Cruise Report

Field Oceanography

Team 5, Leg 3

Submitted by:

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Date:

October 27, 2008

1. Objectives

The fieldwork was part of a field oceanography course at the memorial University of Newfoundland.The goal was to give students the chance to gather experience on a scientific research vessel, to learn how to organize ship-based fieldwork and to collect oceanographical data. The data will be used for oceanographial analyses and help to increase the current knowledge about the complex oceanographical processes in Conception Bay.

2. General Information

2.1 Vessel Information

Name: Anne S. Pierce
Port of Registry: St. John's, NL
Gross Tonnage: 296 t
Length: 29.90 m
Breadth: 8.00 m
Depth: 4.20 m

2.2 Cruise Date

Leg three of the cruise took place between the following times and dates.

Start: 0800 Thursday, October 09, 2008
Finish: 1700 Friday, October 10, 2008

2.3 Participants

Leg three consisted of members of teams 5 and 6. In addition to the students there were four instructional personnel, a cook, an engineer and the captain aboard the vessel. Below is a list of all people on the vessel on leg three.

Team 5

Peter Hülse

Lina Stolze

Madlena Hukobyan

Allison Kennedy

Team 6

Julio Salcedo

Brian Claus

Sarah Graham

Instructors

Daniel Bourgault

Ralf Bachmeyer

Jack Foley

Crew

Captain –

Cook –

Engineer –

3. Study area

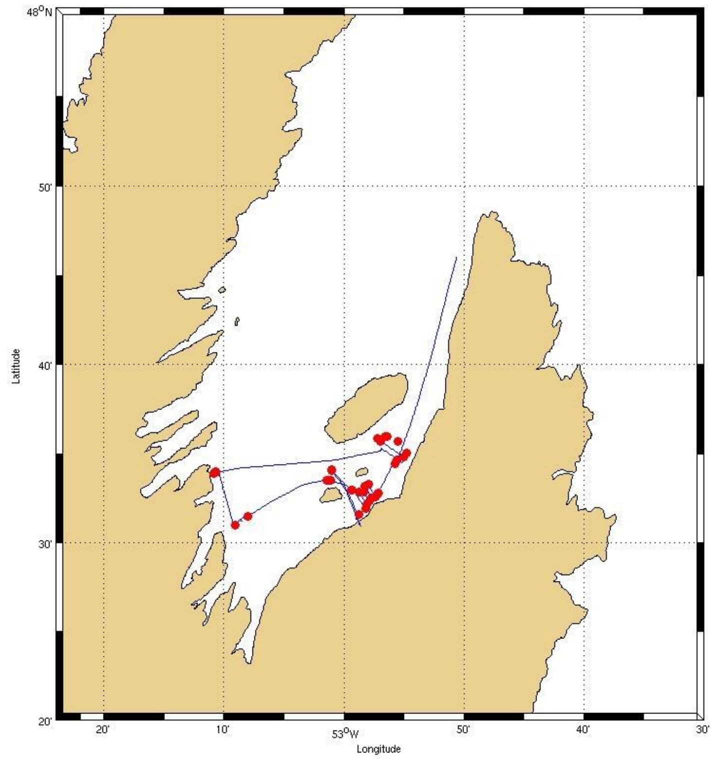


Figure 1: Map of the investigation area

4. Fieldwork and data collection

4.1 Work accomplished

During the 1.5 days of oceanographical fieldwork parts of the Bell Island Tickle, a transsect across southern Conception Bay, as well as several coastal locations in southern Conception Bay and the Manual River haven been surveyed. See figure 1 for details.

The data can be subdivided into three groups:

- Ship based electronic surveys and sampling (Sidescan Sonar, Subbottom Profiler, Delta-T-Multibeam, CTD, ADCP,)
- Ship based biological water column and bottom sediment sampling (Nets, Secchi Disk, Grabsampler)
- Moored instruments (ADCP, Thermistor Chain)

The data collection included bathymetrical mapping (Edgetech Sidescan Sonar), subbottom profiles (Edgetech Subbottom Profiler), current measurements (towed Acoustic Doppler Current Profiler, ADCP), bathymetry and sea-floor properties (Delta-T-Multibeam), plankton collection within and below the photic zone (kind of net), photic zone thickness measurements (Secchi Disk), seafloor sediment sampling (Grabsampler), as well as conductivity (salinity), temperature, density (CTD), oxygen saturation, fluorescence, backscatterance and irradiance measurements (attached to CTD). Additonally a mooring, which had been deployed during Leg 1, has been recovered, equipped with an Acoustic Doppler Current Profiler and a Thermistor Chain for temperature measurements. The individual sampling methods will be described in more detail in the next section.

4.2 Amount of data

Electronic surveys and Moorings	
Instrument	**Amount**
Delta-T-Multibeam	390 MB
Towed ADCP	18.78 MB
Biosonics Echosounder	2.08 GB
EdgeTech Subbottom Profiler	812 MB
EdgeTech Sidescan Sonar	1.082 GB
CTD	562.19 MB
Moored ADCP	4.03 MB
Moored Thermistorchain	584 KB
TOTAL	**4.95 GB**
Plankton and sediment sampling	
Grabsamples	3
Plankton Net (within photic zone)	4
Plankton Net (below photic zone)	3

4.3 Problems

There were problems with the display of the Edgetech Subbottom Profiler. However that was just a problem with the display, which could be adjusted manually. The data collection still was successful. Another problem with the Edgetech Subbottom Profiler were several sudden system failures. The Profiler stopped working and the computer froze. This was possibly due to power supply shortages. A recommendation for future cruises would be to use one single power supply unit for the Edgetech Subbottom Profiler, because it uses a lot of power and during the cruise several instruments were sharing the same power supply unit with the Profiler.

