GEOLOGICAL SURVEY OF CANADA
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Seabed Mapping Surveys, SW Makkovik Bank, Harrison Bank NRCAN Expedition Report 2008028

G.V. Sonnichsen and M. Lamplugh

2008

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Seabed Mapping Surveys, SW Makkovik Bank, Harrison Bank

NRCAN Expedition Report 2008028

Photo by Mike Lamplugh, CHS

CCGS MATTHEW

July 29-August 12, 2008
Days 211-225

Senior Scientist: **Gary Sonnichsen, GSC Atlantic**
Hydrographer-in-Charger: Mike Lamplugh

Master: Capt. Garth Sveinson

Geological Survey of Canada (Atlantic)

Open File # 5931

Table of Contents

Photo by Mike Lamplugh, CHS

2008028 Expedition Summary

Vessel: CCGS Matthew
Depart: Makkovik, NL, August 2nd, 2008
Arrive: Nain, NL, August 13th, 2008

Geographic Location:
SW Makkovik Bank, inner Marginal Trough, NE Harrison Bank, NL.

Scientific Personnel:

Gary Sonnichsen	NRCan	Senior Scientist
Mike Lamplugh	DFO-CHS	Hydrographer in Charge
Andrew Craft	DFO-CHS	Hydrographer
Glenn Rodgers	DFO-CHS	Hydrographer
Mike Collins	DFO-CHS	Hydrographer
Eric Balcom	DFO-CHS	Hydrographer
Savarine Fournier	DFO-CHS	Hydrographer
Julie LeClerc	DFO-CHS	Ship's Technician

Accomplishments

30	stations	FFCPT probe tests
1000	km^2	EM710 multibeam bathymetric data
3000	line km	3.5 kHz profiles collected with EM710 surveys

Background

Increasing demand for petroleum is encouraging oil and gas companies to look to northern, offshore basins for new discoveries. Offshore Labrador, with large proven natural gas reserves (> 87 billion m3 in Bjarni and N. Bjarni fields alone), and a world-class drilling success rate, is generating significant new interest. 2D seismic surveys have been conducted on the shelf and slope offshore Labrador from 2004 to 2008. The Canada-Newfoundland Offshore Petroleum Board (CNLOB) released a 2008 Strategic Environmental Assessment (SEA) which defines where and under which conditions new exploration drilling will be allowed to proceed (Sikumiut Environmental Management Ltd., 2008). The results of a new land lease sale comprising four blocks on Makkovik and Harrison Banks and Cartwright Saddle will be announced in September 2008. The government of Newfoundland and Labrador is actively promoting the petroleum prospectivity of the Labrador offshore and encouraging studies to evaluate the engineering and economic constraints to development of the offshore gas.

Since 2004, the Geological Survey of Canada (NRCAN) have been conducting seabed geological investigations on the Labrador Shelf and slope to ensure that regulators and policy makers have timely and appropriate information for informed decisions on seabed engineering development. Slope research has been regional and reconnaissance in

nature because so little is known: drilling cannot proceed without understanding risks related to steep, irregular terrain, slope stability, and shallow drilling conditions including boulders. The shelf research has focused principally on Makkovik Bank where proven gas remains unexploited in part because of high uncertainty related to difficult seabed conditions. For example, a key uncertainty is iceberg scour protection for subsea facilities on the shelf. Additionally, in the 1980s, un-mapped subsurface boulders caused a loss of more than 45 days drilling (and 10s of $M) in one season. Our goal is to collect state-of-the-art data to re-evaluate these geological barriers to the production and transport of proven gas reserves on Makkovik Bank.

Purpose

Data collected during Matthew 2008028 will help assess seabed impediments to safe and cost-effective exploitation of offshore gas discoveries. The multibeam data provide accurate, high resolution imagery and depth information on seabed iceberg scours, and an understanding of the post-glacial morphology of the banks, margin and inshore bedrock exposures. Resulting data and knowledge allow GSC to provide sound advice to government, regulatory agencies and industry tasked with ensuring safe and sustainable development of Canada's offshore regions. The survey was conducted under NRCAN's national Geoscience for Ocean Management program (GOM) under the Geohazards and Constraints to Offshore Development (GCOD) project which focuses on regional geohazard assessment in active exploration regions or potential exploration regions.

Specific Expedition 2008028 objectives were fourfold:

1. Complete coverage started in 2006 (2006038) within Inner Marginal Trough
2. Establish new repetitive mapping site on outer Harrison Bank
3. Characterize seabed sediment character and strength as determined by free-fall cone penetrometer tests (FFCPT)
4. As necessary, complete Matthew's five year re-survey of Makkovik Bank repetitive seabed sites (Bjarni, ESRF, Gladys and Bertha) initiated by C-CORE in July, 08, prior to the start of 2008028

Methods

Bathymetric operations[a]

EM710

A Kongsberg EM710 permanently installed aboard Matthew was the primary instrument used. HIC Lamplugh developed survey strategies to cover all NRCAN objectives and all data were collected to CHS standards. Lines were run to 100% overlap (i.e. 200% coverage) by surveying along outer edge of coverage. Outer beams were excluded (in

[a] The Canadian Hydrographic Service is the only certified source for bathymetric data. Data collected by CHS for NRCAN use is for geological characterization of the seabed and is not to be used for navigation. GSC is a source of seascape imagery and digital terrain models developed for geological use. Any users requiring data for charting, navigation or other purposes must approach CHS for the information.

post-processing) to avoid refraction errors as necessary. Lines were run from 10-12 knots with an acoustic footprint of 1° by 1° and sounder set to "high density" (i.e. four hundred sounding per ping). Data were usually collected with the ping length set to "shallow mode " to maintain uniform backscatter strength but deeper settings and "Auto " mode had to be used in depths of over ~ 300 meters, especially where there was extreme seafloor relief. Tidal corrections were based on a predicted tide model supplied by Tidal Section of CHS, such that all processed data are referenced to chart datum. Sound velocity casts were used to correct beam dispersion due to water column stratification. The associated CTD profiles were used to compute absorption coefficient files for each of the frequencies used in order to better calibrate backscatter. Casts were conducted at dawn and dusk, or when refraction errors appeared in the data.

EM3002

During Day 223 (Aug 10th 2008), launches Pipit and Plover collected Kongsberg EM3002 data over inner portions of the bank to ensure survey areas were completed within the timeframe given. The data were integrated into the HIPS/SIPS NRCAN project and are not a separate data deliverable.

3.5 kHz Subbottom profiler

Description

A Knudsen 320B sounder is installed permanently aboard Matthew. While not routinely operated during Hydrographic operations, it is operated during geoscience programs to provide insight into seabed and subsurface sediment character. To avoid interference with the EM710 multibeam, the 320B transmission is controlled by the PosMV motion package. Hence, 3.5 kHz data is only collected when the EM710 is sounding, and then only if the 320B is on and logging. The 3.5 kHz sounder is controlled by a server located in the transducer room, but operated remotely from the Sonar Control lab behind the bridge, using Remote Desktop. The on-duty EM710 operator can then view the incoming data, advise Senior Scientist of problems, and perform line start /stop procedures as directed.

Operation

Three files were recorded for each line:

1. An ASCII **.kea** file records sounder settings and navigational data for each ping.
    a. This file is the source of GSCA navigation information. Routines are available to extract the nav, reformat the time to Julian day, UTM time, and output a file suitable for input into the Exploration database.
2. A binary compressed **.keb** file records each ping in a proprietary Knudsen form
    a. This file is importable into Chesapeake Technology, Inc.'s SonarWiz.Map with the Subbottom profiler license module (SonarWiz.MAP+SBP)
3. A binary **SEGY** file is modeled after the open industry seismic data standard.

