CRUISE REPORT

USNS Henson (T-AGS-63)

U.S. Law of the Sea cruise to map the foot of the slope and 2500-m isobath of the Northeast US Atlantic continental margin

CRUISES H04-1, 2 and 3

August 23, to November 30, 2004

Gulfport, MS to Norfolk, VA

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Table of Contents

Introduction

An exhaustive study of the US data holdings pertinent to the formulation of U.S. potential claims under the United Nations Convention of the Law of the Sea (UNCLOS) identified several regions where new bathymetric surveys are needed (Mayer, et al., 2002). The report recommended that multibeam echosounder (MBES) data are needed to rigorously define (1) the foot of the slope (FoS), a parameter of a UNCLOS-stipulated formula lines, and (2) the 2500-m isobath, a parameter of a UNCLOS-stipulated cutoff line. Both of these parameters, the first a precise geodetic isobath and second a geomorphic zone, are used to define an extended claim. The National Oceanic and Atmospheric Administration (NOAA) was given the charge to contract for the new surveys and they used the Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) of the University of New Hampshire to manage the surveys and archive the resultant data. This is the report of the U.S. Law of the Sea cruises to map the US Atlantic continental margin (Figs.1 and 2).

NOAA entered into an agreement with the US Naval Oceanographic Office (NAVOCEANO) to perform the entire survey beginning August 23, 2004. NAVOCEANO made available the 329-ft, 5000-ton hydrographic ship USNS *Henson* (Fig. 3) with a hull-mounted Kongsberg Simrad EM121A MBES as well as a ODEC Bathy2000 3.5-kHz chirp sub-bottom profiler and a BGM-5 Bell Gravity Meter. The planned schedule for the cruise called for 3 legs of 30 days of operations and three port calls.

NAVOCEANO was responsible for system calibration, data collection and quality control and overall cruise management whereas Science Applications International Corp. (SAIC) was contracted by NOAA to perform bathymetry processing aboard ship. The overall responsibility of cruise planning, both before and during the cruises, as well as processing MBES acoustic backscatter and 3.5-kHz profiler data were the responsibilities of the UNH/NOAA representative aboard ship.

The first leg of operations required a six-day, 3450 km, transit from Gulfport, MS to an area near the claimed US-Canadian maritime boundary (Fig. 1). A patch test (exclusive of a yaw calibration) was performed in this area and was followed by 17 days of progressively mapping the margin from north to south. Leg 1 of the survey was completed on September 19, 2004 and the ship transited to Newport, RI for re-supply and a crew change. The first leg collected 7899 line km of MBES and 3.5-kHz profiler lines. Leg 2 of the survey departed Newport, RI on September 24, 2004 and collected 10,397 line km of MBES and 3.5-kHz profiler lines before arriving at Little Creek, VA on October 22, 2004. Leg 3 departed Little Creek, VA on October 26, 2004 and collected 13,755 line km of MBES and 3.5-kHz profiles and arrived in Norfolk, VA on November 29, 2004, ending the cruise. The cruise mapped a total of ~130,000 km^2 in 59.2 survey days, with an average speed of 13 kts. The remainder of the time was consumed by weather delays, port calls, transits, and evacuations. A summary of the cruises is given in Table 1.

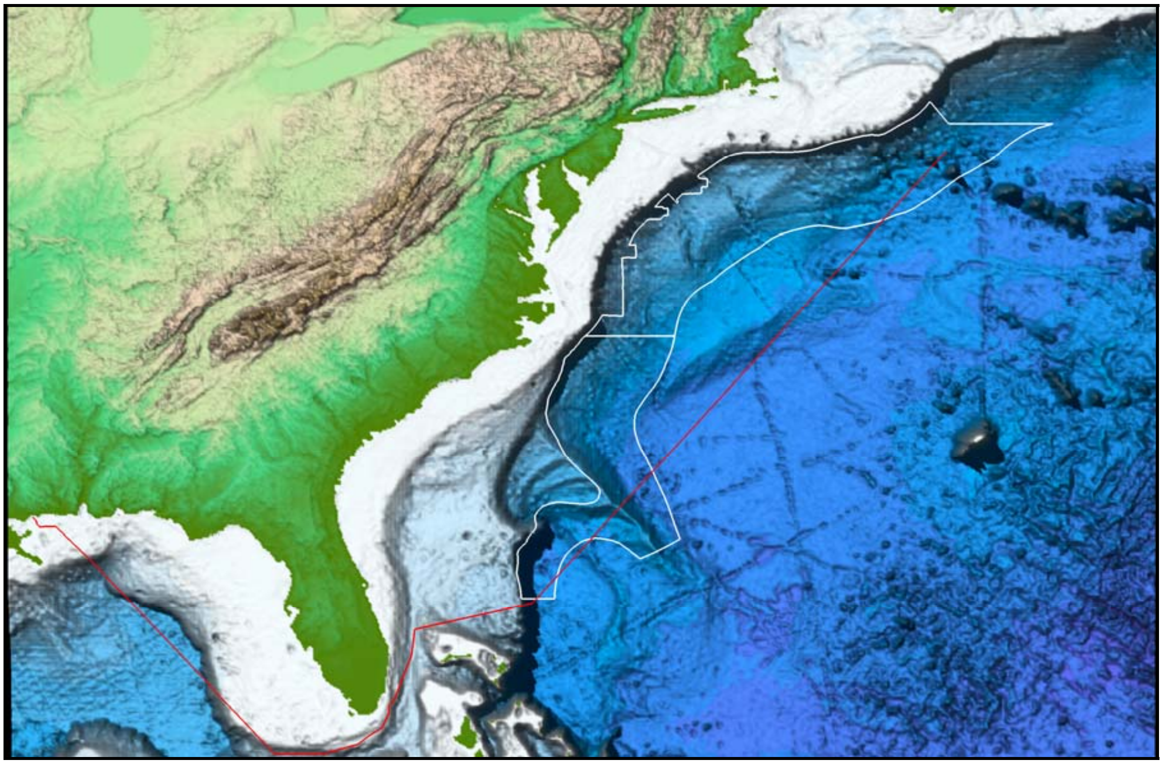


Figure 1. Transit track (red line) from Gulfport, MS to the patch test area. White polygons outline the survey areas (see Fig. 2).

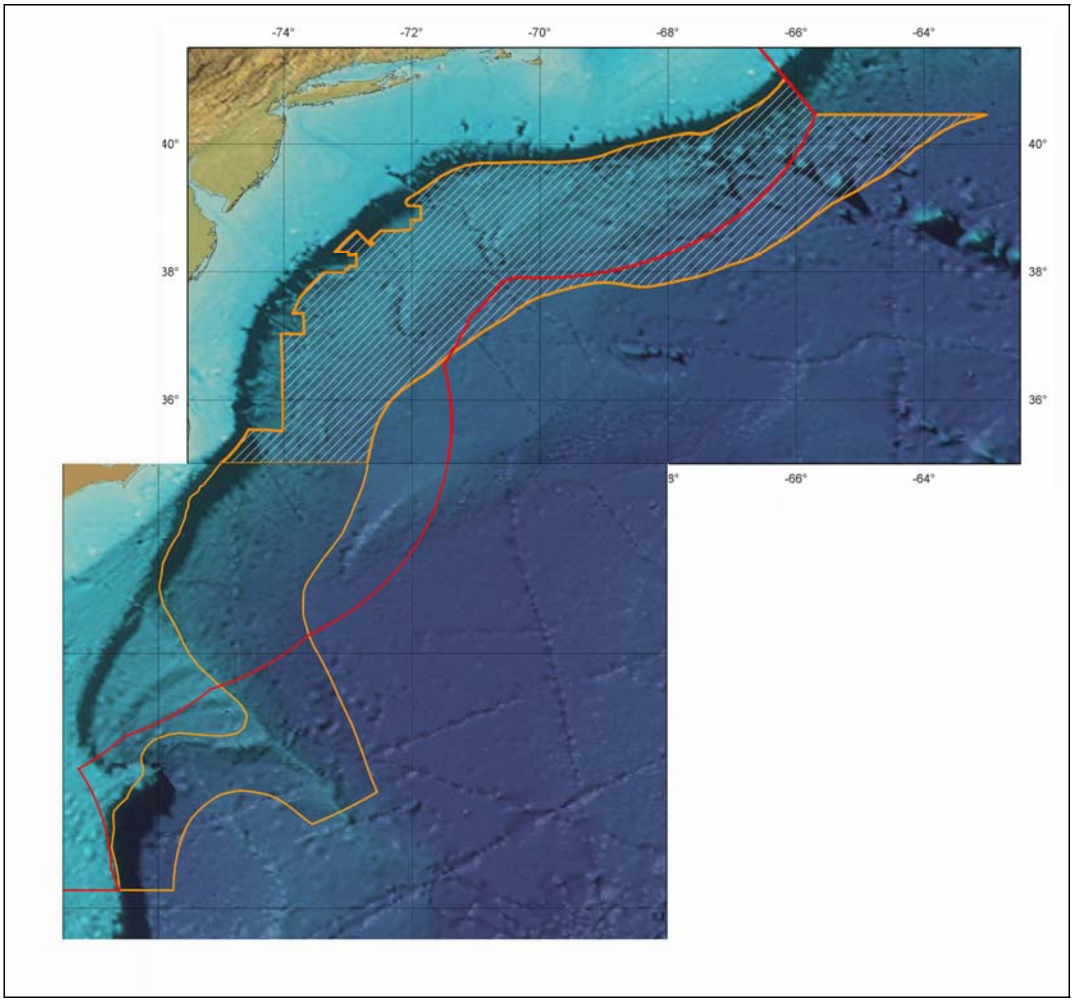


Figure 2. Survey area (orange polygon) of the US Atlantic margin. Red polygon is the limit of the US Exclusive Economic Zone.

Figure 3. USNS Henson used to map the U.S. Atlantic margin.

