F.G. CREED EXPEDITION 2005-075

Multibeam and magnetometer survey of the St. Lawrence Estuary west of Rimouski, October 27th to November 28th 2005

Geoscience in support of ocean management of the Estuary and Gulf of St. Lawrence
Geological Survey of Canada Open File 5390

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GEOLOGICAL SURVEY OF CANADA

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Staff

NRCan-RNCan

Andrée Bolduc	Project leader	Nov 12-27
Calvin Campbell	Marine Geoscientist	Oct 26-31, Nov 18-25
Mathieu Duchesne	Marine Geophysicist	Nov 5- Nov 11
Paul Girouard	Data processor	Oct 26- Nov 19

CHS-SHC

Roger Côté	Project Manager : Data Acquisition
Sonia Beaulieu	Hydrographer

Acknowledgements

We would like to thank the officers and crew of the F.G. Creed (figure 1) for their professionalism, their willingness to try new equipment (towed magnetometer) and the excellent hospitality and cuisine. We would also like to thank the staff at Institut Maurice-Lamontagne (IML) for facilitating the installation of the station magnetometer and for allowing occasional access to check the status of the instrument.

Figure 1- Survey vessel, CCGS F.G. Creed at the dock in Rimouski.

Introduction

The St. Lawrence Estuary and upper Gulf of St. Lawrence are the outlet for the Great Lakes catchments. The Great Lakes catchments support a population of over 20 million people. While many of the impacts of this population are felt in the Great Lakes, they also impact the estuary system downstream. The Upper Gulf is an area of competition for use of ocean space, with traditional uses such as fishing and shipping competing with demands for conservation (e.g. marine protected areas), cable and pipeline corridors and other industrial uses.

The need to understand ocean management issues in this region has lead to the development of the *Geoscience in support of ocean management of the Estuary and Gulf of St. Lawrence Project* under the Geological Survey of Canada Geoscience for Ocean Management Program (GOM). The project will deliver the geoscience knowledge within the St. Lawrence Estuary and Gulf upon which sound management planning can be founded. The current phase of the project will compile existing data and information from the area, establish stakeholders in the region and develop partnerships, collect new multibeam and other geophysical data, and provide preliminary reports summarizing the activities, creating a foundation for future work in the eastern and southern Gulf. During this first year, a 4-5 year project plan will be established for identified highest priority areas in the Gulf of St. Lawrence. The multi-year project will deliver maps, databases and interpreted reports of the seafloor morphology, surficial sediments, benthic habitats, geohazards and potential fossil fuel/mineral/aggregate resources of key areas of the Gulf of St. Lawrence.

During October 27th to November 28th, 2005, a multibeam and marine magnetometer survey was conducted by the Geological Survey of Canada in partnership with the Canadian Hydrographic Service. The survey took place in the St. Lawrence Estuary, west of Rimouski onboard the CCGS F.G. Creed (figure 1). This survey is the third data collection component of the project. For more information on the other surveys, see Campbell et al. (2005) and Campbell et al. (2006).

Project Objectives

The objective of this project is to provide the geoscientific knowledge necessary for effective decision-making on competing resource management issues in the Estuary and Gulf of St. Lawrence. For example, decisions will need to be made on the location and construction of infrastructures, fisheries, aquaculture, conservation, marine environmental quality, conventional and unconventional hydrocarbon exploration/exploitation, for which prior geoscience knowledge is critical for sound management.

Specifically the objectives are to:

1. Compile existing geological data from the region, including seafloor maps, geophysical data, and ground truth data, into a GIS.

2. Acquire multibeam data (bathymetry and backscatter), ancillary geophysical and physical oceanographic data, and provide preliminary results of field activities in a targeted area of the St. Lawrence system identified through consultation with partners
3. Consult and develop partnerships with other government, university, and private sector stakeholders in the region.
4. Develop a 4-5 year project plan based on the outcomes of year one activities.

Survey Objectives

This survey directly addresses objective 2 of the project objectives and will help in developing the 4-5 year project plan. The proposed field activities for year one are to collect multibeam bathymetry and backscatter as well as coincident magnetometer data in the St. Lawrence Estuary between the Saguenay River and Mont-Joli, with full coverage from the deepwater portion of the estuary to 30 metres water depth. This expedition consisted of the final 31 days of a planned 55 day field program conducted during the 2005 field season. Thirteen days were completed in June (Campbell, et al. 2005) and twelve days were completed in August-September (Campbell et al. 2006). The areas covered by the 2005 surveys are shown in Figure 2.

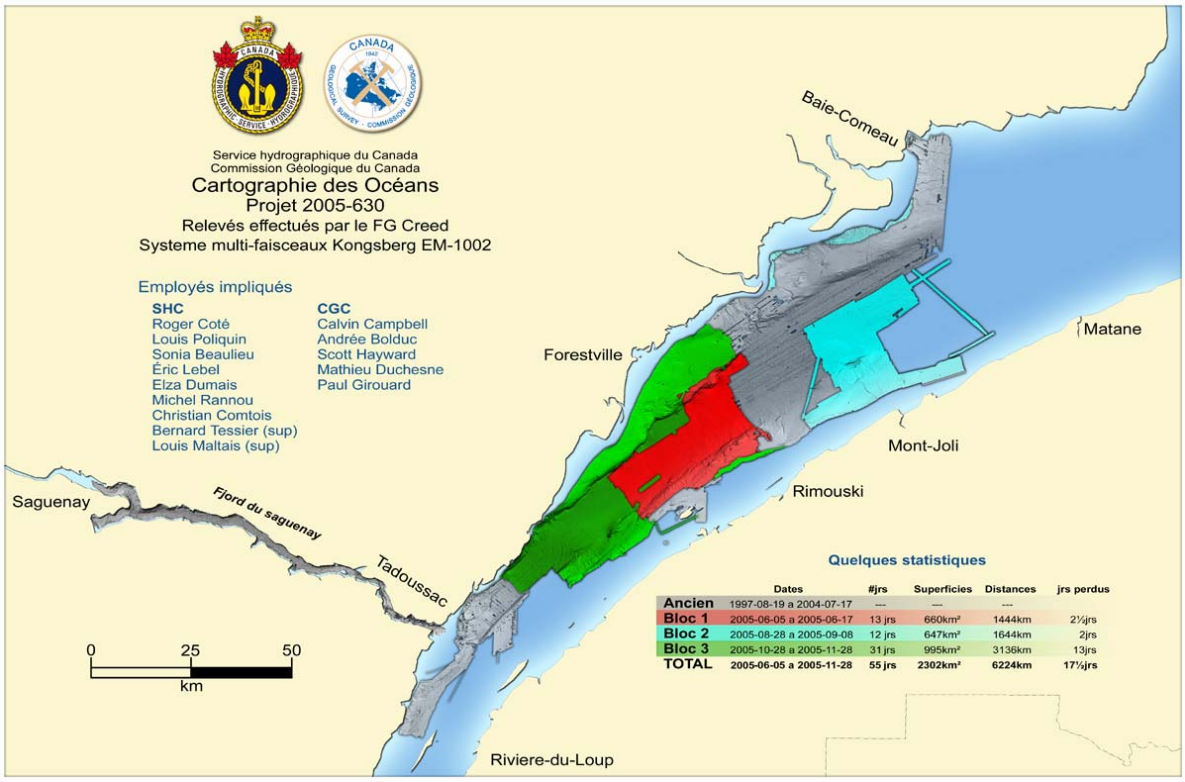

Figure 2- Shaded relief imagery of multibeam coverage in the St. Lawrence Estuary. Coloured areas are data collected in 2005 and the grey areas are existing data. (Image courtesy of Roger Côté, CHS)

Daily Log
The daily log is a running dialogue of activities and observations throughout the expedition and is compiled on a day to day basis.