There was a fair bit of settings adjustment to optimize for water depth and sediment character, but all these settings are recorded in the resulting Knudson KEB files. These settings can be reviewed using Knudsen's SounderSuite PostSurvey software (v 1.55). Typically the 320B was configured to record a 50 m window that

autoscales with depth. The 320B manuals suggest that the number of samples recorded is hard-coded so the larger the depth window recorded, the lower the resolution of the samples.

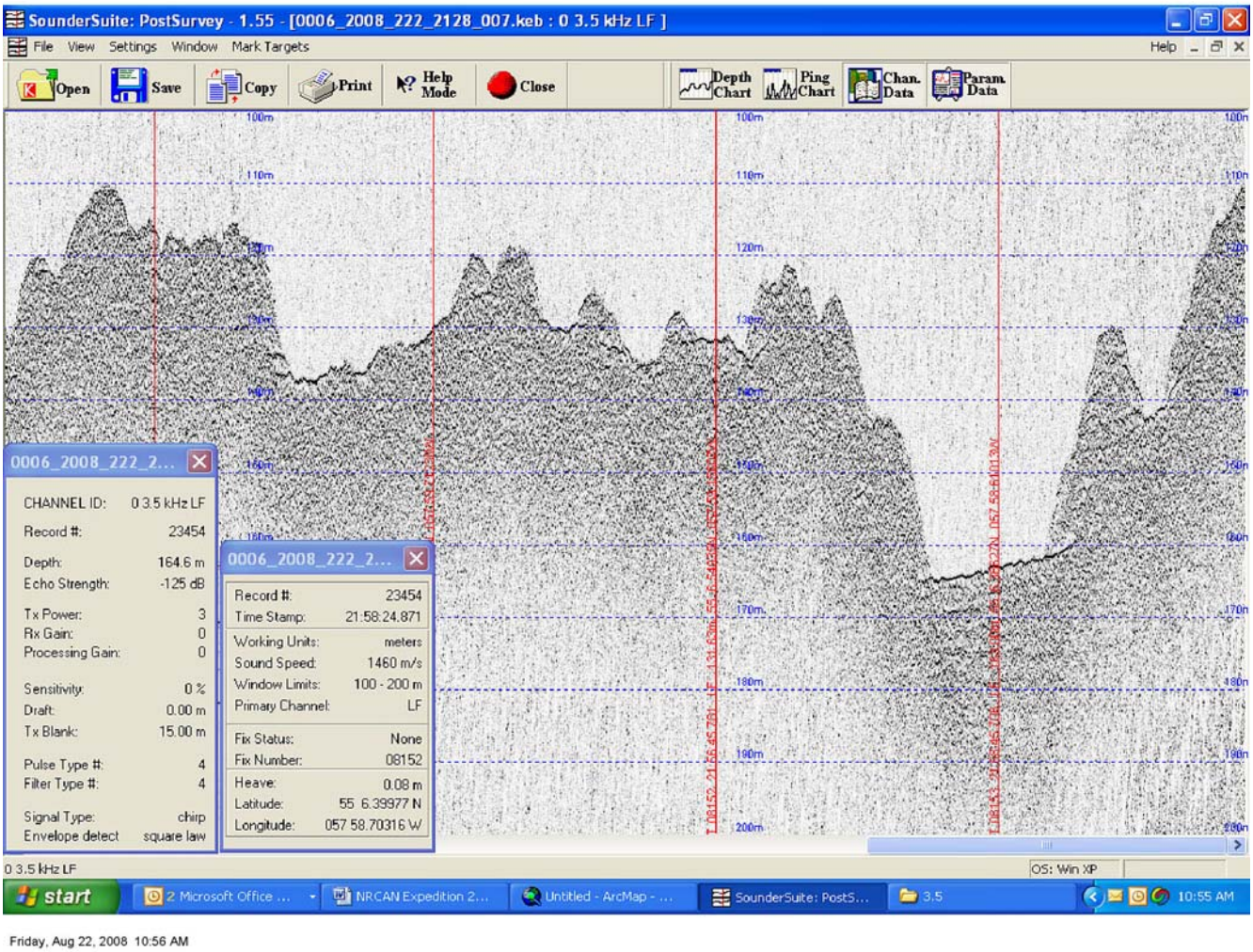

Figure 1: example of 3.5 kHz data collected during 2008028, as viewed using SounderSuite PostSurvey software. The record is typical with a hard reflective bottom over bedrock peaks and variable penetration into smoother softer sediments in depressions.

All data were copied from the server, and organized by JD and by data type (.kea,.keb,.SGY). DVDs of data coverage were provided to GSCA Data Curation, Navigation data for all 3.5 kHZ data and Station details are available through the GSCA Expedition Database (ED) website:
http://www.gsca.nrcan.gc.ca/ED/GSC/ed-f-menu.cgi

Free-Fall Cone Penetrometer Tests

Description

The Free Fall Cone Penetrometer Tool (FFCPT), developed by Brooke Ocean Technology Ltd. and Christian Situ Geoscience Inc. provides a method for rapid profiling of the near-surface sediment column, yielding geotechnical parameters analogous to conventional CPT methods (e.g. strength parameters and lithologic proxies). The FFCPT is a 1.6 m-long, ~50 kg self-contained instrument that free falls through the water and penetrates the seabed; deceleration and dynamic pore pressure response are recorded internally to characterize sediment layering, grain size, and sediment shear strength data. It has a maximum water depth rating of 600 m. The FFCPT is designed to be deployed repeatedly from a BOT MVP (Moving Vessel Profiler), or in discrete drops from a cable or rope. The discrete drop process was used during 2008028 given concerns over damage to the EM cable and CHS reliance on it for SVP operations. It was operated in water depths up 320 m, the limit of available rope on the winch.

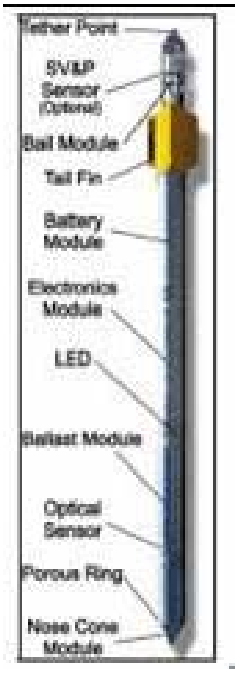

Figure 2: FFCPT probe

Equipment

1. FFCPT probe (figure 1)
2. 350 m rope with > 2000 lb strength, measured in 20 m intervals
3. Stainless steel shackle and swivel
4. Swan 50 HP electric winch with spooler.
5. Rope used to tie off FFCPT at rail for freefall.

Operation

The porous ring at the nose was primed with mineral oil to ensure proper transfer of sediment pore pressures to the internal pore pressure sensor. The FFCPT must be programmed and armed via an RS-232 communications interface box. Battery power is checked (should be above 11 V). Date and time, and file names are set. A target depth is established, below which the FFCPT starts recording data at high sample rate. A re-arm depth is defined; the probe is re-armed once it is retrieved above that depth. The FFCPT is armed in Autostart mode so it can record multiple drops without recovering and reprogramming. A Green dummy plug is used to keep power going to the probe. All settings are saved in the probe until it is shut off with the Red dummy plug; it must then be reconfigured.