The Multibeam Echosounder System and Associated Systems

A hull-mounted Kongsberg Simrad EM121A MBES system was used throughout the survey. The EM121A is a 12-kHz, MBES system that generates 121-1˚ receive apertures over a 120˚ swath. Two Applied Microsystems Ltd Smart SV&T sound-velocity sensors are hull mounted to measure the sound speed at the array for accurate beamforming. Equiangular beamforming for the EM121A produced seafloor footprints of each receive beam that grow with angle away from nadir. For 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 interferometric phase detection. Individual soundings are spaced approximately every 50 m, regardless of survey speed.

The manufacturer states that, at the 15-ms pulse length used during this survey (deep mode), the system is capable of depth accuracies of 0.3 to 0.5% of water depth. The motion reference units (MRU) included a Hippy for heave and a Sperry Model Mark 39 gyro for pitch and yaw. 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. An Applanex POS/MV 320 version 3 inertial motion unit (IMU) was interfaced with a Wide Area Differential-Aided GPS (DGPS) using Fugro SkyFix differential signals to provide position fixes with an accuracy of < ±5 m. All horizontal positions were geo-referenced to the WGS84 ellipsoid and mapping (vertical referencing) was to instantaneous sea level.

The Simrad EM121A is capable of simultaneously collecting full time-series acoustic backscatter along with the bathymetry. This represents a time series of 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 calibrated backscatter should provide clues as to the composition of the surficial seafloor.

Water-column sound-speed profiles were calculated from casts of Sippican model T10 (200 m maximum depth) and Deep Blue (760 m maximum depth) expendable bathythermographs (XBTs) to measure temperature as a function of depth routinely every 6 hours and between scheduled casts as required.

The Area: The US Atlantic Margin

The specific area mapped during this cruise was defined in Mayer et al., 2002 as those areas of the U.S. Atlantic margin where a potential U.S. claim beyond the US EEZ could be made under UNCLOS Article 76. In order to satisfy the requirements of Article 76, the entire continental slope off the eastern U.S. between the ~2000 and 4800-m isobaths needed to be mapped. This area contains numerous large submarine canyons, zones of massive failures, a chain of volcanic seamounts, major sediment tongues, and a huge sediment drift.

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 (Folger, et al., 1979; Emery and Uchupi, 1984; Poag, 1992; O'Leary and Dobson, 1992). A deep mantle plume or hot-spot erupted off the axis of the North Atlantic spreading ridge in the Early Cretaceous (about 130 m.y. ago). The hot spot produced a string of volcanic seamounts, the New England Seamounts, that continued for ~50 m.y. until the Late Cretaceous (about 73 m.y. ago; Duncan, 1984). The northern part of the survey mapped the western-most of these seamounts. 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 m.y.), a period dominated by at least 18 major fluctuations of eustatic sea level (Shackleton, 1987). The age of major canyon cutting is unknown but is thought to have occurred during the Neogene and Quaternary (Poag, 1992). The southern part of the survey area is dominated by the Blake Outer Ridge and Blake Spur. 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. The barrier diverted the surface waters of the Caribbean and Gulf of Mexico into an anticyclonic gyre that merges with the Antilles Current between Florida and the Bahamas and then continues to the NW.

The US eastern margin was subdivided into 5 areas for generating overview maps (Fig. 4). Each map was gridded with a 100-m cell size because our 12 to 14 kt mapping speed allowed at least 3 soundings to fall within in each footprint regardless of water depth. Operationally, we were required to subdivide the area into 9 NAVO Areas (Fig. 5). Individual lines were required to stay within each NAVO Area during the mapping. The NAVO Areas are not to be confused with the overview areas. The maps in Appendix 3 of this report are of the overview areas.

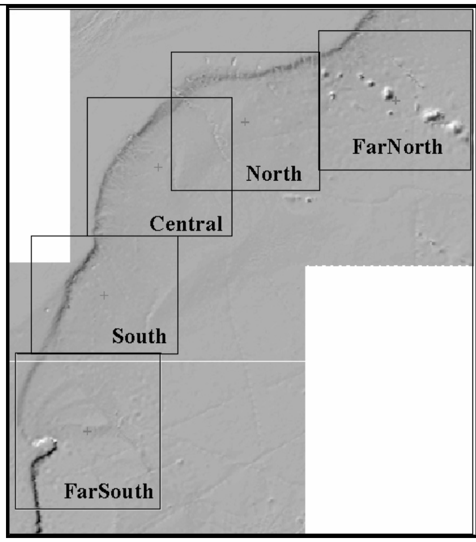


Figure 4. Index of overview map areas.

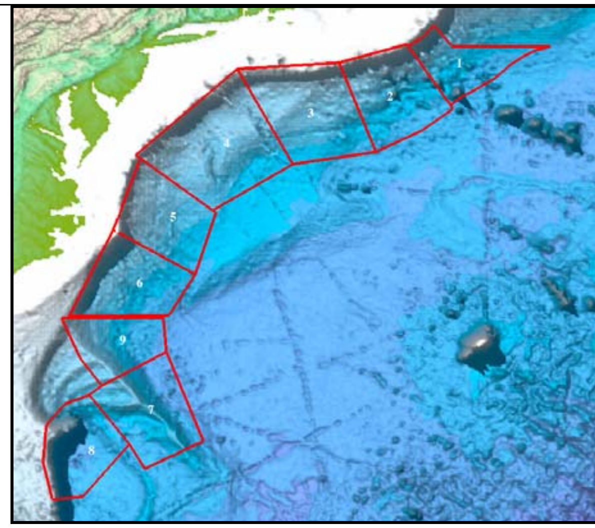


Figure 5. Index of NAVO areas used for operations only.

Daily Log Leg 1

August 23, 2004 (JD236)

We departed Gulfport, MS at 1515 L (2015 Z) and began the transit to the northern survey area. Numerous teething difficulties occurred during the day, including problems with the MBES that was missing the inner 40 beams. Networking the various computers was a headache and was not resolved. Transit speed was ~14 kts on calm seas and clear weather.

August 24, 2004 (JD237)

We transited south through the northeastern Gulf of Mexico all day. We continued to have teething problems getting the systems going and online. The MBES and 3.5-kHz systems came online in the early afternoon and seemed to be running smoothly. Networking problems were solved and by late afternoon all systems were connected and online. Transit speed was ~14 kts on calm seas and clear weather. The transit data were not available to non-NAVOCEANO personnel because they were deemed a "Military Survey". However, the Simrad console showed the system seemed to be performing to specifications.

August 25, 2004 (JD238)

We transited out of the Gulf of Mexico in the early afternoon and began the leg north between Florida and the Bahamas riding the Florida Current. The ship slowed to ~6 kts at 1400 L to lower the hydrographic survey launches (HSLs) over the side, one at a time, for some kind of required monthly exercise. The HSLs were secured on deck by 1600 L and we continued on the transit to the planned calibration site at 39.61169˚N 65.75108˚W, just to the SW of Balanus Seamount (Fig. 6). Transit speed was ~15 kts over the ground. Around JD238/2000Z we transited over a large area of sink holes (blue holes?) that appeared to follow a trend of about 010˚.

August 26, 2004 (JD239)

We continued the transit at about 15 kts between Florida and the Bahamas under calm seas and winds. We crossed beyond the northern Bahamas-US maritime boundary in the mid afternoon and continued the transit in deep water. So far, no data have been collected for public release.

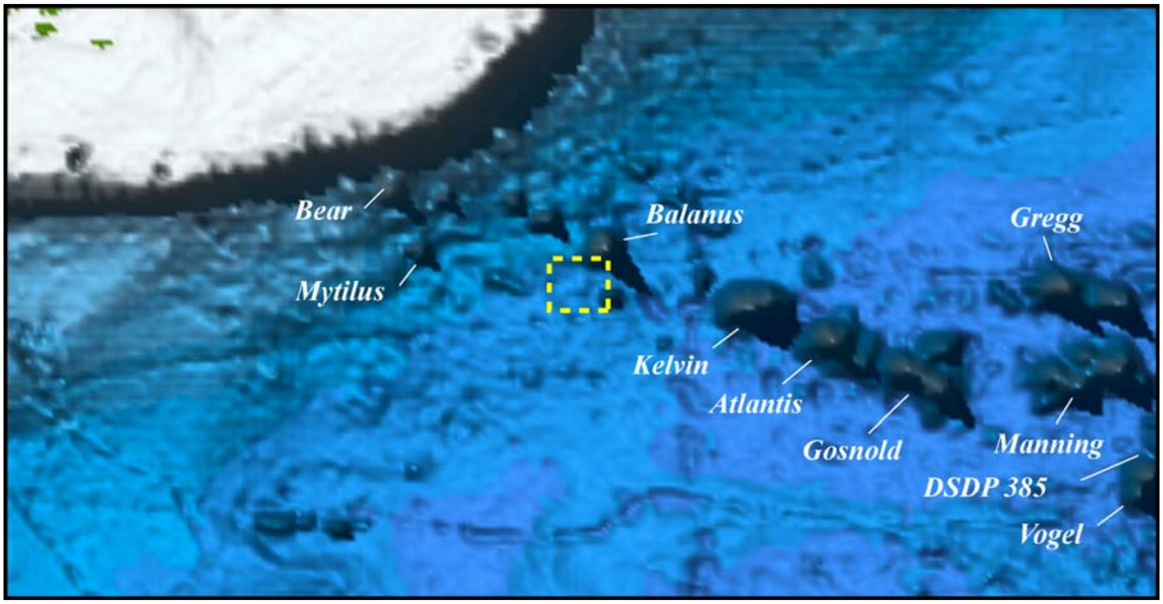


Figure 6. Shaded relief of NW New England Seamounts. Bathymetry from ETOPO2. Yellow box is area of patch test.

We crossed a beautifully formed perched channel with 12 m high levees on both sides at JD 239/1719Z. The channel showed up on the 3.5-kHz profiler but did not show on the MBES data.