JD 299 Wednesday, Oct 26

- Drove from BIO to Mont-Joli. Installed station magnetometer at IML at the pump station, the same location as the August-September survey. The sensor was setup in an open grassy area away from the pump house and the GPS antenna was installed on a temporary mast (soccer goal post).The initial setup of the mag sensor was successful with readings in the 55 000 nT range with variance of less than 30 nT over a 1 hour period. The station will be checked regularly during the survey. Drove to Rimouski to meet the Creed. Upon arriving, discover the ship is not there. Called the Creed and find out that they are delayed in Sept-Iles for a day and will arrive the next day at 3 pm.

JD 300 Thursday, Oct 27

-The Creed arrived in Rimouski at 3 pm. Helped off-load CHS gear and on-load our magnetometer and computers. We are told that we will not be surveying until Saturday, except for a patch test that will be done the following day. The ship lost two anchors during the previous couple of weeks and they needed to be replaced.

JD 301 Friday, Oct 28

- Setup processing and mag acquisition computers. Installed magnetometer. Around noon the captain informs us that there is a problem with the rudder and that divers are coming to inspect. Drove to IML to check station magnetometer. It is working fine and appears to be collecting good quality data. When we return to the Creed, we are told that the ship will have to go into dry dock before we can survey to repair the port rudder (probably a worn-out bearing). The earliest date to get into to dry dock would be Tuesday Nov 1st in Gaspé. It is a 16 hour steam there and back. We are told that a decision to go to dry dock will not be made until Monday morning. The two options will be to either cancel the remaining survey or to go to dry dock and do the repairs.

JD 302 Saturday, Oct 29

- Continued to clean data from June and September.

JD 303 Sunday, Oct 30

- Continued to clean data from June and September.

JD 304 Monday, Oct 31

- Continued to clean data from June and September. Ship inspector onboard to examine problem with rudder. Determined that problem originated with a cracked housing inside the hull, identical problem on both port and starboard. Repairs can be done alongside in Rimouski. Shipyard personnel onboard in pm to examine work to be done, welder to be onboard Tuesday morning. Calvin Campbell returned to Halifax by train.

JD 305 Tuesday, Nov 1

- Continued to clean data from September. Drove to IML to check station magnetometer, appears to be functioning well. Repairs to rudders completed by 6pm followed by sea trials after supper. Repairs determined to be sufficient to complete season.

JD 306 Wednesday, Nov 2

- Continued to clean data from September. Crew change.

JD 307 Thursday, Nov 3
Survey lines 3 and 4

- Sailed from Rimouski at 5:30 am as captain was concerned that extra low tide might prevent a later departure. Performed multibeam patch test at known area. Ship's roll artifacts were showing up in data. As they were attempting to resolve the problem the bridge UPS shut down. The problem had disappeared when the UPS was back on line. A further problem occurred when the primary GPS signal was lost. It eventually returned, the cause unknown. It was later also discovered that the satellites were lost when the bridge depressed the broadcast button on channel 24 but returned as soon as the button was released.
- Proceeded to Isle Biquette in pm to replace RTK batteries. While there, discovered that tide gauge had been displaced during recent storm and was sitting high and dry. A decision will be made by Monday whether or not it will be redeployed. Did one MVP dip then deployed the magnetometer at 14:45 for the start of the survey but it was recovered at 15:45 when twists began to appear in the cable. Nothing was observed fouling the fins. ~8km2 of good quality multibeam data collected with coincident (except for the last 45min) magnetometer data (towed at 10 to 12 kts). Returned to Rimouski at 5:45 pm.
- Drove to IML to check stn mag, computer had shut down at ~00:30 JD306 (Nov.01). Moved probe to rear of building as Public Works determined that the cable across the driveway would interfere with snow removal. System back on line with readings of ~55000 nT.

JD 308 Friday, Nov 4
Survey lines 5 to 17

- Sailed from Rimouski at 6am to survey north of Channel off Pointe-de Portneuf. Magnetometer removed from cable and streamed cable with only cone attached in an attempt to remove slight coiling in cable. No apparent change, probably not enough weight on end of cable. Did one MVP dip. Collected ~75km^2 of good quality multibeam data, with coincident magnetometer data. The magnetometer cable towed well with no apparent twisting. Arranged for someone at IML to check station mag, still logging. ~1hr of survey time lost due to repeated problems with Simrad communications and ship blackout due to an overheated breaker. Returned to Rimouski at 6:45pm.
- Mathieu Duchesne joined the Creed for the week.

JD 309 Saturday, Nov 5
Survey lines 18 to 26

- Sailed from Rimouski at 6:30am to continue survey where we left off yesterday. Upon arrival the weather was too severe to work and headed for area worked Thursday west of Bic. Did one MVP dip and started multibeam and magnetic survey at ~10am. Survey terminated after 2 lines, around noon, due to severe weather conditions. Apparent wreck discovered towards end of second line. A new survey was begun in shallow water between Bic and Isle du Bic. Again headed out to deeper water west of Bic and again terminated survey because of weather. Tied up at Rimouski at 6:45pm. Collected ~55km^2 of multibeam data with coincident magnetometer data, but much of it in shallow area outside project boundary. ~1min. slice of navigation on last line showed cyclic offset of up to 4m., cause unknown.

JD 310 Sunday, Nov 6

- Alongside in Rimouski because of weather. Cleaned and rechecked data collected so far.

JD 311 Monday, Nov 7

Alongside in Rimouski because of weather. Continued to recheck data collected so far as well as older data from previous years. Went to IML to check stn mag. Mag was still online but further study of data back on Creed revealed cyclic interference at ~1.5 hrs intervals.

JD 312 Tuesday, Nov 8

Alongside in Rimouski because of weather. Continued to recheck data from previous years. Went to IML in the morning to again move the probe, this time closer to its

original site. Checked with technician in pumping stn who confirmed that pump usually cyles at roughly the observed period in mag data. Mag interference was probably due to the probe being to close to underlying intake pipes. Notified the commissionaire that the probe had been moved back to the original area but kept the cable off pavement. Denis Desrosiers, PWGSC person who had originally requested that we move the probe, was not in but the commissionaire said that he would pass on the message.
- Another trip made to IML late in afternoon (~3:30) to check the data quality, found it to be less than satisfactory. Again moved probe but observed frequent dropouts in the readings. Shut down system and moved probe ~1m. but could not tune instrument when the program restarted. Shut everything down, including power to probe, and moved it to within 2m. of its original position. Waited ~15min. then powered up all systems. Systems came up fine and data still looked good after ~20 min. of onsite observations. Returned to Creed at 7pm.

JD 313 Wednesday, Nov 9
Survey lines 29 to 45

- Sailed from Rimouski at 5:45am and headed to Isle Biquette to replace batteries. The tide gauge was also retrieved as it will not be put back. The OTF tides are satisfactory. Performed MVP cast and streamed mag. ~85km^2 of good quality multibeam data collected with coincident magnetometer data. Ran 4 short lines over wreck found Saturday then continued on coverage of area west of Bic (zone 4c) begun on Saturday. Mag layback may not have been entered for first short line over weck. Problem with short period of nav offset first noticed on Saturday reoccurred. Tied up at Rimouski at 9pm.

JD 314 Thursday, Nov 10
Survey lines 46 to 59

- Sailed from Rimouski at 5:30am and headed to zone 4b, the area adjacent to the north side of area covered yesterday. Performed MVP cast and streamed mag. Mag stopped shortly after start, restarted software and worked fine. Did not zero pressure before restarting, fish stayed in water. Second MVP cast done at 4:30 because of apparent refraction in data. ~160km^2 of multibeam data collected with coincident magnetometer data. Same problem with nav showed up on a couple of lines during early morning. Serious problem with right outer sector of beam array, more acute today than previously. Tied up at Rimouski at 8:30pm.