Deployment procedures

1. Water depth was pre-determined using ship sounder and multibeam data. Based on water depth a trigger depth was programmed into the FFCPT (usually 10 m off the bottom) during initialization (See Operation).
2. The FFCPT was lowered to ~25 m or more above seabed (FFCPT must achieve terminal velocity) and then tied off. The probe must be above the trigger depth.
3. Slack rope was then pulled off the winch for free fall and carefully coiled on deck. The amount of slack was well in excess of the free fall distance, and

accommodated wire angle.

4. At a signal, when crew and bridge were ready, the slack coil was thrown into the water and the rope holding the FFCPT to the rail was cut, allowing the probe to free fall (and achieve terminal velocity) prior to penetration into the seabed.
5. The FFCPT was usually recovered to the surface, inspected for damage, mud washed off (if present), and the mud-line LED inspected and cleaned. A blinking LED indicated the probe was re-armed and ready for another deployment. On some drops, we set the re-arm water depth deeper (say 50 or 150 m) so we did not have to recover the probe to surface between drops (once we had more confidence in seabed conditions and our operation procedures)
6. Process was repeated as required at that location without powering down.
7. After 2-4 drops at a site, the FFCPT was recovered, washed down with fresh water, its nose placed in a bucket of water (to keep mineral oil in porous ring saturated), and data downloaded using the RS232 cable and junction box.

Note, inadvertently, the laptop planned for downloading did not have a Serial port. The alternative was to carry the probe close to the Hydrographic lab so that data could be downloaded onto an alternate desktop computer. This caused excessive heavy carrying and handling of the probe, and should be avoided in future operations.

Figure 3: a) FFCPT probe and winch with 350 m rope
b) Deploying FFCPT through A-frame

Figure 4: a) tying off rope to allow slack for free-fall
b) Throwing slack and cutting tether for freefall

Safety Considerations

1. The FFCPT is heavy and awkward to hold and manoeuvre. It was always handled by two personnel.
2. Ropes, shackle, swivel and winch were load-tested and certified and fit for purpose.
3. The free fall procedure is hazardous if the depth and slack wire have not been properly established. If free fall exceeds the slack, the FFCPT will come up short, exerting an abrupt force on the rope. Safety concerns are the rope breaking, and/or whiplash on the cable. Our procedure was to use an over-strength rope and to ensure personnel were safely out of way during the release.
4. Personnel were also well clear of the rope and slack to avoid any chance of contact during the deployment.

Results

Bathymetric Data

Re-survey of 2003 Repetitive Mapping Sites

As a joint effort between NRCAN and C-CORE, four seabed sites surveyed with multibeam in 2003 (Fugro-Jacques Geophysical (FJGI), 2003, C-CORE, 2006) were re-surveyed in 2008 by CHS aboard CCGS Matthew (Figure 1). Bertha, ESRF, Bjarni were surveyed prior to start of 2008028 under agreement between C-CORE and CHS; Gladys was surveyed by NRCAN during this expedition (2008028).

Scours detected in the 2003 data have been digitally mapped and analyzed (Davis et al., 2003), and captured in a geographically referenced database (FJGI, 2004; C-CORE, 2006). After the 2008 data are cleaned and processed by CHS, they will be analyzed to document changes/additions to the 2003 ice scour populations over the intervening five years. This will be a joint effort with NRCAN, C-CORE and oil and gas companies active in Labrador waters.

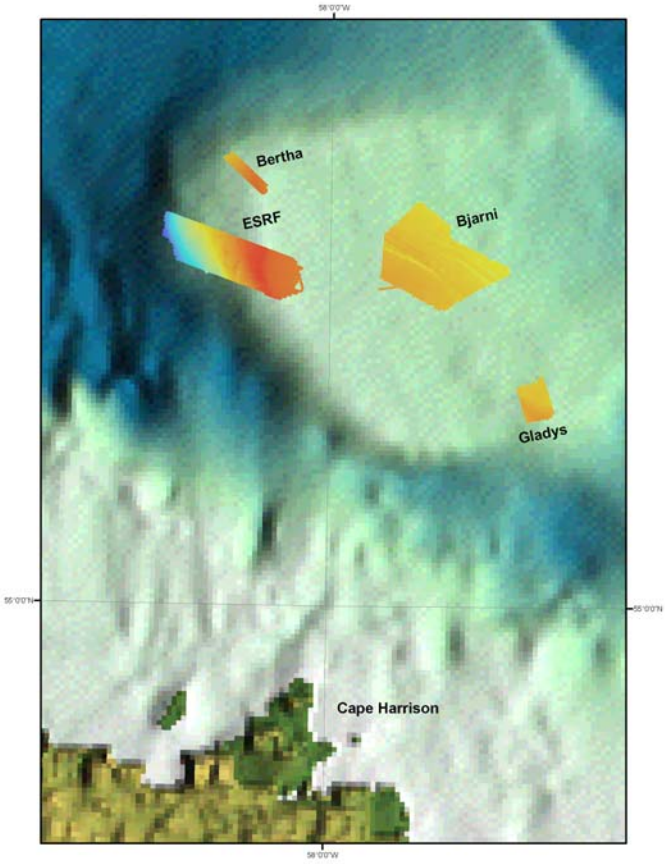

Figure 5: Four repetitive seabed mapping sites established on Makkovik Bank in 2003 were resurveyed in 2008

The 2008 resurvey is the first time that two successive multibeam surveys have been conducted offshore eastern Canada to document scouring rates. The repeat multibeam is far superior to previous efforts that had to rely on variable quality and poorly-georeferenced sidescan coverage. Confidence should be significantly higher with these results.

Infill work, Southern Makkovik Bank, Marginal Trough

Multibeam surveys were conducted by CCGS Matthew offshore of Cape Harrison in 2006 for NRCAN (Expedition 2006038) and in 2007 for C-CORE (FJGI, 2007; C-CORE, 2008). An objective of 2008028 was to join the two surveys and expand the coverage to the NE onto southern Makkovik Bank (Figure 2).

1. 90 hours were spent between August 3 and 6th (Julian Day (JD) 216 UTM 0400 to JD 219-1900) using the EM710 system to expand seabed coverage from the marginal trough onto southern Makkovik Bank. The Gladys repetitive mapping site was resurveyed as part of this overall survey.
2. An additional 40 hours of EM710 data and 12 hours EM3000 (Hydrographic Launch Plover) data were collected (between 222/1930 and 224/1100) to infill a large gap between the 2006 and 2007 surveys on the inner shelf.

The infill data complete an excellent picture of the complex physiography of the area offshore Cape Harrison which comprises:

- **inner shelf** zone of highly irregular relief due to exposed bedrock and narrow, incised over-deepened fractures and channels
- a deep **inner marginal trough** with muted, irregular relief consisting of variable glacial sediment overlying bedrock and small isolated overlying patches of soft (sand and mud)
- flat, **bank-top** setting with thin, reworked sands and gravels and positive relief evident in bank-edge moraines and fluted troughs on the interior of the bank, likely indicative of subglacial erosion.
- **Nearshore** zone with smoother, seafloor relief where thicker unconsolidated sediments have infilled bedrock depressions.

The data will be interpreted and mapped to further our understanding of the Quaternary evolution of the Labrador shelf and its control on both seafloor sediment character (strength, thickness, and distribution) and the history and severity of the seabed ice scour processes in the region. Plans are to extract scour parameters from the new coverage to add to the existing Makkovik area scour databases (C-CORE, 2006, 2008; FJGI, 2003, 2004, 2007; King and Sonnichsen, 2008).