August 27, 2004 (JD240)

We continued the northward transit in international waters on gentle seas and breezes. The average transit speed continued to be ~14 kts. We received official word that we could survey inside the Canadian and Bahaman EEZs, although our intent continued to be to only make turns within those zones. However, we were also informed of a US Navy exclusion zone that we were not allowed into because of “operational exercises”. The exclusion zone only affects a small portion of the anticipated mapping area in the far NE section of the northern survey box (Fig. 7).

Figure 7. Map showing the survey box 1 (yellow) and the Navy exclusion zone (white area).

August 28, 2004 (JD241)

We continued the northward transit in international waters with continued good weather. Our transit speed averaged ~14.5 kts. We crossed into the northern polygon area in the evening and began to collect data for comparisons of ship noise and swath coverage versus speed over the ground.

At 1245L (1648Z) we were informed that an Atlas missile launch was scheduled for today from Cape Canaveral, FL this afternoon. The debris field from the launch is an area from offshore Cape Hatteras to offshore Nova Scotia, directly along our transit path. The Captain slowed the ship to 10 kts and changed course to a more easterly one so as to avoid the debris-field zone. Although the launch window was scheduled for only 75 minutes duration, we were not informed when exactly the launch was to occur. If the launch is scrubbed for today, we were informed it would be rescheduled for tomorrow, with the same debris-field warning. We hove-to for 4 hours waiting for word of the launch and finally got underway to continue the transit at 1700 L with no sighting of a missile. Word arrived aboard ship that the missile launch was scrubbed for today and has been rescheduled for 1500 L tomorrow.

We passed into the survey polygon at 2130L and ran two speed trials. the first at 12 kts (over the ground) for a hour and the second at 10 kts for an hour. The analysis of the data showed that the data were clean and acquired sufficient mapping density at both speeds so we planned to run the survey at 12 kts (over the ground). We then continued the transit to Balanus Seamount for the patch test.

August 29, 2004 (JD242)

We arrived at the patch test site at 0730L and launched an expendable CTD, but the wire broke at 600 m depth. The CTD was rigged and launched at 0815L and got a good record down to 4500 m. An analysis of the speed trials revealed an artifact in the bathymetry data. “Railroad tracks” occur at ~35˚ on either side of nadir (Figs. 7 and 8).

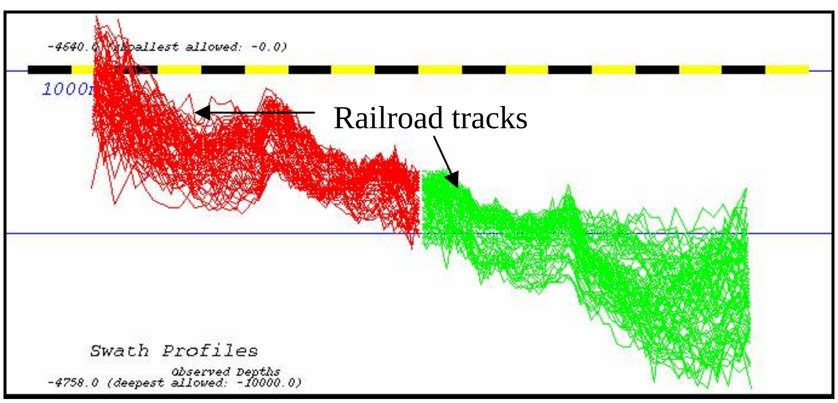


Figure 7. Profile view of full swath of 60 pings showing the “railroad” artifact at ±~35˚ from nadir.

The horns are not composed of a single beam on each side of the array; several beams are involved, centered at ±35˚. The resulting DTM has severe “railroad tracks” that parallel the ship track (Fig. 8). The tracks have a relief of ~10 m in water depths of4600 m. There seems to be no cure for the artifact; they occur regardless of the transmit power and receiver gain settings. However, we did notice that the horns and tracks do not occur in water depths of 2000 to 3000 m.

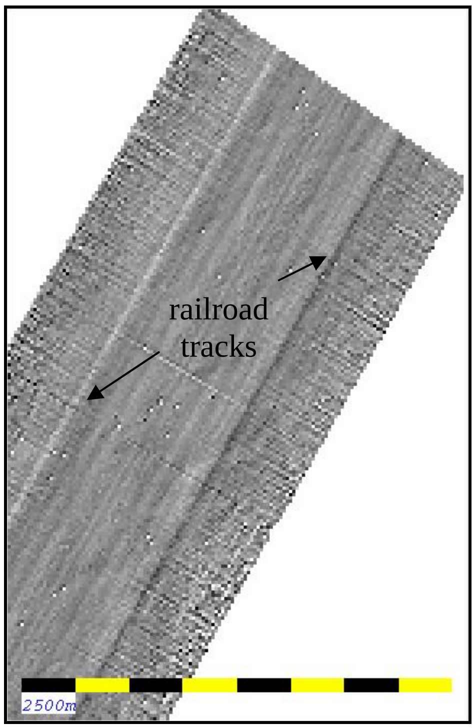


Figure 8. DTM showing DTM view of “railroad tracks” artifact.

Two CTDs were lowered on the wire to inter-calibrate them and they showed remarkable similarities. The CTD station was completed by 1400L. However, we were again warned of the Florida missile launch so we steamed due south towards a patch test site on the southwest side of Balunas Seamount. This location was determined to be out of harm's way. The weather was bright but the winds were blowing a sustained 25 kts with gusts to 30 kts.

At 2015L we were informed that the missile launch was canceled again and rescheduled for tomorrow. We reversed course and transited back into the survey polygon to perform the patch test. However, almost immediately after starting the transit, we were informed that Tropical Storm Hermine had abruptly formed and was to merge with Tropical Depression Gaston and together was only a few hundred miles southwest of us and headed directly at us. The projected seas were 14 ft, which had the Captain nervous. Certainly, we could not map under those conditions, so plans were made to move out of the way of this weather if it materialized. We continued to transit back into the survey polygon throughout the evening.

August 30, 2004 (JD243)

We located a flat area inside the survey polygon at 0030L and began a full patch test. The patch test was completed at 0845L with no offsets needed to the lever arms. The results of the differences in depth running over the same ground shows that the EM121A MBES achieved a vertical precision of ~0.1% of water depth (Fig. 8).

At 0915L, the Captain informed us that he had been informed that the missile launch was again scheduled for this evening. However, there was a possibility the launch would be delayed for days because of the approaching Hurricane Francis (Fig. 10). In addition, the Captain told us that the weather predictions had the combined Hermine and Gaston passing right through our area with predicted waves of 14+ ft. The Captain wanted to keep the ship in the eastern part of our survey area so we transited to a location 63 km from the southern border of the survey polygon and began mapping Atlantic_line_1, on a course of 058˚ at 1125L. This line will run just south of Balanus Seamount (Fig. 6). The logic of this line placement was that, although we had not yet identified the foot of the slope, this line should be in the vicinity of it. Once the weather and missiles were past, we planned to immediately run the dip line to define the location of the foot of the slope.

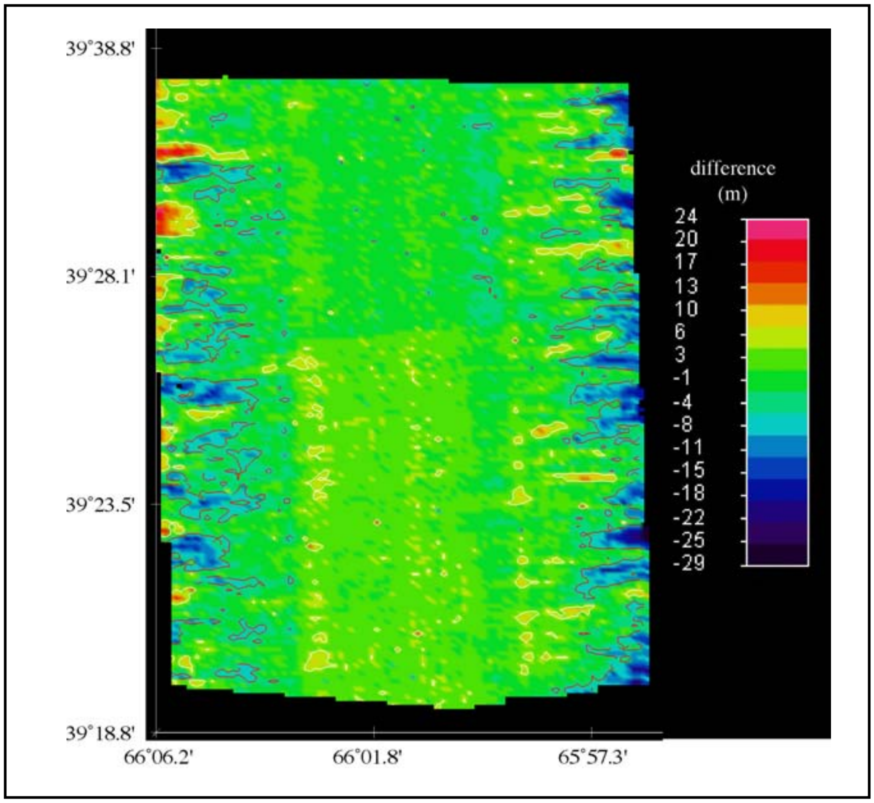


Figure 8. Difference surface comparing patch1 and patch2 run on reciprocal courses. The red contour is –0.1%WD and the white contour is +0.1%WD.

The CTD and XBT casts showed an uncomplicated sound-velocity profile (Fig. 9) so the Gulf Stream proper and warm- and cold-core rings had not presented a problem.

No missile launch occurred today and we were left alone to continue mapping. The weather and seas appeared to improve over the afternoon conditions.