JD 315 Friday, Nov 11
Survey lines 60 to 69

- Sailed from Rimouski at 6am and headed to shallow side of zone 2a, off Portneuf. Performed MVP cast and streamed mag. Good survey weather. Some refraction problems while steaming across mouth of Portneuf river. Strong magnetic anomalies over Grenville

rock. ~50km^2 of multibeam data collected with coincident magnetometer data. Problem with right sector beam less acute today but there appears to be some signal diffusion on both ends of beam array. Roger not terribly happy with quality of data. Tied up at Rimouski at 6:30pm.
- Checked Station mag in evening. Data appears to be of good quality. Checked a section of Nov. 11 data. Only minimal cyclic noise remaining, ~.3nT.

JD 316 Saturday, Nov 12
Survey lines 71 to 92

- Sailed from Rimouski at 7am and headed to zone 2a to continue survey. Another good survey day . Performed MVP cast and streamed mag. Roger decided to shorten lines from 16km to 8km because of refraction problems. First ran check line across yesterday's survey. ~50km^2 of good quality multibeam data collected with coincident magnetometer data. Data of much better quality than yesterday's data. A check line was run from the end of today's data through data collected on earlier survey this summer to the south. Data fit perfectly. There was also a good fit in small area to the SW where the two separate surveys met. Tied up at Rimouski at 5:45pm. Mathieu Duchesne left the Creed, Andrée Bolduc joined the ship.

JD 317 Sunday, Nov 13
Survey lines 93 to 129

- Sailed from Rimouski at 5:30am and headed to zone 2a to continue survey. Another good survey day. Performed MVP cast and streamed mag. Completed 2 remaining areas of Zone 2a and began Zone 1a. Three MVP casts done as conditions quite different in 3 areas. Retrieved and redeployed mag at each cast. . ~75km^2 of good quality multibeam data collected with coincident magnetometer data. Problem with Simrad during last line, could not keep track of bottom. Had to restart both computer and transducer 3 times before resuming. System also appears to get confused with the port beams, many holes appear in data. The solution is to stop pinging and restart it. Roger thinks it may get some reflection of the port sponson and the algorithm gets confused. Tied up at Rimouski at 8:30pm.

JD 318 Monday, Nov 14

- Alongside in Rimouski because of weather. Caught up on data cleaning and checking. Checked station mag at IML. Computer had shut down today at 8:08 am. Everything restarted OK.

JD 319 Tuesday, Nov 15
Survey lines 01 to 23

- Sailed from Rimouski at 5am and headed to zone 1a to continue survey. Good survey day, no wind. Performed MVP cast and streamed mag. Did second MVP cast around 3pm as we started surveying in shallower water. Mag on deck for second MVP but logging not re-enabled when it was once again streamed. Probably hit logging state button rather than stop/start button by error (no-one noticed red button). Completed 2 remaining areas. ~70km^2 of good quality multibeam data collected with coincident magnetometer data where it was logging. Tied up at Rimouski at 8pm.

JD 320 Wednesday, Nov 16

- Crew change. Caught up on data cleaning. Went to IML to check station mag, all normal.

JD 321 Thursday, Nov 17
Survey lines 26 to 48

- Sailed from Rimouski at 5am and headed to zone 1a to continue survey. Good survey day, winds W20 to 25 kts in morning, light in afternoon. Performed MVP cast and streamed mag. ~85km^2 of good quality multibeam data collected with coincident magnetometer data. No mag data between 1:45pm and 2:40pm because system lost time sync from GPS. This coincides with problem with Simrad navigation when RTK system crashed. Could not resync as there appeared to be no communication with magnetometer. Disconnected then reconnected power to mag, system came back. No interruption in logging doing this time. Tied up at Rimouski at 7:30pm. Andrée Bolduc leaves for meetings in Mont-Joli, Calvin Campbell rejoins the ship.

JD 322 Friday, Nov 18
Survey lines 49 to 72

- Sailed from Rimouski at 530 am and headed north to shallow area on northern slope. Conducted an MVP cast and deployed magnetometer. Collected ~40 km^2 of multibeam data in the area. There were some navigation errors, minor refraction problems, and occasional regular beam artifacts, but otherwise the data were ok. Then conducted a tieline to the south and steamed toward a small shallow water area immediately north of Rimouski and conducted another velocity cast (recovered and redeployed mag in doing so). Collected ~15 km^2 of good quality multibeam data with minor navigational errors. There was some fairly severe icing of the ship today due to the low temps and winds. Returned to Rimouski at 8 pm. Paul Girouard disembarks and Andrée Bolduc rejoins the ship.

JD 323 Saturday, Nov 19

Survey lines 73 to 89

- Sailed from Rimouski at 530 am and steamed towards just west of previous day. Conducted an MVP cast and deployed magnetometer. As day progressed, winds increased to ~30 kts with waves up to 3 m. This resulted in some motion artifacts in the data (not too severe). Collected about 40 km^2 of multibeam and coincident mag data with minor navigation problems on a few lines. At 330 pm steamed toward Rimouski in attempt to get out of the SW wind but conditions were similar and it was decided to return to Rimouski early. Docked at 530 pm.

JD 324 Sunday, Nov 20
Survey lines 90 to 107

- Sailed from Rimouski at 700 am and steamed towards where we left off yesterday, on the north side of the channel off Pointe au Boisvert. Conducted MVP cast and deployed magnetometer. Collected ~28 km^2 good quality multibeam and coincident mag data. Winds 25 kts in the morning an tapering off in the afternoon. There were minor navigational errors, but the heave effects from the previous day were not apparent. Seabed relatively featureless with no pockmarks. Some interesting debris cones are present downslope from some potential tidal channels in ~30 m of water. Returned to Rimouski at 730 pm.

JD 325 Monday, Nov 21
Survey lines 108 to 109

- Sailed from Rimouski at 530 am and steamed towards area off Pointe au Boisvert. Conducted MVP cast and deployed magnetometer. Smooth sailing. Collected 42 km2 of excellent quality multibeam data and coincident magnetometer data. There were some minor navigational errors in the morning. Crew at IML redirected RTK antennae on Bicquette and problem resolved. Surveyed featureless bank top with occasional pockmarks. There are a series of escarpments in this area of various "freshness" on the channel's north slope. Tied up at Rimosuki at 730 pm.
- Drove to IML to check magnetometer. Everything appears to be working properly and a backup was made.

JD 326 Tuesday, Nov 22
Survey lines 142 to 158

- Sailed from Rimouski at 700 am and steamed toward shallow water area north of Rimouski. Conducted MVP and deployed magnetometer. Collected 13 km^2 of bathymetry and coincident magnetometer data. Returned to Rimouski at 1330 because of low fuel and impending gale force winds. Opportunity to perform support vehicle

maintenance (oil change on NRCan truck, flat tire on Coast Guard vehicle). Created ascii dump of lines from JD 307 to JD 324.

JD 327 Wednesday, Nov 23
Survey lines 159 to 165

- Sailed from Rimouski at 1230 pm. Decision was made at 12 pm as to whether or not we would sail (high winds and freezing temperatures). Steamed to area west of Rimouski off Pointe au Boisvert. Conducted MVP cast and deployed magnetometer. Collected excellent quality data (minor refraction). Ran a patch line in the channel to correct data collected in June. Tied up at Rimouski at 8 pm.

JD 328 Thursday, Nov 24
Survey lines 131 to 152

- Sailed from Rimouski at 530 am. Steamed to area west of Bicquette and conducted MVP cast and deployed magnetometer. Completed small area that remained from previous day's surveys to reach the 30 m mark. At 1030 steamed further westward to southern channel slope and conducted another MVP cast (recovered then redeployed mag). Collected data on the slope showing area of unique bedforms, seafloor relief and channeling. Returned to Rimouski at 4 pm because of impending northeaster. Returned in driving winds (30-40 kts) and heavy snowfall. Tied up at Rimouski at 6 pm. Winds are supposed to come around to the west for Friday and a decision will be made Friday morning whether or not we will sail.