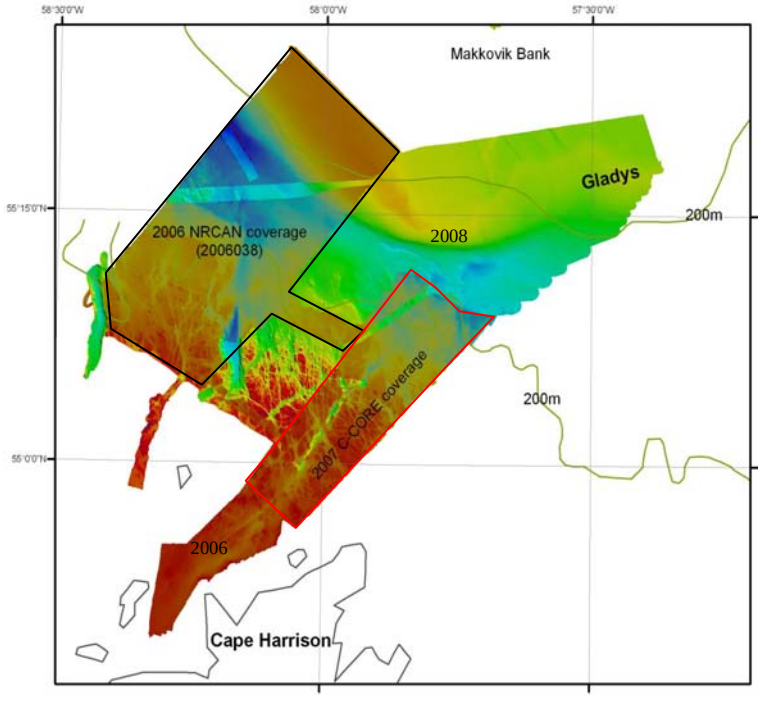

Figure 6: Composite of 06, 07, 08 multibeam coverage on SW Makkovik Bank and Inner Marginal Trough. Gladys is a repetitively mapped seabed site, surveyed with sidescan in 1985, and multibeam in 2003 and 2008

Harrison Bank Repetitive mapping site

It is important to compare iceberg scour regimes in different water depths, geographic locations and seabed types. To date, GSCA's repetitive mapping sites have been established on either Makkovik Bank or Saglek Bank (Breton et al., 2008). With the exception of the ESRF site (Hodgson et al., 1988), none were originally intended as repetitive mapping sites, rather they were pre-existing industry site surveys (Bjarni) or surveys to document an observed grounding event (Bertha, Gladys, Caroline (Saglek Bank), or reconnaissance sidescan surveys (Saglek East and West (Breton et al., 2008)). Accordingly, they were not all well situated to record new scour events. One main objective of 2008028 was to establish a repetitive mapping site on an outer bank where we would expect to see future iceberg impacts from icebergs carried in the outer branch of the Labrador Current. With no bathymetric filtering, we expect larger icebergs to be transiting in the deeper water offshore of the banks.

2008028 operations included mapping a large tract of seabed on the NW tip of Harrison Bank in water depths from > 300 m up to approximately 140 m (Figure 3). Depths were shallower than anticipated which required modifications to the survey plan and time allotted (survey coverage is a function of water depth (~ 4 X water depth). We did not complete the intended coverage due to time constraints and left a gap in coverage to the south.

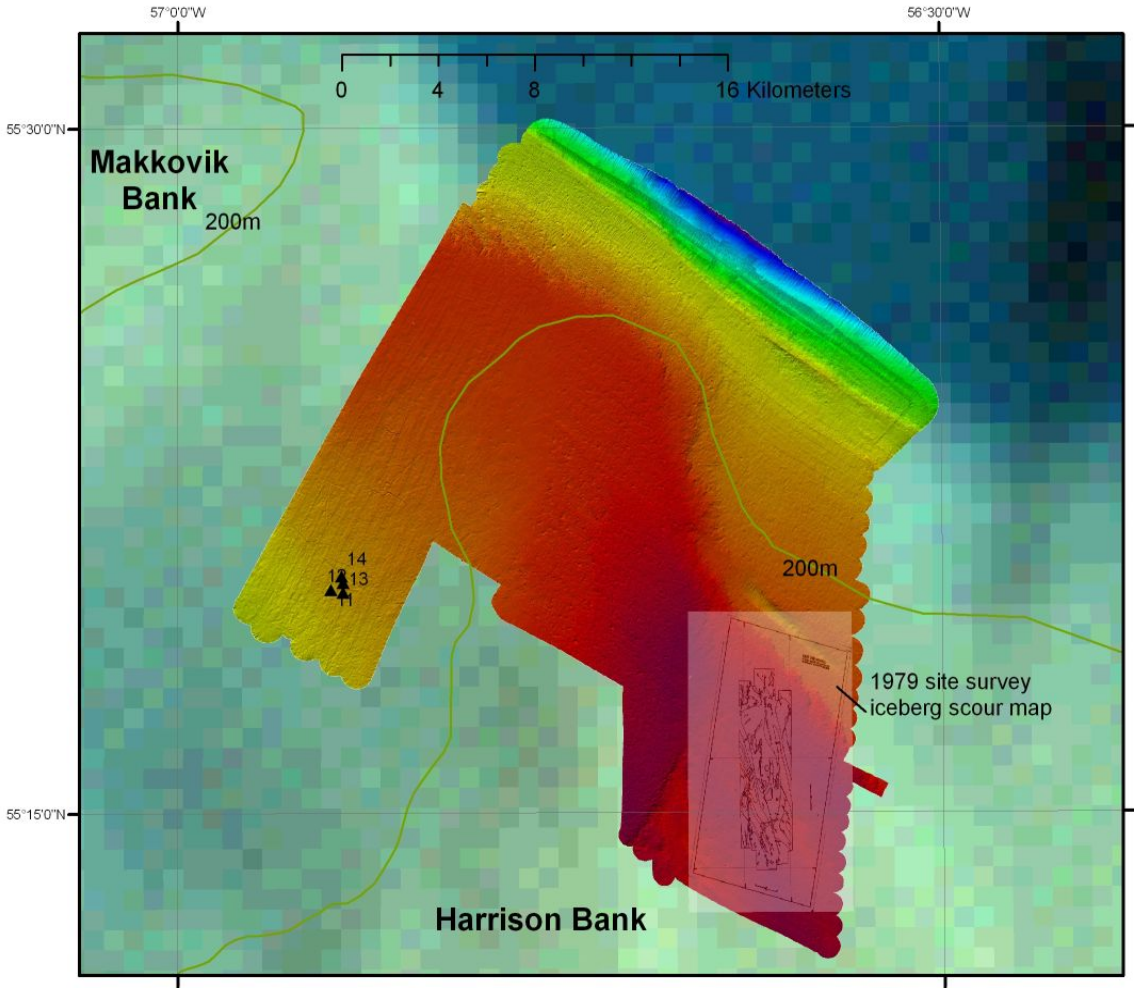

Figure 7: 2008 repetitive mapping site on NW Harrison Bank in (water depths 500 m (blue) to <140 m (red). A 1979 scour map dereived from sidescan data is superimposed. The prominent ridge trending NW-SE is likely a glacial moraine recording a glacial ice front position. Triangles are FFCPT stations (Table 1).

The Harrison Bank site meets several objectives:

1. We have new coverage over a 1979 sidescan survey done in anticipation of a well that was never drilled. All we have is a map of iceberg scours mapped from the (now lost) 1979 sidescan sonar data. Without the original data, it will be difficult to correlate the 1979 scours to 2008 scours; regardless we'll gain insights into the longevity of seabed scours and possibly record some new scour events that have occurred over 29 years. Comparison of the multibeam data to the scour map will be a task for the coming year.

