CRUISE REPORT

NOAA Ship *Ronald H. Brown* (R-104)

U.S. Law of the Sea Cruise to Map the Foot of the Slope of the Northeast U.S. Atlantic Continental Margin: Leg 7

CRUISE RB12-02

July 2 to July 16, 2012

Charleston, SC to Miami, FL

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With introduction, multibeam description, onshore processing description, area description, and pre-cruise daily log sections by James V. Gardner

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Table of Contents

Introduction

This report details the 2012 Atlantic Extended Continental Shelf (ECS) bathymetry mapping cruise for the U.S. Extended Continental Shelf Project. This cruise is the seventh ECS cruise to map the U.S. Atlantic continental margin (Figure 1). Reports of the previous legs can be found at http://ccom.unh.edu/theme/law-sea/reports. The rational for and objectives of the previous mapping in the U.S. Atlantic margin can be found in Gardner (2004), Cartwright and Gardner (2005) and Calder and Gardner (2008). The 2012 cruise was planned after analyses of the 2004, 2005 and 2008 bathymetry demonstrated that gravity-driven down-slope transport of terrigenous sediments in some regions of the Atlantic margin extends much farther to the east than was previously documented. Consequently, the 2012 cruise focused on mapping the extent of the down-slope sediment transport at the base of the lower continental margin.

The Office of Ocean Exploration and Research, National Oceanic and Atmospheric Administration (NOAA) made available a 30-day window in the schedule of the NOAA Ship *Ronald H. Brown* (Figure 2) for the 2012 mapping cruise. The *Ronald H. Brown* is an 84.5 m (274 ft) 3250 ton multipurpose oceanographic research vessel with a hull-mounted Kongsberg EM122 multibeam echo sounder (MBES). The University of New Hampshire (UNH) Center for Coastal and Ocean Mapping/Joint Hydrographic Center JHC/CCOM leased a Knudsen 3260 3.5-kHz chirp sub-bottom profiler for the cruise because the ship does not have an adequate deep-water subbottom profiler. A deep-water subbottom profiler was required to image the top 50± m of the sediment layer to aid in the identification of deposits of sediment that have been transported by gravity (down-slope) processes.

NOAA personnel aboard the ship were responsible for system maintenance and real time data management. UNH CCOM/JHC personnel aboard the ship were responsible for cruise planning, a patch test of the EM122 MBES, data (MBES, subbottom and water column sound speed) collection and quality control and data processing of the MBES bathymetry and acoustic-backscatter and subbottom data.

The cruise required a 27-hour transit to a deep-water (~5000 m water depth) so that a complete patch test could be performed prior to mapping operations. The patch test included a calibration of the XBT system with a deep-water CTD cast as well as the determination of additional static lever-arm offsets in pitch and roll and calibration of heading. Once the patch test was successfully completed, a dip line was run in the South Area for bathymetry uncertainty statistics with cross lines and then the mapping commenced. Finally, a transit was run from the South Area to Miami, FL. The cruise collected and mapped a total area of 69,287 km^2.

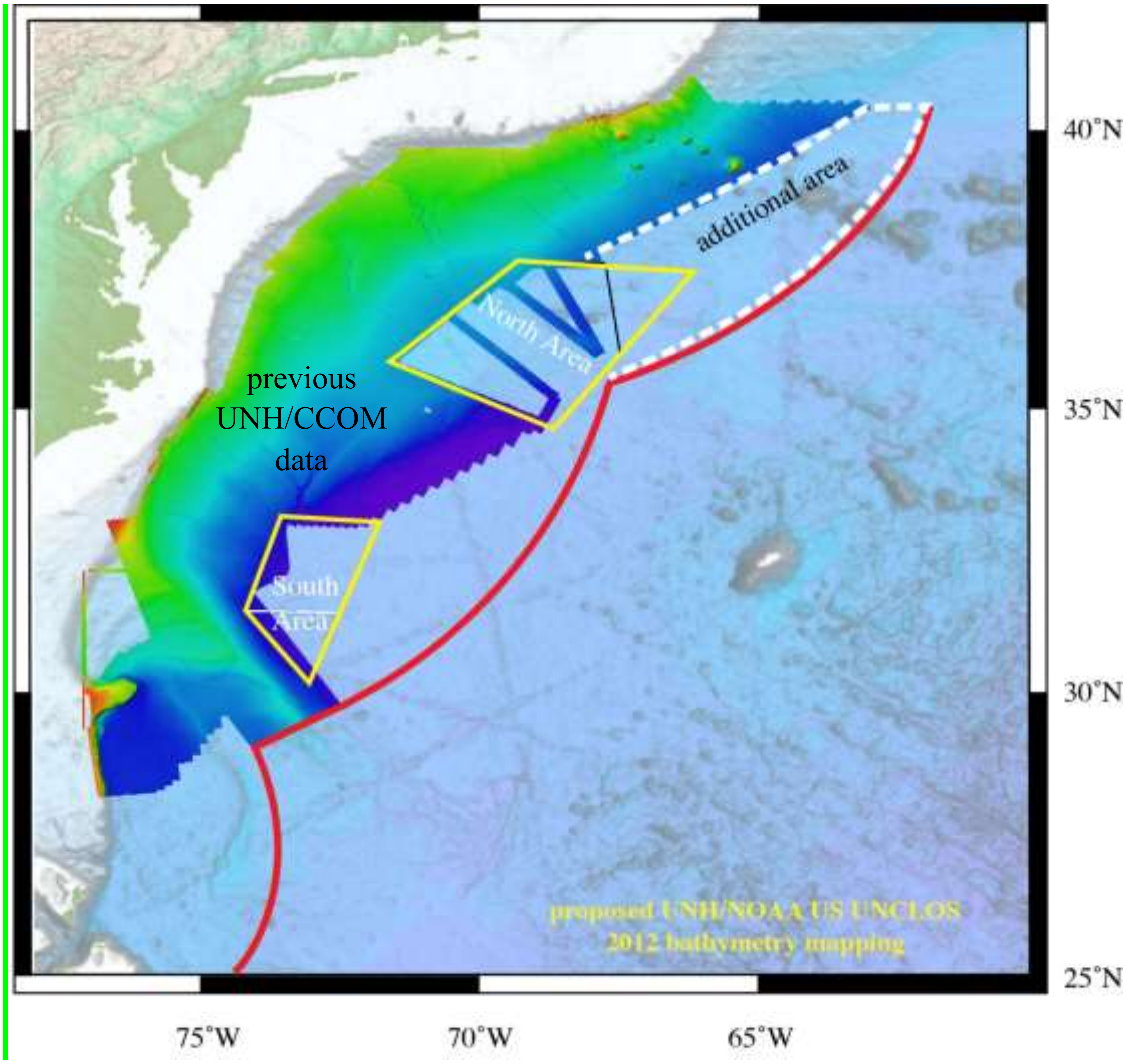

Figure 1. Areas of planned 2012 mapping (yellow polygons) overlain on previous UNH/CCOM Atlantic multibeam mapping. Only the South Area and a seaward extension of that area was mapped on the shortened cruise. Red arcs are 350 nautical miles from U.S. baselines.

Figure 2. NOAA Ship *Ronald Brown*.

The Multibeam Echo Sounder System and Associated Systems

The hull-mounted Kongsberg Maritime EM122 MBES (s/n 116) system aboard RV *Ron Brown* is a 12-kHz multibeam echo sounder that transmits a 1˚ wide (fore-aft) acoustic pulse and then generates 432-2˚ receive apertures ("beams") over a 150˚ swath. The system can automatically adjust the pointing angles of the receive beams to maximize the achievable coverage or a maximum aperture can be defined by the operator. The transmit cycle can be rapidly duplicated to provide two swaths per ping, each transmitted with a small along-track offset that compensates for water depths and ship speed to generate a constant sounding spacing in the along-track direction. This mode can provide as many as 864 soundings per transmit cycle swath (432 soundings per swath) in the high-density dual-swath mode. With more than one sounding generated per beam in the high-density mode, the horizontal resolution is increased and is almost constant over the entire swath when run in the equidistant mode. In addition, the transmit beams can be steered as much as 10° forward or aft to reduce the effects of specular reflection at nadir and near-nadir angles.

The EM122 uses both continuous wave (CW) and frequency modulation (FM) pulses with pulse compression on reception to increase the signal-to-noise ratio. The transmit pulse is split into several independently steered sectors to compensate for vessel yaw. The system is pitch, yaw and roll stabilized to compensate for vehicle motion during transmission. The 15-ms pulse length (deep mode) used in this survey includes a significantly longer FM chirp pulse waveform for the outer transmit sectors. Its bandwidth corresponds to the resolution of the 15-ms CW pulse of the inner and mid-range transmit sectors but the longer duration of the FM chirp pulse allows pulse compression on reception for a gain in signal-to-noise ratio of about 15 dB. Kongsberg Maritime states that, at the 15-ms pulse length, the system is capable of depth accuracies of 0.3 to 0.5% of water depth. The Kongsberg Maritime EM122 Product Description should be consulted for the full details of the MBES system.

Two hull-mounted Reson SVP 70/71 sound-speed sensors were available to measure the sound speed at the MBES array for accurate beam forming. Each sensor was calibrated at the factory. Beam forming during this cruise used the high-density equidistant mode with FM enabled and Automatic mode in deep water. For receive beams at near-normal incidence, the depth values are determined by center-of-gravity amplitude detection, but for most of the beams, the depth is determined by split-beam phase detection. The spacing of individual sounding is approximately every 50 m.

An Applanix POS/MV model 320 version 4 inertial motion unit (IMU) with dual BD960 GPS receivers was configured with its internal differential GPS receiver acquiring Fugro MarineSTAR satellite-based differential correctors, and thereby achieving an estimated positioning uncertainty of ~0.35m (rms) in the horizontal and ~0.55m (rms) in the vertical. The IMU provides roll, pitch and yaw at accuracies of better than 0.02˚ at 100 Hz. The MBES system can incorporate transmit beam steering up to ±10˚ from vertical, roll compensation up to ±10˚ and can perform yaw corrections as well. All horizontal positions were georeferenced to the WGS84-derived ellipsoid and vertical referencing was to instantaneous sea level.

The Kongsberg Maritime EM122 is capable of simultaneously collecting full time-series acoustic backscatter that is co-registered with each bathymetric sounding. The full time-series backscatter is a time series of acoustic-backscatter values across each beam footprint on the seafloor. If the received amplitudes are properly calibrated to the outgoing signal strength, receiver gains, spherical spreading, and attenuation, then the corrected backscatter should provide clues as to the composition of the surficial seafloor. However, the interpreter must be cautious because the 12-kHz acoustic signal undoubtedly penetrates the seafloor to an unknown, but significant (meters) depth, thereby generating a received signal that is a function of some unknown combination of acoustic impedance, seafloor roughness and volume reverberation.

The sound-speed profiles derived from frequent XBT casts (see below) were used to raytrace each MBES receive signal to the seafloor and back to the receiver to compensate for the refraction effects within the water column.

In addition to the MBES, the NOAA Ship *Ron Brown* is equipped for this cruise with a Knudsen 3200 high-resolution chirp subbottom profiler. Subbottom data were continuously collected throughout the cruise, although much of the data were subsequently determined to be irretrievably garbled as a result of a bug in new firmware installed by the manufacturer.

NOAA assigned the 2012 cruise with their designator of RB12-02 All raw MBES files were initially labeled by the Kongsberg Seafloor Information System (SIS) data capture software with a unique file designator but the files were renamed to Atlantic_line_X, where X is a consecutive line number starting with 500 (see Table 3). Beginning the line numbering at 500 differentiates lines from this 2012 cruise from previous U.S. ECS cruises in the Atlantic while maintaining the "Atlantic_line_x" format for all Atlantic cruises. Transit lines and patch test lines were given line numbers prefixed with "tran" or "patch", respectively. The renaming was done so that the individual lines would be unequivocally identified with the survey area in the future.

Water-column sound-speed profiles were routinely collected every 6 hrs during the cruise as well as anytime the sound speed measured at the hull-mounted sensor differed for a significant amount of time by >0.5 m/s from the value at the transducer depth from the XBT-derived sound speed. Sound speeds were calculated from measurements of water temperature vs depth using Sippican Deep Blue expendable bathythermographs (XBTs). Deep Blue XBTs have a 760-m maximum depth of measurement so the profiles were extrapolated to 12,000 m using Kongsberg software to provide a profile throughout the water column. A Sea Bird Electronics model SBE-911+917+ CTD was used to calibrate the XBTs during the patch test. The two temperature sensors (serial no. 2013 and 2700), the conductivity sensor (serial no. 3326) and the pressure sensor (serial number 92859) were last calibrated by Sea Bird Electronics on May 27, 2011. Derived sound-speed profiles derived from the two systems (CTD vs XBT) from data collected during the patch test were compared between the systems to calibrate the XBT (see Daily Log JD213).

A full patch test was conducted in the survey area to ensure sensor offsets were correct. The patch test confirmed the existing settings; no modifications were made. Tables 1 and 2 show the sensor offsets used for the survey. The patch test layout and seafloor is shown in Figure 3.

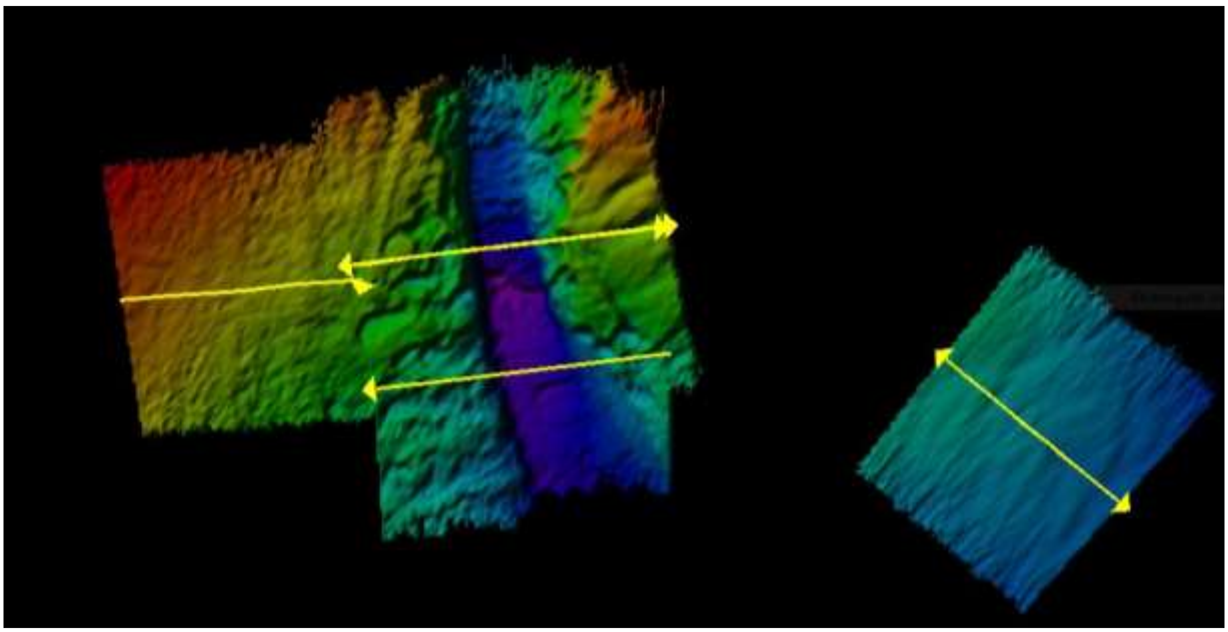

Figure 3. Seafloor image of patch test site and lines run.

Table 1. Initial system sensor offsets

Water Line Vertical Location (m) - WLZ = 0.48

TX Transducer Along Location (m) - S1X = 7.46

TX Transducer Athwart Location (m) - S1Y = -0.52

TX Transducer Vertical Location (m) - S1Z = 5.89

TX Transducer Heading (deg) - S1H = 359.98

TX Transducer Pitch (deg) - S1P = -0.01

TX Transducer Roll (deg) - S1R = -0.03

RX Transducer Along Location (m) - S2X = 12.02

RX Transducer Athwart Location (m) - S2Y = 0.01

RX Transducer Vertical Location (m) - S2Z = 5.97

RX Transducer Heading (deg) - S2H = 0.08

RX Transducer Pitch (deg) - S2P = 0.18

RX Transducer Roll (deg) - S2R = 0.20

Table 2. Offset corrections determined by Patch Test

Offset	Value
pitch	0
roll	-0.42°
heading	0
latency	0

Ancillary Systems

Knudsen 3260 chirp subbottom profiler

A Knudsen 3260 chirp subbottom profiler was leased by UNH/CCOM-JHC for the cruise because the ship did not have a deep-water subbottom system. The Knudsen 3260 electronics and power supply were installed by a Knudsen engineer two days prior to sailing. The leased system produces a 3.5-kHz FM signal with a 2-kHz bandwidth with up to 10 KW of power using the ship's existing 3x4 hull-mounted transducer array. The system has adjustable pulse lengths up to 64 ms, power and gain settings that allows it to acquire good bottom detection and subbottom resolution to about 50 m subbottom. The profiler was synchronized with the EM122 so that the EM122 controlled the profiler, limiting its transmission to coincide with the EM122 transmission and thereby avoid profiler transmission during the multibeam receive cycles. The synchronization eliminated any interference of the profiler signal with the multibeam signal. The Knudsen chirp profiler was configured to record digital data in SEG-Y format. On July 11, despite repeated efforts to open and process the SEG-Y files, and multiple consultations with experts ashore and the manufacturer, we were informed by the manufacturer that a firmware bug in the system was resulting in no decipherable data being recorded in the SEG-Y files, and that no shipboard or factory processing could recover any data. We received and installed a new firmware update from Knudsen, and the SEG-Y data became readable. From that time forward, we recorded data in both the SEG-Y format and the Knudsen KEB format. SEG-Y line names were changed to Atlantic_3.5kHz_line_X.sgy where X is a consecutive line number that began with 500. The SEG-Y line numbers correspond with the MBES line numbers.