5. Type of data collected

5.1 Multi-Beam Sonar

Multi-beam sonar named DELTA- T provides detection over a 120° x 3° field of view for bottom profiling applications. The 3° field of view is also applicable to obstacle avoidance in near-bottom applications where the narrow vertical extent of the beam reduces false obstacle detection. It provides 3D full area mapping with bathymetry. White areas are where there was no sonar data available. Sonar is used for large area surveys and creation of bathymetry maps of seabed areas. Particularly, the Delta T Profiler has applications in seafloor bathymetry, seafloor debris identification, wreck detection (in co-operation with SS sonar), pipeline and cable route seabed profiling, creation of bathymetry mapping and contour mapping. Depth ratings are in 300m to 6,000m range for transducers. Digital signal processing is used to optimize data usage from all channels to achieve the best possible resolution at every point in the field of view. Recent advances in computing power have made it possible to transfer and process this data at resolutions equal to computer monitor resolution Multi-beam sonar is extremely useful when assessing seafloor for debris and other anomalies.

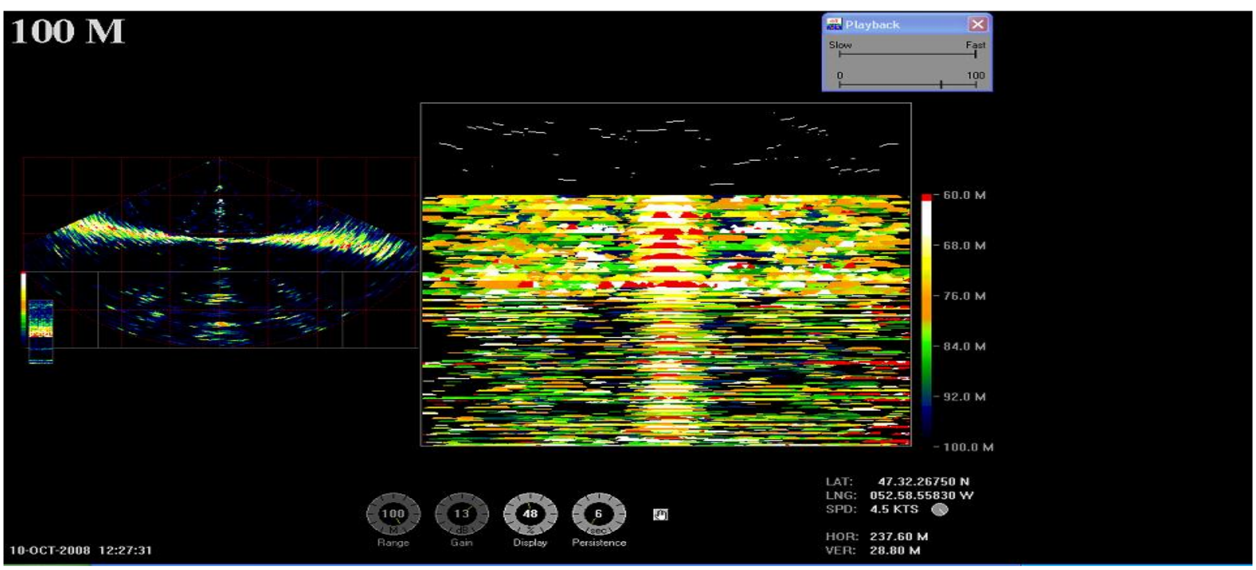


Figure 2: Image of Multi-Beam Sonar data

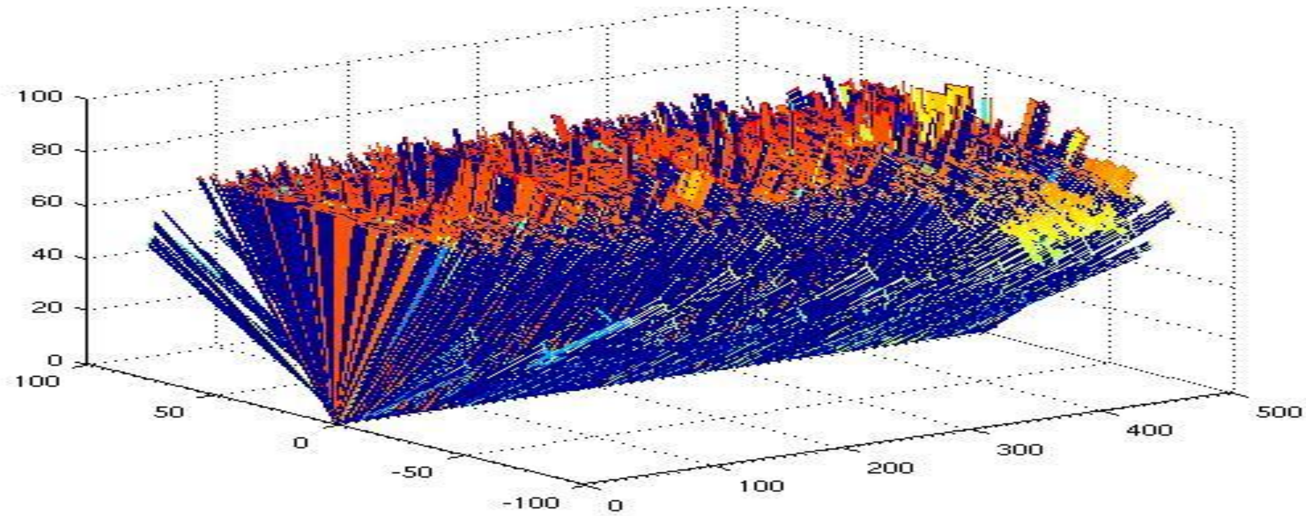


Figure 3: Plotted Multi-Beam Sonar data

5.2 Acoustic Doppler Current Profiler (moored and towed)

ADCP transducers project beams of sonic pulses (pings) into the water each second. These sounds are reflected from suspended particles, tiny organisms, or bubbles. ADCPs measures of the Doppler shift to calculate the speed of moving water. The Doppler affect occurs whenever a sound source is moving either away or towards a receiver, thus producing a decrease or increase in the frequency. Sound is first emitted as a series of pulses. The instrument then listens for echoes produced by particles (such as plankton) moving within the water column due to the