2. We have detailed seabed scour information from a new location. Extraction and analysis of scour parameters from Harrison Bank will allow us to comment on the spatial variability of scouring processes, valuable insights as exploration expands into new lease block areas.

3. A large positive ridge in the centre of the coverage is interpreted as a glacial moraine. It is much more heavily scoured than the surrounding seabed, and it appears to be more heavily scoured on the up-current (NW) side. Heavy scouring is likely due to both increased keel impacts over the shallower ridge, and to their preservation in what is inferred to be a glacial till substrate. This will be quantified once data have been processed to produce a high resolution digital terrain model (DTM) for the site.

4. A prominent linear ridge at approximately the shelf break is tentatively considered a record of the terminal position of grounded ice at its outermost extent off the shelf.

3.5 kHz data

Approximately 3000 line kilometres of 3.5 kHz data of varying quality were collected during 2008028 (Figure 8). The system is not monitored routinely as the Senior Scientist cannot be in the Sonar Control lab continuously. Rather, it is set up and tuned and allowed to operate remotely. There are occasions where it loses bottom lock, or the server loses a network connection and the 320B does not record useful data. That said, the sheer volume of data collected over the close line-spacing of a swath bathymetric survey reduces the risk of occasional data loss. Ideally, it would be continually manned and QC'd- it is a function of priority and available personnel. Figure 9 demonstrates the excellent value in collecting subbottom data with this through-hull system.

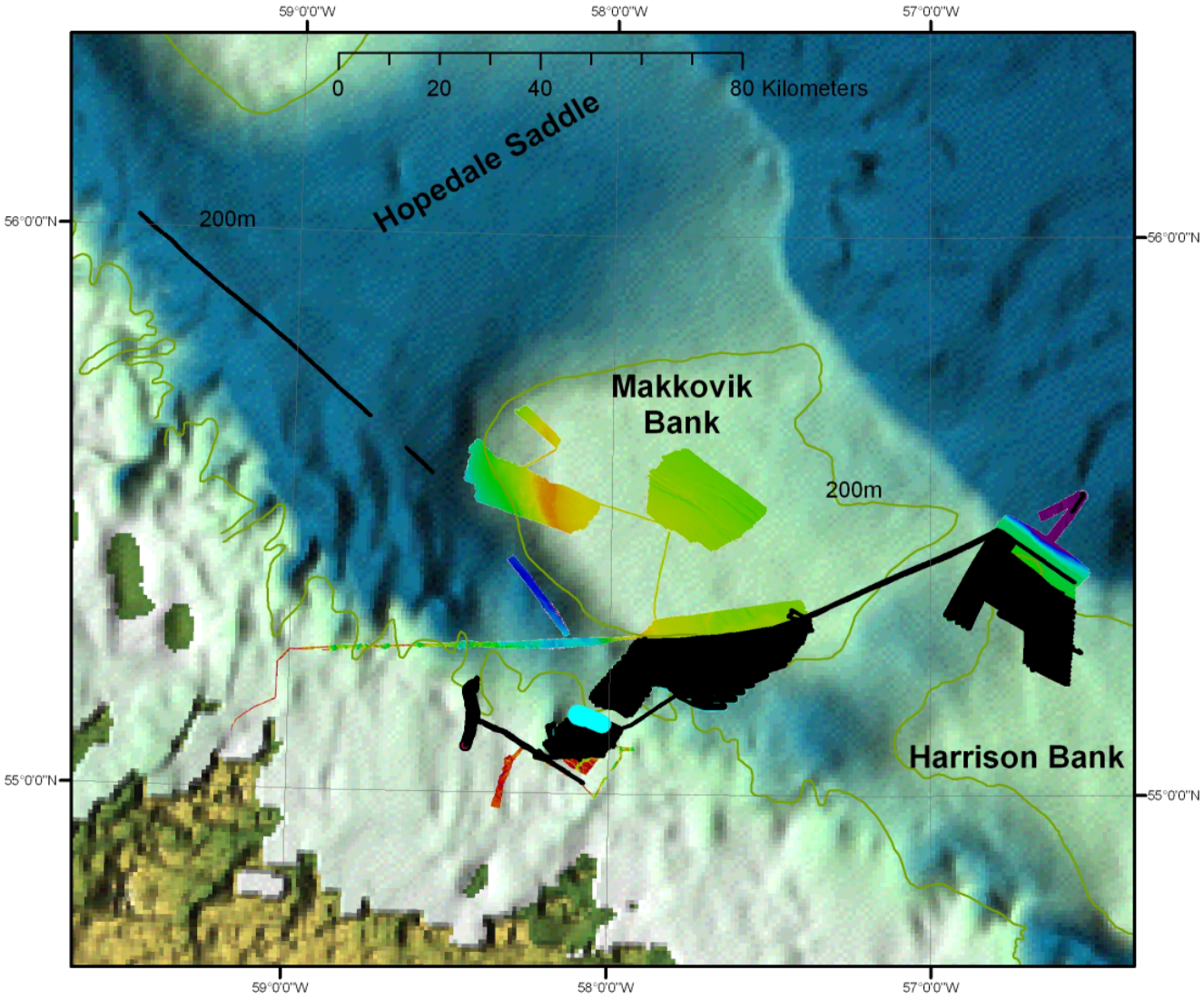

Figure 8: 3.5 kHz subbottom coverage achieved during 2008028 (Black lines). Line density is high because it is run concurrent with multibeam operations. Fig 9 shown in blue

Little processing or interpretation was done onboard. KEB files were imported into Chesapeake Technology, Inc.'s SonarWiz.Map (Figure 9 is an image export from Chesapeake) to evaluate suitability for interpretation. SonarWiz.Map imports files readily (unless there are imbedded bad navigation points) and does allow data enhancement with filters, gains. A major advantage is the automatic adjustment for delay changes so the bottom is continuous and not offset each time the 320B window changes (Fig 9). Delay changes are uncorrected in Knudsen, SounderSuite PostSurvey software. SonarWiz.Map horizon picking routines appear un-sophisticated but manageable. It was not clear how to start and stop a horizon that was discontinuous across bedrock highs – only solution was to map each vector as a horizon. More investigation will be required.