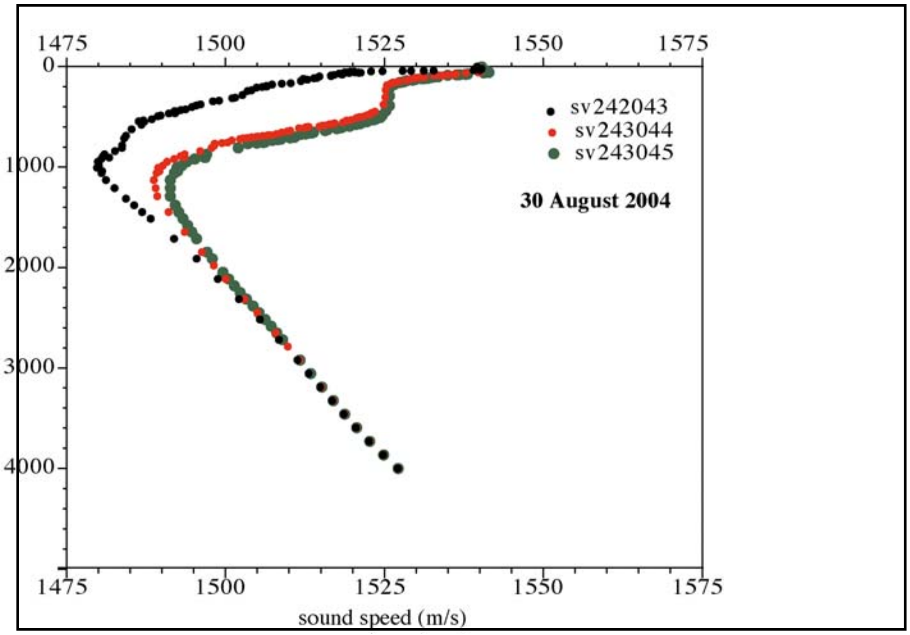


Figure 9. Three XBT casts from day 30 August 2004 showing the variability in sound-speed profile in a small area over a 18 hr period.

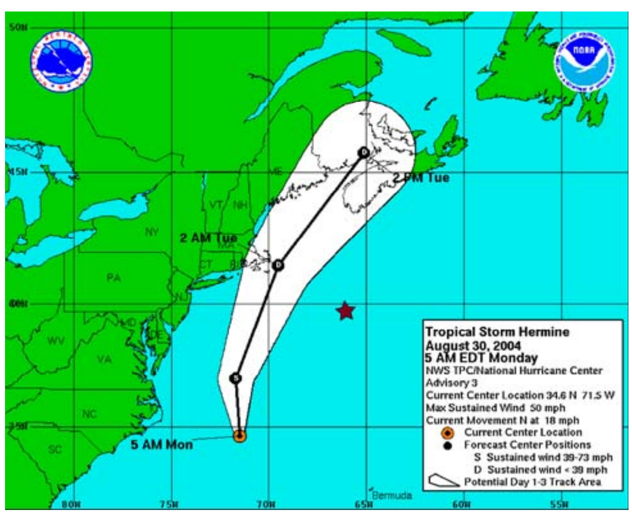


Figure 10. Weather forecast received on 30 August showing the path of the combined Tropical Storms Hermine and Gaston. The position of the ship is shown by the red star.

August 31, 2004 (JD244)

The wind freshened over the night as Tropical Storm Gaston drew closer and by morning the wind was blowing a steady 25 kts out of the NW directly on our beam. The wind and seas induced a significant crab in our orientation along the survey line. The seas were running 6 to 8 ft and we were pitching a bit, but the data quality looked OK. However, by noon the seas were 10 to 12 ft and pitching was interfering with the data quality. The ship was slowed to 10 kts over the ground and the data quality improved somewhat.

We ran the second line, with a heading of 060˚ as the seas continued to build. The Captain informed us that the forecast was for the seas to continue building throughout the afternoon. We started line 3 but only 50 minutes into it, at 1445 L, we broke off the line because a weather forecast update predicted seas in the 15 to 20 ft range by evening for the area we were heading toward. We headed due south collecting no data to an area predicted to be calmer where we hove-to to ride out the storm.

August 31, 2004 (JD244)

We hove-to all night and left the holding area at 0830L to begin the 8 hr transit back to the map area. The weather forecast was for diminishing seas throughout the day in the area. We also were notified that the missile launch occurred last night, so we were no longer be hounded by that problem.

We transited the survey polygon at 1600 L and began to collect data as Line 4. The transit took us to the break-off point of Line 3a and then continued the line to the NE.

September 1, 2004 (JD245)

We mapped all day with no problems from weather and we received word that the missile launch occurred so that was no longer a worry.

September 2, 2004 (JD246)

Mostly a routine day of mapping at a steady 12 kts. At 0830L we lost all navigation for about 5 minutes. This left a small data gap in Line 6 but did not affect our ability to locate the foot of the slope so we did not re-run the gap portion of the line. Other than that, all was routine.

We made a pass on either side of Kelvin Seamount but left a large holiday at the summit area. We couldn't leave it that way, it just didn't seem right, so we made a small box survey to map the summit. We just *had* to do it.

September 3, 2004 (JD247)

Routine day of mapping. The weather was sunny and warm with calm wind and seas. A 3-ft long-period swell was all we had. The survey speed was a steady at 12 kts.

We completed the deep-water section of the northern-most survey polygon and started a dip line directly up the margin to help locate the foot of the slope and the 2500-m isobath. A small detour developed when communications between the bridge and the survey tech got confused. That confusion accounted for a short line too close to Kelvin Seamount, then a short transit, then the dip line.

September 4, 2004 (JD248)

We completed the cross line in the northern mapping polygon and then commenced mapping from shallow towards deeper water. The cross line shows that in this area there is not a distinct foot of the slope (Fig. 11).

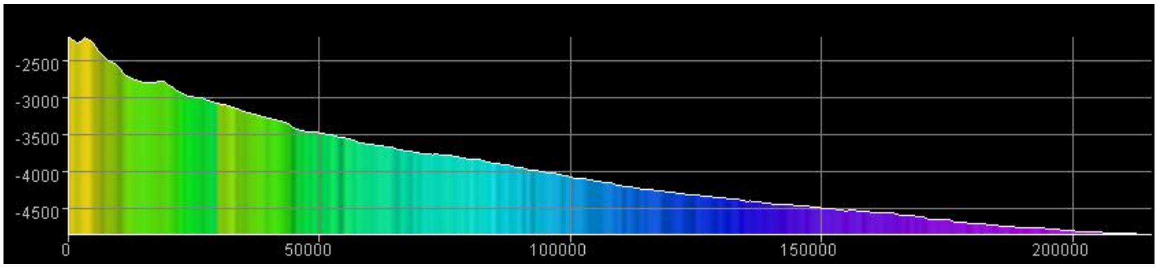


Figure 11. Profile of cross line showing no distinct foot of the slope in northern area.

A cross-check analysis of the cross line showed the difference between mappings from the cross lines, at the 95% confidence level, was 0.7% of the water depth (Fig. 12).

Beams 56 to 66 of pings 302 to 338 and 392 to 435 placed the seafloor 17 m below the mean surface creating strange rectangular depressions. These two artifacts were the only occurrence of these artifacts. The gridding algorithm smoothed out the artifacts making them almost undetectable in the area maps.

September 5, 2004 (JD249)

Routine day of mapping. The wind picked up to ~30 kts in the early morning and stayed in the range of 25 to 30 kts. The wind created some lumpy seas but they did not affect the data quality. The backscatter data for Line 29 was lost because the raw.all file was corrupted. However, the GSF file was unaffected so bathymetry was not lost.

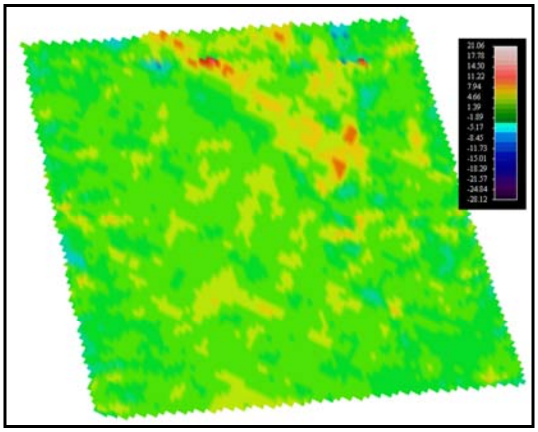


Figure 12a. Difference surface between the DTM and the cross line. The difference at the 95% confidence level is 0.7% of water depth.

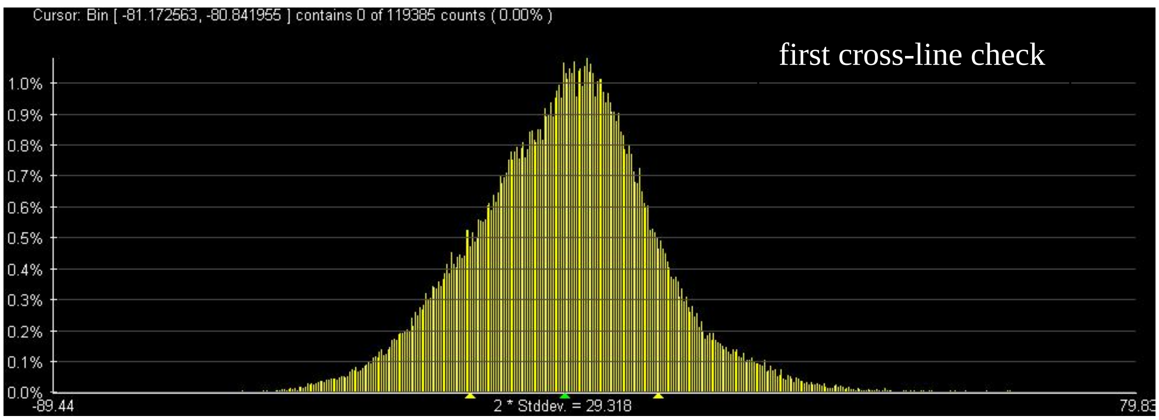


Figure 11b. Frequency of depth differences comparing the cross line with the mapped surface.