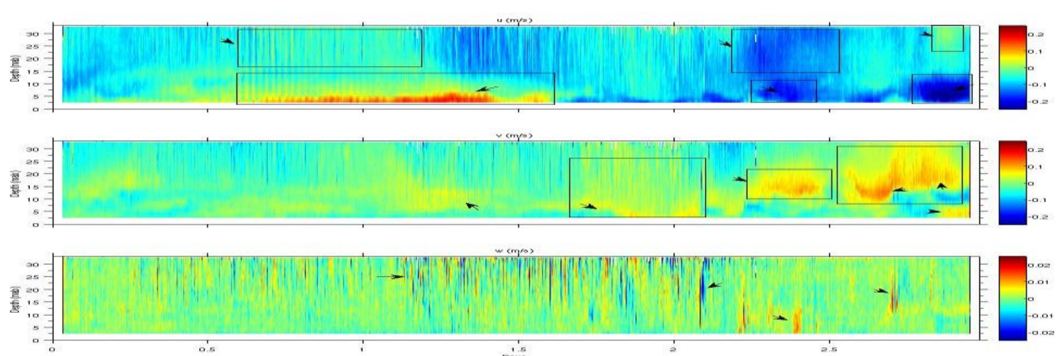


Figure 4: Moored ADCP

currents. The frequency shift is measured within discrete depth bins (i.e. segments), where the distance between the instrument and the reflecting particles is estimated from the delay between the emission of the sound and the arrival of the echo. If the echoes from a given depth bin arrive with a higher frequency than the emitted sound, then the volume of water at this distance is moving toward the instrument, and if the echoes arrive with a lower frequency, then this volume of water is moving away. The relative speed is directly proportional to the amount of frequency shift (or phase difference). By analyzing the frequency shift and other characteristics of returned

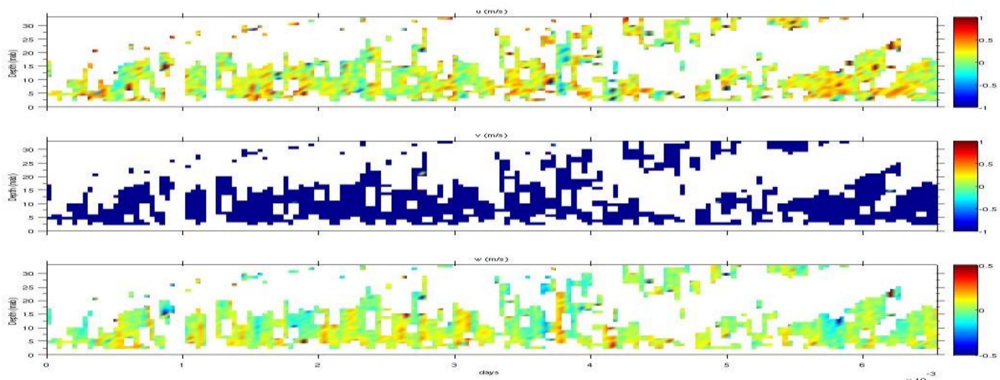


Figure 5: Towed ADCP

signal the direction of the currents beneath the ships can be determined. When three beams of sound are emitted in precisely known different directions, then the results from the three beams can be mathematically treated to provide a three-dimensional velocity. ADCP systems can measure currents to a depth of about 200 meters. Figure 4 and 5 show examples of moored and towed ADCP data.

5.3 Edgetech Subbottom Profiler

For geological studies, such as seafloor properties and sediment distribution, the EdgeTech 3200-XS Sub-bottom Profiling System and an EdgeTech SB-216S towed vehicle were used. The EdgeTech 3200-XS Sub-bottom Profiling System is a high-resolution wideband frequency modulated sub-bottom profiler utilizing EdgeTech's Full Spectrum CHIRP technology. The system transmits a FM pulse that is linearly swept over a Full Spectrum frequency. The acoustic