MBES Data Processing and Quality Assurance

The raw multibeam bathymetry and acoustic backscatter data were processed aboard ship for quality control purposes using Caris HIPS and SIPS software. Each Kongsberg .all file was collected by the onboard Kongsberg SIS data-acquisition system. Once a line was completed, the .all file was copied to a server that could be accessed by the UNH computer via the shipboard network. Each .all file was renamed from the Kongsberg-generated file name to *Atlantic_line_n.all* (see Table 3) so that later each file could be easily identified to the area and cruise. The line numbers commenced with Atlantic_line_tran500 beginning with the transit to the patch-test site and then commenced to Atlantic_line_5XX when the actual mapping began. Each .all file is composed of individual data packets of beam bathymetry (range and angle), beam average and full time-series acoustic backscatter, navigation, parameters, sound-speed profiles, orientation and sound speed at the transducer.

The data were reprocessed ashore for the final ECS products. The first step in the processing separates each of these data packets into the individual files.

The second step in the processing plots the navigation file so that any bad fixes can be flagged. Once this step is completed, the validated navigation is merged with the bathymetry and acoustic backscatter files.

The third step involves editing (flagging) individual soundings that appear to be fliers, bad points, multipaths, etc. The entire file of soundings is viewed and edited in a sequence of steps through the file. Once the bathymetry file has been edited, the valid individual soundings are gridded into subarea DTM maps and the co-registered valid acoustic backscatter full beam time series is assembled into a file and gridded into subarea mosaics.

The entire region was subdivided into 14 subarea bathymetry maps and (Figure 4). These are the same subarea maps used in the 2004, 2005 and 2008 mapping and the new data were simply added to the appropriate subarea map. Each subarea map was designed to maximize the spatial resolution allowed by the mapped water depths within the area.

A representative sample of swath crossings were analyzed to establish the overall uncertainty and confirm the internal consistency of the multibeam data. The results are presented in Appendix 3, and establish that this survey has a depth uncertainty less than 0.3% of water depth and is well within the applicable IHO Order 2 standards as well as the more stringent Order 1b standards (IHO 2008).

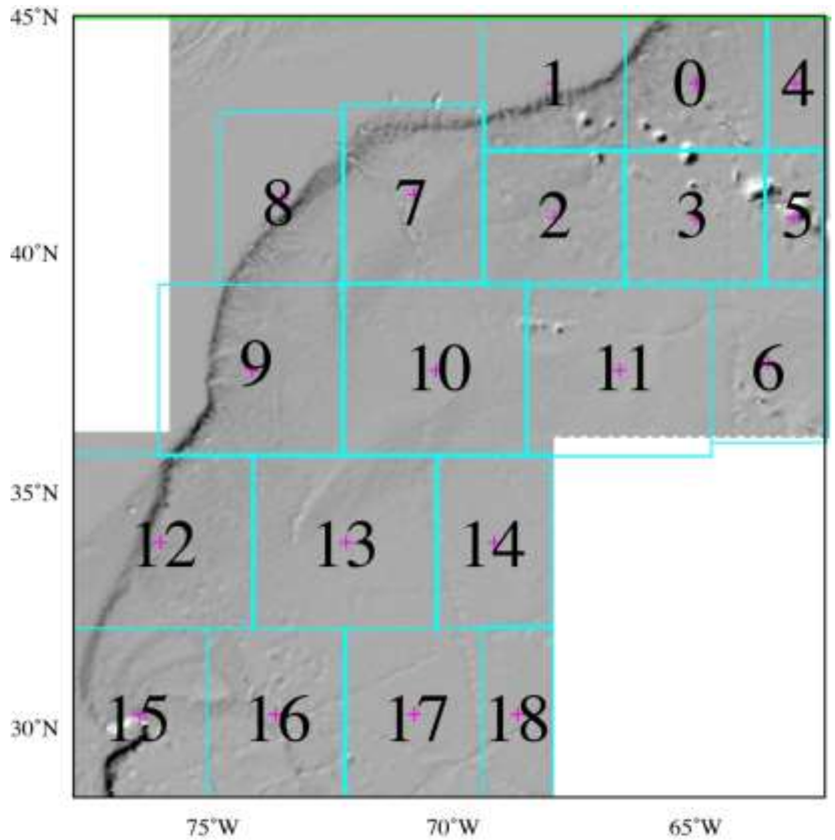

Figure 4. Subareas for the Atlantic

The Area: The US Atlantic Margin

The specific area mapped during this cruise is immediately east of the region defined in Mayer et al., 2002 as those areas in the North East and South East Atlantic where a potential U.S. claim beyond the U.S. EEZ could be made under UNCLOS Article 76. In order to satisfy the requirements of Article 76, the entire continental margin off the eastern U.S. between the 1000 and 5000-m isobaths needed to be mapped. The areas mapped in this 2012 cruise were identified as additional areas that needed modern MBES bathymetry after analyses of the 2004, 2005 and 2008 data. This region contains numerous large submarine canyons, a chain of volcanic seamounts, major sediment tongues, and a huge sediment drift (Figure 5).

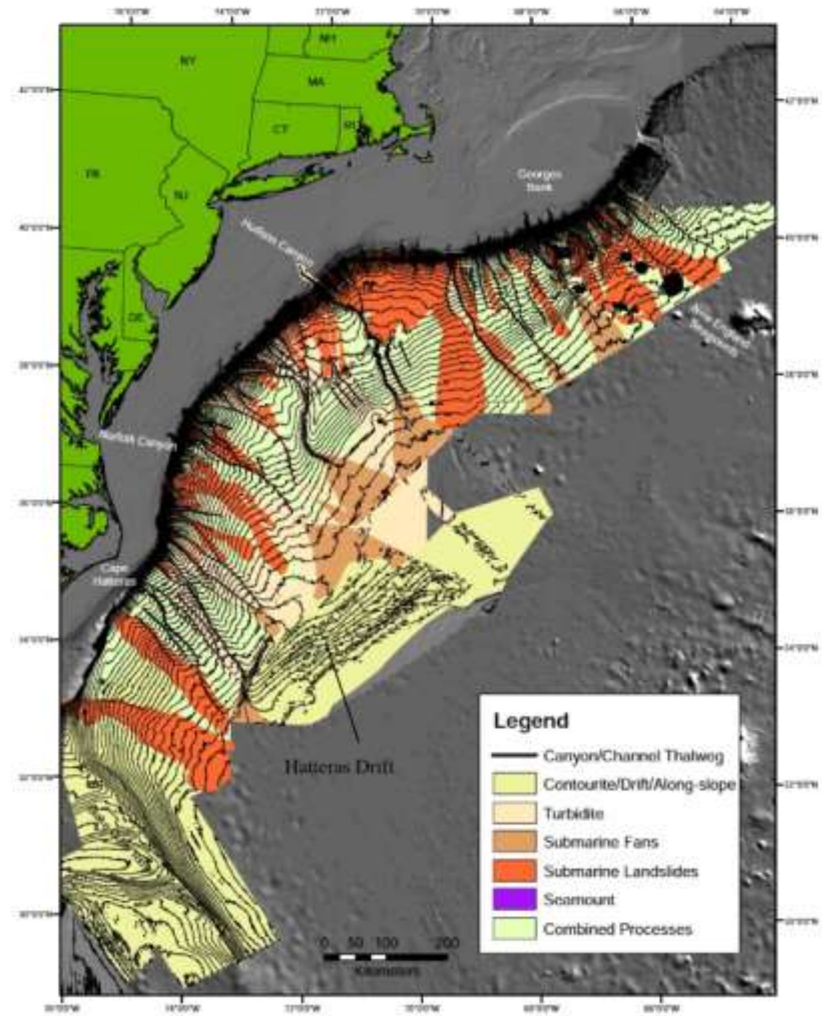

Figure 5. Map of various Quaternary processes that have formed the modern U.S. Atlantic margin (after Chaytor et al., 2007).

The U.S. eastern margin is a huge constructional prism of sediments and buried reefs that have accumulated over the continent-ocean boundary since the Late Jurassic opening of the Atlantic Ocean (Emery and Uchupi, 1984; Sheridan and Grow, 1988; Poag and Graciansky, 1992). A deep mantle plume or hot-spot erupted off the axis of the nascent spreading ridge in the Early Cretaceous (about 130 m.y. ago). The hot spot produced a string of volcanic seamounts, the New England Seamounts, which continued for ~50 m.y. until the Late Cretaceous (about 73 m.y. ago; Duncan, 1984). Most of the present geomorphology of the margin is thought to be the result of sedimentation and erosion that occurred during Quaternary (the past 1.8 Myr), a period dominated by at least 18 major fluctuations of eustatic sea level (Shackleton, 1987). The age of major canyon cutting is unknown but thought to have occurred during the Neogene and Quaternary.

The southern part of the survey area is dominated by the Blake-Bahama Outer Ridge and Blake Spur (Pratt and Heezen, 1964). These sedimentary features are thought to be related to the formation of the Gulf Stream that resulted from the closing of the Isthmus of Panama during the Late Miocene to Early Pliocene (Kaneps, 1979; Pinet et al., 1981). The barrier diverted the surface waters of the Caribbean and Gulf of Mexico into a anti-cyclonic gyre that merges with the Antilles Current between Florida and the Bahamas and then continues to the NW.

The entire US eastern margin was subdivided into 4 areas (Figure 6) for generating overview maps. Each map was gridded with a 100-m cell size because our 12 to 14 kt mapping speed allowed at least 3 mappings to fall within in each footprint regardless of water depth. Bathymetry from the 2012 mapping cruise has been combined with earlier USLOTS bathymetry for the final products.

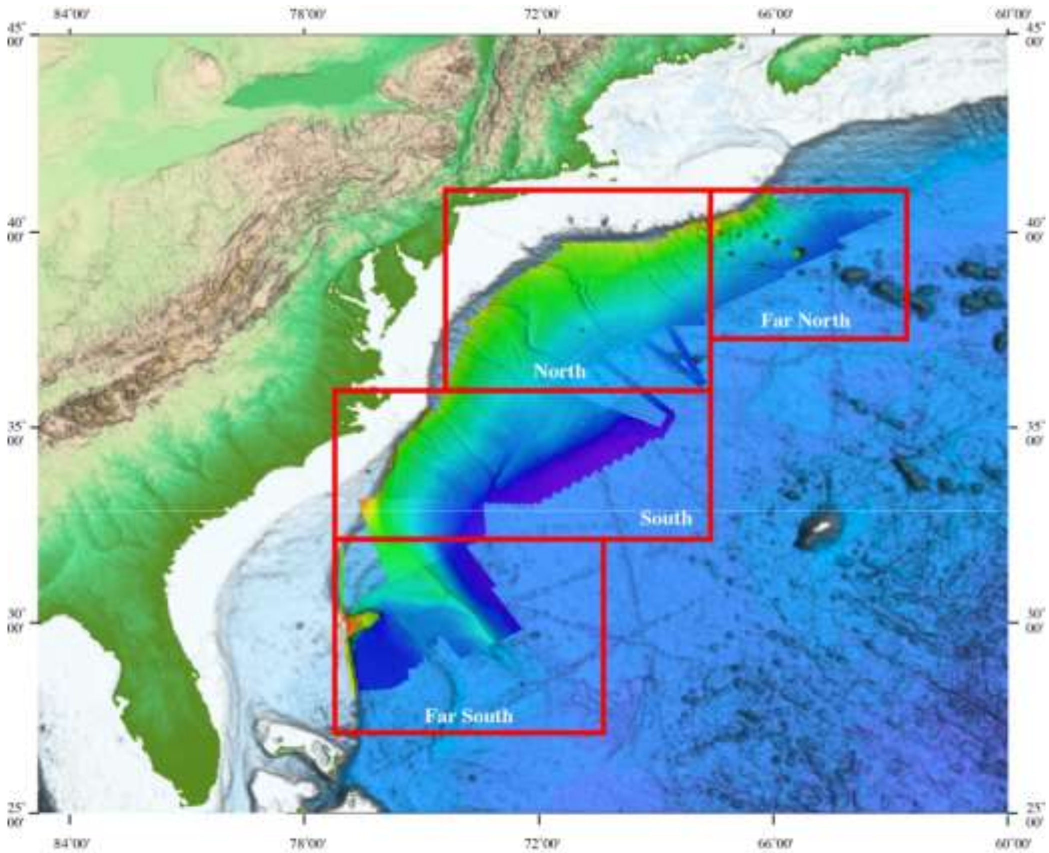

Figure 6. Subareas of Atlantic margin used to compile all the data from the 2004, 2005, 2008 and 2012 cruises.

Pre- Cruise Daily Log—James V. Gardner

Thursday June 14, 2012 (JD166)

Darren Gibson, an engineer from Knudsen Engineering, and Jim Gardner were picked up at 1330L at the Patriots Pier fuel dock in Mt. Pleasant, SC and ferried to the ship. Once aboard, the ship steamed out of Charleston Harbor to the open sea. The engineer spent the afternoon testing the electrical impedance of the ship's 3.5-kHz transducers and installing a Knudsen 3260 Chirp subbottom profiler power supply and processing unit.

The ship's scientific equipment was in a state of disarray. The CTD cable was not terminated, the EM122 had not been turned on since before the yard period a month previously and the XBT system was in an unknown state.

The Knudsen engineer and Jim Gardner were transferred back to the beach via a 1.25 hr zodiac ride because the ship had transited out of Charleston harbor onto the shelf during the afternoon. The ship had to stay on the shelf for the next 24 to 26 hr for dynamic positioning trials and work on the generators.

Friday June 15, 2012 (JD167)

The ship stayed at sea all day while the science party stayed on the beach. No contact from the ship.

Saturday June 16, 2012 (JD168)

The ship arrived back at the pier at 2000 hr L but we were not notified the ship had arrived.

Sunday June 17, 2012 (JD169)

The science party arrived at the ship at the prearranged time of 1030 L but no one was aboard other than the OD. Regardless of the lack of help, the science party set up their computers, RAID arrays and a local network. However, no one from the ship was there to set up the network to the ship network. We left about 1330 hr L for food because the ship was not serving lunch or dinner. The science party spent the remainder of the day in town but spent the night aboard ship.

Monday June 18, 2012 (JD170)

I was informed by the survey tech that only one hull-mounted velocimeter was installed on the ship after dry dock and that one was not working properly. The second velocimeter was aboard ship but not installed. The Ops Officer told me that the installed velocimeter would be checked out by the ET. However, the ET spent the morning terminating the CTD cable. I informed the Ops Mgr that the second velocimeter must be installed so he planned for the ship to hove-to once we are at sea and away from currents and for a diver to install the second velocimeter.

The work on the generators continued through the day. We spent an hour in the afternoon installing the Fugro OmniStar upgrade that will provide differential correctors to the POS/MV positions. By early evening the POS/MV was receiving OmniStar XP differential correctors.

Tuesday June 19, 2012 (JD171)

I was informed by the Captain this morning at breakfast that the generator that has just been rebuilt blew a piston and the entire generator has to be rebuilt again. The estimate of the work is that it will take at least until Friday at the earliest and possibly several days longer.

The Captain called an all-hands meeting at 12 noon to inform us all that the most optimistic estimate to get the generator rebuilt was late afternoon Monday June 25. But even once rebuilt, there would need to be a trials cruise to make sure the generator was operational. This put the cruise in grave jeopardy. I sent an email to Andy Armstrong updating him on the estimate of the delay. Spent the rest of the afternoon awaiting word from Andy.

Late in the afternoon the Captain and the Ops Officer dove to the transducers to install the second sound-speed sensor on the receive array. The existing sound-speed sensor is still not talking to the SIS.

Wednesday June 20, 2012 (JD172)

The second sound-speed sensor appears to be sending data but the SIS is not receiving the data. It might be a format problem or a network issue. The ET is working on it. Late in the morning the ET informed me that he had an article that suggested if the TR-109 transducers were rewired as specified by the Knudsen engineer, cavitation would occur at the transducer faces. I strongly suggested the ET contact the Knudsen engineer to discuss this. The issue is that, as wired, the transducer array will only produce 6 kw of power. The rewiring suggested by the Knudsen engineer would allow the transducers to produce 10 kw of power. Because the two survey areas are both in 5000+ m water depths and the objective for the subbottom profiler is to image the top 50 m of sediment, we need maximum power from the transducers. So far, the transducers have not been rewired to the Knudsen engineer's specifications.

The CTD winch cable has not yet been terminated because, according to the technician, the winch can't be run (because of the work on the generator) to lower the wire to the deck.

Thursday June 21, 2012 (JD173)

The Captain and Ops Officer held a science and tech meeting in the morning to go over what still needs to be completed from the science perspective. He reported that Caterpillar had only two mechanics working 10-hr days to repair the generator. We reviewed progress with the science systems and I reported that the sound-speed sensors were still not talking to the SIS. In addition, I reported the reluctance of the ET to rewire the Knudsen and the lack of a termination of the CTD cable. We provided Knudsen and Kongsberg names and phone numbers for the ship to contact those technical folks. By 1045L, after contacting Kongsberg, one sound-speed sensor was communicating with the SIS.

Finally, the Senior Survey Tech informed me that the EM122 and XBT Mk-21 unit are not networked to any distributed storage, nor are they backed up in any way. This is the case even though there is a full-rack NetApp server in the lab. I was told by the Senior Survey Tech that he was told that server could not be turned on. Consequently, data from these two systems need to be transported by USB thumb drive. The data will be stored and retrieved for processing as shown below.

Data type	Drive	Folder
EM122.all	local D:	RB12-02
Knudsen	network C:	RB12-02_Knudsen
XBTs		

In the early afternoon the ET informed me that two of the 12 TR-109 transducers were dead, thereby reducing the 4x3 array to a configuration shown below. This will reduce to output power.