JD 329 Friday, Nov 25

- At 7 am, weather forecast predicts winds from the southwest 35-45 kts reducing to 25-35 kts late this afternoon. Decision is made not to sail. Calvin Campbell and Andrée Bolduc commence demobbing the magnetometer. Calvin Campbell demobs the station magnetomer and towed magnetometer and drives back to Halifax.

JD 330 Saturday, Nov 26
Survey lines 166-172, 001-017

- Sailed from Rimouski at 630 am to Les Escoumins on the north shore, area just adjacent to the Saguenay Marine Park. Conducted velocity cast. Surveyed an area of approximately 184 km^2, from Les Escoumins south-eastward. There is an abrupt deepening on the northern shore from 30 m to 200 m. The escarpment is highly incised, with small fans at the bottom. The bottom of the Laurentian Channel is relatively flat with the deepest part being more than 325 m. Did a second velocity cast as there was a lot of refraction in the deeper water data. Lost On the Fly corrections (OTF) on the tie

line, we will use GPS and correct tide manually. It was decided to dock at Les Escoumins in order to reduce transit time and to take advantage of the exceptionally good weather. Docked at 945 pm.

JD 331 Sunday, Nov 27
Survey lines 018-041

- Sailed from Les Escoumins at 515 am west to area between yesterday's survey and area surveyed in 2002. Conducted velocity cast. Problems with the OTF were encountered early in the morning, the signal becoming clear and strong after the first 2 lines. Surveying near the north shore became problematic due to the high variability of the sea bottom and the abrupt water depth changes. The data from the deep featureless bottom of the channel (>325 m) is highly refracted. Conducted a second velocity cast near the south shore. Surveyed an area of approximately 100 km^2 between les Escoumins and older dataset, and 75 km2 to complete area near south shore. Docked at Rimouski at 630 pm. Drove to Québec City. END OF SURVEY

Preliminary Results

The following pages illustrate the preliminary results of multibeam bathymetry and towed magnetometer surveys (figures 3, 4, and 5).

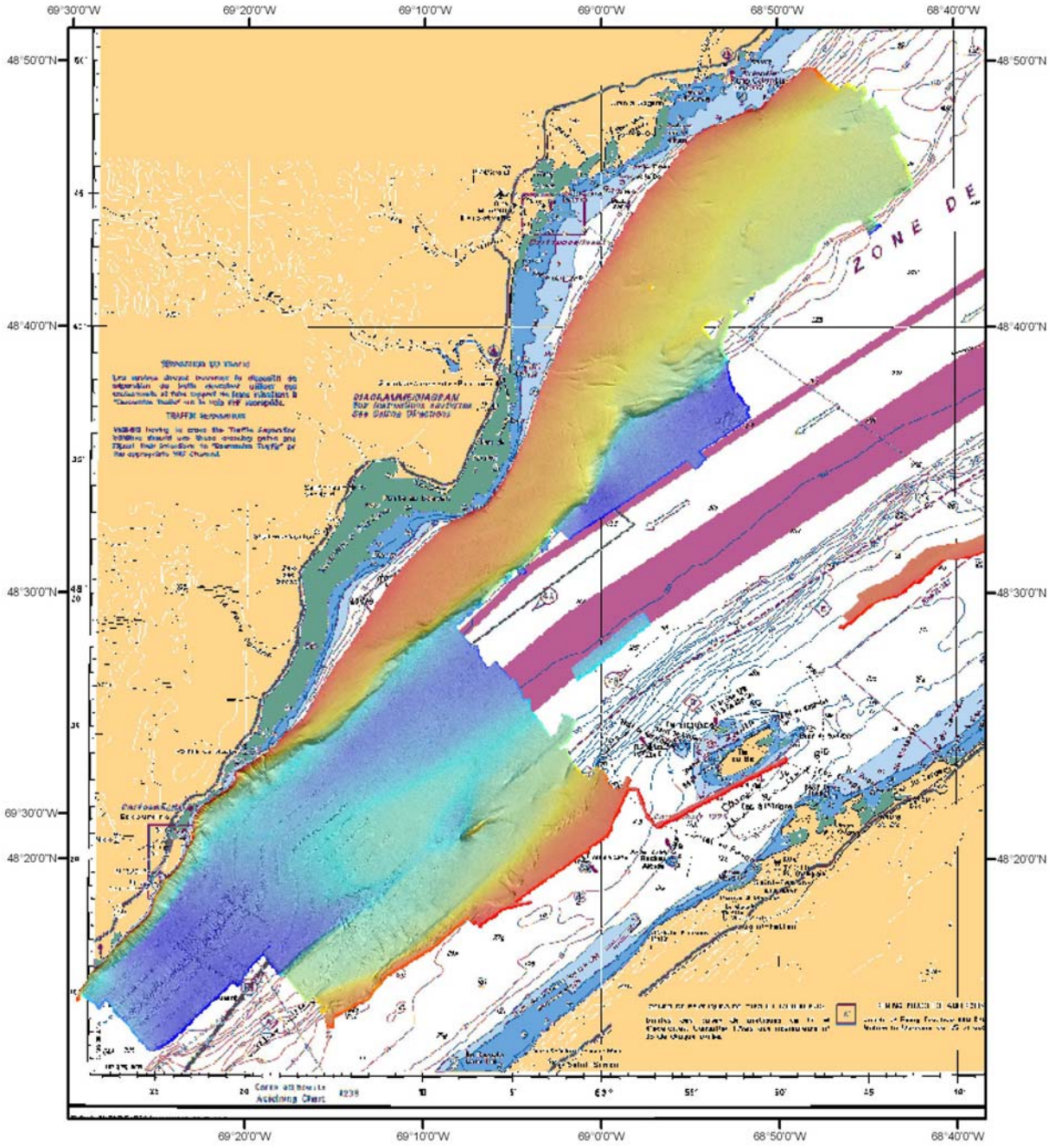

Figure 3- Shaded relief DEM of the mutibeam bathymetry collected during the survey. Water depths range from ~340 m on the channel floor (dark blue) to <30 m on the banks (red).