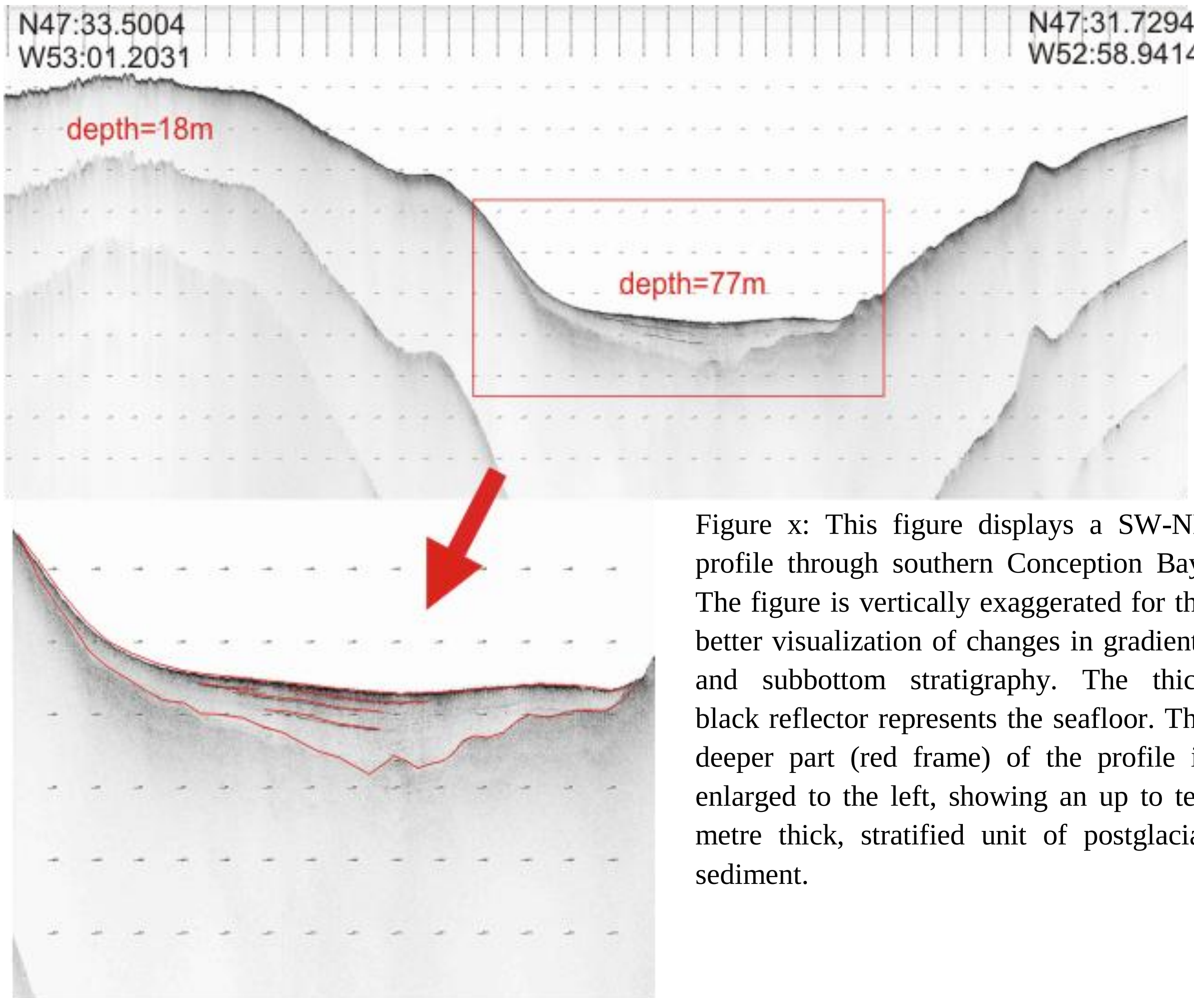


Figure x: This figure displays a SW-NE profile through southern Conception Bay. The figure is vertically exaggerated for the better visualization of changes in gradients and subbottom stratigraphy. The thick black reflector represents the seafloor. The deeper part (red frame) of the profile is enlarged to the left, showing an up to ten metre thick, stratified unit of postglacial sediment.

return received at the hydrophones is passed through a pulse compression filter, generating high-resolution images of the sub-bottom stratigraphy in oceans, lakes, and rivers (www.edgetech.com/subbottomlevel3s3200xs.html.). For visualization and processing EdgeTech's DISCOVER software was used.

The example above (figure 6) shows a subbottom profile (2-15 kHz) through southern Conception Bay. In the deeper areas a sedimentary basin with up to 10m of well stratified sediments were discovered.

5.4 Sidescan Sonar

The sidescan sonar was deployed and used to collect data pertaining to the sea floor profile along a number of transects across the Bay. The results consisted of a bottom profile at a range of approximately 40 m off either side of the vessel. The results for each transect were reviewed briefly to observe areas of interest. Currently the data can only be viewed as video recordings along the vessel tracks. Software is currently being developed to enable viewing multiple tracks at the same time so that a view of an entire area of the sea floor can be seen an analyzed. The tracks are put together like the pieces of a puzzle so that configurations can be spotted and