Transducer array showing location of dead TR-109 jugs (red)

	11	**12**	
7	**8**	**9**	**10**
3	**4**	**5**	**6**
	1	**2**	

I was asked which configuration I wanted. I suggested they contact Knudsen Engineering. They apparently were reluctant to do that. Consequently, I contacted Darren Gibson at Knudsen and he suggested the transducers be rewired with each row of 4 to have very similar impedances. By 1330 L Caterpillar had 7 mechanics working on the generator. The ET that left the ship last weekend was called back to the ship and arrived in the early afternoon. Together, the two ETs fussed with the Knudsen transducers and communicated with someone in NOAA Ops. They informed me in the mid-afternoon that they had rewired the transducers and considered that job complete.

Sometime during the afternoon 5 additional Caterpillar mechanics arrived to work on the generator, but by 5 pm all 7 were gone.

No word from NOAA HQ or CCOM-JHC throughout the day as to the fate of the cruise.

Friday June 22, 2012 (JD174)

At the 0900 L meeting with the Captain and Ops Officer, the Captain reported that the ABS inspector overlooking the generator repair was unhappy with the quality of the work being done. The inspector has requested higher quality work, but the effect of that request on the workmanship is unknown. However, this request might further delay sailing.

I requested that our SVP laptop, the XBT Mark 21 computer and the SIS computer be networked so we do not have to transfer data with a USB thumb drive from lab to lab. The Captain and Ops Officer said it would be done and it was. Only one of the sound-speed sensors has been tested through the SIS and I requested the second one be tested. The CTD termination still has not been made but I was told it will be done today.

The Captain held a 1430 L all-hands meeting and announced that our arrival in Miami has been extended 2 days to 17 July. The plan is for the Caterpillar mechanics to have the generator assembled by Sunday evening and we will depart Monday morning at 0800 L for testing the generator. The generator testing will take most of the day and then, if the tests are good, the mechanics and the ABS inspector will be ferried to the beach by zodiac and the transit to the patch test site would begin once the zodiac returns to the ship.

Saturday June 23, 2012 (JD175)

The Captain informed me that the delay would be until Monday morning. He said the generator rebuild was not progressing as suspected. The tentative sailing was set for 0800 L.

Sunday June 24, 2012 (JD176)

The Captain informed me that the delay would be until Monday afternoon. He said the generator rebuild was not progressing as suspected. The tentative sailing was set for 1400 L. I made the decision that if we do not depart at 1400 L on Monday, I would cancel the cruise and the science team would fly home on Tuesday. I informed Andy Armstrong of this decision and he concurred.

Monday June 25, 2012 (JD177)

An offhand remark I made to the ET about the lack of storage backup of the MBES data elicited a remark that the Kongsberg computer had a RAID array striped 5, thereby providing backup. I asked to have that computer connected to the local network I had established over a week ago and he agreed to do it. The computer was networked and a read-only folder was created on D:/sisdata/raw/RB1202.

I took the science staff to the hotel, came back to the ship and packed up the computers and Knudsen 3260, packed everything into a rental van and I left the ship at ~2200 L.

Daily Log—Andrew Armstrong, Brian Calder, Shepard Smith

Sunday July 1, 2012 (JD 183)

Second survey crew arrived back at the ship, which has subsequently undergone repairs, and reports being ready to get underway. Set up computer systems again, and attempted to interface sound speed process software to SIS. This did not appear to be communicating correctly, although this was ignored for now while the rest of the system was set up.

Monday July 2, 2012 (JD 184)

Ship got underway at 1400L and proceeded to sea for the first sea-going leg of the cruise. A BIST test was conducted at ~1515L in relatively shallow water, and completed correctly with no warning lights. The issue with the SVPEditor connection was that the DataDistrib software on the SIS machine was not running; once restarted, the SVPEditor software started receiving data appropriately. The survey parameters on SIS were set for warnings on sound speed at 0.5 m/s, and errors at 1.0 m/s, and finally only to turn over lines at 10-hr increments. (The plan being to turn over lines at 6-hr increments, and therefore never have to deal with automatic line increments.) The ship continued underway at 13 kts heading for the patch test site.

Tuesday July 3, 2012 (JD 185)

Underway as before, heading to the patch test site. Knudsen started in ~60m water at 2100L; pinging on EM122 at the same time, and no evidence so far of interference. EM 122 is operating well, with 4X water depth in 4000+ m of water depth, although there are signs of Knudsen interference in the water column display, and possibly EM122 interference in the Knudsen display. The seafloor return is not affected in either system, however. Started XBT prior to CTD cast at ~1755L. Cast in the water ~1840L at 33 18’ 26”N, 73 15’ 20” W for equalization and then recovered to the surface, and dropping to bottom (~4980m in this location). Cast on the way up, and preparing second XBT for cross-calibration at 2036L. On the surface at 2143L.

Comparison of XBT and CTD casts showed good agreement in general in the range of depths at which measurements were taken (Figure 7), differing only in the extension region where the XBT data were based on the World Ocean Atlas (Figure 8).

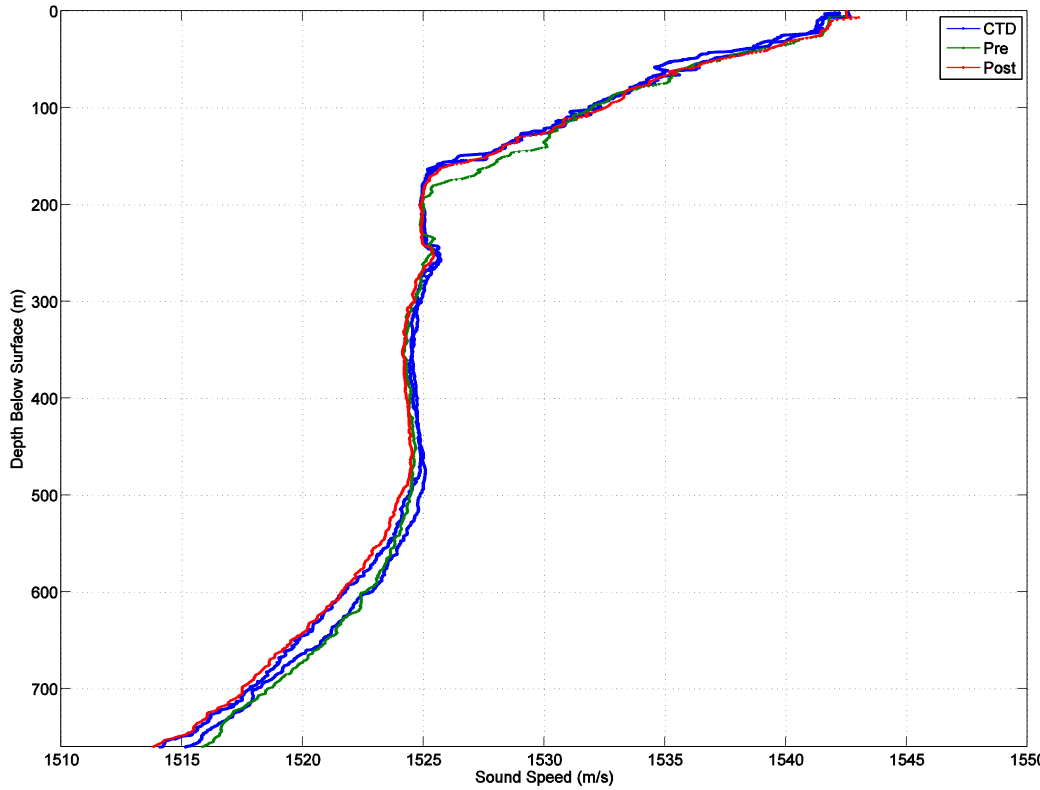

Figure 7. Comparison of XBT and CTD estimates of the sound speed profile at the patch test site. Note that both upcast and downcast are shown for the CTD data (in blue), 'Pre' indicates the XBT taken before the CTD, and 'Post' indicates the XBT taken afterwards.

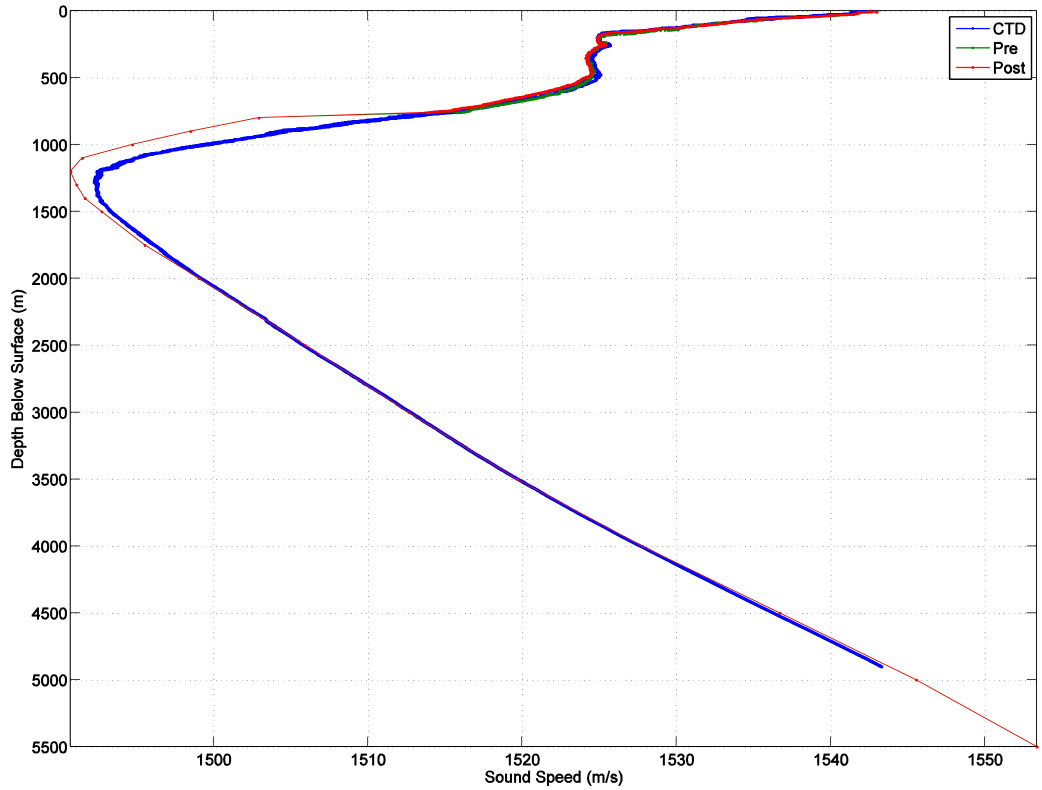

Figure 8. Comparison of the XBT and CTD estimates of sound speed profile to the maximum depth recorded by the CTD sensor. The XBT data were extended using information from the World Ocean Atlas for the area of operation, and therefore show some variability from the CTD measurements.

Wednesday July 4, 2012 (JD 186)

CTD loaded into SIS via SVP Editor, and start of patch test line for pitch at 0222Z (Kongsberg Line 0014).

0233Z Beginning Patch Test; bridge reports difficulty with tracking system, so will run this first line as line 3 at 6 kts.

0440Z Completed first line; turning for second line at 12 kts (line 2 in the patch test line plan, primarily for pitch calibration).

0514Z Bridge reported speed at 4 kts because of problems with the autopilot computer; they are investigating.

0519Z Speed started returning. Bridge reported that they believe that they understand the problem, but are unable to resolve it immediately. They therefore will attempt to drive the rest of this line with the autopilot, and then switch to driving in hand for the next line.

0543Z EOL. Bridge is going to attempt the turn in line following mode, with the backup plan of going to a separate system if that doesn't work; slowing down to accommodate.

0622Z Bridge reported that an engineering 'issue' was causing them to have to reduce speed to ~8.5 kts while they investigated.

0642ZBack to 12 kts. Line complete 0707Z, moving to roll lines while testing pitch/timing. Analysis of pitch and timing lines completed without indication of any offset that would make a significant improvement. These offsets were therefore left as currently configured.

0811Z Started on first roll line; bridge having difficulties getting system into autotrack; achieved about a third of the way down the track.

0850Z Line complete

0950Z Completed roll lines. Analysis shows no offset to be corrected, even with adjustments in the 0.01-0.02 degree scale. Roll offset was therefore left as currently configured.

1034Z Started last line, for yaw. Complete 1131Z. Yaw line (#18) processed and compared to one of the parallel pitch/timing lines (#16) on a distinct ridge on the canyon wall. Analysis shows no discrepancy between lines, so the Kongsberg was left as currently configured. Begin dead head to eastern end of dip line. Science team engaged in troubleshooting the Knudsen triggering, laying out a poster, and establishing a backscatter processing procedure. Bridge team tuning the DP system for steering survey lines.

1312Z XBT starts SSV 1539.4m/s

Reduced the ping rate for the Knudsen from automatically pinging based on depth to pinging every 18 seconds, roughly the same interval as the EM122. This has, at least, reduced the amount of interference.

1743Z Email arrived from Knudsen Engineer via Jim G that input cable should be plugged into Aux 2 rather than the BNC where we had it. Moved cable and set sync to external; system began pinging under sync from EM122 as we wanted. Will monitor EM122 data for interference.

1932Z XBT starts SSV 1538m/s. Remarkable agreement between the cast and the WOD (Figure 9.).

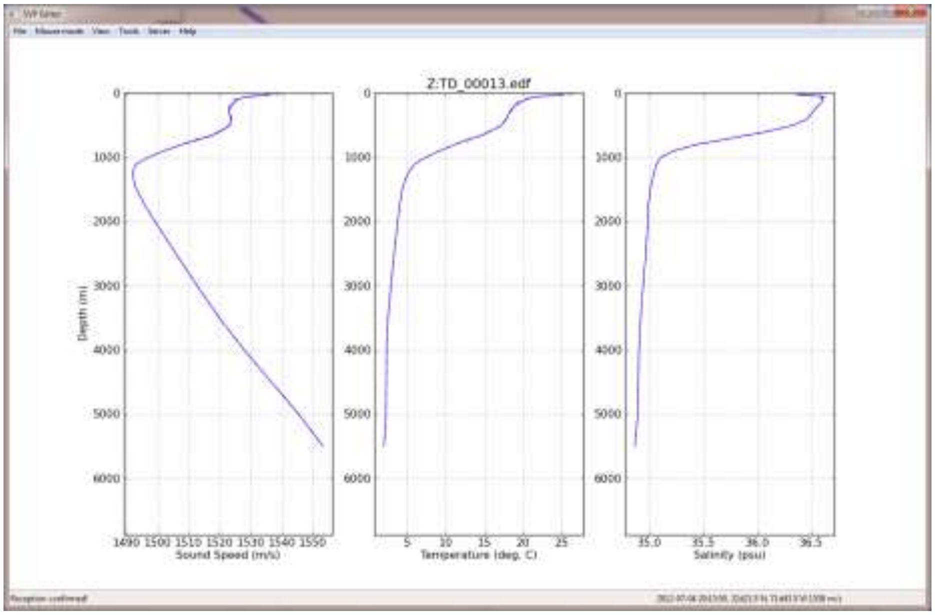

Figure 9. Cast results within World Ocean Atlas bounds

1945Z Screenshot showing distinct change of seafloor texture, near outer end of dip line (Figure 10.). This is from the dead-head line. Expect similar in reverse on westbound dip line.

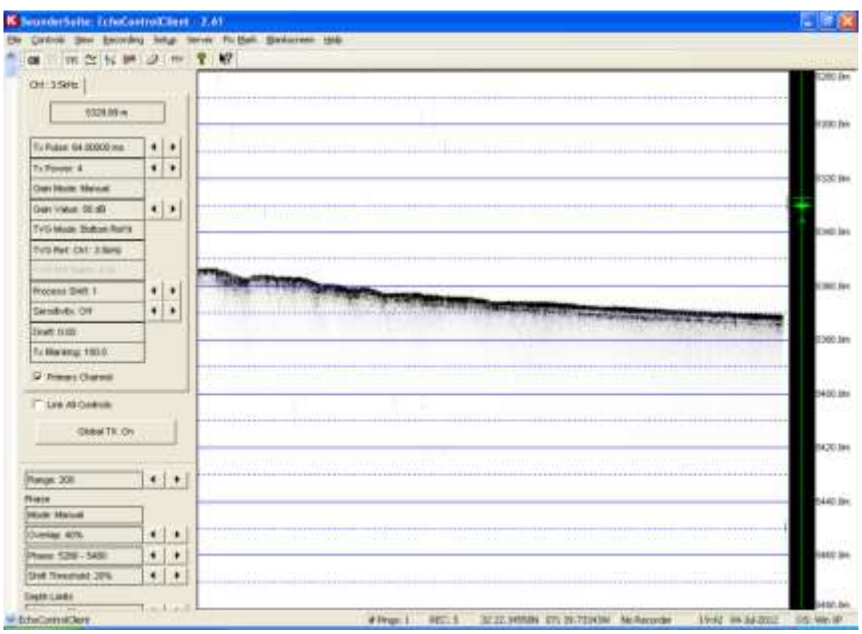

Figure 10. Screenshot of Knudsen data showing transition from slumping seafloor to smooth seafloor

1956Z Dip begins, westbound. Started new line on both Knudsen and EM122.

2216Z Bridge (LT Chamberlain) reports adjusting the autopilot to reduce rate of turn (to 5 deg/min) and reducing the cross track error gain.

Thursday July 5, 2012 (JD 187)

0000Z XBT starts. Attempted to use the TSG salinity to adjust the XBT conversion; this is not used in the processing for the MBES data, but will make the data more useful for the ship and NODC. Unfortunately, the location in which this can be specified is cryptic; will investigate further. Meanwhile, profile TD_00014 entered 0015Z.

0155Z XBT starts. Salinity is specified in the 'Post Processing' options menu, in parts per thousand, but needs to be entered before the launch is started. Profile 15 underway with salinity 35.2. Probe went to auto-launch when locked into the launcher, but resetting and reseating the probe allowed the same canister to be used for profile 16 without loss. Profile 16 added 0207Z.