September 6, 2004 (JD250)

Routine day of mapping.

September 7, 2004 (JD251)

Routine day of mapping. We began to notice that when the difference between the measured surface sound speed and the surface value of the SVP exceeded ~2 m/s and a new sound velocity profile was applied, whether from a new XBT or from an existing one, we saw a significant depth artifact on the DTM (Fig. 13). A new sound velocity profile was required because we passed through alternating warm and cold filaments of Gulf Stream eddies that significantly changed both the surface sound speed and the sound velocity profile. We decided that when the difference between the two surface sound

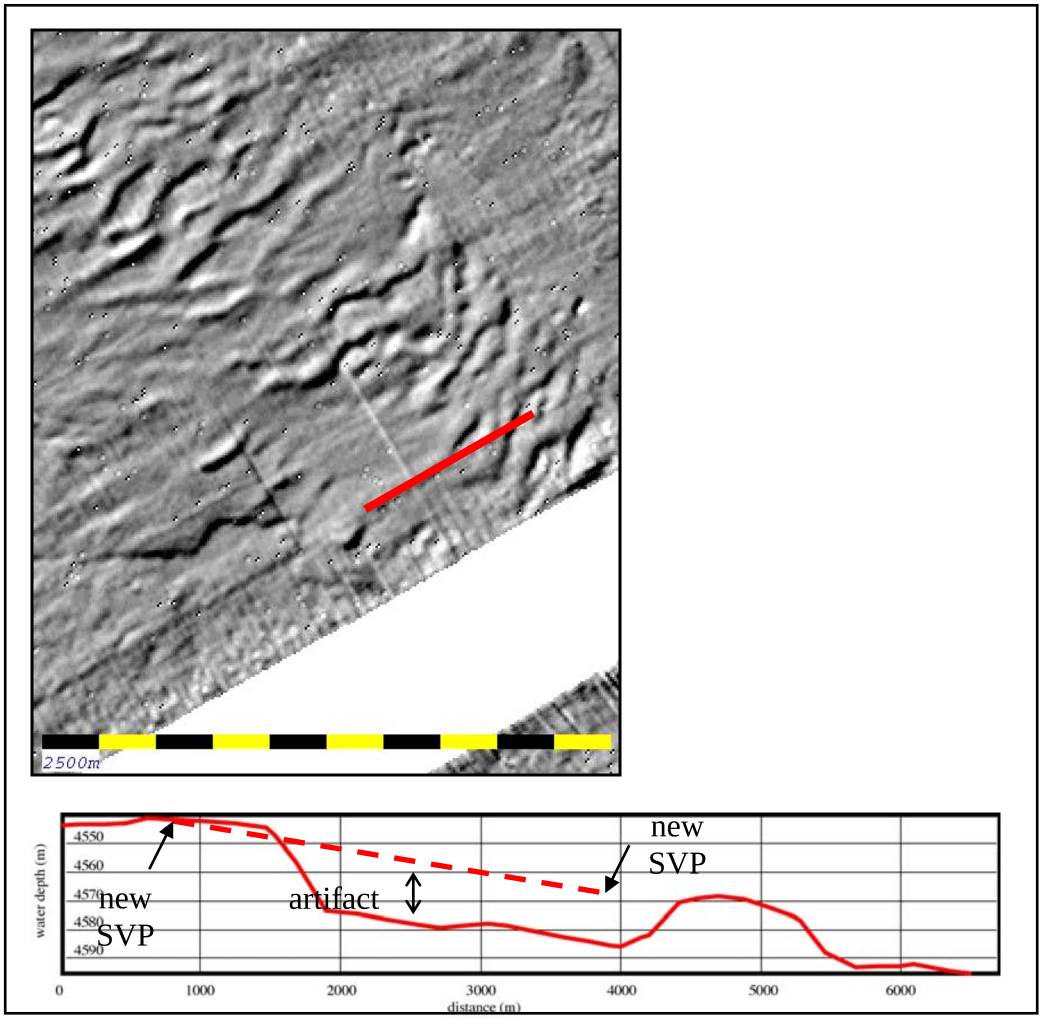


Figure 13. DTM (top) of dropdown caused by application of new sound velocity profile (SVP). Profile (bottom) shows the resulting 15-m depth artifact.

speeds reached a value of 0.5 m/s an XBT would be launched and a new SVP would be applied. This threshold should reduce the large artifact in bottom depths.

September 8, 2004 (JD252)

Both the Sperry gyro and the Simrad logger crashed during the night. The systems were restored and the line was continued but the Simrad logger did not log data on the resumed line (NAVO Line 41). The acoustic backscatter and navigation for Line 41 was lost but the ISS-60 logged bathymetry.

We transited to the southern border of the northern polygon and completed the southern-most line and then continued the track SW about 70% through the bottom of the next mapping polygon. We than began to run a cross line up the margin to look for any recognizable foot of the slope in this area.

The seas were lumpy throughout the afternoon and evening causing a lot of data dropouts. We reduced speed from 14 to 12 kts but saw little improvement. Refraction continued to be a headache as we passed through filaments spun off Gulf Stream rings.

September 9, 2004 (JD253)

The sea state deteriorated throughout the night, evidently because of the re-emergence of Hurricane Francis as it passed back into the North Atlantic. The confused seas causes a lot of short-period rolling and pitching which affected the quality of the data. In addition, to maintain course on line, the ship had to crab ~20˚.

Most of the day was spent running the dip line up the margin. We stopped midway up the dip line to take a full-rosette (water bottles) CTD cast. The cast took about 3.5 hrs to complete, in part because of mechanical and electrical problems with the CTD.

The seas calmed in the mid afternoon and we increased speed to 14 kts with excellent data quality. The raw.all data from the dip line (Line 47) had corrupted times and azimuths that rendered the data useless. Fortunately, and unexplained, the ISS-60 generated a perfectly good GSF bathymetry file that could be used for cross-line checks. The data continued to have a precession better than 0.5% of the water depth.

The first line of the second mapping polygon was run south of the polygon boundary because of the location of the 2000-m isobath on the dip line. This will save at least two survey days.

The 3.5-kHz data continue to be high quality for the most part (Fig. 14). The quality is especially surprising because most of it has been collected at 13 to 14 kts.

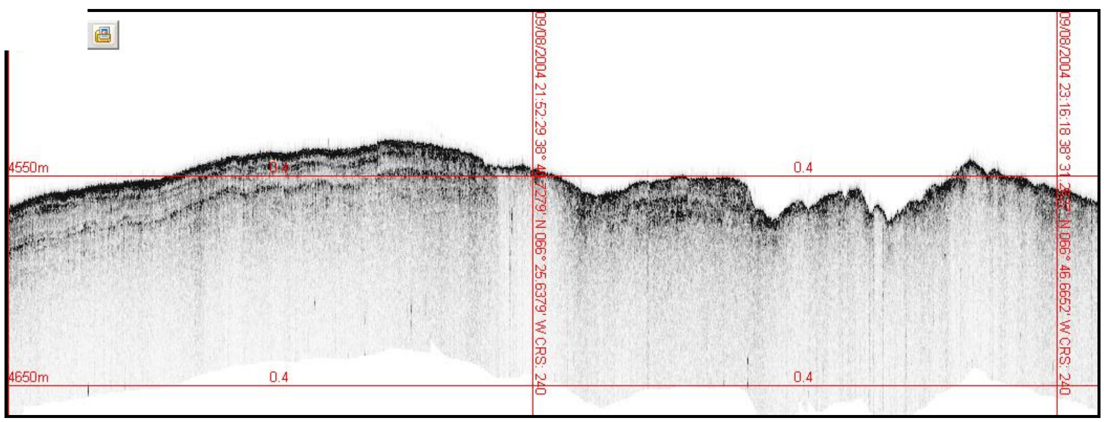


Figure 14. Sample of typical 3.5-kHz profile from day 040908. Note the excellent penetration even though the data were collected at 14 kts.

September 10, 2004 (JD254)

The seas again became confused and very lumpy during the night and throughout the day. We apparently were still under the influence of the remnants of Hurricane Francis. Routine day of mapping the upper slope in the second mapping polygon. Canyons along the upper slope complicate the physiography and required tighter line spacing than we would have preferred, but to get full-bottom coverage, we had to keep to a tight spacing.

The trend of the isobaths on the upper slope differed from our planned survey lines resulting in a variable swath width from the NE to the SW portions of the second mapping polygon. This required a 50% swath overlap in the SW but only a 15% overlap in the NE.

September 11, 2004 (JD255)

Routine day of mapping. The sea and swell were relatively minor and the wind was only ~15 kts. The weather was cool and overcast. Survey speeds with 13 to 14 kts.

September 12, 2004 (JD256)

Routine day of mapping. The sea and swell were minor with 15 kt breezes. The weather was cool and overcast.

It was clear that the railroad-track artifacts (Fig. 7) first appears in water depths of ~2700 m. A query to Simrad replied that this is a trait of the EM121A and only occurs with the system is operating in the Deep mode using 1˚x1˚ beam angles.

September 13, 2004 (JD257)

For the most part, it was a routine day of mapping. Weather and seas fine. Most of the morning was spent filling in two large holidays on a seamount and just to the north of the seamount. The holidays occurred in a zone that includes the 2500-m isobath, so it was considered worth the time spent.

A severe sound-speed change occurred during Line 69 starting at ping 1352 and continuing until ping 1534. The surface-water temperature showed we passed through a zone with a sudden +2˚ SST change. The data for this time had to be edited out because the beam forming could not compensate and the mappings were severely affected.

At 1845 L we were informed by the Captain that we had a medical emergency (Third Mate had appendicitis) aboard and we had to immediately terminate the mapping of Line 70 and head for shore.