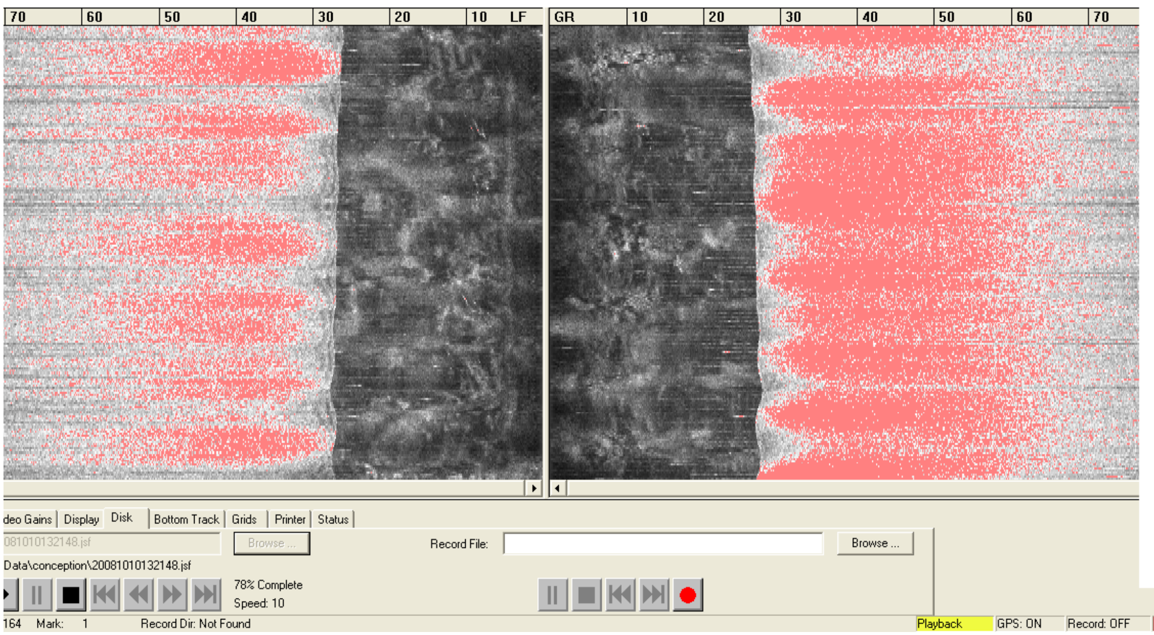


Figure 7: Typical Side Scan Sonar

analyzed correctly. These combined side scan sonar pictures will be reviewed and analyzed in the future. It is uncertain if noise from the engine or other equipment has altered the recorded data in any way. Sometimes noise can cause disruptions in the data and skew the image. The side scan data could be filtered to ensure that there is no error due to unwanted noise. This process may be time consuming and impossible to complete in the time frame of this course. It would however, be beneficial to ensure accurate data.

A few typical images from the unfiltered side scan data is in figure 7 and 8. As you can see the coordinates of latitude and longitude are listed on the side.

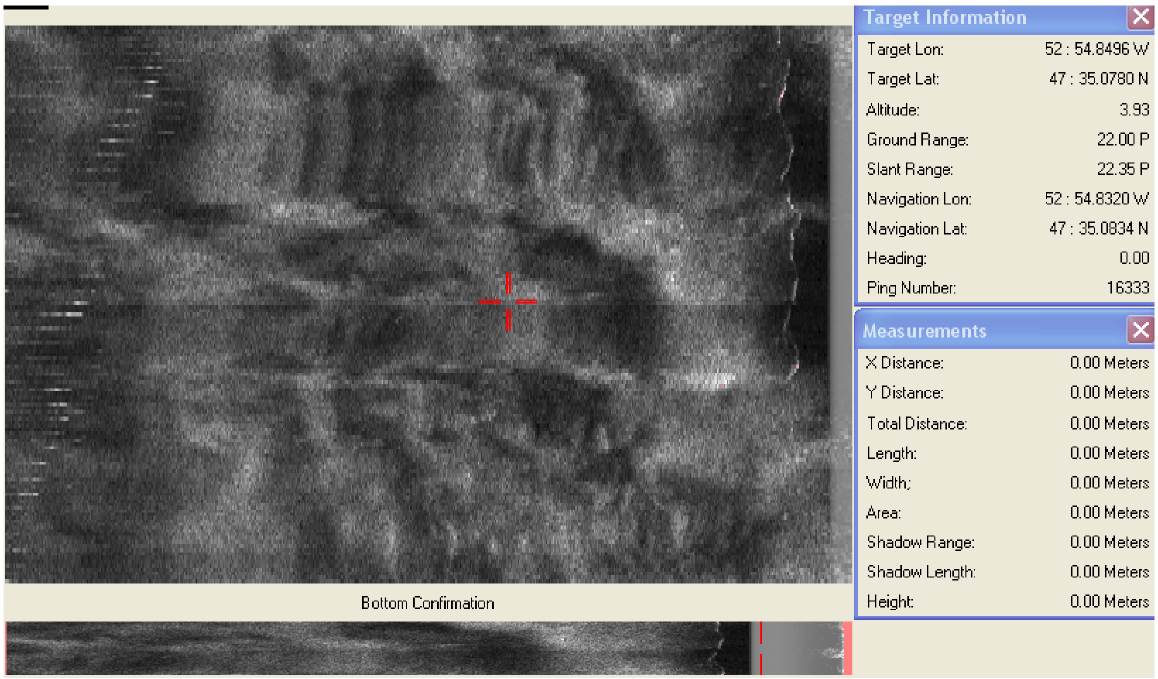


Figure 8: Zoomed in Image from Side Scan Sonar

5.5 Biosonics Echosounder

To analyze the underwater physical and biological components an echosounder device was deployed on starboard side for each station and transect. This instrument utilizes sonar technology in which the returned acoustic signal is digitized. The data collected on board give information about bathymetry, bottom substrate class and marine life (e.g. fish, plankton and submerged vegetation) (see figure 9).