0305Z XBT starts. Cast misfired twice before getting to launch correctly, although the same probe was used each time. Profile 19 added 0310Z.

0523Z Start of first line of main scheme. XBT started after turn. Profile 21 added 0530Z.

0547Z XBT started since there appeared to be a localized pocket of water with sound speed approximately 1.5 m/s lower than the surrounding upslope area. The boundaries of the pocket appear to be almost exactly on the edge of the survey area. Profile 24 applied 0554Z.

0635Z XBT started, dropped into slower water pocket, then stabilized. The probe launcher continues to exhibit false launches (where the system believes that the probe has left the launcher while in fact it is still firmly attached). The probes can be re-seated and re-used, but this may indicate a creeping failure of the launcher that should be investigated; ST on duty would prefer to leave this to the ET when he comes on watch in the morning. Applied 0643Z.

0700Z XBT started again after drop of another 1.2 m/s in approximately 5 min. Applied 0710Z.

0800Z XBT started, and launched cleanly first time. Applied 0808Z.

1038Z XBT started, and launched cleanly first time. Applied 1045Z.

1122Z XBT started. Applied cast 31 1133Z (cast 30 failed).

1400Z XBT started. Applied cast 32 1408Z.

1645Z XBT started. Applied cast 33 1651Z

1758Z XBT started. Applied cast 34 1805Z

1827Z XBT started. Applied cast 35 1834Z

2120Z XBT started. Applied cast 36 2124Z

2158Z XBT started. Navigation Failure on MK21 Program. Position input manually. Applied cast 37 2203Z.

2232Z XBT started. Applied cast 38 2237Z.

Analysis of today's data overlap areas suggests that the mean depths from the beams on the starboard side are deeper than depths from port side beams in the same location. This does not exceed the allowable depth error, however. We suspect some transducer or transceiver sensitivity loss.

Friday July 6, 2012 (JD 188)

Underway, routine mapping operations

0005Z Error in the time series display that records roll/pitch/heave just after turn/new line. Most likely a display issue. Only lasted a few moments before returning to normal function.

0025Z XBT started. Applied cast 39 0030Z.

0100Z XBT started. Applied cast 40 0110Z.

0150Z POS/MV reported user accuracy issue on heading due to GAMS lock failure. System recovered in a couple of minutes, but the Secondary receiver reports that it is not achieving Omnistar XP lock. Since this implies that the primary and secondary will have significantly different uncertainties, it might be engendering issues with GAMS. It is unknown at this time whether this is a reception issue that is course related, or something else. For the time being, we continue to monitor the situation.

0215Z XBT started; first launch failed at start with bad data; cast 42 succeeded and applied 0230Z.

0515Z XBT started. Applied cast 43 0524 Z.

0543Z POS/MV lost GAMS lock and did not recover as before; asked bridge to reverse direction, move back up the line, and return. This allowed the GAMS to reacquire, although why it lost lock in the first place is unknown. There is, however, a less than advantageous GPS constellation currently, with only nine SVs in a rough line oriented with the current survey axis. Executed the turn, which helped the system lock, although the performance continues to be more variable than is typical with POS/MV V4 systems. Restarted survey line 33 at 0602Z; line 32 is the turn and should not be used.

0720Z XBT started; cast 44 applied 0724Z.

0840Z XBT started; cast 45 applied 0846Z.

1057Z XBT started; cast 46 applied 1104Z.

1352Z XBT started; cast 47 applied 1357Z.

1757Z reduced speed to allow a crossing vessel to pass ahead safely. Screenshot included showing increased swath width as well as current speed (Figure 11). Red boxes added for clarity.

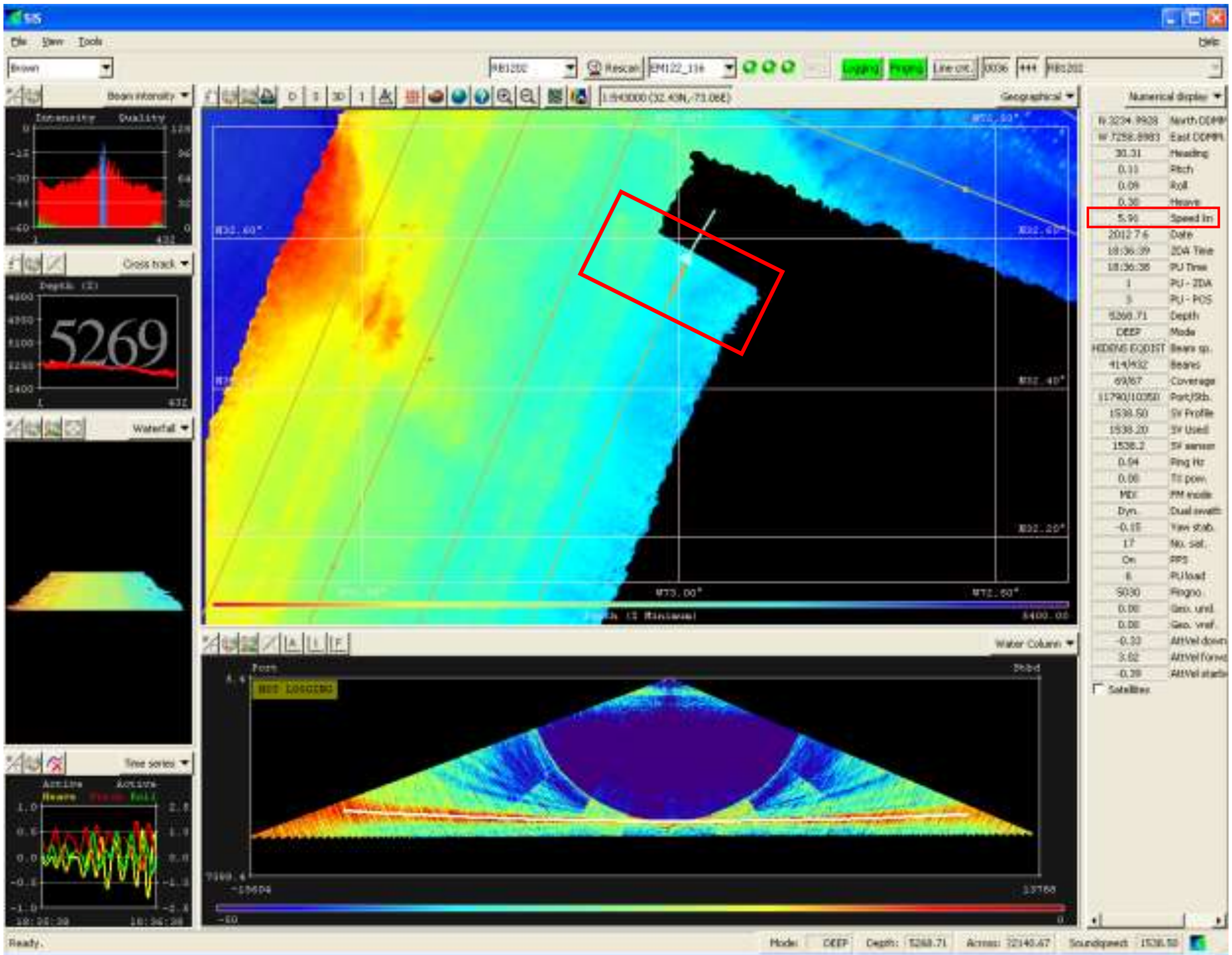

Figure 11. Screenshot of SIS display showing wider swath after reducing speed.

1758Z XBT started; cast 48 applied 1804Z.

1845Z Ship has resumed normal survey speed.

1950Z XBT started; cast 49 applied 1955Z.

2035Z XBT started; cast 51 applied 2040Z. Cast 50 was a false launch for the probe.

2317Z XBT started; cast 52 applied 2321Z.

Saturday 7 July, 2012 (JD 189)

Underway, routine mapping operations

0010Z XBT started; cast 54 applied 0015Z [Cast 53 was a false launch for the probe].

0039Z XBT started; cast 55 applied 0046Z.

0215Z XBT started; cast 56 applied 0221Z.

0429Z XBT started; cast 57 applied 0437Z.

0514Z XBT started; cast 58 applied 0520Z.

0623Z XBT started; cast 60 applied 0629Z.

0702Z XBT started; cast 61 applied 0707Z.

0945Z XBT started; cast 62 applied 0950Z.

0958Z XBT started; cast 63 applied 1004Z (small pocket of slower water at the southern end of the survey area).

1028Z XBT started; cast 64 applied 1035Z.

1432Z XBT started; cast 65 applied 1436Z.

1818Z XBT started; cast 66 applied 1822Z.

2111Z XBT started; cast 67 applied 2115Z.

2225Z XBT started; cast 68 applied 2232Z.

Sunday 8 July, 2012 (JD 190)

Underway; routine mapping operations

0000Z XBT started; cast 69 applied 0008Z.

0428Z XBT started; cast 70 applied 0435Z.

0632Z Bridge passed the word that the primary generator (#1) is causing problems, and therefore that the ship has to slow down to ~8 kt while this is diagnosed and repaired.

0835Z Bridge passed the word that generator #1 is back on line and the ship will recover to 12 kt slowly.

0946Z XBT started; cast 71 applied 0955Z.

1802Z XBT started; cast 72 applied 1806Z.

1930Z XBT started; cast 73 applied 1935Z.

Monday 9 July, 2012 (JD 191)

Underway; routine mapping operations

0011Z XBT started; cast 74 applied 0018Z.

0315Z XBT started; cast 75 applied 0324Z.

0513Z XBT started; cast 76 applied 0518Z.

0634Z XBT started; cast 77 applied 0646Z

0828Z XBT started; cast 78 applied 0835Z.

1018Z XBT started: cast 79 applied 1023Z.

1506Z XBT started; cast 80 applied 1512Z.

1823Z XBT started; cast 81 applied 1827Z.

2227Z XBT started; cast 82 applied 2232Z.

Tuesday 10 July, 2012 (JD 192)

Underway; routine mapping operations

01221Z Extended GAMS outage caused the accuracy of the heading on the POS/MV to degrade sufficiently that the ship was turned to a reciprocal heading, reversed track two miles, and then returned to line in an attempt to recover heading. GAMS locked almost immediately on turning, and stayed locked during maneuver, line resumed 0152Z.

0235Z XBT started; cast 83 installed 0244Z.

0512Z XBT 84 failed launched

0514Z XBT started; cast 85 applied 0519Z

0728Z XBT started; cast 87 applied 0735Z.

1320Z XBT started; cast 88 applied 1326Z.

1646Z XBT started; cast 89 applied 1650Z.

1804Z XBT started; cast 90 applied 1809Z.

1958Z XBT started; cast 91 applied 2002Z.

2145Z XBT started; cast 92 applied 2149Z.

Wednesday 11 July, 2012 (JD 193)

Underway; routine mapping operations

0119Z XBT started; cast 93 applied 0124Z

0223ZXBT started; cast 94 applied 0227Z.

0251ZXBT started; cast 95 applied 0257Z.

0355Z XBT started; cast 96 applied 0403Z.

0605Z XBT started; cast 97 applied 0611Z.

0823Z XBT started; cast 98 applied 0827Z.

1357Z XBT started; cast 99 applied 1403Z. XBT showed initial temperature value of 4.75C then showed a temperature of 35.5C for the next 16m. Then probe continued with normal function. Sound speed profile looked well enough to continue without extra XBT.

1445Z Received email from Jim directing us to change Knudsen recording format from SEG-Y to KEB. Stopped recording and changed to KEB, resumed recording.

1608Z XBT started; cast 100 applied 1612Z.

1751Z XBT started; cast 101 applied 1755Z.

1859Z XBT started; cast 102 applied 1902Z.

2305Z XBT started; cast 103 applied 2311Z.

Thursday 12 July, 2012 (JD 194)

Underway; routine mapping

0000Z XBT started; cast 104 applied 0005Z.

0135Z XBT started; cast 105 applied 0145Z.

0223Z XBT started; cast 106 applied 0229Z.

0440Z XBT started; cast 107 applied 0447Z.

0503Z Restarted Knudsen Computer to apply Windows Updates. During processing, it was observed that sequential line 67 was missing; this appears to be a double-click of the 'Line Count' button on the SIS computer: lines 66 and 68 adjoin.

0705Z XBT started; cast 108 applied 0711Z.

0850Z XBT started; cast 109 applied 0855Z.

1119Z XBT started; cast 110 applied 1123Z.

1205Z XBT started; cast 112 applied 1210Z.

1636Z XBT started; cast 113 applied 1641Z.

1725Z XBT started; cast 114 applied 1729Z.

1914Z XBT started; cast 115 applied 1918Z.

2239Z XBT started; cast 116 applied 2243Z.

2354Z XBT started; cast 117 applied 2358Z.

Friday 13 July, 2012 (JD 195)

Underway; routine mapping

0055Z XBT started; cast 118 applied 0102Z.

0255Z XBT started; cast 119 applied 0302Z.

0406Z XBT started; cast 120 applied 0412Z.

0453Z XBT started; cast 121 applied 0500Z.

0625Z XBT started; cast 122 applied 0631Z.

0933Z XBT started; cast 123 applied 0940Z.

1407Z Changed .SGY format from raw to filtered on Knudsen 3260 at advice of experts ashore.

1403Z XBT started; cast 124 applied 1408Z.

1642Z XBT started; cast 125 applied 1648Z.

2105Z XBT started; cast 126 applied 2110Z.

2248Z XBT started; cast 127 applied 2253Z.

Saturday 14 July, 2012 (JD 196)

Underway; routine mapping

0048Z XBT started; cast 128 applied 0055Z.

0129Z XBT started; cast 129 applied 0134Z.

0155Z XBT started; cast 130 applied 0201Z.

0233Z XBT started: cast 131 applied 0238Z

0250Z XBT started; cast 132 applied 0255Z.

0311Z XBT started: cast 133 applied 0315Z.

0427Z XBT started; cast 134 applied 0432Z.

0510Z XBT started; cast 135 applied 0515Z.

0528Z XBT started; cast 137 applied 0534Z. [Cast 136 was aborted]

0607Z XBT started: cast 139 applied 0612Z. [Cast 138 was aborted]

0640Z XBT started; cast 140 applied 0645Z.

0800Z XBT started; cast 141 applied 0806Z.

1234Z XBT started; cast 142 applied 1238Z.

1614Z XBT started; cast 143 applied 1618Z.

1717Z XBT started; cast 144 applied 1722Z.

2141Z XBT started; cast 145 applied 2145Z.

2154Z began southwestward line down slope of Cape Fear Slide.

Sunday 15 July, 2012 (JD 197)

Underway on final day of mapping in the project area. Discovered that degradation of multibeam data noted during the evening before coincided with ship trimming down in the stern to aid in draining wash-down water from the deck. Asked the Captain to maintain forward down trim at all times.

0200Z XBT started; cast 146 applied 0207Z.

0317Z completed cross line down slope of Cape Fear Slide and began additional main scheme line along edge of survey area.

0639Z XBT started; cast 148 applied 0642Z. [Cast 147 aborted.]

0805Z XBT started; cast 149 applied 0811Z.

1013Z completed extra main scheme line toward the south west and headed to beginning of line along spine of Blake Ridge.

1256 Z Began line south along spine of Blake Ridge

1417Z XBT started; cast 150 applied 1421Z.

1554Z XBT started; cast 151 applied 1558Z.

1800Z Discovered that the ship had been trimmed down aft for draining water from deck in last evening and night. This is very likely the reason that multibeam performance was so poor when steaming into the seas and pitching.

1830Z Completed mapping distal end of Blake Ridge and turned west for transit to Miami. Will run EM122 until arrival at Bahamas EEZ.

2148Z XBT started; cast 152 applied 2152Z.

2200 Z – 2300Z Ran EM 122 on a flat seafloor in the full range of transmit modes to record any differences in swath coverage by mode

2330Z Logging secured on EM122 and Knudsen as we enter the Bahamanian EEZ. Configured the SVP Editor software for server mode, so that SSPs continue to be sent to the EM122 based on the World Ocean Atlas.

Monday 16 July, 2012 (JD 198)

Transiting to Miami

0015Z Ran EM122 BIST. All passed.

Arrived in Miami and disembarked.

Color Maps of Bathymetry and Acoustic Backscatter

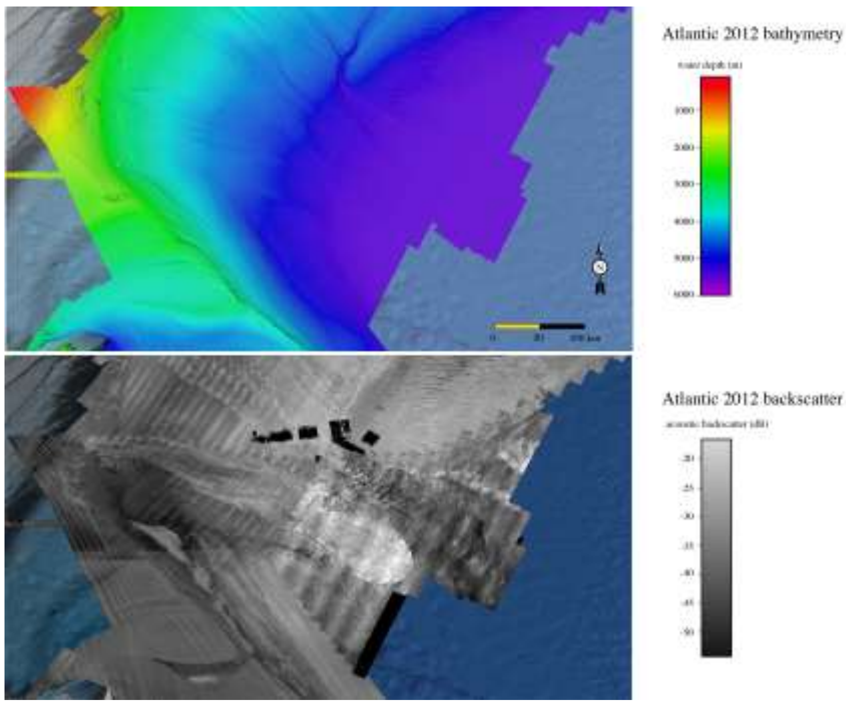

Figure 12. Color-coded shaded relief map, top, and acoustic backscatter map, bottom of "South" area.