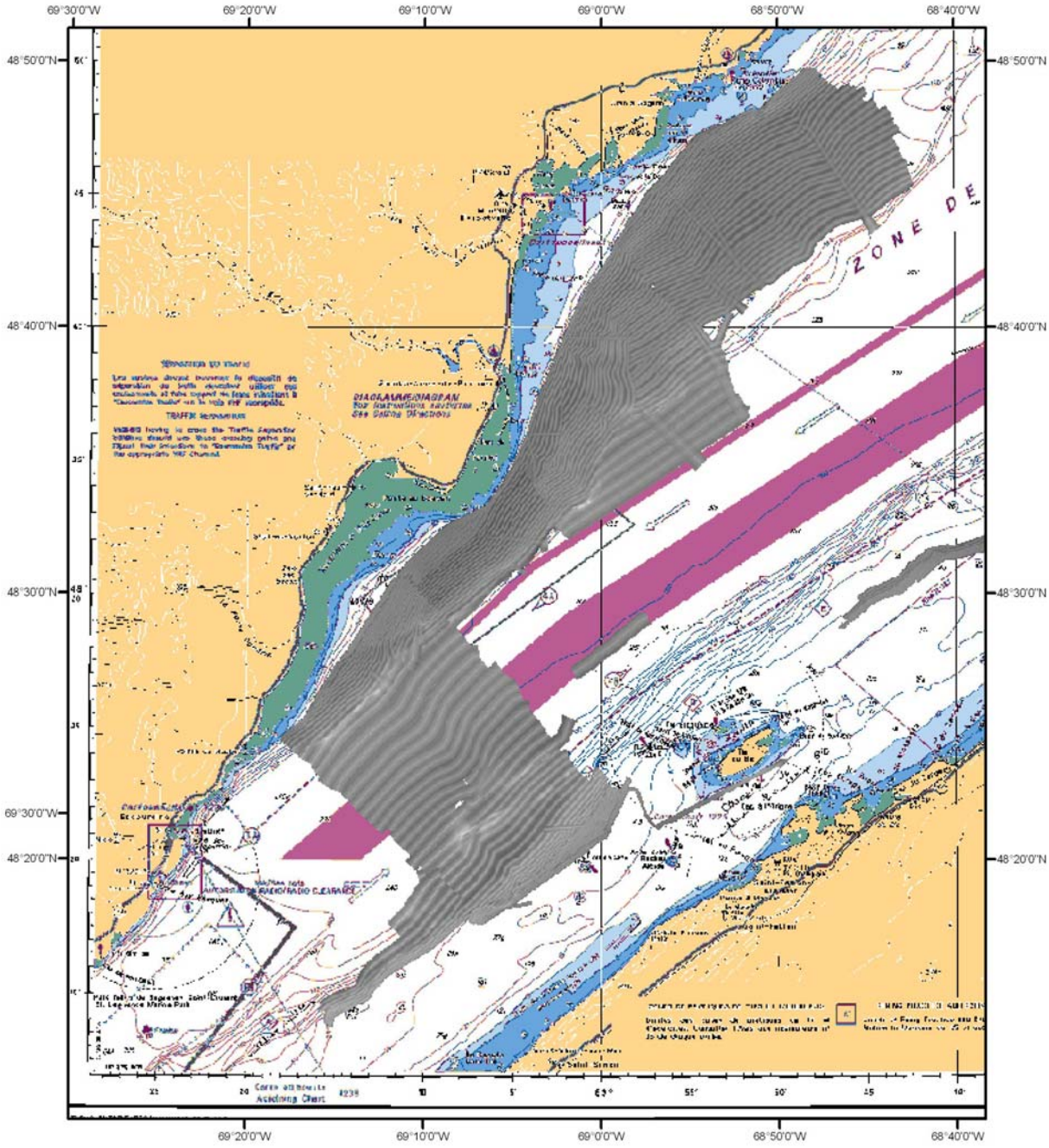

Figure 4- Backscatter intensity from high (black) to low (white). Raw data, no grazing angle correction. Note, backscatter information for the last two days of the survey was not available at the time this report was prepared.

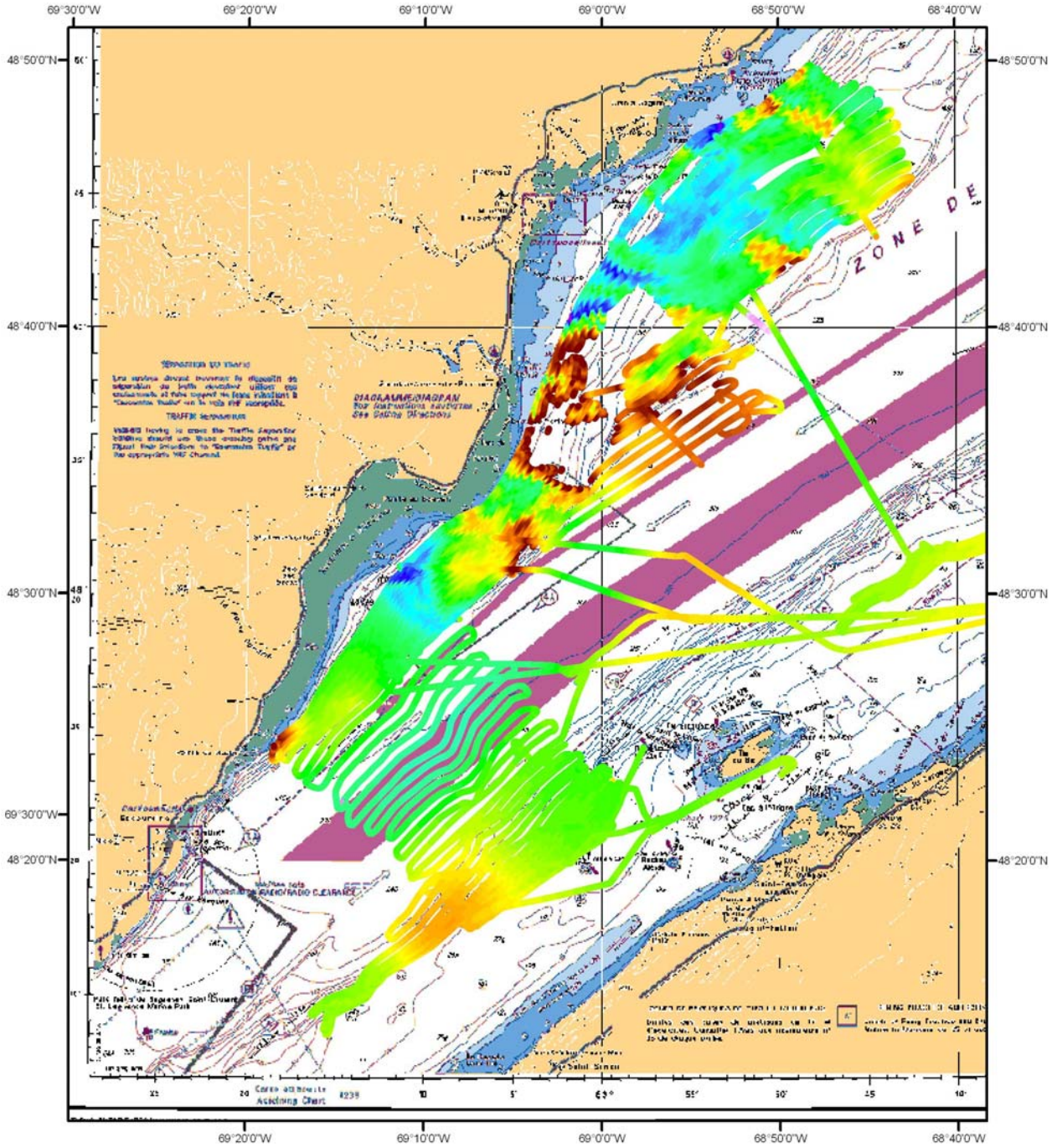

Figure 5- Along-track presentation of towed magnetometer data. Warm colours indicate higher values and cool colours indicate lower values. Note, no magnetometer data was collected during the last two days of the survey.

Technical Summary

Survey Vessel:

The vessel used in this survey was the *CCGS F.G. Creed* (figure 6). The vessel is operated by the Canadian Coast Guard. She is a twin-hulled SWATH (Small Water Area Twin Hull) vessel built in 1988. She is 20.4 m long and 9.75 m wide and can accommodate 4 ship's crew (Captain, Engineer, First Mate, and cook) as well as 5 scientific staff. The vessel has a data processing lab aft which has space for several workstations. She is equipped with a Simrad EM 1002 multibeam echosounder, a BOT MVP100 moving vessel profiler and has a large aft deck for her size which can accommodate other oceanographic equipment, such as the marine magnetometer in the case of this survey.

Figure 6- CCGS F.G.Creed

Multibeam System, Simrad EM1002:

EM 1002 multibeam echosounder is a short to medium range, high resolution echosounder with 111 narrow beams of 2 x 2 degrees, and a sounding accuracy that satisfies the requirements for IHO S-44 order 1 surveys. The 95 kHz operating frequency is robust for pollution and particles in the water, resulting in a range performance in combination with resolution and accuracy which is attractive for many applications. The swath coverage of the EM 1002 Multibeam echosounder is up to 7.5 times the distance from the transducer face to the seabed, or a maximum of approximately 1200 meters (depending upon conditions). The sounding pattern is stabilized for the ships roll movements, and the sounding pattern can be selected as equiangular or equidistant on the bottom. On the Creed, the positioning may come from various sources. The Pos/MV is the primary positioning system and uses differential corrections from the Coast Guard DGPS network (Rivière-du-Loup, 300.0 kHz in this survey area). For the purpose of this survey, independant RTK positioning was used with a base station installed at Bicquette. The advantage of RTK positioning is a precision of a few centimeters in the 3 axes (xyz). The z component is very useful as it records the water level during surveying in areas far away from any tide gauges.