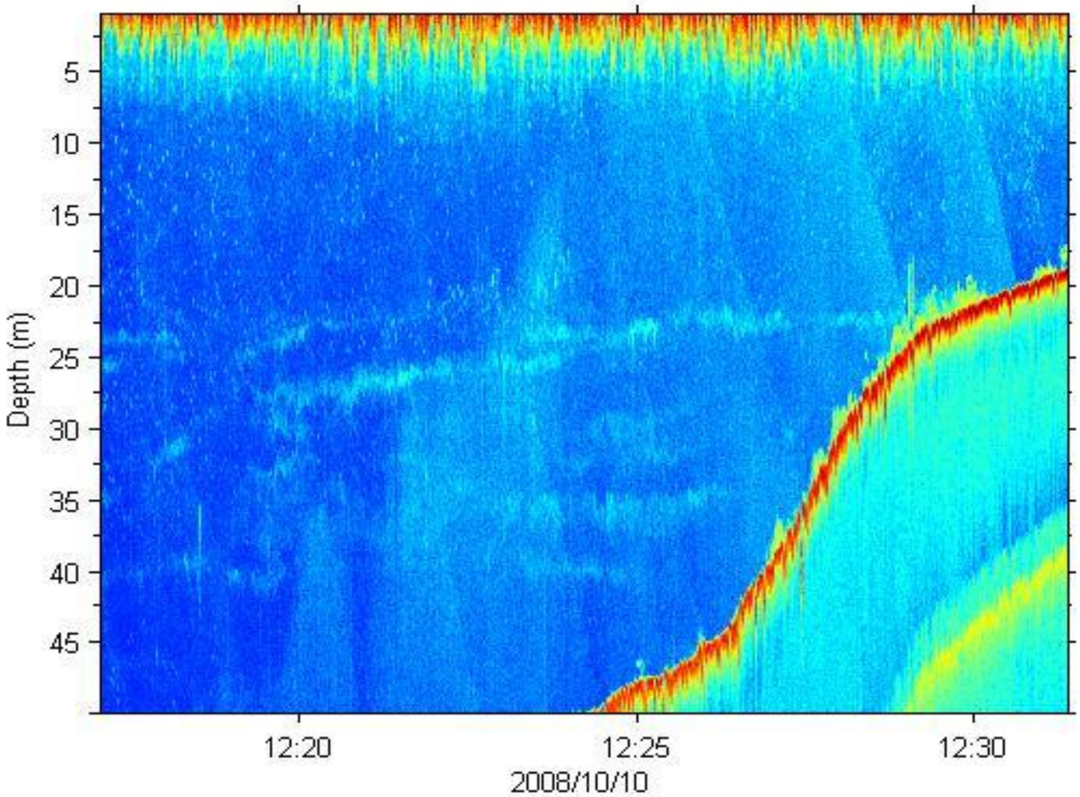
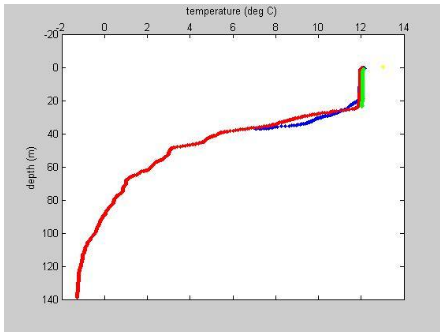
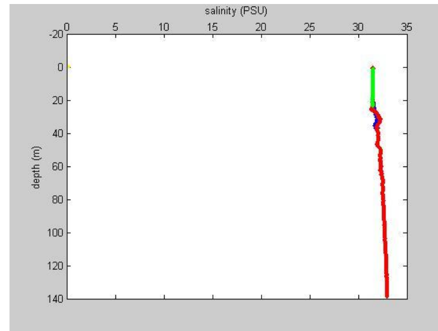


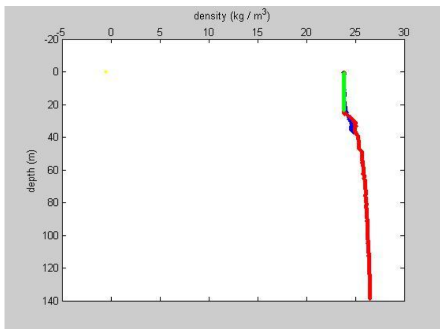
Figure 9: Plotted data of Biosonics Echosounder

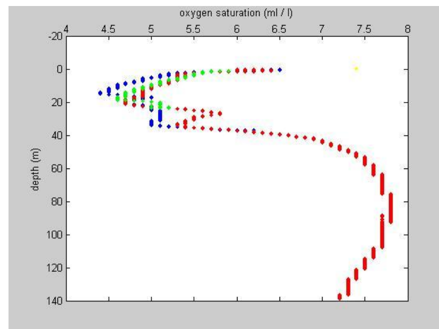
5.6 Conductivity-Temperature-Depth profiler (CTD)

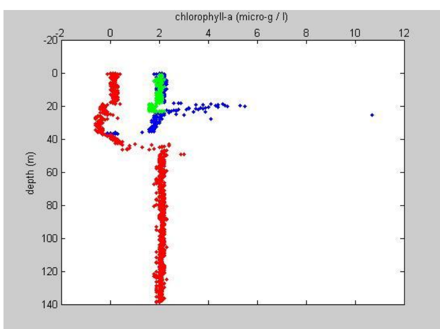
To measure profiles of ocean temperature, salinity and density a CTD recorder (SeaBird model 19plus) was deployed on starboard side and lowered through the water column at each station. During this process the parameters pressure, temperature and conductivity were recorded continuously and salinity and density were calculated from these measurements. Additionally, profiles of the parameters oxygen saturation, chlorophyll-a concentration, turbidity and irradiance were determined by particular sensors for oxygen, fluorescence, light transmission and PAR. All measurements were recorded in digital form, stored by the CTD recorder and transferred to the computer after recovering the instrument. Figure 10 shows typical profiles of the analyzed parameters.

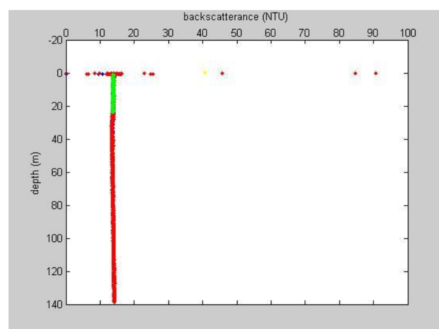


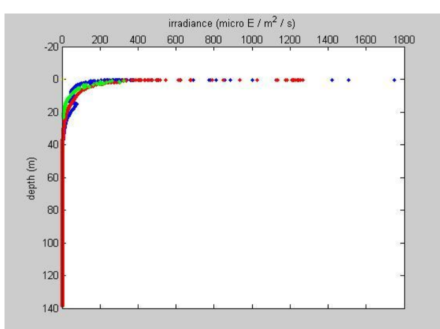












blue: station 4

red: station 5

green: station 6

Figure 10: CTD profiles

5.7 Secchi Disk

The Secchi Disk is used for the visual determination of the depth of the photic zone. It is a black and white disk which is lowered on a rope into the water column until it is out of visibility. The rope is marked in meter intervals to determine the depth. It has been deployed prior to the planktonic sampling at the stations S4 to S6.