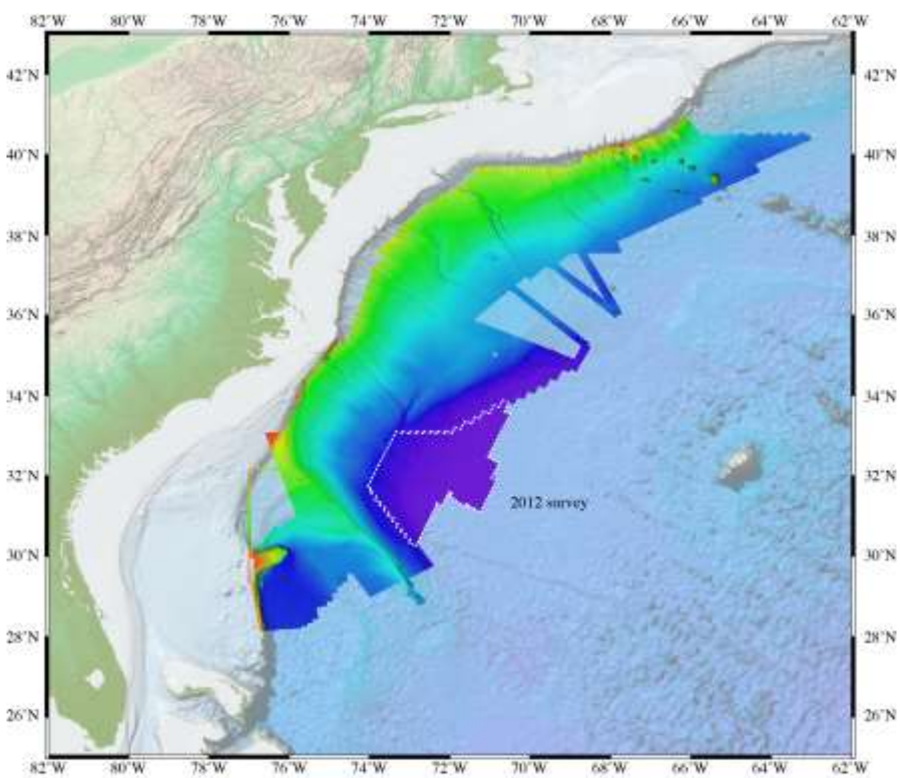

Figure 13. Color-coded shaded relief of the total area mapped in the Atlantic ECS Project showing outline of RB 12-01 survey.

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Table 3. Conversion table of Kongsberg .all file names to UNH file names by Julian Day

JD	Data Folder	Kongsberg file name RHB.all	UNH file name .all	Notes
185	**120703**	**0001_20120703_015541**	**Atlantic_line_tran500**	**transit**
		0002_20120703_020038	Atlantic_line_tran501	transit
		0003_20120703_120353	Atlantic_line_tran502	transit
		0004_20120703_125254	Atlantic_line_tran503	transit
		0005_20120703_134316	Atlantic_line_tran504	transit
		0006_20120703_144322	Atlantic_line_tran505	transit
		0007_20120703_154316	Atlantic_line_tran506	transit
		0008_20120703_160446	Atlantic_line_tran507	transit
		0009_20120703_170449	Atlantic_line_tran508	transit
		0010_20120703_180446	Atlantic_line_tran509	transit
		0011_20120703_190447	Atlantic_line_tran510	transit
		0012_20120703_202530	Atlantic_line_tran511	transit
		0013_20120703_212521	Atlantic_line_tran512	transit
186	**120704**	**0014_20120704_022331**	**Atlantic_line_tran513**	**Patch test**
		0015_20120704_0443581	Atlantic_line_tran514	Patch test
		0016_20120704_060157	Atlantic_line_tran515	Patch test
		0017_20120704_081141	Atlantic_line_tran516	Patch test
		0018_20120704_085547	Atlantic_line_tran517	Patch test
		0019_20120704_103525	Atlantic_line_tran518	Patch test
		0020_20120704_114738	Atlantic_line_tran519	Patch test
		0021_20120704_194313	Atlantic_line_tran520	Patch test
		0021_20120704_194313	Atlantic_line_521	Deadhead to dipline
		0022_20120704_195619	Atlantic_line_t22	dipline
187	**120705**	**0023_20120705_000016**	**Atlantic_line_523**	**dipline**
		0024_20120705_040750	Atlantic_line_524	turn
		0025_20120705_052333	Atlantic_line_525	First survey line
		0026_20120705_115941	Atlantic_line_526	Survey line
		0027_20120705_132554	Atlantic_line_527	Turn
		0028_20120705_142218	Atlantic_line_528	Survey line
		0029_20120705_180016	Atlantic_line_529	Survey line
		0030_20120705_225421	Atlantic_line_530	Turn
		0031_20120705_235756	Atlantic_line_531	Survey line
		_		
188	**120706**	**0032_20120706_053337**	Atlantic_line_532	Turn lots of pitch/roll
		0033_20120706_060211	Atlantic_line_533	Survey line
		0034_20120706_095725	Atlantic_line_534	turn
		0035_20120706_104808	Atlantic_line_535	Survey line
		0036_20120706_180017	Atlantic_line_536	Survey line
		0037_20120706_211742	Atlantic_line_537	turn
		0038_20120706_221210	Atlantic_line_538	Survey line
189	**120707**	**0039_20120707_040038**	**Atlantic_line_539**	**Survey line less noise**
		0041_20120707_094312	Atlantic_line_540	No line 0040
		0042_20120707_170008	Atlantic_line_541	Survey line

Table 2 (continue)

JD	Data	Kongsberg file name	UNH file name	Notes

	Folder	.all	.all	
		0043_20120707_214255	Atlantic_line_542	turn
		0044_20120707_222520	Atlantic_line_543	Survey line-very noisy
190	**120708**	**0045_20120708_042543**	**Atlantic_line_544**	**Survey line**
		0046_20120708_112916	Atlantic_line_545	Turn data improved
		0047_20120708_122840	Atlantic_line_546	Survey line
		0048_20120708_180017	Atlantic_line_547	Survey line noisy
191	**120709**	**0049_20120709_013842**	**Atlantic_line_548**	**turn**
		0050_20120709_030351	Atlantic_line_550	Survey line
		0051_20120709_094607	Atlantic_line_551	Survey line
		0052_20120709_172442	Atlantic_line_552	turn
		0053_20120709_181918	Atlantic_line_553	Survey line
192	**120710**	**0054_20120710_002635**	**Atlantic_line_554**	**Survey line**
		0055_20120710_012128	Atlantic_line_555	loop
		0056_20120710_015328	Atlantic_line_556	Survey line
		0057_20120710_075319	Atlantic_line_557	Survey line
		0058_20120710_103928	Atlantic_line_558	turn
		0059_20120710_120053	Atlantic_line_559	Survey line
		0060_20120710_185519	Atlantic_line_560	Survey line
193	**120711**	**0062_20120711_005600**	**Atlantic_line_561**	**Survey line**
		0063_20120711_065753	Atlantic_line_562	Survey line
		0065_20120711_111719	Atlantic_line_563	No line 0064
		0066_20120711_153604	Atlantic_line_564	Survey line
		0068_20120711_165946	Atlantic_line_565	No line 0067-turn
		0069_20120711_174843	Atlantic_line_566	Survey line
194	**120712**	**0070_20120712_005648**	**Atlantic_line_566**	**loop**
		0071_20120712_013108	Atlantic_line_567	Survey line
		0072_20120712_050230	Atlantic_line_568	turn
		0073_20120712_062551	Atlantic_line_569	Survey line
		0074_20120712_103647	Atlantic_line_570	turn
		0075_20120712_112034	Atlantic_line_571	Survey line
		0076_20120712_142508	Atlantic_line_572	turn
		0077_20120712_163411	Atlantic_line_573	Survey line
		0078_20120712_220500	Atlantic_line_574	Survey line
195	**120713**	**0079_20120713_040500**	**Atlantic_line_575**	**Survey line**
		0080_20120713_051314	Atlantic_line_577	turn
		0081_20120713_061904	Atlantic_line_578	Survey line
		0082_20120713_084344	Atlantic_line_579	turn
		0083_20120713_093239	Atlantic_line_580	Survey line
		0084_20120713_114923	Atlantic_line_581	turn
		0085_20120713_135908	Atlantic_line_582	Survey line
		0086_20120713_201129	Atlantic_line_583	Survey line
		0087_20120713_210349	Atlantic_line_584	Survey line

Table 2 (continued)

JD	Data	Kongsberg file name	UNH file name	Notes

	Folder	**.all**	**.all**	
196	**120714**	**0088_20120714_033002**	**Atlantic_line_585**	**turn**
		0089_20120714_042441	Atlantic_line_586	Survey line
		0090_20120714_083804	Atlantic_line_587	turn
		0091_20120714_084454	Atlantic_line_588	Survey line
		0092_20120714_164424	Atlantic_line_589	turn
		0093_20120714_173445	Atlantic_line_590	dipline
		0094_20120714_174140	Atlantic_line_591	Survey line
		0095_20120714_214946	Atlantic_line_592	Survey line
		0096_20120714_215458	Atlantic_line_593	dipline
197	**120715**	**0097_20120715_**	**Atlantic_line_594**	**Transit survey line**
		0098_20120715_	Atlantic_line_595	End of main survey
		0100_20120715_	Atlantic_line_596	Survey line
		0101_20120715_	Atlantic_line_597	Blake Ridge axis
		0102_20120715_	Atlantic_line_598	Blake Ridge axis
		0103_20120715_	Atlantic_line_599	transit
		0104_20120715_	Atlantic_line_600	transit
		0105_20120715_	Atlantic_line_tran601	transit
		0106_20120715_	Atlantic_line_602	transit
		0107_20120715_	Atlantic_line_603	Knudsen test

Table 4. Locations of XBT casts

XBT number	Date/Time	Latitude	Longitude	Serial Number	TYPE
4	2012-07-03/2200	33 18.4873N	73 18.0293W	01179082	Deep Blue
5	2012-07-04/0044	33 18.18311N	73 15.71045W	01179086	Deep Blue
6	Failed				
7	2012-07-04/0804	33 16.99048N	72 50.17432W	01179091	Deep Blue
8	Failed				
9	2012-07-04/1024	33 16.61011N	72 58.77295W	01179087	Deep Blue
10	2012-07-04/1317	33 04.31763N	72 56.36572W	01179084	Deep Blue
11	2012-07-04/1514	32 51.552N	72 33.01172W	01179088	Deep Blue
12	Failed				Deep Blue
13	2012-07-04/1931	32 23.50293N	71 41.8833W	01179093	Deep Blue
14	2012-07-05/0000	32 40.47632N	72 34.01416W	01179089	Deep Blue
15	Aborted	(No Probe)	(False Launch)		Deep Blue
16	2012-07-05/0159	32 48.89746N	72 59.10693W	01179085	Deep Blue
17	Aborted	(No Probe)	(False Launch)		Deep Blue
18	Aborted	(No Probe)	(False Launch)		Deep Blue
19	2012-07-05/0306	32 53.7644N	73 14.00244W	01179034	Deep Blue
20	Aborted	(No Probe)	(False Launch)		Deep Blue
21	2012-07-05/0525	33 2.62476N	73 16.22021W	01179038	Deep Blue
22	Aborted	(No Probe)	(False Launch)		Deep Blue
23	Aborted	(No Probe)	(False Launch)		Deep Blue
24	2012-07-05/0550	32 58.09766N	73 18.53125W	01179042	Deep Blue
25	2012-07-05/0639	32 49.7146N	73 22.81055W	01179043	Deep Blue
26	Aborted	(No Probe)	(False Launch)		Deep Blue
27	2012-07-05/0704	32 45.43994N	73 24.99219W	01179039	Deep Blue
28	2012-07-05/0804	32 34.85278N	73 30.37891W	01179035	Deep Blue
29	2012-07-05/1041	32 6.34912N	73 44.83789W	01179044	Deep Blue
30	Failed				Deep Blue
31	2012-07-05/1128	31 57.89331N	73 49.10254W	01179036	Deep Blue
32	2012-07-05/1400	31 31.73535N	73 55.67432W	01179037	Deep Blue
33	2012-07-05/1645	31 55.86621N	73 39.73584W	01179041	Deep Blue
34	2012-07-05/1758	32 9.24438N	73 32.95312W	01179045	Deep Blue

35	2012-07-05/1827	32 14.54297N	73 30.24854W	01179061	Deep Blue
36	2012-07-05/2120	32 46.07202N	73 14.18213W	01179060	Deep Blue
37	2012-07-05/2158	32 52.350N	73 10.960W	01179059	Deep Blue
38	2012-07-05/2232	32 59.19189N	73 7.45996W	01179058	Deep Blue
39	2012-07-06/0025	32 58.15405N	72 57.48291W	01179062	Deep Blue
40	2012-07-06/0104	32 51.24048N	73 1.04053W	01179063	Deep Blue
41	Failed	Bad Profile			Deep Blue
42	2012-07-06/0226	32 36.66992N	73 8.51709W	01179065	Deep Blue
43	2012-07-06/0515	32 5.83691N	73 24.27393W	01179066	Deep Blue
44	2012-07-06/0721	31 49.14502N	73 32.75586W	01179067	Deep Blue
45	2012-07-06/0842	31 34.43115N	73 40.2251W	01179068	Deep Blue
46	2012-07-06/1101	31 16.19775N	73 39.10156W	01179069	Deep Blue
47	2012-07-06/1352	31 46.29297N	73 23.8125W	01179073	Deep Blue
48	2012-07-06/1758	32 30.98096N	73 0.96191W	01179077	Deep Blue
49	2012-07-06/1950	32 48.02271N	72 52.1875W	01179072	Deep Blue
50	Aborted	(No Probe)	(False Launch)		
51	2012-07-06/2035	32 56.12549N	72 48.00781W	01179076	Deep Blue
52	2012-07-06/2317	32 51.56543N	72 39.85547W	01179081	Deep Blue
53	Aborted	(No Probe)	(False Launch)		
54	2012-07-07/0010	32 41.6687N	72 44.96826W	01179080	Deep Blue
55	2012-07-07/0042	32 35.77783N	72 48.01123W	01179071	Deep Blue
56	2012-07-07/0218	32 18.2854N	72 57.02344W	01179075	Deep Blue
57	2012-07-07/0434	31 53.91162N	73 9.52637W	01179079	Deep Blue
58	2012-07-07/0514	31 46.76587N	73 13.18652W	01179078	Deep Blue
59	Aborted		(False Launch)		
60	2012-07-07/ 0623	31 33.90576N	73 19.750W	01179070	Deep Blue
61	2012-07-07/0707	31 25.4209N	73 24.07422W	01179074	Deep Blue
62	2012-07-07/0947	30 58.54712N	73 27.40039W	01179129	Deep Blue
63	2012-07-07/1001	31 0.86572N	73 26.22412W	01179128	Deep Blue
64	2012-07-07/1030	31 5.74268N	73 23.74365W	01179127	Deep Blue
65	2012-07-07/1432	31 48.39136N	73 1.94092W	01179126	Deep Blue
66	2012-07-07/1818	32 29.75513N	72 40.62793W	01179122	Deep Blue
67	2012-07-07/2111	33 0.15991N	72 24.86035W	01179123	Deep Blue
68	2012-07-07/22:28	33 3.45703N	72 12.60791W	01179124	Deep Blue
69	2012-07-08/00:05	32 45.82983N	72 21.79346W	01179125	Deep Blue
70	2012-07-08/0430	31 58.9834N	72 46.07275W	01179118	Deep Blue