Data acquisition and processing

Multibeam data acquisition on the Creed is controlled on the bridge (Figure 7). This allows for easy communication between the hydrographer and the captain. During this survey,there was one workstation on the bridge for acquiring data and another for quality control. Within the lab on the main deck, there was one primary ("multifonction") workstation and two secondary processing workstations that worked on data stored on the "multifonction" station over the ship's network (figure 8). Software included Simrad SIS acquisition software and Caris HIPS/SIPS (v. 5.4) processing suite.

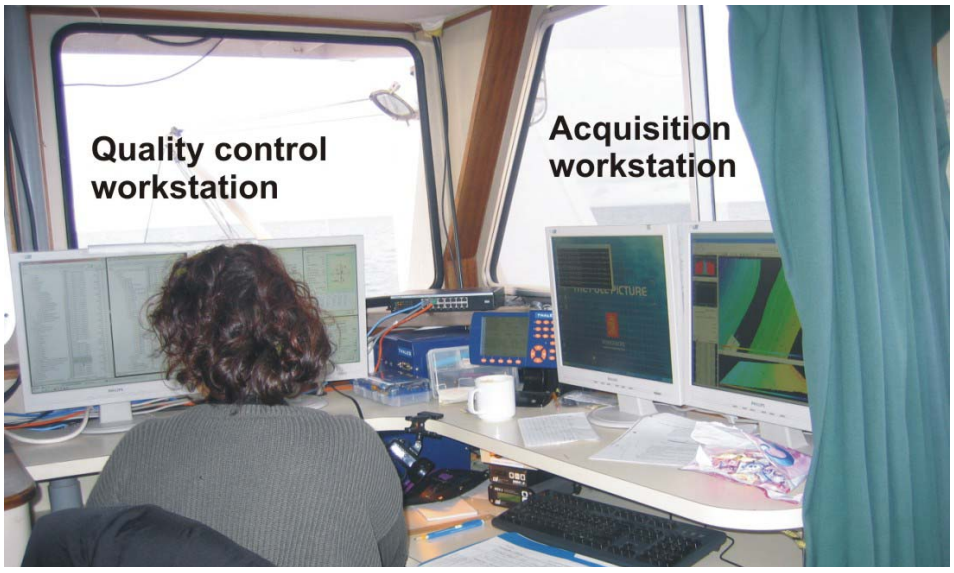

Figure 7- Bridge configuration onboard the Creed.

The following steps were used during onboard processing:

1. Once a line was completed, the .all file was copied from the acquisition computer on the bridge to the "multifonction" workstation in the lab.

2. The line was converted to Caris HDCS format (conversion wizard).

3. The line was loaded into Caris HIPS.

4. GPS tide was calculated.

5. Navigation data processed. Remove spikes and errors from speed/distance/course made good data.

6. Attitude data processed. Removed spikes from heave/pitch/roll and GPS tide data.

7. Apply tide corrections. Mainly used GPS tide data. Measured tide may be applied back at office where the GPS tide was poor quality.

8. Merge file (compute and interpolate depths/positions and apply water level, refraction coefficients, etc.).

9. Swath editor to remove severe sounding anomalies.

10. Create fieldsheet and render a shaded relief image of the data.

11. Subset editor. Systematically edit sounding data to remove spikes.

12. Refraction editor, where needed to remove refraction errors from the data.

13. At the end of each day, a fieldsheet of the entire day was created and a shaded relief image was rendered. A mosaic of the sidescan data (backscatter information) was produced.

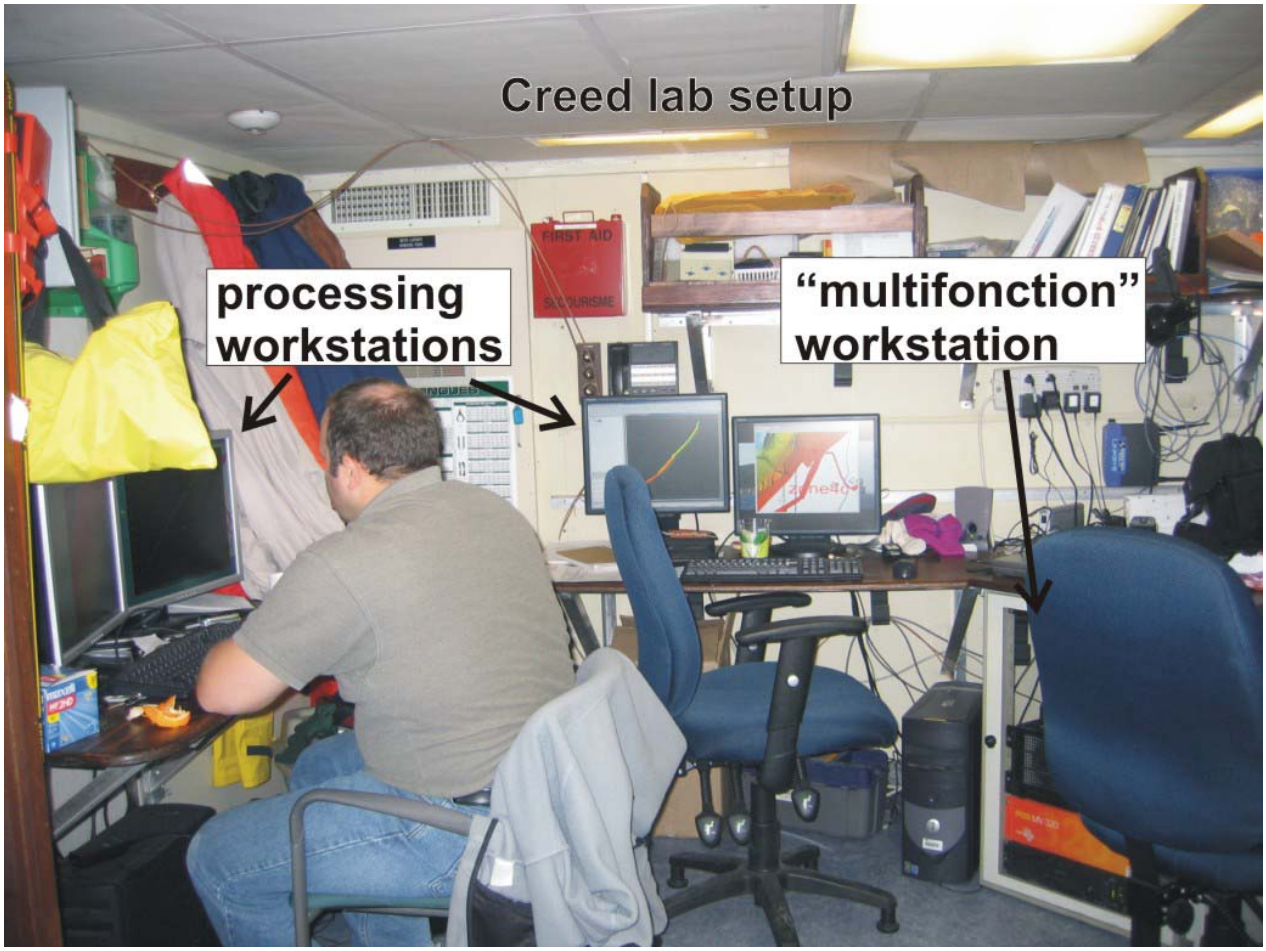

Figure 8- Lab configuration.

SeaSpy Marine Magnetometer:

This was the third GSCA survey with the SeaSpy Magnetometer. The fish was towed at an average depth of 1 m below the sea surface at a speed of 10-12 kts in varying sea states. The system uses Overhauser sensors and measures ambient magnetic field regardless of survey direction or orientation with the field. The system requires 2 people to deploy the fish (~20 kg), but is rather low maintenance once it is deployed. All preliminary field observations show data quality as excellent.