September 14, 2004 (JD258)

We hove to at a buoy off Newport, RI at 0700 L and evacuated the Third Mate. We then reversed course and at 1000 L began the transited back to the survey area to resume mapping.

September 15, 2004 (JD259)

The two-way transit took 29 hr. The MBES system and 3.5-kHz were not recorded on the round-trip transit. We arrived back at the end of Line 70 at 2345 L and began mapping Line 71.

September 16, 2004 (JD260)

Routine day of mapping. Weather warm, bright and seas calm.

September 17, 2004 (JD261)

Routine day of mapping. Weather warm, bright with 20-kt breezes and 2-ft seas. We have been passing back and forth through a warm surface filament off the Gulf Stream for the past couple of days and it has cause artifacts in the bathymetry. Often, when a new sound-velocity profile (SVP) is applied we get a sudden drop of ~10 m in the bathymetry affecting beams 55 through 65 (±5˚ of nadir) (Fig. 13). The drop in bathymetry is consistently below 0.5% of water depth so the artifact has not been a concern, however, it is present in the data. A new SVP is required when we pass into and out of filaments of the Gulf Stream with sea-surface temperatures that differ by 1.5˚ to 2.5˚ from the surrounding water. This temperature change cause severe refraction artifacts so a new XBT is dropped and the resulting new SVP is applied. Once through the filament, the previous SVP is applied, thus causing he step in bathymetry.

September 18, 2004 (JD262)

At 0910L the Captain informed us that he had been advised that the weather was predicted to deteriorate in our immediate area over the next 8 hours to 14-ft seas. This weather is the lingering effects of Hurricane Ivan. The Captain ended the survey immediately and head NW into the weather but towards Newport, RI seeking calmer waters on the coast. This decision ended the mapping on Leg 1.

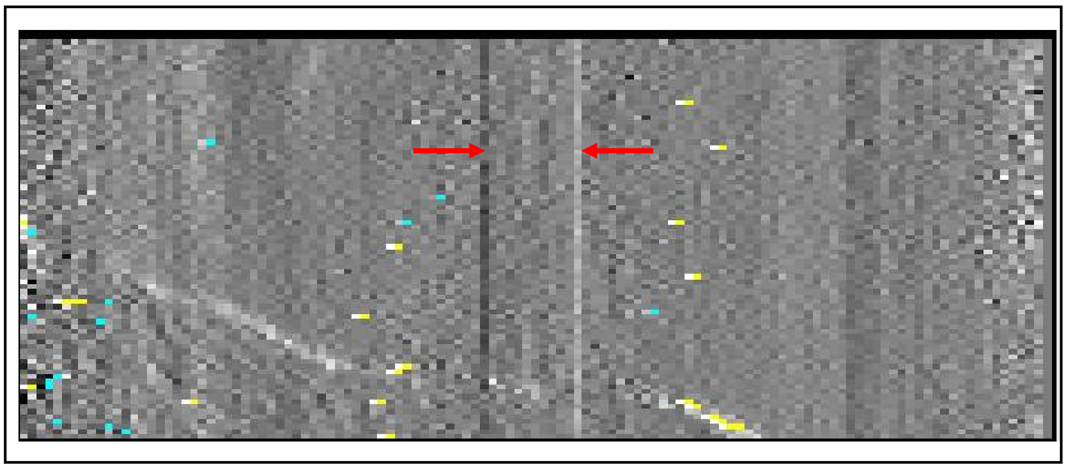


Figure 13. Bathymetric artifact (red arrows) caused by the application of a new SVP. The nadir region has dropped ~10 m relative to the middle- and outer-beam mappings

September 19, 2004 (JD263)

We arrived at the dock in the Newport Navy shipyard at 0900 L.

Daily Log Leg 2

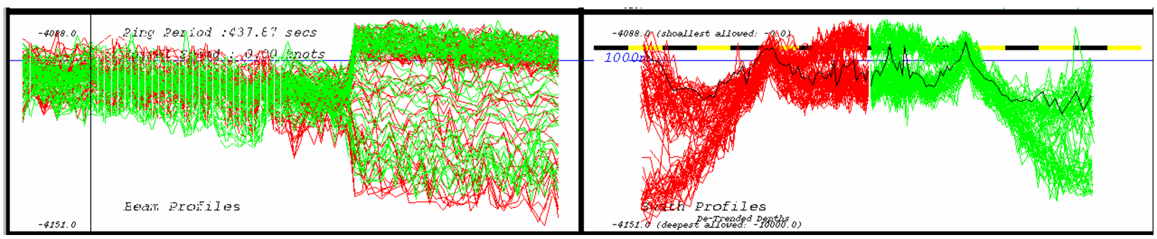
September 24, 2004 (JD268)

We departed Newport, RI at 1600 L (2100 Z) and transited to the northern survey area. Transit speed was ~14 kts on calm seas and clear weather.

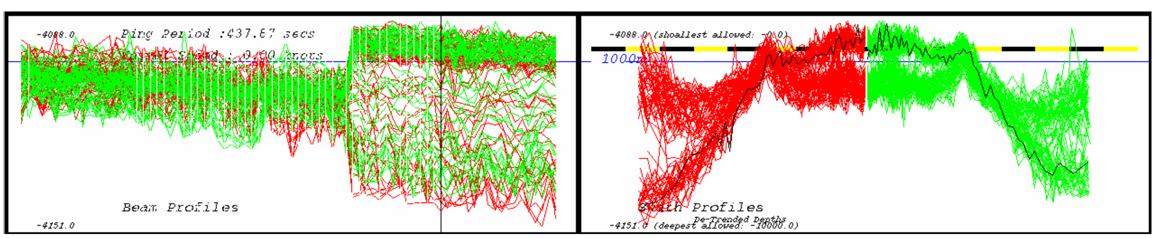
September 25, 2004 (JD269)

We completed a dip line in NAVO Area 3. The topography suggests the foot of the slope will be ambiguous in the area and will require extended mapping.

An analysis of the ray-tracing effects of changing the surface sound speed was made during the dip line. The analysis shows that changing the surface sound speed to an older SVP caused a sudden jump in the depths and degraded the ray tracing (Fig. 15)



Black line illustrates example profile before change in sound speed profile



Black line illustrates example profile after change in sound speed profile

Figure 15. Before and after a change in sound speed profile was applied. Whereas the difference between the surface sound speed sensor and the profile was reduced from 2.5 m/s to 0.6 m/s the overall ray tracing was degraded. (4 hour old cast used).

September 26, 2004 (JD270)

Routine day of mapping in NAVO Area 2. We logged data on a turn to evaluate the effects of turning on the Hippy sensor. A cursory analysis using DelayEditor software made it clear that roll was affected for approximately 10 to 5 minutes as is specified by the manufacturer of the Hippy Sensor (Fig. 16). Even though specified by the manufacturer to be at the 1-2 meter level, the false-heave amplitude was not visible.

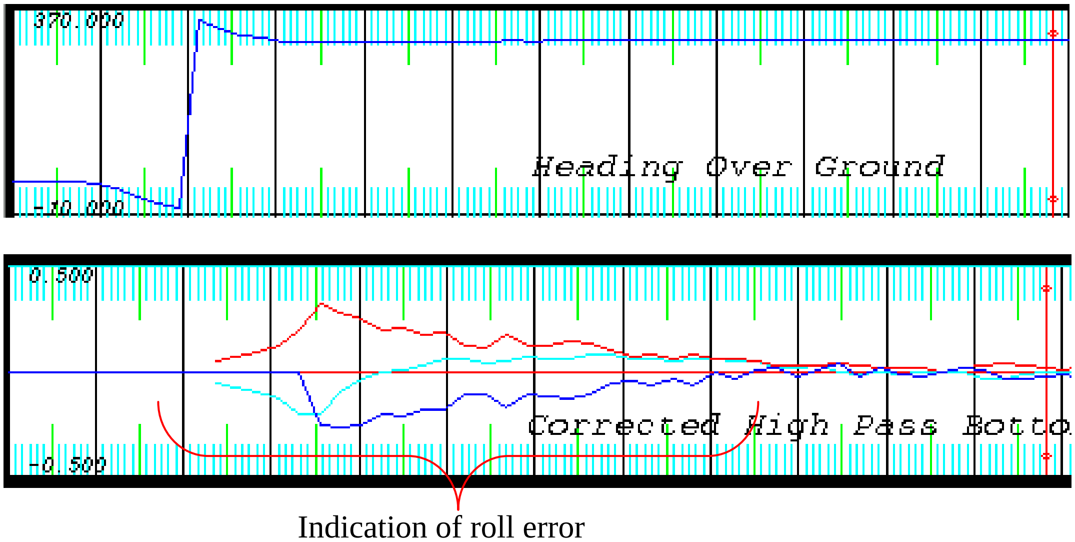


Figure 16. Images show heading change through a turn and the induced roll artifacts as evidenced by an induced bottom slope.

September 27, 2004 (JD271)

Routine day of mapping in NAVO Area 2.

September 28, 2004 (JD272)

Routine morning of mapping to finish NAVO Area 2. Weather degraded throughout the afternoon. Mapping was suspended at 2026L because of bad weather.

September 29, 2004 (JD273)

The seas were still too rough to map. A communication from OTSR route surveillance stated that "the conditions forecast exceed your stated limits for this mission" and that "course and speed should be adjusted as safe navigation permit" .

September 30, 2004 (JD274)

Sea conditions continued to be unacceptable for mapping.

October 1, 2004 (JD275)

Sea conditions began to calm, and we were able to begin mapping at 0000 L. We completed the last line of NAVO Area 2 started mapping in the deep section of NAVO Area 3.

October 2, 2004 (JD276)

Routine day of mapping at southern end of NAVO Area3. We filled in holidays before proceeding northward. Surface sound speed sensor ceased to function at 1855L but was quickly repaired. The POS/V lost position for 250 m. This POS/MV glitch has been shown to appear on a 7-day cycle but is minor in time duration

October 3, 2004 (JD277)

Routine day of mapping in NAVO Area 3. A 3-hr CTD cast was taken from 1300L

October 4, 2004 (JD278)

Routine day of mapping in NAVO Area 3.