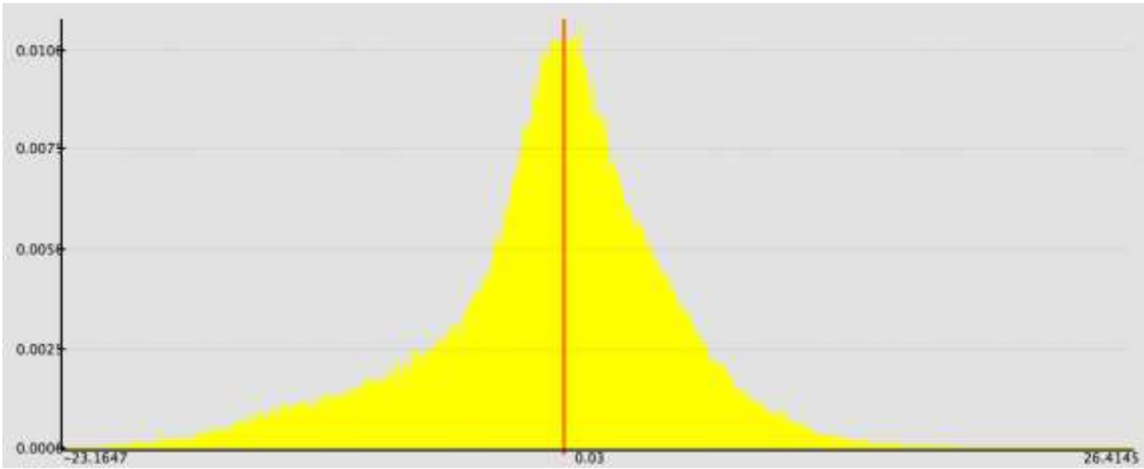
71	2012-07-08/ 0949	31 8.74146N	73 11.87842W	00179121	Deep Blue
72	2012-07-08/1802	31 40.01587N	72 45.42773W	01179120	Deep Blue
73	2012-07-08/1930	31 56.04297N	72 37.1416W	01179119	Deep Blue
74	2012-07-09/0015	32 48.75049N	72 9.73291W	01179109	Deep Blue
75	2012-07-09/0317	33 8.05298N	71 48.99463W	01179108	Deep Blue
76	2012-07-09/0513	32 47.62549N	71 59.73633W	01179112	Deep Blue
77	2012-07-09/0637	32 32.62866N	72 7.59033W	01179113	Deep Blue
78	2012-07-09/0831	32 12.14575N	72 18.28857W	01179117	Deep Blue
79	2012-07-09/1018	31 52.57886N	72 28.4668W	01179116	Deep Blue
80	2012-07-09/1506	30 59.21191N	72 56.05566W	01179107	Deep Blue
81	2012-07-09/1823	30 26.96167N	73 2.2915W	01179111	Deep Blue
82	2012-07-09/2227	31 12.30176N	72 38.90527W	01179115	Deep Blue
83	2012-07-09/0237	31 51.73193N	72 18.40869W	01179110	Deep Blue
84	Failed launch				
85	2012-07-10/0514	32 20.08887N	72 3.58203W	01179106	Deep Blue
86	Failed	Probe Shorted			
87	2012-07-10/0732	32 44.64844N	71 50.67969W	01179097	Deep Blue
88	2012-07-10/1320	33 10.76953N	71 25.4834W	01179096	Deep Blue
89	2012-07-10/1646	32 34.63086N	71 44.70312W	01179095	Deep Blue
90	2012-07-10/1804	32 21.25977N	71 51.7832W	01179094	Deep Blue
91	2012-07-10/1958	32 1.43481N	72 2.14307W	01179101	Deep Blue
92	2012-07-10/2145	31 42.76367N	72 11.94434W	01179100	Deep Blue
93	2012-07-10/0119	31 20.93799N	72 13.3916W	01179105	Deep Blue
94	2012-07-11/0223	31 32.77637N	72 7.36963W	01179099	Deep Blue
95	2012-07-11/0251	31 37.97241N	72 4.72754W	01179104	Deep Blue
96	2012-07-11/0359	31 50.45142N	71 58.36377W	01179103	Deep Blue
97	2012-07-11/0608	32 13.56274N	71 46.53955W	01179098	Deep Blue
98	2012-07-11/0824	32 38.39429N	71 33.79199W	01179102	Deep Blue
99	2012-07-11/1357	32 30.3291N	71 27.50635W	01179210	Deep Blue
100	2012-07-11/1608	32 6.62695N	71 39.71045W	01179206	Deep Blue
101	2012-07-11/1751	31 55.0752N	71 35.20312W	01179202	Deep Blue
102	2012-07-11/1859	32 8.05347N	71 28.51416W	01179211	Deep Blue
103	2012-07-11/2305	32 52.78198N	71 5.33594W	01179207	Deep Blue
104	2012-07-12/0000	33 2.50391N	71 0.43994W	01179203	Deep Blue
105	2012-07-12/0137	33 13.76733N	70 54.59082W	01179212	Deep Blue
106	2012-07-12/0226	33 22.42432N	70 50.16455W	01179208	Deep Blue
107	2012-07-12/0442	33 46.6272N	70 37.74414W	01179213	Deep Blue
108	2012-07-12/0708	33 34.87866N	70 54.01758W	01179204	Deep Blue
109	2012-07-12/0852	33 15.77441N	71 4.3042W	01179209	Deep Blue
110	2012-07-12/1119	32 58.98364N	71 22.20117W	01179205	Deep Blue
111	Failed launch				
112	2012-07-12/1205	33 7.23267N	71 18.05273W	01179222	Deep Blue
113	2012-07-12/1636	33 32.62207N	70 34.08105W	01179224	Deep Blue
114	2012-07-12/1725	33 24.06396N	70 38.59082W	01179225	Deep Blue
115	2012-07-12/1914	33 4.80127N	70 48.771W	01179218	Deep Blue
116	2012-07-12/2239	32 28.39819N	71 7.89307W	01179219	Deep Blue

117	2012-07-12/2354	32 15.13208N	71 14.82959W	01179220	Deep Blue
118	2012-07-13/0058	32 4.06592N	71 20.60254W	01179221	Deep Blue
119	2012-07-13/0259	31 43.18872N	71 31.46777W	01179217	Deep Blue
120	2012-07-13/0410	31 31.26343N	71 37.64844W	01179216	Deep Blue
121	2012-07-13/0457	31 23.33447N	71 41.75781W	01179215	Deep Blue
122	2012-07-13/0628	31 31.62671N	71 46.98242W	01179214	Deep Blue
123	2012-07-13/0936	31 58.66992N	71 44.40674W	01178998	Deep Blue
124	2012-07-13/1403	31 17.29932N	71 34.05566W	01178999	Deep Blue
125	2012-07-13/1642	31 45.24683N	71 19.60352W	01179000	Deep Blue
126	2012-07-13/2105	32 20.06567N	70 50.35156W	01179001	Deep Blue
127	2012-07-13/2248	32 1.55249N	71 0.20557W	01179005	Deep Blue
128	2012-07-14/0052	31 39.0376N	71 12.14502W	01179009	Deep Blue
129	2012-07-14/0129	31 32.38989N	71 15.66211W	01179004	Deep Blue
130	2012-07-14/0158	31 27.20752N	71 18.3999W	01179008	Deep Blue
131	201207-14/0238	31 21.00708N	71 21.66943W	01179003	Deep Blue
132	2012-07-14/0250	31 18.13306N	71 23.18555W	01179007	Deep Blue
133	2012-07014/0315	31 14.52979N	71 25.08252W	01179002	Deep Blue
134	2012-07-14/0427	31 7.2478N	71 17.98584W	01179006	Deep Blue
135	2012-07-14/0510	31 15.76392N	71 13.69629W	01179131	Deep Blue
136	Failed Launch	No Probe			
137	2012-07-14/0531	31 19.95459N	71 11.57959W	01179138	Deep Blue
138	Failed Launch	No Probe			
139	2012-07-14/0612	31 26.73267N	71 8.15967W	01179134	Deep Blue
140	2012-07-14/0640	31 32.79077N	71 5.10254W	01179130	Deep Blue
141	2012-07-14/0804	31 48.08716N	70 57.3584W	01179135	Deep Blue
142	2012-07-14/1234	32 19.83203N	71 41.93506W	01179132	Deep Blue
143	2012-07-14/1614	32 43.79395N	72 29.18457W	01179133	Deep Blue
144	2012-07-14/1717	32 50.44897N	72 42.48779W	01179136	Deep Blue
145	2012-07-14/2141	32 7.06763N	73 8.43311W	01179137	Deep Blue
146	2012-07-14/0203	31 36.65771N	72 21.77051W	01179141	Deep Blue
147	Launch	Failure			
148	2012-07-14/0639	30 58.01636N	72 35.12744W	01179139	Deep Blue
149	2012-07-14/0809	30 41.31543N	72 43.70264W	01179162	Deep Blue
150	2012-07-14/1417	29 31.25049N	73 11.78906W	01179158	Deep Blue
151	2012-07-14/1554	29 14.73804N	72 59.58838W	01179154	Deep Blue
152	2012-07-14/2148	28 42.2627N	73 26.98291W	01179155	Deep Blue

Appendix 1. Cruise Personnel

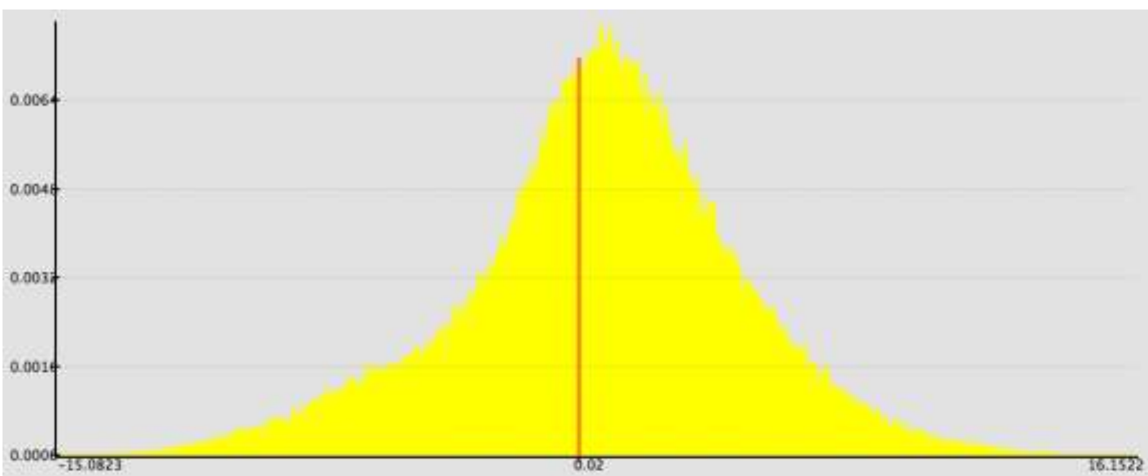
Name	Position	Organization
	Science Party	
CAPT (ret) Andy Armstrong	Chief Scientist	NOAA
CDR Shep Smith	Co-Chief Scientist	NOAA
Dr. Brian Calder	Co-Chief Scientist	UNH/CCOM-JHC
Mr. David Armstrong	Watchstander	UNH undergrad student
Mr. Chukwuma Azuike	Watchstander	UNH grad student
Ms. Christina Fandel	Watchstander	UNH grad student
Mr. Brian Meyer	Watchstander	NOAA/NGDC
	Ship	
CAPT Mark Pickett	Commanding Officer	NOAA
LT James Brinkley	Field Operations Officer	NOAA
LT Paul Chamberlain	Field Operations Officer	NOAA
Mr. Jonathan Shanahoff	Sr. Survey Tech	NOAA
Ms. Laurie Roy	Survey Tech	NOAA
Mr.Clay Norfleet	Electronics Tech	NOAA

Appendix 2. Cross Check Analysis Results



Histogram of sounding-depth differences from cross-line check of Atlantic Line 582 and Dipline 588. Kongsberg Maritime EM122.

Line 582 vs dipliine 588	Mean water depth	5412 m
	Mean Z difference	-0.52
	Standard deviation	5.54
	Number of samples	114,439
	Percent of water depth	0.21 at 2σ

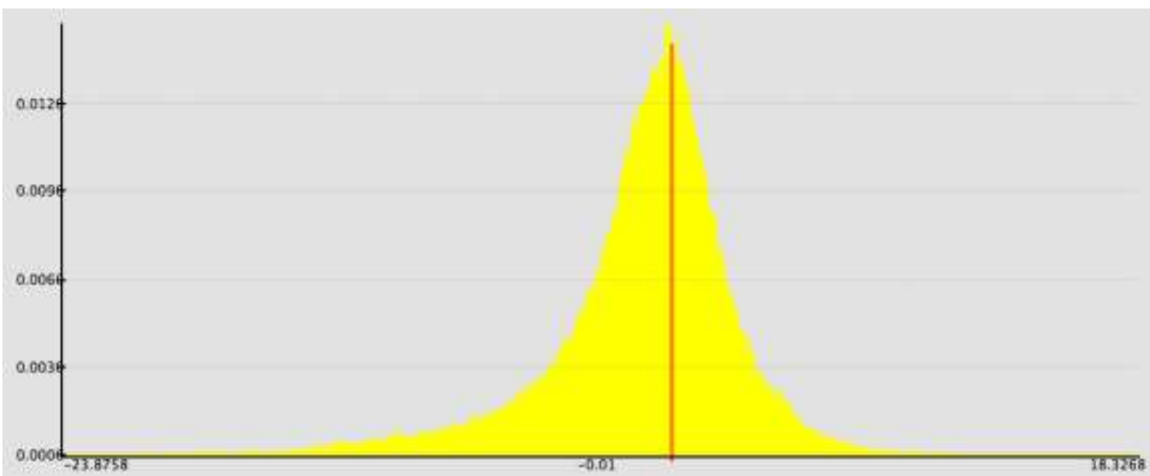


Histogram of sounding-depth differences from cross-line check of Atlantic Line 584 and Dipline 588. Kongsberg Maritime EM122.

Line 584 vs dipliine 588	Mean water depth	5414 m
	Mean Z difference	0.63
	Standard deviation	4.05
	Number of samples	112,659
	Percent of water depth	0.16 at 2σ

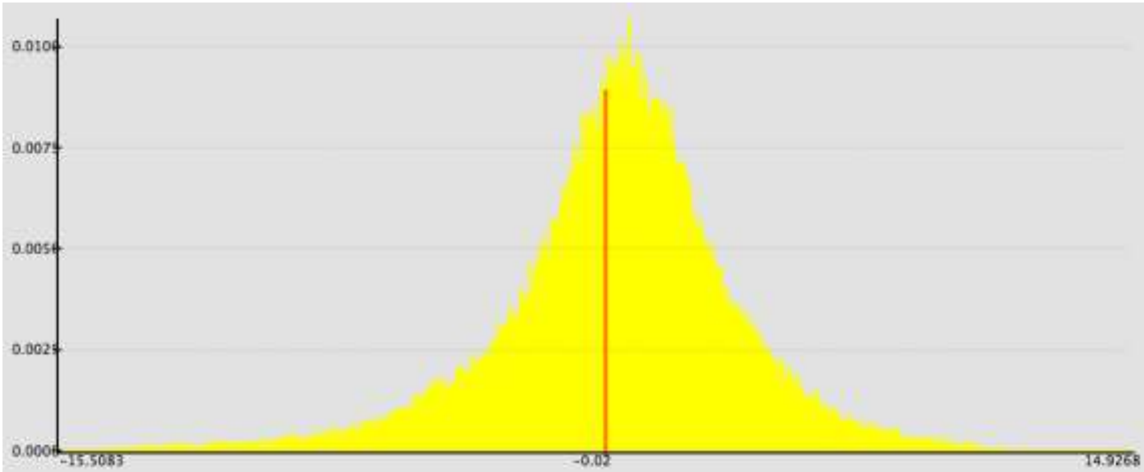
Histogram of sounding-depth differences from cross-line check of Atlantic Line 575 and Dipline 588. Kongsberg Maritime EM122.

Line 575 vs dipliine 588	Mean water depth	5540 m
	Mean Z difference	1.48
	Standard deviation	4.07
	Number of samples	90,247
	Percent of water depth	0.18 at 2σ



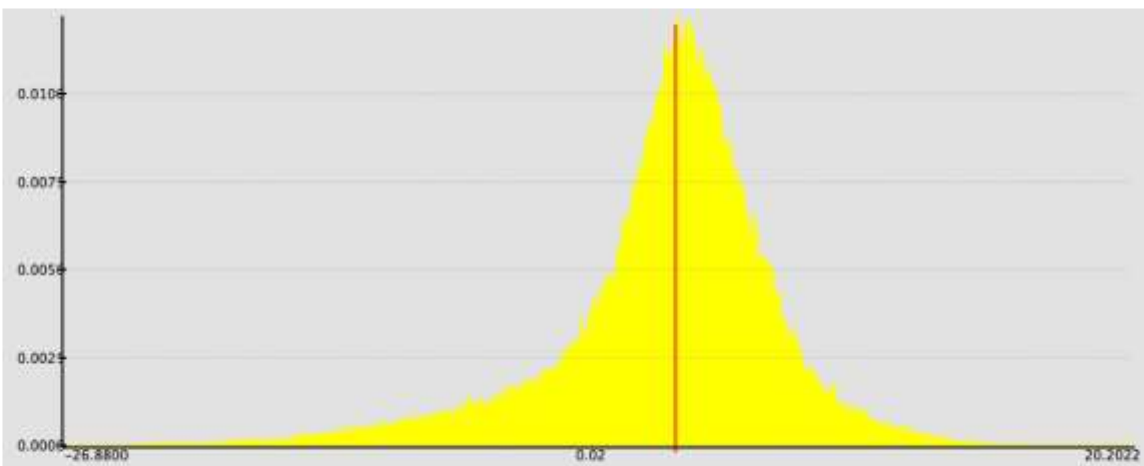
Histogram of sounding-depth differences from cross-line check of Atlantic Line 561 and Dipline 588. Kongsberg Maritime EM122.

Line 561 vs dipliine 588	Mean water depth	5396 m
	Mean Z difference	-1.10
	Standard deviation	3.71
	Number of samples	77,559
	Percent of water depth	0.16 at 2σ



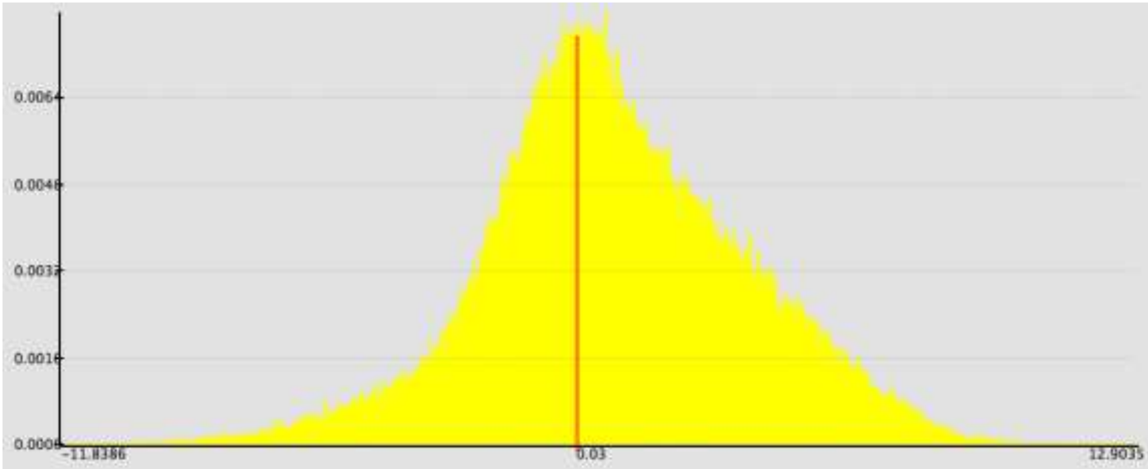
Histogram of sounding-depth differences from cross-line check of Atlantic Line 563 and Dipline 588. Kongsberg Maritime EM122.