Procedures for Sea-Spy Magnetometer deployment during this survey

1. Tow point on Fish- 60m of cable measured on wharf (3 times vessel length)- Using Samson braid rope, created tow point (braided, clamped and taped).

2. Tow point on Vessel- Approximately 2 m of Samson braid rope tied to aft-port cleat. Tow points connected by two small shackles and a quick release shackle (figure 9).

3. Spool- 60 m *cable* wrapped loosely around port cleats (figure 10), wooden spool on aft quarter/bridge-deck, deck lead to lab through conduit. Deck lead to adapter to small black input box. Black input box output splits to COM port input and power supply. (See manual for more details).

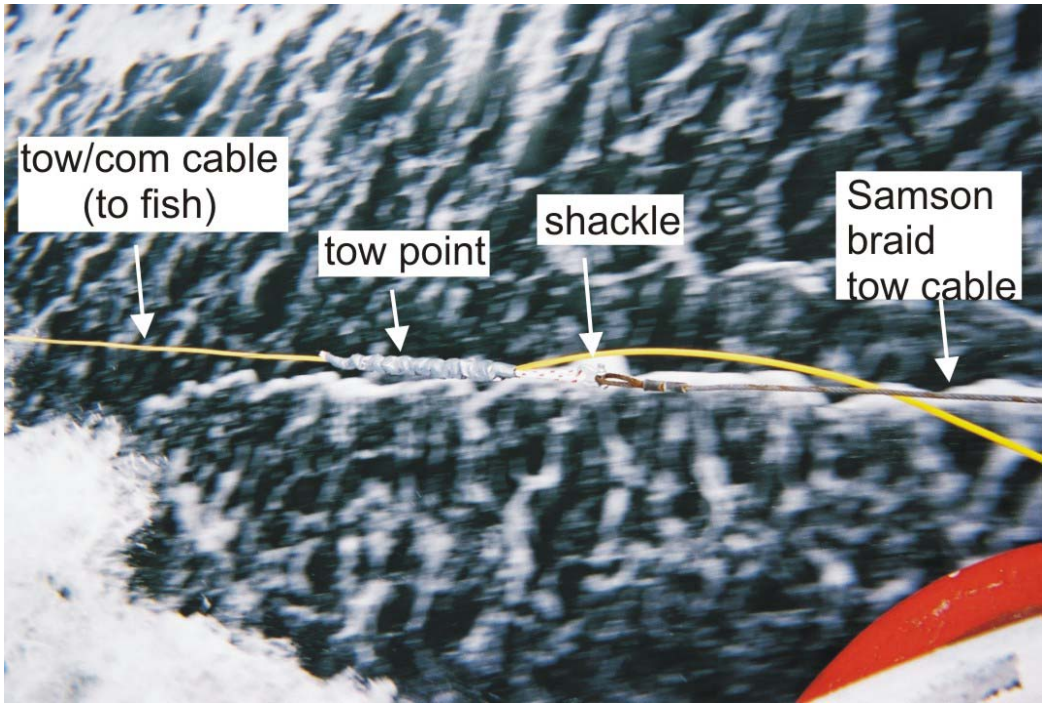

Figure 9- Magnetometer tow point in action.

4. Setup GPS input. Software accepts standard NMEA nav input from a COM port. Software requires baud rate, parity, etc. to be set. In this case it was a baud rate of 9600 and no parity. Nav was updated at 10 Hz.

5. Determine layback. In this case approximately 3 x Vessel Length (60m) + Vessel DGPS/RTK offset (7.5m) + Towpoint (1m) = 68.5m

5. Deployment Procedures- Slowed to deployment speed of 2-4 kts. Before deploying, startup SeaLINK software. Check that GPS data is streaming in the GPS window. Press the "sync GPS" button to sync the computers clock to the GPS. In the command window, enter "p" to zero pressure the depth sensor on the tow fish. Set the cycle rate (usually 1 or 2 Hz). Press the "append GPS values button" to attach position information to the file. Enter the calculated layback. Fish lowered over top of railing on the side of vessel with person 1 holding tension on fish. Wraps were taken off cleats by person 2 as to not tangle cable or transfer tension to deck. Tow point on last wrap handled by person 1 while person 2 pulls wire cable over railing and shackles the rope tow point to wire cable. Tension was then slowly released by person 1. Note two additional wraps were left on deck cleats as safety back up. Once fish is deployed, press the logging button on the acquisition computer to begin logging. Bring ship to survey speed (10-12 kts) (figure 11).

6. Retrieval Procedures- Slowed to recovery speed of 2 to 4 kts. Person 1 hand recovers fish while person 2 neatly wraps the tow cable on deck (not tight around cleats). When tow fish is along side, bring fish on board carefully, ensuring that the fish does not impact the hull. Removed composite nose piece and using potable water (starboard side of the Creed) rinsed thoroughly brass connector and body of the fish, replaced nose piece and secured fish to railing. Note, corrosion takes place fairly quickly when the saltwater, fresh air and brass are all in contact, it is important to rinse the fittings after each retrieval, however it is not necessary to break the brass seal during this process, the o-rings provide the true seal.

Figure 10- Setup of magnetometer while on deck.

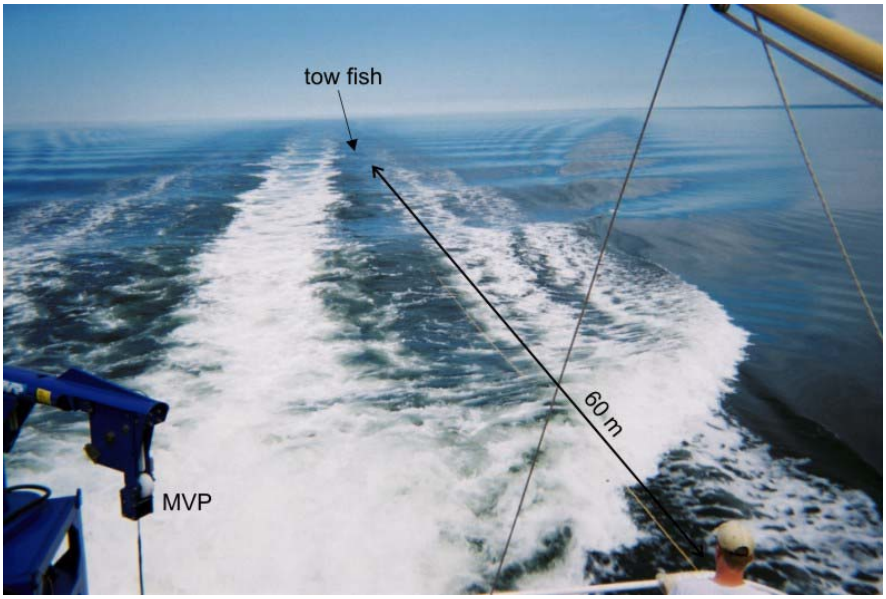

Figure 11- Setup of magnetometer while acquiring data.

SeaLink setup and magnetometer software configuration

- Requirements – System Windows 95 or higher with two available com ports.

- The Magnetometer requires both a Serial connection to the towfish and a real-time NMEA nav string from DGPS.

- A cycle rate of 1 to 2 hz is desirable on the magnetometer at 12 kts, 1 Hz gives reading ~ every 20 metres, 2 Hz every 10 m.

- Mag Baud 9600 string com1.

- GPS Baud 9600 10hz NMEA string com2.

Issues

- No valid navigation string found, program restarted/rebooted until com port found.

- No valid magnetometer com link, Windows OS interpreted mag com port as a plug and play mouse. Power disconnected from magnetometer until windows completed reboot, power reconnected and program initiated.