October 5, 2004 (JD279)

Routine day of mapping in NAVO Area 3.

October 6, 2004 (JD280)

Routine day of mapping in NAVO Area 3. The wind and sea states worsened throughout the day with winds up to 25 to 30 kts by evening, although the data quality remained good.

October 7, 2004 (JD281)

Routine day of mapping in NAVO Area 3.

October 8, 2004 (JD282)

Routine day of mapping in NAVO Area 3, The POS/MV needed to be reset at 1330L. This is the 7-day POS/MV glitch cycle.

October 9, 2004 (JD283)

Routine day of mapping in NAVO Area 3.

October 10, 2004 (JD284)

Routine day of mapping in NAVO Area 3.

October 11, 2004 (JD285)

At 0500L we were no longer able to map. Because of tropical storm Nicole. The ship ran SW from the storm but attempted to remain in position for a dip line when we return to NAVO Area 3.

October 12, 2004 (JD286)

We were unable to return to NAVO Area 3 because of tropical storm Nicole. It was not possible to run regular lines in NAVO Area 4 but the sea state allowed us to run SE lines with acceptable data quality, so we were able to survey a dip line through NAVO Area 4.

October 13, 2004 (JD287)

The sea state improved so we ran a second dip line NW through NAVO Area4 to get the ship back to NAVO Area 3. We resumed mapping in NAVO Area 3 at 1620L.

October 14, 2004 (JD288)

We continued mapping in NAVO Area 3 in the morning. The ship was required to break off line at 1115L to allow the US Navy to perform small-arms exercises in our area.

The Captain broke the line at 1530L to run from weather because a large storm (3 converging lows) was approaching. While transiting away from the storm, we were able to map in NAVO Area 3 and the first line of NAVO Area 4 was completed.

October 15, 2004 (JD289)

We finished the first line of NAVO Area 4 in the early morning. The weather was acceptable for mapping but the Captain was advised that conditions in NAVO Area 3 were poor so we continued mapping in NAVO Area 4.

A problem was discovered with the logging of the 3.5-kHz echosounder and no data were recorded from 0000 to 0430L.

October 16, 2004 (JD290)

We continued to map in NAVO Area 4 while waiting for the storm to abate in NAVO Area 3. Sea conditions were rough, although the data quality was good for most of day. The data quality started to suffer from foul weather in the evening.

October 17, 2004 (JD291)

We stopped mapping at 0100L because of rough seas and did not resume until 1715L but at speeds of only 6 to 7 kts. Conditions improved throughout day. Lines 151 and 152 can not be used for backscatter because of noise but are acceptable for bathymetry.

October 18, 2004 (JD292)

We continued mapping in NAVO Area 4 in the morning. Sea conditions were much improved and the data quality was very good. At 1730L we resumed mapping in NAVO Area 3 to map areas missed because of Navy activities and weather.

October 19, 2004 (JD293)

Routine mapping in North East corner of NAVO Area 3. Sea and weather conditions were good.

October 20, 2004 (JD294)

Sea conditions degraded with 10 to 12 ft seas. We continuing to map in NAVO Area 3, with good quality data from lines running east to west but marginal quality data from lines running west to east. NAVO Area 3 was finished and we began mapping SW lines in NAVO Area 4. Line 167 was not be used for backscatter but are acceptable for bathymetry

October 21, 2004 (JD295)

We completed a SW-running line in NAVO Area 4 at 1100L and then the Captain made the decision to head for a coastal area because of degrading sea conditions and aforecast of 16-ft seas in the area.

October 22, 2004 (JD296)

We spent the morning off of Cape Charles waiting for weather to improve. A decision was made at 1200L by the SNR, the ship's Captain and NAVOCEANO to terminate the leg because of the weather conditions and the forecast of worsening conditions. We were along side a pier at Little Creek Navy Base at 1700L, ending Leg 2.

Daily Log Leg 3

October 30, 2004 (JD304)

We departed Little Creek Navy Base (Norfolk, VA) at 1100 L and began the transit at 15 kts to the end of the last line of Leg 2 in NAVO Area 4. However, at 1645L the Captain slowed the ship to 7 kts because of dense fog. After about an hour in dense fog we broke out into clear skies and renewed transit speed to 15 kts. We arrived at the point at 1930L to take CTD and BXT casts to acquire a stable sound velocity profile. The slip rings of the CTD winch malfunctioned when the sensor was only a few 10s of meters deep so it was brought back onboard for repair. A T-7 (760 m maximum depth) and a T-5 (1500 m maximum depth) XBT were launched and the profiles matched perfectly. The casts were completed at 2015L and we moved to the start point and began mapping Line 171 at 2038L (JD305 0038Z).

October 31, 2004 (JD305)

Routine day of mapping in NAVO Area 4. The wind blew a steady 15 kts creating a lumpy sea but did not affect the quality of the data.

Line Atlantic_line_173 was not ended at the change of the Julian day but allowed to run an additional 20 minutes. It was then ended and Atlantic_line_174 was started. However, this means that the GSF line and the Simrad raw.all files are not of the same data.

November 1, 2004 (JD306)

Routine day of mapping in NAVO Area 4. The wind was blowing 20 kts out of the NW during the morning under sunny skies lumpy seas. However, the data quality was excellent, even at 15 kt speeds. The wind continued to strengthened during the afternoon producing seas of 6 to 8 ft but data quality held at excellent. At about 1515L (2015Z) we had been on line 175 for about 15 minutes when we took a large roll and had to hove-to to secure loose gear on the fantail. We resumed the SW line with a new line number (Line 176).

November 2, 2004 (JD307)

Routine day of mapping in NAVO Area 4. The wind and seas calmed during the night so that by morning we were in 2-ft seas and 10-kt winds. Also during the night, a large freighter was bearing down on us and showed no intention to alter course so we had to break line and divert away. Other than that, it was an uneventful day.

November 3, 2004 (JD308)

Routine day of mapping in NAVO Area 4. The early morning was cloudy and rainy with the wind blowing a steady 10 kts all day and the seas were ~3 ft. By mid morning the sun was out but the wind had increased to a steady 25 kts and the seas were 3 to 5 ft and building. It was too wild outside, and the ship was rolling ±6˚ on a short period, to take the mid-afternoon XBT. However, the data quality continued to be excellent. The backscatter continues to be of excellent quality.

An analysis of lines crossing the dip line in this area shows the MBES is consistently achieving depth precision of <0.5% of the water depth. The only artifacts in the bathymetry continue to be railroad tracks but they are only about 1 m high and thus well below the requirements.

November 4, 2004 (JD309)

The wind and seas calmed during the night and the day broke partly cloudy with 10 kt breezes and a 2-ft swell. However, by evening the winds had increased to 35 kts and the sky was menacing. The seas started to build and by midnight we were taking 15˚ rolls and pitching badly.

November 5, 2004 (JD310)

Conditions stayed foul during the night but the data quality was acceptable. By morning the winds were blowing a steady 40 kts and the seas were 10 to 12 ft. At 0710L the Captain terminated the line (Line 189) because he felt the ship was taking a beating. We turned the bow into the seas to reduce the motion and just made way to the NW for 9 hr. Finally, at 1600 hr the wind had dropped to ~10 kts and the seas had calmed to 4 to 6 ft so we came about and steamed back to the break-off location to complete the line. We arrived at the bread-off location and began mapping at 1930L in NAVO Area 4. The seas were still lumpy but data quality was good.

November 6, 2004 (JD311)

The seas stayed lumpy all night and through the morning but the wind calmed to ~10 kts. We continued to map in NAVO Area 4. At 1120L the POS/MV crashed so we had to terminate Line 191, make a loop after the POS/MV was rebooted, and then continued were we left off as Line 192.

November 7, 2004 (JD312)

Routine mapping in NAVO Area 4 with sunshine, calm seas and no wind.

November 8, 2004 (JD313)

Routine day of mapping in NAVO Area 4. We lost ~2 hr to repair a leaking hatch on the fantail. The wind freshened out of the south while the repairs were being made and by the time we were back to mapping we had persistent 25 kt winds.

November 9, 2004 (JD314)

Routine day of mapping in NAVO Area 4. The seas remained choppy and the wind blew a steady 20 kts on our beam, making for an uncomfortable ride but the data continued to be of excellent quality.

November 10, 2004 (JD315)

Routine day of mapping in NAVO Area 4. The seas were very rough during the night but calmed somewhat by day break. The data quality continued to be excellent. A small, apparently uncharted seamount (Fig. 17), informally named Henson Seamount, was mapped early in the morning. The 1184 m high seamount is located at 37˚23.89254N 70˚52.43640W and the summit rises to 2947 m water depth. The area immediately adjacent to the seamount underscores the erosional effects of the southwestward-flowing Western Boundary Undercurrent where the 4100-m isobath outlines a moat on the SW side and a drift of sediments s seen on the NE side.