Station	Latitude	Longitude	Seastate	Date	Local Time	Photic zone depth
S4	N 47°33.997	W 053°10.616	calm	10/9/08	14:11	11 m
S5	N 47°31.126	W 053°08.921	calm	10/9/08	14:55	11 m
S6	N 47°34.418	W 052°59.931	choppy	10/10/08	14:11	11 m

Note: The photic zone had the same depth at all three locations, not being influenced by changes in cloud cover.

5.8 Plankton Net

There was a plankton net deployed at a number of station points along the vessels route through the bay. The plankton nets were dropped both above and below the photic zone. The photic zone, or euphotic zone, is the maximum depth at which photosynthesis can occur. The photic zone was estimated on the cruise by deploying a Secchi Disk. There are more precise methods of determining photic zone measurements however these are both more tedious and expensive and therefore the utilized method was deemed adequate.

The plankton nets captured numerous types of organisms which were all filtered and preserved in mason jars for further analysis. The organisms captured include the following:

- Copepod
- Cladoceran
- Gastropod Larvae
- Chaetognath
- Larvacean
- Starfish Larvae
- Echinoderm Larvae
- Jelly
- Ctenophore
- Shrimp Larvae
- Pteropod
- Mysid
- Polychaete Larvae
- Hyperiid
- Decapod
- Isopod

All of the organisms mentioned above are too small to observe fully with the naked eye and must be viewed under a microscope. Below are pictures representing a few of the captured organisms.

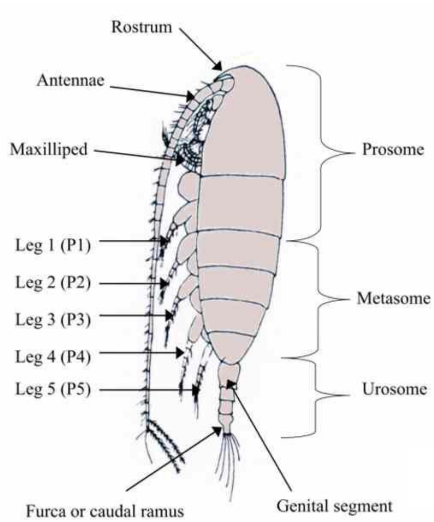


Figure 11: Copepod

Figure 12: Cladoceran

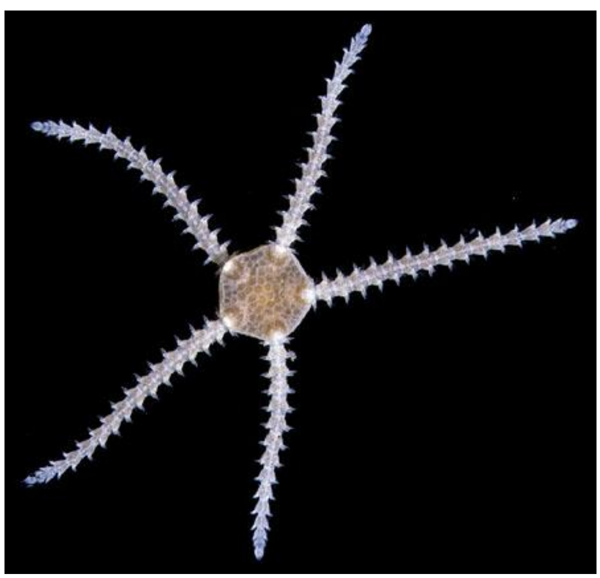


Figure 13: Echindoderm Larvae

Each of the preserved samples were split into numerous, manageable samples that had approximately 300 organisms in them. These samples were observed underneath a microscope to determine the quantity of each type of organism in each sample. The volume of water that filtered through the plankton net while it was deployed could be found by multiplying the flow rate by the volume of the net. The flow rate was measured using flow meters attached to the opening of the net. This allows the quantity of organisms per certain volume of sea water to be obtained.

5.9 Moored Thermistor Data

There were a total of 11 thermistors moored at a station which recorded water temperature values throughout the duration of the cruise (the entire 5 days) at two minute intervals. The thermistors were positioned in a vertical line and were each 4 meters apart with one at sea level and the lowest at a depth of 40 meters. The recorded data of temperature verses time for each thermistor was imported into Matlab. A plot of depth verses temperature with contours of constant temperature was constructed. The result of this plot is shown below in figure 14.