Line 563 vs dipliine 588	Mean water depth	5400 m
	Mean Z difference	0.33
	Standard deviation	3.38
	Number of samples	82,712
	Percent of water depth	0.13 at 2σ



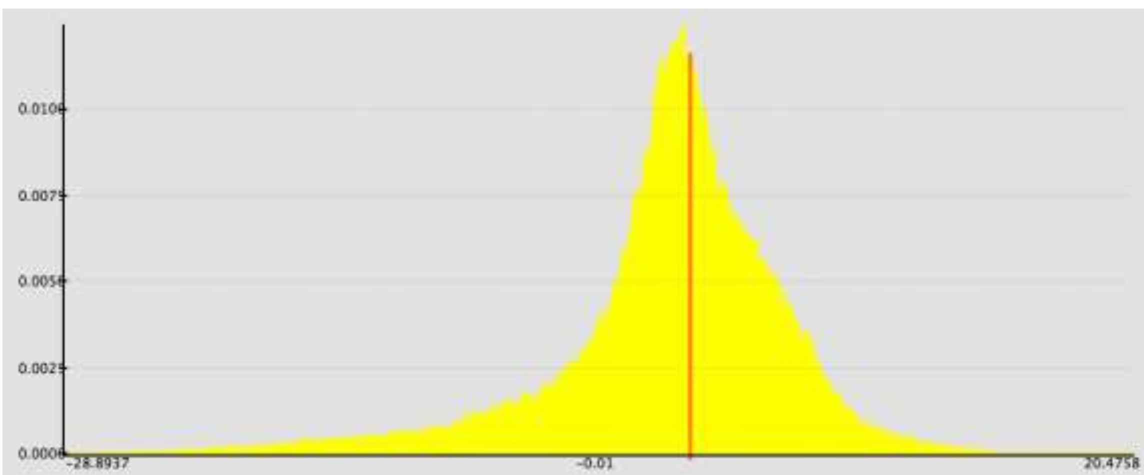
Histogram of sounding-depth differences from cross-line check of Atlantic Line 566 and Dipline 588. Kongsberg Maritime EM122.

Line 566 vs dipliine 588	Mean water depth	5405 m
	Mean Z difference	-0.34
	Standard deviation	4.91
	Number of samples	107,164
	Percent of water depth	0.19 at 2σ



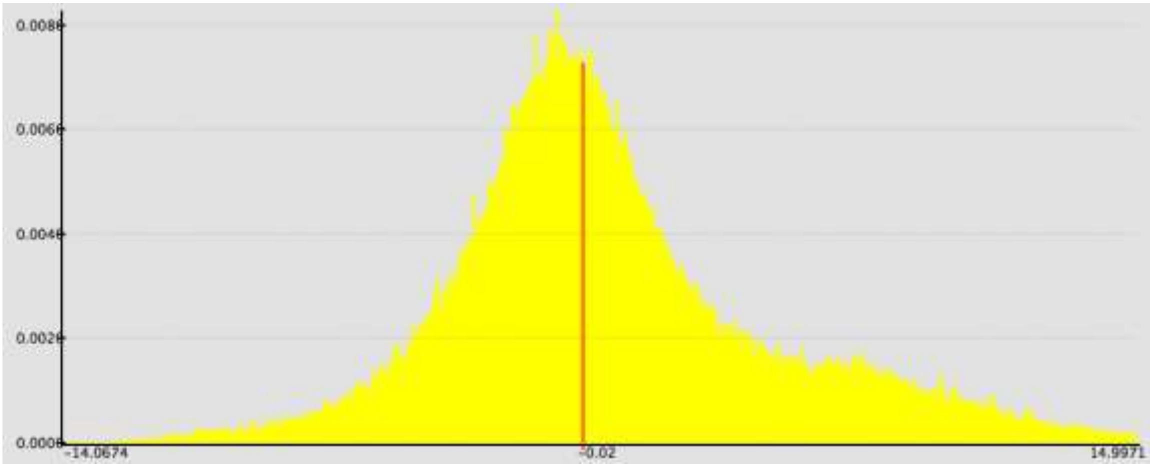
Histogram of sounding-depth differences from cross-line check of Atlantic Line 556 and Dipline 588. Kongsberg Maritime EM122.

Line 556 vs dipline 588	Mean water depth	5384 m
	Mean Z difference	0.91
	Standard deviation	3.02
	Number of samples	92,046
	Percent of water depth	0.13 at 2σ



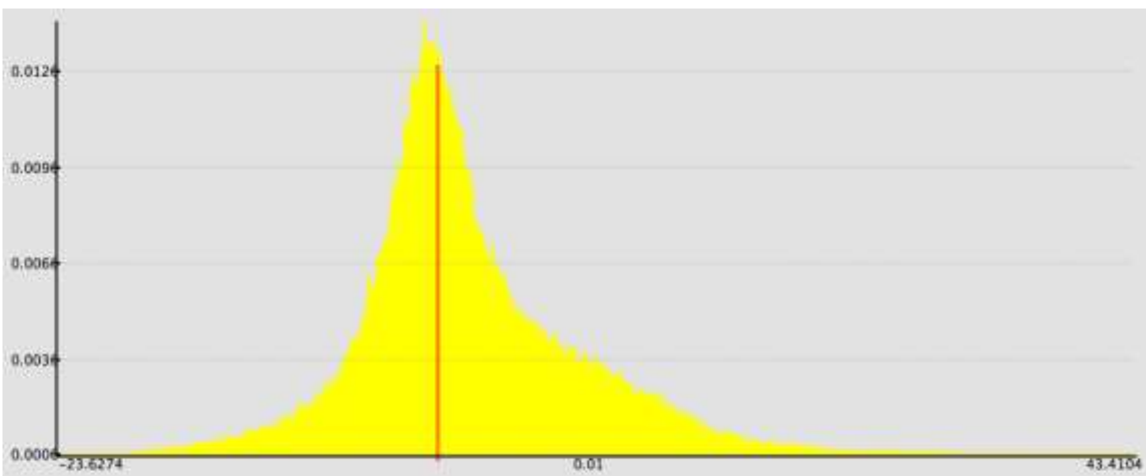
Histogram of sounding-depth differences from cross-line check of Atlantic Line 559 and Dipline 588. Kongsberg Maritime EM122.

Line 559 vs dipline 588	Mean water depth	5392 m
	Mean Z difference	-0.96
	Standard deviation	5.42
	Number of samples	122,506
	Percent of water depth	0.13 at 2σ



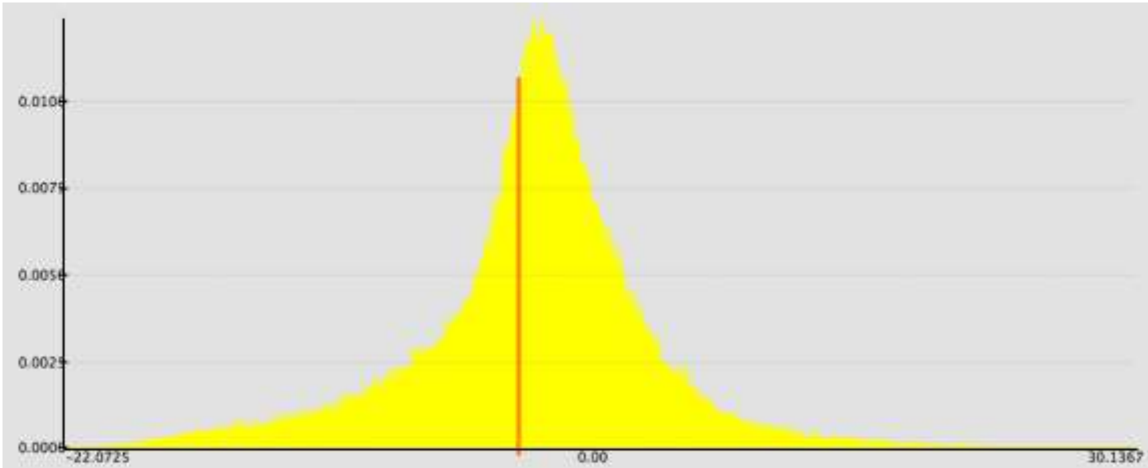
Histogram of sounding-depth differences from cross-line check of Atlantic Line 550 and Dipline 588. Kongsberg Maritime EM122.

Line 550 vs dipline 588	Mean water depth	5378 m
	Mean Z difference	0.71
	Standard deviation	4.40
	Number of samples	90,671
	Percent of water depth	0.18 at 2σ



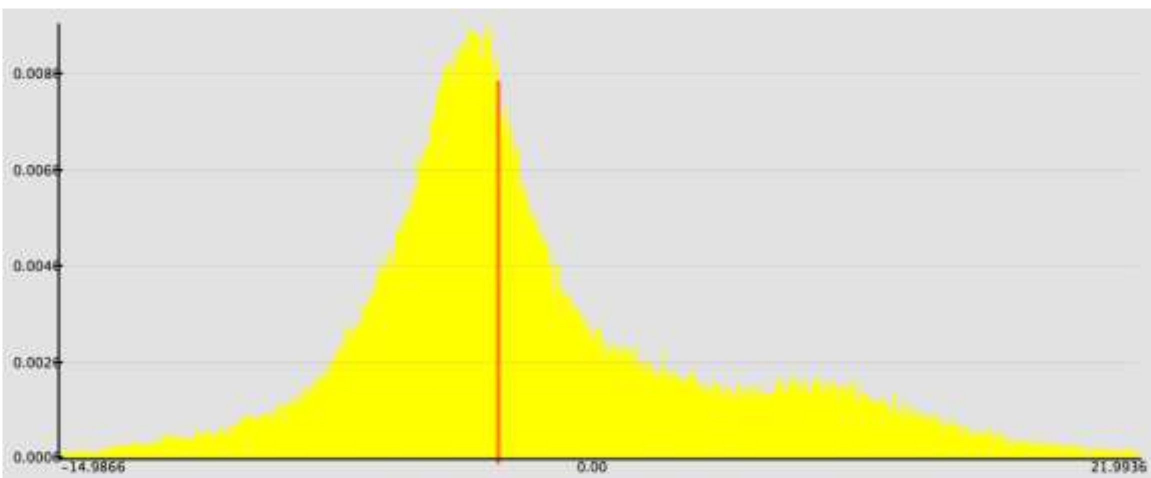
Histogram of sounding-depth differences from cross-line check of Atlantic Line 547 and Dipline 588. Kongsberg Maritime EM122.

Line 547 vs dipline 588	Mean water depth	5367 m
	Mean Z difference	1.91
	Standard deviation	6.93
	Number of samples	115,667
	Percent of water depth	0.29 at 2σ



Histogram of sounding-depth differences from cross-line check of Atlantic Line 541 and Dipline 588. Kongsberg Maritime EM122.

Line 541 vs dipline 588	Mean water depth	5337 m
	Mean Z difference	0.72
	Standard deviation	5.63
	Number of samples	103,399
	Percent of water depth	0.22 at 2σ



Histogram of sounding-depth differences from cross-line check of Atlantic Line 543 and Dipline 588. Kongsberg Maritime EM122.

Line 543 vs dipline 588	Mean water depth	5353 m
	Mean Z difference	1.23
	Standard deviation	6.09
	Number of samples	91,157
	Percent of water depth	0.25 at 2σ

Appendix 3. Kongsberg EM122 Built-in self tests (BIST) Results

Saved: 2012.06.15 13:04:17
Sounder Type: 122, Serial no.: 116
Date Time Ser. No. BIST Result

2012.06.15 12:50:41.860 116 0 OK
Number of BSP67B boards: 2
BSP 1 Master 2.3 090702 4.3 070913 4.3 070913
BSP 1 Slave 2.3 090702 6.0 080902
BSP 1 RXI FPGA 3.6 080821
BSP 1 DSP FPGA A 4.0 070531
BSP 1 DSP FPGA B 4.0 070531
BSP 1 DSP FPGA C 4.0 070531
BSP 1 DSP FPGA D 4.0 070531
BSP 1 PCI TO SLAVE A1 FIFO: ok
BSP 1 PCI TO SLAVE A2 FIFO: ok
BSP 1 PCI TO SLAVE A3 FIFO: ok
BSP 1 PCI TO SLAVE B1 FIFO: ok
BSP 1 PCI TO SLAVE B2 FIFO: ok
BSP 1 PCI TO SLAVE B3 FIFO: ok
BSP 1 PCI TO SLAVE C1 FIFO: ok
BSP 1 PCI TO SLAVE C2 FIFO: ok
BSP 1 PCI TO SLAVE C3 FIFO: ok
BSP 1 PCI TO SLAVE D1 FIFO: ok
BSP 1 PCI TO SLAVE D2 FIFO: ok
BSP 1 PCI TO SLAVE D3 FIFO: ok
BSP 1 PCI TO MASTER A HPI: ok
BSP 1 PCI TO MASTER B HPI: ok
BSP 1 PCI TO MASTER C HPI: ok
BSP 1 PCI TO MASTER D HPI: ok
BSP 1 PCI TO SLAVE A0 HPI: ok
BSP 1 PCI TO SLAVE A1 HPI: ok
BSP 1 PCI TO SLAVE A2 HPI: ok
BSP 1 PCI TO SLAVE B0 HPI: ok
BSP 1 PCI TO SLAVE B1 HPI: ok
BSP 1 PCI TO SLAVE B2 HPI: ok
BSP 1 PCI TO SLAVE C0 HPI: ok
BSP 1 PCI TO SLAVE C1 HPI: ok
BSP 1 PCI TO SLAVE C2 HPI: ok
BSP 1 PCI TO SLAVE D0 HPI: ok
BSP 1 PCI TO SLAVE D1 HPI: ok
BSP 1 PCI TO SLAVE D2 HPI: ok
BSP 2 Master 2.3 090702 4.3 070913 4.3 070913
BSP 2 Slave 2.3 090702 6.0 080902
BSP 2 RXI FPGA 3.6 080821
BSP 2 DSP FPGA A 4.0 070531
BSP 2 DSP FPGA B 4.0 070531
BSP 2 DSP FPGA C 4.0 070531
BSP 2 DSP FPGA D 4.0 070531
BSP 2 PCI TO SLAVE A1 FIFO: ok
BSP 2 PCI TO SLAVE A2 FIFO: ok
BSP 2 PCI TO SLAVE A3 FIFO: ok
BSP 2 PCI TO SLAVE B1 FIFO: ok
BSP 2 PCI TO SLAVE B2 FIFO: ok
BSP 2 PCI TO SLAVE B3 FIFO: ok

BSP 2 PCI TO SLAVE C1 FIFO: ok
BSP 2 PCI TO SLAVE C2 FIFO: ok
BSP 2 PCI TO SLAVE C3 FIFO: ok
BSP 2 PCI TO SLAVE D1 FIFO: ok
BSP 2 PCI TO SLAVE D2 FIFO: ok
BSP 2 PCI TO SLAVE D3 FIFO: ok
BSP 2 PCI TO MASTER A HPI: ok
BSP 2 PCI TO MASTER B HPI: ok
BSP 2 PCI TO MASTER C HPI: ok
BSP 2 PCI TO MASTER D HPI: ok
BSP 2 PCI TO SLAVE A0 HPI: ok
BSP 2 PCI TO SLAVE A1 HPI: ok
BSP 2 PCI TO SLAVE A2 HPI: ok
BSP 2 PCI TO SLAVE B0 HPI: ok
BSP 2 PCI TO SLAVE B1 HPI: ok
BSP 2 PCI TO SLAVE B2 HPI: ok
BSP 2 PCI TO SLAVE C0 HPI: ok
BSP 2 PCI TO SLAVE C1 HPI: ok
BSP 2 PCI TO SLAVE C2 HPI: ok
BSP 2 PCI TO SLAVE D0 HPI: ok
BSP 2 PCI TO SLAVE D1 HPI: ok
BSP 2 PCI TO SLAVE D2 HPI: ok

2012.06.15 12:50:44.694 116 1 OK
High Voltage Br. 1

TX36 Spec: 108.0 - 132.0
0-1 121.7
0-2 121.7
0-3 121.3
0-4 121.7
0-5 122.1
0-6 120.9
0-7 121.7
0-8 122.1
0-9 122.1
0-10 121.3
0-11 121.7
0-12 122.1
0-13 121.3
0-14 121.7
0-15 121.3
0-16 123.0
0-17 122.1
0-18 122.1
0-19 121.7
0-20 121.7
0-21 121.7
0-22 122.6
0-23 121.7
0-24 122.1

High Voltage Br. 2

TX36 Spec: 108.0 - 132.0
0-1 122.6

0-2   121.7
0-3   121.7
0-4   122.2
0-5   121.7
0-6   121.7
0-7   121.3
0-8   122.6
0-9   122.2
0-10   121.3
0-11 122.6
0-12 122.2
0-13 121.7
0-14 122.2
0-15 121.3
0-16 123.0
0-17 122.2
0-18 121.7
0-19 122.2
0-20 122.2
0-21 122.2
0-22 122.6
0-23 122.2
0-24 121.7

Input voltage 12V

TX36   Spec: 11.0 - 13.0
0-1   11.9
0-2   11.9
0-3   11.8
0-4   11.9
0-5   11.9
0-6   11.8
0-7   11.9
0-8   11.9
0-9   11.9
0-10   11.8
0-11   11.9
0-12   11.9
0-13   11.8
0-14   11.9
0-15   11.8
0-16   11.9
0-17   11.9
0-18   11.9
0-19   11.9
0-20   11.9
0-21   11.9
0-22   11.9
0-23   11.9
0-24   11.8
Digital 3.3V