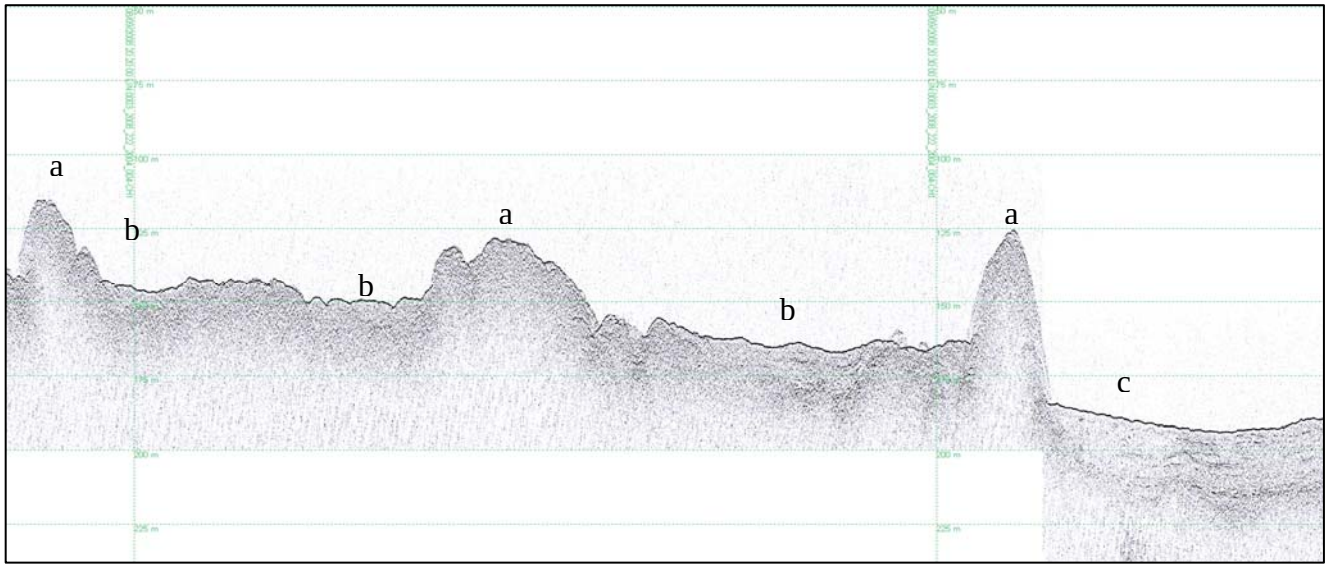

Figure 9: Example 3.5 kHz profile illustrating irregular seabed relief with bedrock exposed on highs (a), less transparent sediments of irregular thickness overlying the bedrock between bedrock highs (b) , and ponded acoustically transparent and stratified sediments in channel troughs(c). Location shown on Figure 8.

FFCPT Data

Thirty FFCPT stations were successfully completed (Figure 10, Table 1). Onboard examination of the FFCPT data indicates the probe was operating properly and good results are anticipated once the drops are fully analyzed. A preliminary analysis of an FFCPT (Figure 11) demonstrates the information derived from the penetration data.

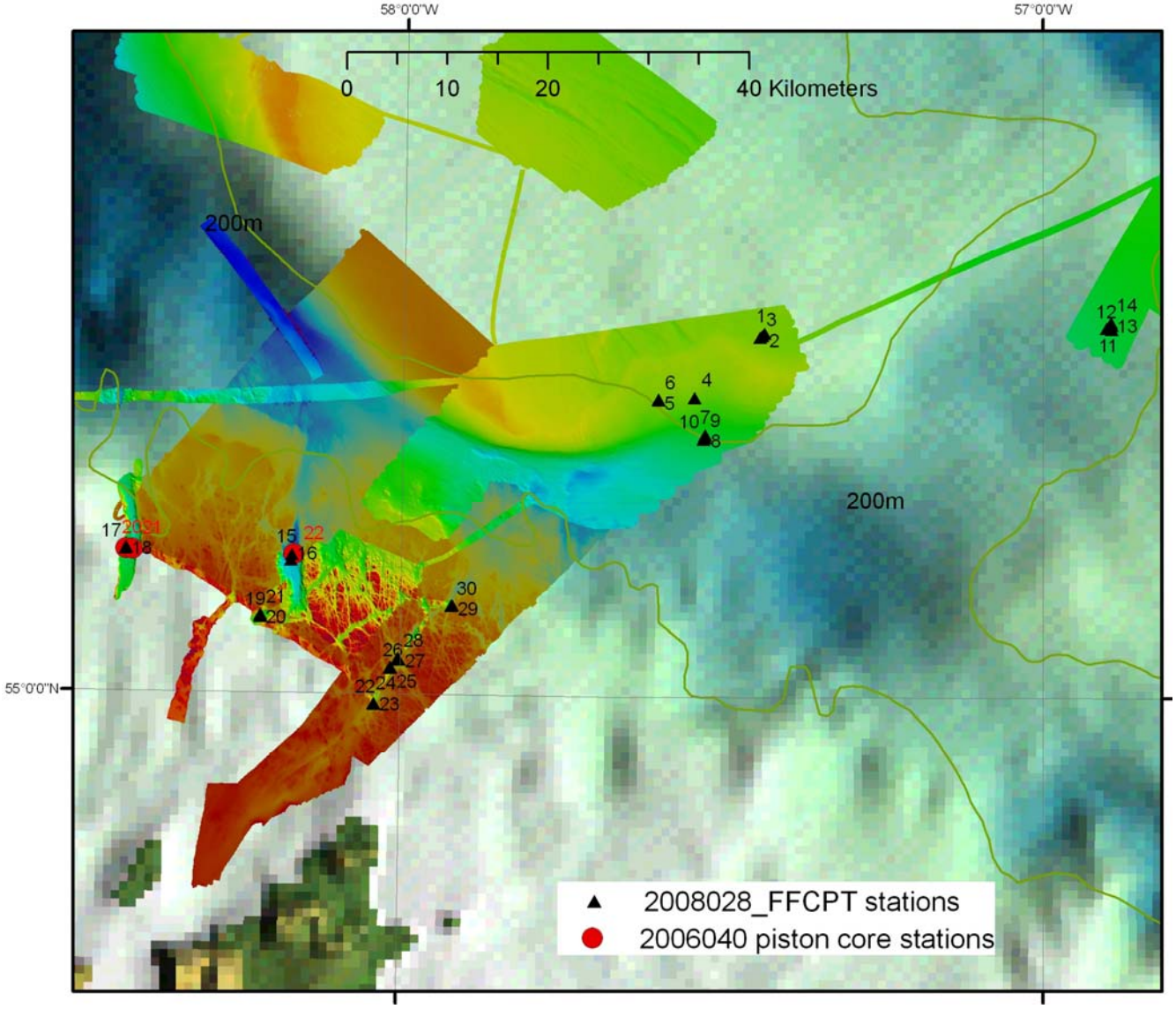

Figure 10: Location of 2008028 FFCPT sample stations. Note FFCPT stations were collected over Expedition Hudson 2006040 piston core stations 20, 21 and 22

2008028 successfully collected good quality FFCPT data at sites of three GSCA piston cores (Figure 10; 2006040-stations 020,021,022). We will analyze the FFCPT data and compare results to geotechnical and textural measurements performed in the lab on piston core sediments. The piston cores are significantly longer than the FFCPT(up to ~ 12 m of sediment recovery) so comparison is only possible in the upper 1.5 m. Regardless, a successful, blind comparison between the FFCPT and lab measurements will provide confidence in the FFCPT as a fast, inexpensive method to acquire reconnaissance sediment property information. This is of interest to ODIM-BOT, the probe manufacturer, and to the broader geotechnical community.

Table 1: 2008028 Station samples (FFCPT)