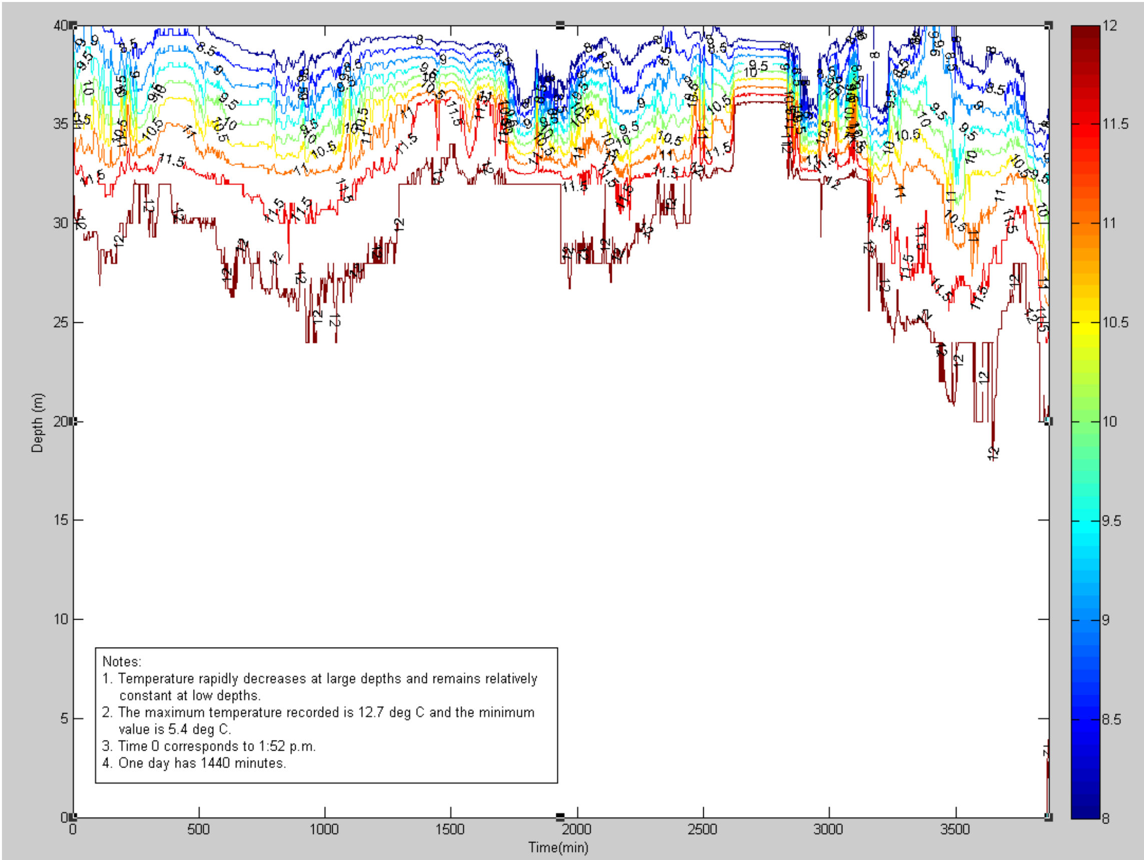


Figure 14: Depth Vs Time + Constant Temp Contours

It first should be noted that the temperature readings ranged from a low value of 5.4 °C to a high value of 12.7°C. It should also be mentioned that time zero on the above plot represents 1:52 pm on the first day of the cruise, Monday, October 6, 2008, and one day is 1440 minutes. As you can see from the curve, the temperature stays relatively constant at low water depths. Above approximately 20 meters the water all stays between 12 – 12.7°C. There were some initial low values at these shallow depths but since they didn't correlate well with the remaining data it was assumed that the thermistors required some time to adjust to the water before accurate temperatures could be recorded. Below 20 meters the water temperature varies more dramatically with slight change in depth and time of day.

6. Plan for scientific analyses

EdgeTech Subbottom Profiling

Future analyses will include the comparison and/or correlation of the recorded subbottom profiles. This will help to bring discovered structures into a larger context. Further the location and shape of sedimentary deposits will be correlated with current measurements to investigate how the sediment might be moved through the bay. In turn, the structure and shape of sedimentary deposits also can be used to locate bottom currents. Additionally the study of subbottom profiles will be used to discover areas of undisturbed sediment accummulation, which would represent valuable archives for paleoenvironmental and paleoceanographical studies. These areas then could be cored during future fieldtrips.

Plankton Net

In future analysis the samples taken above the photic zone and those below could be compared to see the variance, if any. The results could also be compared to thermistor and current data at each station to see if there is a correlation between number of organisms and temperature or current. It would also be beneficial to compare the results at each station with the sonar data to see if the water depth has an effect on organism numbers. Finally, the results could be measured against existing data gathered at a different time of year, for example in the Spring, to see the seasonal difference.

ADCP

Data from moored ADCP revealed that the currents within the same depth are different from each other. As a function of time the currents may have high or low velocity depending on the day and time the data was collected. The features for u and v components that are interesting for the future investigations are included in boxes., or pointed by arrow. The future analysis should include the study of chart map and possibly available data from other platforms, instruments and researchers. This may help to understand if there is a pattern or regularity that we are observing for this particular region. Data from towed ADCP has showed to have a lot of missing data. To find out the reason the rest of the towed ADCP data for days 4 and 5 needs to be investigated. The data from the days 1 , 2, 3 also needs to be checked.

Multibeam

Multi-beam sonar was deployed together with other instruments that were also deployed on the boat. Collecting data from different sensors has enormous advantage of gaining information about the area of our interest, but at the same time it may be obstacle. One instrument may add additional noise to the data collected by another instrument. This is the case in the data collected by Multi-beam sonar. The filtering of the noise from Multi- beam sonar data is one of the tasks that needs to be done before analyzing the data. At the same time some useful information can be extracted from ADCP to help to analyze the data from Multi-beam sonar.

Moored Thermistor Data

These results will be compared with CTD data to see if there is a correlation between temperature readings and current values. The temperature changes will be analysed for a one day period to see how much the temperature varies with time of day. Plots will be made of temperature verses depth at various times to get an idea of the thermocline in this area.

Sidescan Sonar

These combined side scan sonar pictures will be reviewed and analyzed in the future. It is uncertain if noise from the engine or other equipment has altered the recorded data in any way. Sometimes noise can cause disruptions in the data and skew the image. The side scan data could be filtered to ensure that there is no error due to unwanted noise. This process may be time consuming and impossible to complete in the time frame of this course. It would however, be beneficial to ensure accurate data.

Biosonics Echosounder

The data could be compared with the data obtained through CTD, plankton net and subbottom analysis for a more precisely investigation of the biological and physical conditions of the water column and the sea bottom.

Conductivity-Temperature-Depth profiler (CTD)

Applications for future analysis could be the comparison of the data taken during this field trip with data taken before to analyze possible changes of the physical and biological conditions in the water column over a long period of time.