- The pressure sensor provided erroneous calculations of depth throughout the cruise, sometimes showing fish above surface of the water. Fish could be observed under most conditions riding 60m aft and .5m or greater, below the surface.

- No ability to configure the "x" of "z" offset of the Magnetometer is provided with the sealink software, due to the MVP mounting aft centre, it was necessary to deploy magnetometer approximately 3m to the Port of the RP, giving an overall error of positioning +- 6m instead of the usual DGPS corrected positioning of +- 3m. Primary corrections received from Coast Guard DGPS station in Riviere du Loup (300 Khz) and RTK reference station Ile du Bic

- During the Creed 2005-066 survey (Campbell et al. 2006) the magnetometer tow cable developed a twist during survey operations (Sept 6th more severe than Sept 8th). The reason appears to be seaweed which wrapped around the fins on the tow fish thus affecting the hydrodynamics of the towed body (figure 12). Twisting was not an issue on this survey, except for a minor incident on the first survey day. However, if severe twisting occurs (figure 13), care must be taken not to kink the tow cable.

Figure 12- Seaweed wrapped around the fins of magnetometer towfish.

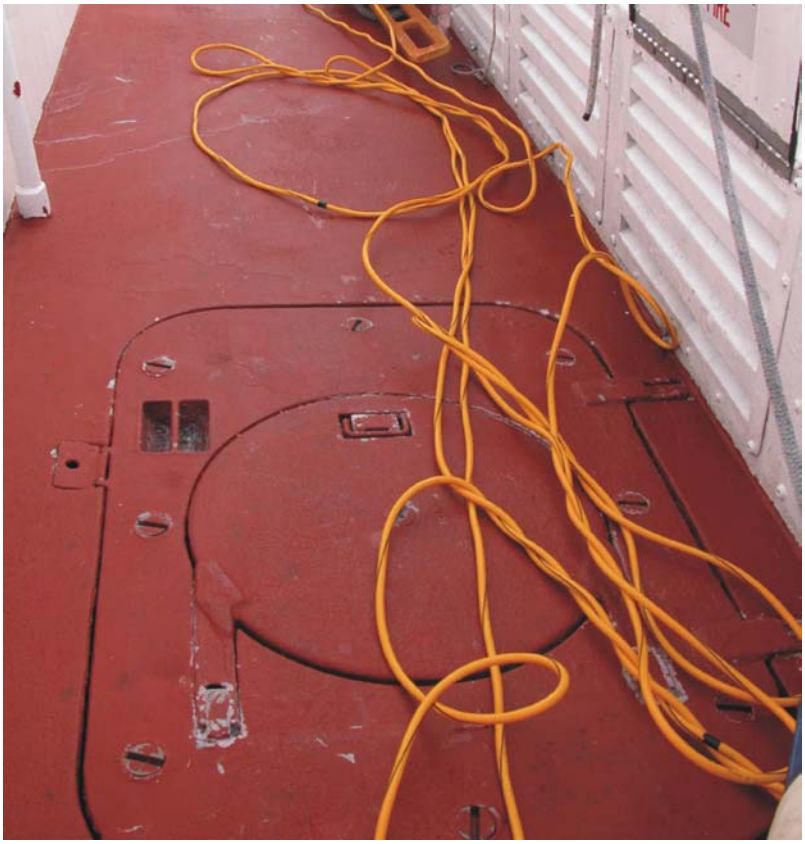

Figure 13- Twisted tow cable on deck.

Magnetometer Base Station at IML:

Base station at IML was set up on Wednesday, Oct. 26th, using the same location as for the August-September survey (figure 14). The sensor was setup in an open grassy area away from the pump house and the GPS antenna was installed on a temporary mast (soccer goal post) (figure 15). The CPU, GPS, and other electronics were setup inside the pump house and power supply was provided from a wall socket (figure 16). The initial setup of the mag sensor was successful with readings in the 55 000 nT range with variance of less than 30 nT over a 1 hour period. Had to move probe to rear of building on Nov. 3rd, as Public Works determined that the cable across the driveway would interfere with snow removal. System back on line with readings of ~55000 nT. Power outage on Nov 1st and Nov 14th, however we were not surveying at those times. On Nov 26th, during demobbing, it was discovered that the coaxial cable to the sensor was plowed out of position during snow removal. The sensor did not appear to be damaged, as the computer was still logging data.

Figure 14- Station mag setup location on the IML campus for the three multibeam surveys.

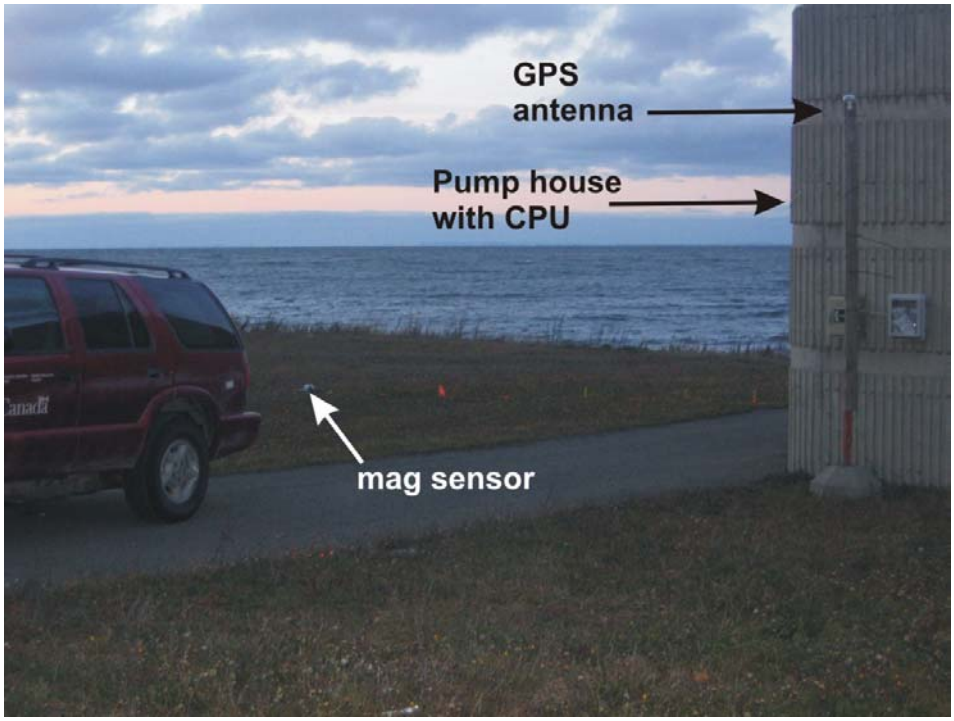

Figure 15- Station magnetometer configuration outside of pump house during this survey.

Figure 16- Station mag setup inside pump house.

Recommendations for future surveys-

- CHS should have some time before the start of the field season to conduct sea-trials of the hydrographic equipment before surveys commence to ensure that everything is operational. This was not possible this year because of a delay getting the ship out of dry-dock.

- The ship docked in Rimouski too often, in instances where the port was not the most time effective place to dock. In the future, it would be much more efficient to dock in other areas.

- It would be more effective to have a single hydrographer committed to the project, or at least have fewer changes which would allow for more flexibility in where the ship docks and improve consistency.

- Refraction artifacts were common in the data. In the future measures should be taken to remedy this (perhaps more velocity casts).

References-

Campbell, D.C., Hayward, S., Côté, R., and Poliquin, L.
2005: F.G. CREED EXPEDITION 2005-038: Multibeam and magnetometer survey of the St. Lawrence Estuary north of Rimouski- June 5th to 17th 2005, GSC Open File Report 4966.

Campbell, D.C., Duchesne, M., Poliquin, L., and Côté, R.
2006: F.G. CREED EXPEDITION 2005-066: Multibeam and magnetometer survey of the St. Lawrence Estuary north of Mont-Joli, Aug 27th to Sept 8th 2005, GSC Open File Report 5078