Station	File	Lat	Long	Depth	Daytime	Comments
001	GLADYS02	55.326853	-57.435932	142	216191912	Gladys repetitive mapping site. Odd response-bounced?
002	GLADYS03	55.324556	-57.438652	141	216192836	Gladys repetitive mapping site
003	GLADYS04	55.323331	-57.442467	141	216193719	Gladys repetitive mapping site
004	S204	55.269386	-57.544282	143	217220123	drop looks good
005	S205	55.267261	-57.601516	155	217223800	good drop over 2006040 Huntec line (daytime 2230229)
006	S206	55.266682	-57.600254	143	217224606	hung up before full impact?
007	D21802	55.236001	-57.527762	209	218173746	FFCPT clock off
008	D21803	55.234209	-57.528698	212	218174801	FFCPT clock off. prob. hung up before full impact
009	D21804	55.233311	-57.529150	214	218175510	FFCPT clock off
010	D21805	55.232180	-57.530563	215	218180342	FFCPT clock off
011	221hb02	55.331987	-56.899825	222	221192024	good drop
012	221hb03	55.331003	-56.891855	221	221194047	good drop
013	221hb04	55.334585	-56.891700	220	221195904	good drop-olive grey sandy mud on tip, no mud line on barrel
014	221hb05	55.337039	-56.892939	219	221201532	good drop-olive grey sandy mud on tip, no mud line on barrel
015	223_01	55.124638	-58.170651	329	223202247	1st of 2 drops at 2005033B PC 20 green silty clay to about 80 cm on barrel
016	223_02	55.119844	-58.171953	316	223204935	2nd of 2 drops at 2005033B PC 20
017	224_01	55.127808	-58.430277	239	224123111	mud to about 75 cm
018	224_02	55.128986	-58.429525	232	224124444	olive green silty sandy mud to 1 m penetration
019	D224_03	55.068480	-58.218474	182	224152226	1 m apparent penetration. olive green mud with silt and fine sand
020	D224_04	55.069700	-58.218500	180	224153500	
021	d224_05	55.070349	-58.218379	179	224154133	took sample from upper 10 cm of barrel for Coulter laser- clayey silt with minor fine sand
022	d224_06	54.991620	-58.039520	142	224170255	clean barrel
023	d224_07	54.992363	-58.040172	143	224171132	clean barrel
024	d224_09	55.025369	-58.015568	134	224174316	clean barrel
025	d224_10	55.024868	-58.014501	138	224180111	clean barrel
026	d224_11	55.024233	-58.015193	138	224180705	looks like it may have hit a rock (tip dented-scratched)
027	d224_12	55.031663	-58.001658	167	224182713	clean barrel
028	d224_13	55.032960	-58.003809	165	224183604	clean barrel
029	d224_16	55.080636	-57.919955	222	224195236	clean barrel
030	d224_17	55.079876	-57.921808	219	224200108	clean barrel

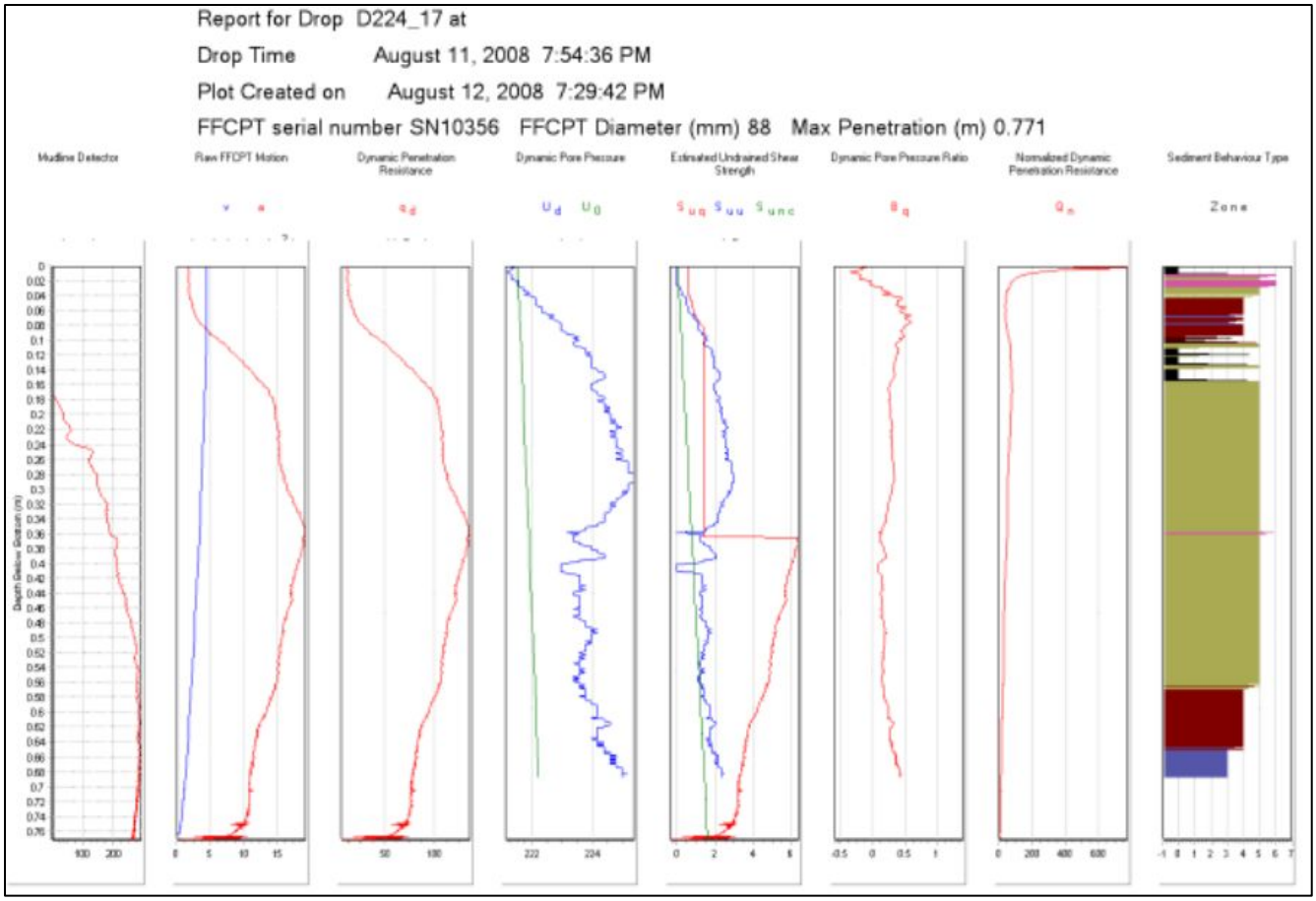

Figure 11: Preliminary Analysis of 2008028 FFCPT Station 030. Not to be used for analysis as subject to revision

Future Work

Multibeam data

1. CHS will finalize processing of the 2008028 HIPS/SIPS data and provide GSCA with clean deliverables.
2. Backscatter processing is a significant challenge due to the different years (2006-08) and settings employed, but a processed uniform backscatter for the entire dataset is desirable. May be done in-house or under contract.

Seabed Ice Scour

1. Provide C-CORE with access to the Gladys multibeam collected during 2008028 to allow complete repetitive seabed analysis of the 2003 Makkovik Bank sites. In return, GSC will seek access to repetitive mapping results.
2. In collaboration with C-CORE and industry partners, extract seabed ice scour parameters from 2008 multibeam.
3. Establish eastern Harrison Bank as a site for future repetitive mapping analysis by mapping and documenting all existing seabed ice scour features into a GIS database. Future re-surveys can then identify changes and additions to the 2008 population.

Surficial Geology

1. Analyse the FFCPT data to produce meaningful estimates of sediment properties at station sites.
2. Process and analyze the 3.5 kHz subbottom profiles to map bedrock, glacial and postglacial sediments as best as possible. Use 2005033B and 2006040 geophysics to constrain the 3.5 kHz interpretation.
3. Using available geological control (grabs, piston cores, FFCPT and camera stations) and geophysical control (Huntec, sleevegun, 3.5 kHz), produce surficial geological maps for the seabed multibeam coverage on southern Makkovik Bank, Inner Marginal trough and Cape Harrison nearshore. This will largely be an in-house GSCA effort.