TX36   Spec: 2.8 - 3.5
0-1   3.3
0-2   3.3

0-3 3.3
0-4 3.3
0-5 3.3
0-6 3.3
0-7 3.3
0-8 3.3
0-9 3.3
0-10 3.3
0-11 3.3
0-12 3.3
0-13 3.3
0-14 3.3
0-15 3.3
0-16 3.3
0-17 3.3
0-18 3.3
0-19 3.3
0-20 3.3
0-21 3.3
0-22 3.3
0-23 3.3
0-24 3.3
Digital 2.5V

TX36 Spec: 2.4 - 2.6
0-1 2.5
0-2 2.5
0-3 2.5
0-4 2.5
0-5 2.5
0-6 2.5
0-7 2.5
0-8 2.5
0-9 2.5
0-10 2.5
0-11 2.5
0-12 2.5
0-13 2.5
0-14 2.5
0-15 2.5
0-16 2.5
0-17 2.5
0-18 2.5
0-19 2.5
0-20 2.5
0-21 2.5
0-22 2.5
0-23 2.5
0-24 2.5
Digital 1.5V

TX36 Spec: 1.4 - 1.6
0-1 1.5
0-2 1.5
0-3 1.5
0-4 1.5

0-5 1.5
0-6 1.5
0-7 1.5
0-8 1.5
0-9 1.5
0-10 1.5
0-11 1.5
0-12 1.5
0-13 1.5
0-14 1.5
0-15 1.5
0-16 1.5
0-17 1.5
0-18 1.5
0-19 1.5
0-20 1.5
0-21 1.5
0-22 1.5
0-23 1.5
0-24 1.5
Temperature

TX36 Spec: 15.0 - 75.0
0-1 26.8
0-2 26.0
0-3 25.6
0-4 24.4
0-5 25.2
0-6 24.8
0-7 24.8
0-8 25.2
0-9 24.8
0-10 24.0
0-11 25.6
0-12 24.4
0-13 24.4
0-14 24.8
0-15 24.4
0-16 25.2
0-17 26.4
0-18 26.4
0-19 25.2
0-20 25.6
0-21 25.6
0-22 26.4
0-23 24.8
0-24 25.2
Input Current 12V

TX36 Spec: 0.3 - 1.5
0-1 0.6
0-2 0.5
0-3 0.5
0-4 0.6
0-5 0.5
0-6 0.5

0-7   0.5
0-8   0.6
0-9   0.5
0-10   0.6
0-11   0.5
0-12   0.6
0-13   0.6
0-14   0.6
0-15   0.5
0-16   0.5
0-17   0.6
0-18   0.5
0-19   0.5
0-20   0.5
0-21   0.5
0-22   0.5
0-23   0.5
0-24   0.6
TX36   power test passed
IO   TX   MB Embedded   PPC Embedded   PPC Download
2.11 One CPU1.13 Reduced Performance: 1 voice/Mar 5 2007/1.07 Jun 17 2008/1.11
TX36 unique firmware test OK

2012.06.15 12:50:51.394 116   2   OK
Input voltage 12V

RX32   Spec: 11.0 - 13.0
7-1   11.8
7-2   11.7
7-3   11.7
7-4   11.8
Input voltage 6V

RX32   Spec: 5.0 - 7.0
7-1   5.7
7-2   5.7
7-3   5.7
7-4   5.7
Digital 3.3V

RX32   Spec: 2.8 - 3.5
7-1   3.3
7-2   3.3
7-3   3.3
7-4   3.3
Digital 2.5V

RX32   Spec: 2.4 - 2.6
7-1   2.5
7-2   2.5
7-3   2.5
7-4   2.5
Digital 1.5V

RX32   Spec: 1.4 - 1.6
7-1   1.5

7-2 1.5
7-3 1.5
7-4 1.5
Temperature

RX32 Spec: 15.0 - 75.0
7-1 26.0
7-2 28.0
7-3 26.0
7-4 24.0
Input Current 12V

RX32 Spec: 0.4 - 1.5
7-1 0.6
7-2 0.6
7-3 0.6
7-4 0.6
Input Current 6V

RX32 Spec: 2.4 - 3.3
7-1 2.9
7-2 2.8
7-3 2.8
7-4 2.9
RX32 power test passed
IO RX MB Embedded PPC Embedded PPC Download

1.12 Generic1.14 GenericMay 5 2006/1.06 May 5 2006/1.07 Feb 18 2010/1.11

RX32 unique firmware test OK

2012.06.15 12:50:51.494 116 3 OK
High Voltage Br. 1

TX36 Spec: 108.0 - 132.0
0-1 121.7
0-2 121.7
0-3 121.3
0-4 121.7
0-5 122.1
0-6 120.9
0-7 121.7
0-8 122.1
0-9 122.1
0-10 121.3
0-11 121.7
0-12 122.1
0-13 121.3
0-14 121.7
0-15 120.9
0-16 122.6
0-17 122.1
0-18 121.7
0-19 121.7
0-20 121.7
0-21 121.7

0-22 122.6
0-23 121.7
0-24 121.7
High Voltage Br. 2

TX36   Spec: 108.0 - 132.0
0-1   122.6
0-2   121.7
0-3   121.7
0-4   121.7
0-5   121.7
0-6   121.7
0-7   121.3
0-8   122.6
0-9   121.7
0-10   121.3
0-11 122.2
0-12 122.2
0-13 121.3
0-14 121.7
0-15 121.3
0-16 122.6
0-17 122.2
0-18 121.7
0-19 121.7
0-20 122.2
0-21 121.7
0-22 122.2
0-23 122.2
0-24 121.7
Input voltage 12V

TX36   Spec: 11.0 - 13.0
0-1   11.9
0-2   11.9
0-3   11.9
0-4   11.9
0-5   11.9
0-6   11.8
0-7   11.9
0-8   11.9
0-9   11.9
0-10   11.8
0-11   11.9
0-12   11.9
0-13   11.8
0-14   11.9
0-15   11.8
0-16   11.9
0-17   11.9
0-18   11.9
0-19   11.9
0-20   11.9
0-21   11.9
0-22   11.9
0-23   11.9

0-24   11.8
RX32   Spec: 11.0 - 13.0
7-1   11.8
7-2   11.8
7-3   11.7
7-4   11.8
Input voltage 6V

RX32   Spec: 5.0 - 7.0
7-1   5.7
7-2   5.7
7-3   5.7
7-4   5.7
TRU power test passed

2012.06.15 12:50:51.594 116   4   OK
EM 122 High Voltage Ramp Test
Test Voltage:20.00 Measured Voltage: 18.00 PASSED
Test Voltage:60.00 Measured Voltage: 59.00 PASSED
Test Voltage:100.00 Measured Voltage: 100.00 PASSED
Test Voltage:120.00 Measured Voltage: 120.00 PASSED
Test Voltage:80.00 Measured Voltage: 85.00 PASSED
Test Voltage:40.00 Measured Voltage: 45.00 PASSED
6 of 6 tests OK

2012.06.15 12:53:15.542 116   5   OK
BSP 1 RXI TO RAW FIFO: ok
BSP 2 RXI TO RAW FIFO: ok

2012.06.15 12:53:22.475 116   6   OK
Receiver impedance limits [350.0 700.0] ohm
Board 1   2   3   4
1: 651.2 594.1 558.6 566.1
2: 644.0 607.2 594.8 571.5
3: 624.2 572.7 550.5 571.0
4: 612.6 585.4 502.2 607.4
5: 654.2 568.5 588.4 617.8
6: 603.0 563.6 563.3 621.5
7: 557.1 584.5 569.7 572.3
8: 652.5 585.7 554.9 551.2
9: 565.0 556.5 545.1 581.1
10: 643.5 606.8 562.3 556.1
11: 627.0 601.5 600.1 562.2
12: 637.0 606.0 544.8 551.4
13: 566.7 613.5 604.0 551.2
14: 600.4 599.8 612.2 614.7
15: 645.6 575.6 541.2 562.2
16: 653.6 598.3 594.5 561.7
17: 583.7 619.4 597.6 596.1
18: 638.6 621.2 625.4 574.0
19: 620.4 594.7 593.1 530.7
20: 622.8 591.9 596.4 580.3
21: 631.2 576.4 578.1 592.2
22: 653.8 583.0 574.1 620.6
23: 626.6 552.5 546.4 579.3
24: 602.7 556.7 628.9 586.3

```
25: 650.7  583.5  588.6  549.7
26: 540.5  541.8  586.9  609.4
27: 617.1  605.4  556.2  551.5
28: 642.0  560.6  569.5  564.9
29: 622.4  605.0  615.6  579.5
30: 591.0  567.6  594.1  591.8
31: 642.3  602.3  612.7  585.6
32: 582.1  579.9  587.8  572.1
Receiver Phase limits [-20.0 20.0] deg
Board  1      2      3      4
1:  -3.1   -0.7    2.3    1.1
2:  -2.1   -1.8   -1.7    0.6
3:  -1.3    1.1    2.0    0.5
4:  -0.3    0.5    6.2   -3.2
5:  -2.9    1.5   -0.8   -3.3
6:   2.0    2.5    0.3   -4.1
7:   5.8    0.5    0.5   -0.5
8:  -2.6    0.0    2.1    2.4
9:   4.3    1.7    3.3    0.4
10:  -1.2   -2.4    1.5    1.1
11:  -1.1   -2.4   -1.8    1.8
12:  -2.3   -2.0    3.4    2.7
13:   4.7   -2.9   -2.3    2.2
14:   1.0   -0.9   -2.9   -3.5
15:  -2.3    1.7    3.5    1.6
16:  -2.8   -1.3   -1.1    1.5
17:   2.9   -2.9   -2.2   -1.8
18:  -1.8   -3.0   -4.3    0.6
19:  -0.7   -1.2   -1.2    3.7
20:  -1.0    0.1   -1.7    0.5
21:  -0.7    1.1    0.9   -1.1
22:  -2.9    0.5    0.3   -3.9
23:  -0.9    3.1    2.7   -0.2
24:   2.0    2.9   -4.1   -0.2
25:  -2.4   -0.1   -0.6    2.1
26:   6.3    3.7   -0.5   -2.9
27:   0.6   -1.9    2.4    1.6
28:  -1.9    2.1    1.2    0.5
29:   0.7   -1.4   -3.0    1.0
30:   1.9    2.3   -1.4   -1.7
31:  -1.8   -1.3   -2.9    0.1
32:   3.8    0.9   -0.2    0.5
Rx Channels test passed
---------------------------------------------------------------------------------
2012.06.15 12:53:56.475  116        7        Error
-------------------
Rack 0  Slot  1
No channel errors
-------------------
Rack 0  Slot  2
No channel errors
-------------------
Rack 0  Slot  3
Ch:  4   Hi phase
Ch:  6   Low Z
Ch:  7   Low Z
```

Ch: 9   Low Z
Ch: 11   Low Z
Ch: 12   Low Z
Ch: 13   Low Z
Ch: 14   Low Z
Ch: 18   Low Z
Ch: 19   Low Z

Rack 0 Slot 4
Ch: 0   Low Z
Ch: 1   Low Z
Ch: 12   Low Z
Ch: 30   Low Z

Rack 0 Slot 5
Ch: 18   Low Z
Ch: 23   Low Z
Ch: 24   Low Z
Ch: 30   Low Z

Rack 0 Slot 6
Ch: 8   Low Z
Ch: 11   Low Z
Ch: 12   Low Z
Ch: 14   Low Z
Ch: 19   Low Z

Rack 0 Slot 7
Ch: 31   Low Z
Ch: 33   Low Z

Ch: 34   Low Z
Ch: 35   Low Z

Rack 0 Slot 8
No channel errors

Rack 0 Slot 9
Ch: 21   Low Z

Rack 0 Slot 10
No channel errors

Rack 0 Slot 11
No channel errors

Rack 0 Slot 12
Ch: 11   Low Z

Rack 0 Slot 13
Ch: 23   Low Z

Rack 0 Slot 14
Ch: 1   Low Z
Ch: 19   Low Z

Rack 0 Slot 15
Ch: 17 Low Z

Rack 0 Slot 16
Ch: 10 Low Z

Rack 0 Slot 17
No channel errors

Rack 0 Slot 18
Ch: 12 Low Z

Rack 0 Slot 19
Ch: 25 Low Z

Rack 0 Slot 20
Ch: 11 Low Z
Ch: 23 Low Z
Ch: 26 Low Z
Ch: 31 Low Z
Ch: 35 Low Z

Rack 0 Slot 21
Ch: 11 Low Z
Ch: 23 Low Z
Ch: 35 Low Z

Rack 0 Slot 22
Ch: 7 Low Z

Rack 0 Slot 23
Ch: 24 Low Z

Rack 0 Slot 24
No channel errors
** Tx Channels test failed **

2012.06.15 12:56:39.306 116 8 OK
RX NOISE LEVEL

Board No:	1	2	3	4	
0:	50.4	48.3	50.3	51.1	dB
1:	50.1	47.5	49.7	51.2	dB
2:	49.7	51.8	49.3	50.9	dB
3:	49.1	49.7	48.7	50.7	dB
4:	51.4	49.9	48.5	50.6	dB
5:	51.2	50.7	47.6	49.9	dB
6:	51.9	51.2	48.3	51.0	dB
7:	49.5	49.9	48.0	50.0	dB
8:	50.2	50.7	47.1	50.3	dB
9:	50.6	51.4	48.9	51.3	dB
10:	50.7	50.6	48.7	51.5	dB
11:	50.4	51.2	49.5	51.4	dB
12:	50.4	51.6	47.1	52.0	dB
13:	50.9	51.0	48.3	51.1	dB
14:	50.1	51.1	50.5	51.5	dB
15:	50.2	49.3	47.9	50.1	dB

16:	51.3	51.6	50.6	50.0	dB
17:	50.5	50.6	50.6	50.4	dB
18:	51.7	51.0	50.4	50.1	dB
19:	50.8	50.7	51.0	49.7	dB
20:	50.7	51.4	51.2	50.1	dB
21:	50.3	50.6	49.9	50.4	dB
22:	50.7	51.7	50.3	50.0	dB
23:	49.1	48.9	50.2	49.4	dB
24:	50.5	50.4	48.7	51.6	dB
25:	50.4	48.5	49.3	51.2	dB
26:	50.5	48.2	51.8	50.3	dB
27:	49.9	48.4	50.7	50.8	dB
28:	51.7	49.2	51.4	51.2	dB
29:	50.1	49.3	50.8	50.4	dB
30:	50.7	49.6	50.9	50.7	dB
31:	50.8	48.0	49.5	49.9	dB

Maximum noise at Board 4 Channel 12 Level: 52.0 dB
Broadband noise test

Average noise at Board 1   50.6 dB   OK
Average noise at Board 2   50.3 dB   OK
Average noise at Board 3   49.7 dB   OK
Average noise at Board 4   50.7 dB   OK

2012.06.15 12:56:47.706 116   9   OK
RX NOISE SPECTRUM

Board No:	1	2	3	4	
10.0 kHz:	48.3	48.3	47.1	48.3	dB
10.2 kHz:	51.1	50.1	49.3	49.2	dB
10.3 kHz:	51.1	49.6	49.6	50.1	dB
10.4 kHz:	52.0	50.8	50.9	51.0	dB
10.6 kHz:	52.1	51.6	50.8	51.2	dB
10.7 kHz:	52.8	52.2	51.8	52.0	dB
10.9 kHz:	51.9	51.7	51.2	52.1	dB
11.0 kHz:	52.1	50.8	50.5	51.4	dB
11.2 kHz:	51.5	50.9	51.0	51.8	dB
11.3 kHz:	50.2	49.9	49.5	50.8	dB
11.4 kHz:	50.6	50.8	50.3	50.4	dB
11.6 kHz:	52.0	51.4	50.1	50.7	dB
11.7 kHz:	50.7	50.6	50.1	50.7	dB
11.9 kHz:	50.7	49.6	49.7	50.5	dB
12.0 kHz:	50.3	50.0	49.9	50.5	dB
12.1 kHz:	50.2	50.0	49.4	49.7	dB
12.3 kHz:	48.8	49.0	48.4	49.5	dB
12.4 kHz:	48.4	48.2	48.1	48.9	dB
12.6 kHz:	48.4	48.1	47.5	48.8	dB
12.7 kHz:	48.3	46.8	46.7	48.0	dB
12.9 kHz:	47.4	46.4	46.3	47.4	dB
13.0 kHz:	46.5	46.1	45.4	46.9	dB

Maximum noise at Board 1 Frequency 10.7 kHz Level: 52.8 dB
Spectral noise test

Average noise at Board 1   50.6 dB   OK
Average noise at Board 2   50.0 dB   OK
Average noise at Board 3   49.6 dB   OK
Average noise at Board 4   50.2 dB   OK

2012.06.15 12:56:56.106 116 10 OK
CPU: PP 432/05x PENTIUM4
Clock 2166 MHz
Die 34 oC (peak: 36 oC @ 2012-06-15 - 12:50:46)
Board 33 oC (peak: 33 oC @ 2012-06-15 - 12:55:40)
Core 1.03 V
3V3 3.27 V
12V 11.91 V
-12V -11.91 V
BATT 1.78 V
Primary network: 157.237.14.60:0xffff0000
Secondary network: 129.100.1.122:0xffff0000

2012.06.15 12:56:56.139 116 15 OK
BIST test 15 June 2012 in 90 m water depths
EM 122
BSP67B Master: 2.2.3 090702
BSP67B Slave: 2.2.3 090702
CPU: 1.2.1 100617
DDS: 3.5.0 100615
RX32 version : Feb 18 2010 Rev 1.11
TX36 LC version : Jun 17 2008 Rev 1.11
VxWorks 5.5.1 Build V1.19-01 Oct 8 2009, 13:31:43
End of BIST test