	0	0	1	0	0	0	0	308	3951
S6-shallow	0	0	0	0	0	0	0	479	1957
S6-deep	0	0	0	1	0	0	0	565	3958

Table 3: A list of the number of Shrimp Larvae, Pteropods, Mysids, Polychaete Larvae, Hyperiids, Decapods and Isopods in each sample analyzed.

Megascopic organisms found in the grab sample: In the grab sample collected on October 7, 2008 at 14:51 UTC (47□35.644N, 52□ 58.802W) we found two specimens of ***Echinarachnius parma*** (the common sand dollar)

Figure 26, a Copepod and a Shrimp Larva from the vertical net tow.

BOTTOM SAMPLE GRAB

Figure 27, Bottom sample taken from the station 1 containing fine sand, pebbles and sand dollars.

Just before releasing the content of the grab on the deck of the Anne S. Pierce, it was expected to have collected pebbles and gravel. But instead the grab released a good quantity of fine sand and a few small pebbles. A few sand dollars enhance the value of our grab.

GLIDER

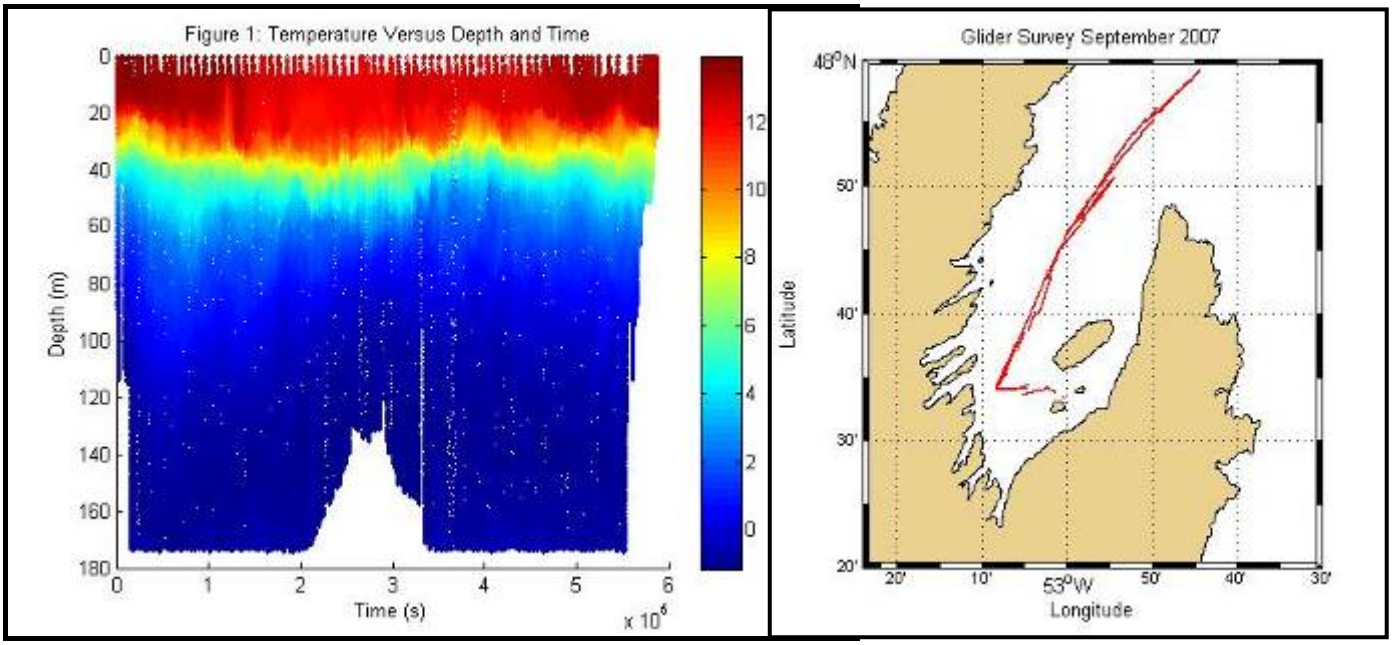


Figure 28 Left, Data from the 2007 glider mission. Right, navigation followed during the mission.

Due to technical difficulties, the glider mission for this year had to be cancelled; therefore the data from last year will be used for subsequent study.

CONCLUSION

The two day leg of the scientific cruise went along quite efficiently, providing much data for analysis. Through initial analysis of the data collected from instrument deployments it was possible to profile ocean characteristics. The CTD data provided information about temperature, salinity, density, oxygen saturation, irradiance and backscatter. Biological studies later in the cruise allowed for examination of the quantity of various marine zooplankton present in the bay. Through the moored ADCP data it was found that larger east / west flow and lower temperatures were present at greater depth. The multi-beam sounder provided imaging of the sea floor, while the echo-sounder provided information regarding density layers and any objects in the bay.

It is from the raw data collected that further analysis will be conducted. All data requires further filtering to eliminate noise interference. One such opportunity relates to the CTD large scale survey and survey along the Bell Island tickle. Further analysis will involve cross referencing the data collected from the cruise to the September 2007 glider survey data taken in Conception Bay, Newfoundland. This study will help make inferences about any inconsistencies in the equipment, or possible changes from the ocean climate. As well, data from the different CTD stations within the bay will be compared, particularly those found between the Bell Island tickle and the large scale survey. As for the moored ADCP data velocity profiles and spectral analysis for evidence of tidal signatures will be carried out. Finally we can compare the long channel and across channel flow via moored and towed ADCPs.