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Daily Log

Date	Time	JD	Activities
July 29	1300		Sonnichsen arrives in Goose Bay.
July 30			Lamplugh advises Matthew enroute to Makkovik with malfunctioning steering pump. Sonnichsen to wait in Goose until replacement pump arrives from BIO and then hand-carry to Matthew in Makkovik.
July 31			Lamplugh running launch surveys in Makkovik bays
August 1			Pump arrives 1100. Sonnichsen on weather hold for flight to Makkovik. Lamplugh running launches in Makkovik bays
August 2	1400		Sonnichsen on weather hold until 1400; flies to Makkovik. Joins Matthew at 1600. Launches complete surveys
	1830		Set sail for Makkovik Bank to complete C-CORE surveys and start Sonnichsen infill work.
August 3	01:30	216	EM710 surveys to connect 2006-07 Matthew coverage to the C-CORE resurvey of the Gladys repetitive mapping site.
	0800		Replaced batteries in GSC FFCPT, tried to configure laptop for serial connections to FFCPT but couldn't configure a USB-to-serial converter. Used the GSC GIS machine in lab as alternative.
	1430		Started the Knudsen 3.5 kHz sounder. Now recording subbottom data concurrent with EM710 surveys.
	1530		Conducted 3 FFCPT deployments on the eastern edge of Gladys site in ~145 m w.d. Deployment procedure worked well, and 3 apparently good drops were recorded. Will send data to BOT/GSC on Mon. for verification. Note: the rope length is in question. Crew measured roughly 230 m, but the marking is not accurate.
August 4	0800	217	EM710 surveys to complete Gladys and connect 2006 coverage, bringing bank coverage down into Marginal trough

Date	Time	JD	Activities
	0900		Worked to optimize the 3.5 kHz data. • Dropped Power level to 1 • Reduced pulse length to 3 ms (1.5 was too noisy; 6 ms was not providing any advantage) for most of day, but eventually switched to 6 ms to clean up noise in water column. • Dropped gain to 1 • Agc on/off didn't make a difference • 50 m window range from 25-400 m water depth • Autophase • Tvg set on 40db; tried bottom-tied tvg but lost track (not sure why) SEGY data quality didn't change with any gain, or agc adjustments.
	1230		Completed an FFCPT deck test (Deck01) using trigger off mudline to get a baseline on sensors.
	1630		Chose two FFCPT targets – 1st along 2006040 Huntec line; 2nd to test the deepest multibeam collected to date. Testing whether there is silt
August 5	0800	218	EM710 surveys to complete Gladys and to connect 2006 coverage. Now working into > 250 m w.d on NW edge. Defined the moraine on the southern end of Makkovik Bank. Changed the 3.5 kHz configuration to see what works. • Increased Power level to 3 • 6 ms pulse. • Dropped gain to 1 • Agc on/off didn't make a difference • 100 m window range from 25-400 m water depth • Autophase • Tvg set on 20db
	1000		Imported the 3_5 data into Chesapeake. Import worked well, but some files have bad nav fixes that throw off the project extents. I just excluded them.
	1430		Chose a deeper FFCPT target. (> 200 m wd) Unsure how much rope is on the drum (incorrectly measured and marked. 4 drops without recovering probe to surface. Data looked good
August 6	0800	219	weather good. Spent day until 1800 completing the inner marginal trough coverage to connect 2006 and 2007 coverage. No FFCPT drops. Total of ~ 90 hours to complete Gladys/Inner margin surveys.
	0900		Worked in Chesapeake, importing 3.5 data, mapping penetration(mud?) where present along lines
	1530		email from D. Cunningham (BOT) confirming the FFCPT data looked good and instrument appeared to be functioning, just in very hard bottom

Date	Time	JD	Activities
	1800		Transit to Harrison Bank along a 2005033B Huntec/sidescan line that starts in east at 2160200
	2030		Commenced EM710 survey on Harrison Bank. Target was the shelf break up onto bank top and across an old map of iceberg scours from a 1979 sidescan mosaic (HB). Will run survey overnight and then reassess coverage and line direction based on bathy. Contours are incorrect on chart. Shallower than anticipated – had hoped to start in +350 m w.d – will need to extend on NE and NW sides.
August 7	0800	220	weather good – sunny. Lines running SW to NE are good but the depths are less than anticipated – increases our completion time significantly. May not complete the box
	1000		Switched line orientation to NW to SE (slope contour parallel) to extend coverage to at least 300 m. 10 mile lines (1 hour) – presently in 230-240 m wd. Heterogeneous seabed on backscatter with larger contour parallel scours. No penetration on 3.5 but rough irregular seabed.
	1100		Starting new 3.5 project for Harrison Bank in Chesapeake. Mapped seabed with 3.5 kHz penetration- isolated to the inshore basin b/w Harrison and Makkovik banks. No soft sediment on Harrison Bank or slope edge.
	1600		Completed slope edge surveys to > 350 m water depth (max ~ 500m). Now working into centre. Will work on that through the night, then reassess. Unlikely to fill the box. Forecast is continued good weather.
August 8	0800	221	weather good – slight winds (<10). Running lines across the Harrison Bank defining a central moraine with intense scouring on its surface. Scours much less intense off the moraine. Coverage is slower than anticipated. May not complete the box
	1530		Did four successful FFCPT drops (Table *) around a 2005033-047 camera site where 3.5 kHz showed a moderately transparent unit with irregular thickness of 2 to 5 m over an irregular diffuse basal unit.
	2200		Night orders are to start running short lines over the east HB sidescan mosaic so we complete that by am.
August 9	0800	222	weather good – slight winds (<10), shifting direction so just a modest long period swell. Completed the East_HB box overnight and started to extend into the void to the west. Moraine continues to the south and shoaled, decreasing coverage on swath. Decided enough time had been spent here and terminated eastHB survey at ~1030 after running a check-line through coverage.

Date	Time	JD	Activities
	1000		Continued check-line over shelf break to determine depth capabilities of the EM710. Bottom lock continued past 1700 m. Line ran through Amundsen EM300 coverage so will have a good check on accuracy.
	1130		Commenced a transit line south parallel to our transit line out to east_HB. Line runs along a 2005033B Huntec/sidescan line that starts in east at 2160200.
	1630		SVP cast and commencing infill lines across the last remaining hole in the combined 2006 and 2007 coverage (Makk_infill).
August 10	0800	223	Plover and Pippit launched. Plover working on Makk_infill(shallow SE quadrant). Pippit doing inshore charting for CHS.
	0900		Very difficult conditions running lines on Matthew due to the incredibly variable relief. Irregular lines and a requirement for lots of short infill lines. Slow progress.
	1600		Re-measured FFCPT rope. 375 m actually on drum.
	1700		Did 4 FFCPT drops in vicinity of 2005033B_stn 22. Only 1st two worked, likely due to a failure to re-arm at depth (not sure why – re-arm depth was 280 and we raised to < 260m….) Good looking data with a metre penetration and reasonable-looking results. Barrel had > 70 cm green slightly silty clay on barrel (only very fine grit on teeth). FFCPT showed a mixture of silty sands overlying clay and ~ 1 m penetration.
	1930		Recovered launches, continued EM710 surveys
August 11	0530	224	Relieved Collins to run EM710. Have completed the Makk_infill. Just filled lines along SW edge until dawn
	0800		Mapping out the basin on the western edge that was only partially surveyed in 2006
	0900		Commenced FFCPT drops at 7 sites over 06-07-08 coverage
	1730		Completed FFCPT surveys by supper in accordance with Captain's instructions for surveys to terminate at 1800. Directed Matthew to NE so we could run a 3.5 kHz line through Hopedale Saddle on way to Nain.
	1830		Started 3.5 kHz for transit line. Logging EM710 in case anything useful.
	2000		Alter course to steam near iceberg
August 12	0100	225	Shut off 3.5 kHz once out of Saddle. Continued logging EM710
	0930		Arrive Nain. Work on data throughout day. Pack up FFCPT to be put back in Scientific Stores. Back-up data
August 13	10:30		Depart Nain aboard CG charter;
	2100		Arrive in Halifax

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