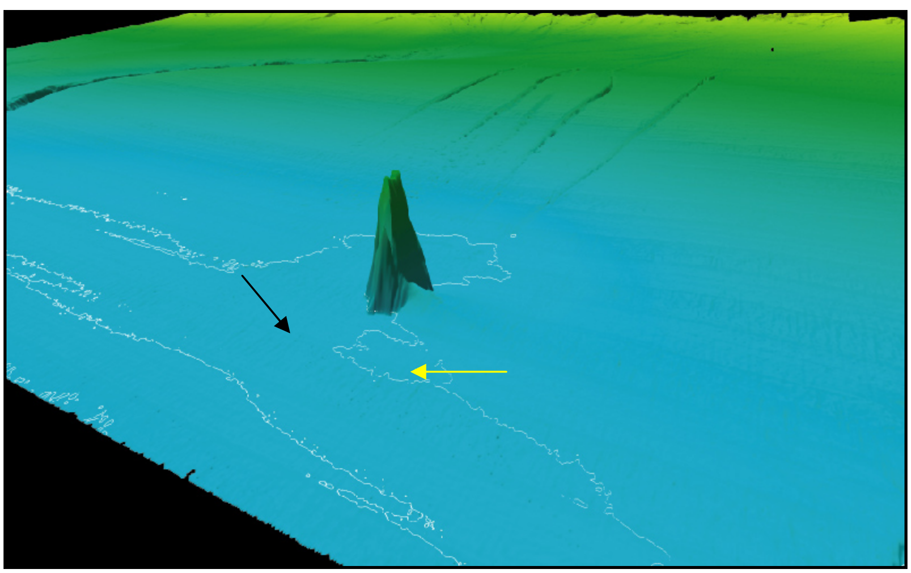


Figure 17. Perspective view of the informally named Henson Seamount. Black arrow points to erosional moat and yellow arrow points to sediment drift. Vertical exaggeration 10x, looking NW.

November 11, 2004 (JD316)

A not-so-routine day of mapping in NAVO Area 4. Conditions were ideal and the data quality was excellent. While running the last line of NAVO Area 4 the GAMS on the POS/MV locked up at 1000L and it took 1.25 hr to get it going again. During the lockup, the navigation output was switched to the TASMIN so no navigation data were lost. Then, at 1500L we had to break line and hove-to for two hours to "let a bunch of warships pass". We didn't get back online to continue the last line until1635L. NAVO Area 4 was completed at 2230L and we mapped into NAVO Area 5 to a point to run the dip line uphill.

November 12, 2004 (JD317)

The dip line was completed at 1000L and we started mapping the 2500-m isobath in NAVO Area 5. The POS/MV locked up several times during the night and a full GAMS calibration was done to get it stable again.

We received a weather warning midday forecasting gale winds and 18-ft seas for the area we just moved to. A vigorous low-pressure system was moving south along the coast and was predicted to hit us sometime midday on Nov. 13th. The wind and seas began building in the mid afternoon but the data quality remained excellent.

November 13, 2004 (JD318)

The seas were rough during the night and early morning but the winds were light out of the NE. However, by 0900L the winds had increased to 30 kts and the seas built rapidly to 10+ft. The data continued to look very good on a SW heading so we continued mapping. The seas and wind continued to build during the afternoon and by 1800L we were in 40-kt winds and 15+ft seas. When we changed course to a NE heading we pitched so violently that the EM121A lost the bottom most of the time. Consequently, at 1845L we hove-to to wait out the storm.

A cross-line analysis of the dip line in NAVO Area5 and the shallow data showed a precision of 0.5% of water depth, well within specifications.

November 14, 2004 (JD319)

The seas and wind continued to increase through the night and the MBES system had difficulty detecting the bottom because of bubbles, etc. We continued to slowly move into the seas and wind but collecting no data. Our objective was to ride out the storm while slowly creeping to the northern way point of one of the lines in NAVO Area 5 so that we could map on a SW course with a following sea. We began to collect data on Line 220 at 1330L Line 220 left a large gap between it and the previously mapped lines in NAVO Area 5 but we planned to fill in the area after the seas and wind abated.

November 15, 2004 (JD320)

The seas held rough through the night and the wind blew a steady 25 kts. NE courses were fairly lively with considerable pitching and rolling but not enough to stop mapping. We had a following sea with a SW course and the data from these lines were excellent.

We were notified that we had to leave NAVO Area 5 on Nov. 16th because US Navy missile exercises were scheduled for this area. We planned to transit to the 2500-m isobath in NAVO Area 6 and map it until the exercises were completed. The missile schedule was for only 6 hours, so the plan was to return to NAVO Area 5 after the missile exercise and complete the mapping there.

November 16, 2004 (JD321)

We ran two lines to define the 2500-m isobath in NAVO Area 6 to keep clear of the missile exercises then moved back to NAVO Area 5 to continue mapping there. The weather was calm and the seas were slight.

November 17, 2004 (JD322)

We had to terminate Line 230 early because we were chased out of the area by the US Navy. They had a scheduled exercise in this area for ~5 hr. Consequently, we moved over to the east and ran Line 231 running NE away from the exercise area. This left the shallow portion of the southern corner of NAVO Area 6 unmapped for now. Once at the northern boundary of NAVO Area 6 we started running lines in NAVO Area 5 because we were told that we now had to be out of NAVO Area 5 from Nov. 21 through Nov. 27 and we needed to complete Area 5 before that ban.

November 18, 2004 (JD323)

Routine day of mapping in NAVO Area 5. Seas and winds calm.

November 19, 2004 (JD324)

We completed Line 235 and stopped mapping at 0115L to transit to Norfolk, VA to let off one of the SAIC people (Meme Lobecker) for compassionate reasons; her grandmother died and she wanted to attend the funeral. Meme's parents requested the evacuation through the Red Cross, NAVOCEANO and the Coast Guard. We resumed mapping at 2145L with Line 236.

November 20, 2004 (JD325)

Routine day of mapping in NAVO Area 5. Weather conditions were near perfect for mapping but the Gulf Stream caused a lot of changes in the surface sound speed. This required dropping an XBT as often as every 10 minutes to keep refraction at bay.

November 21, 2004 (JD326)

Routine day of mapping in NAVO Areas 5 and 6. We were forced to move south to NAVO Area 6 at 1915L to run Line 243 because of military exercises scheduled for all of NAVO Area 5 starting Nov. 22 at 0600L. Weather continued to be ideal for mapping

November 22, 2004 (JD327)

Routine day of mapping in NAVO Area 6. Weather continued to be ideal for mapping but the Gulf Stream continued to play havoc the surface sound speed. Fortunately, frequent XBTs were sufficient to compensate for refraction affects.

November 23, 2004 (JD328)

Routine day of mapping in NAVO Area 5. The weather began to deteriorate throughout the day with seas becoming lumpy by late afternoon. However, data quality remained high.

November 24, 2004 (JD329)

We completed the mapping in NAVO Area 5 in the late afternoon and ran a short dip line in NAVO Area 6 for cross-check statistics. We then proceeded to map in NAVO Area 6. The day was warm and bright but the wind was blowing a steady 25 kts and the seas were lumpy. The wind and seas continued to build throughout the day and by 2000L we were in 10+ ft seas.

November 25, 2004 (JD330)

The ship was experiencing severe pitching and rolling so we broke line 254 at 0200L. The seas and swells were combined at 15+ ft and the ship motion destroyed the data quality. We steamed NW for a spot north of Cape Hatteras to wait out the storm. The NOAA weather buoy (NDBC- 41001) in the SE corner of NAVO Area 5 recorded winds of 41 kts, gusting to 52.5 kts and 20-ft seas and building.

November 26, 2004 (JD331)

We left our weather haven at 0400L and steamed out to NAVO Area 6 and commenced mapping at 1052L with Line 255. The seas were lumpy but the data quality was excellent.

November 27, 2004 (JD332)

Routine day of mapping in NAVO Area 6. The wind blew a steady 25 kts all day and by afternoon the seas were 6 ft and building, coming at us from the east. The ship motion rendered a lot of dropouts in the data and the backscatter was especially hard hit. These conditions continued the rest of the day.

November 28, 2004 (JD333)

Conditions continued to be marginal during the night with confused seas and a large swell. The data quality remained acceptable so the mapping continued. However, by 0630OL, the wind had increased to 30 kts and the seas began to increase to the point where the data quality was bad so logging was stopped on Line 264 and we tried to hove-to. Ship motion was excessive while we hove-to so we continued down the line for a couple of hours, then came about and successfully collected data on a reciprocal course starting at the southern end of the line. It was far too dangerous to allow anyone on deck to collect an XBT cast so we had to allow refraction to take its toll on the data. Once Line 265 met up with the good-data portion of Line 265, we transited back to the south, the only heading we could collect adequate-quality data on, and ran one line to the NE. The gale-force winds and very rough seas continued throughout the day and evening. The data quality had degraded to the point of being unacceptable by 2300L so the data logging was stopped and we headed to Norfolk, VA. The weather and seas worsened throughout the night.

November 29, 2004 (JD33)

We arrived at the dock at Norfolk, VA at 1330L.

References Cited

Duncan, R.A., 1984, Age progressive volcanism in the New England Seamounts and the opening of the central Atlantic Ocean. Jour. of Geophysical Research, v. 89, p. 9980-9990.

Emery, K.O. and Uchupi, E., 1984, The geology of the Atlantic Ocean. Springer-Verlag, New York, 1050p.

Folger, D.W., Dillon, W.P., Grow, J.A., Klitgord, K.D., and Schlee, J.S., 1979, Evolution of the Atlantic continental margin of the United States. *In* Talwani, M., Hay, W., and Ryan, W.B.F. (eds.) Deep drilling results in the Atlantic Ocean: Continental margins and paleoenvironment. American Geophysical Union, Washington D.C., p.l 87-108.

O'Leary, D.W. and Dobson, M.R., 1992, Southeastern New England continental rise: Origin and history of slide complexes. *In* Poag, C.W. and de Graciansky, P.C. (eds.) Geologic evolution of Atlantic continental rises, van Norstrand Reinhold, New York, p. 214-265.

Poag, C.W., 1992, U.S. middle Atlantic continenal rise: Rrovenance, dispersal, and deposition of Jurassic to Quaternary sediments. *In* Poag, C.W. and de Graciansky, P.C. (eds.) Geologic evolution of Atlantic continental rises, van Norstrand Reinhold, New York, p. 100-156.

Shackleton, N.J., 1987, Oxygen isotopes, ice volume and sea level. Quaternary Science Reviews, v. 6, p. 183-190,

Table 1. Cruise Statistics (excluding transits) of data collection

Leg	JD dates	Line miles (nm)
1	243 to 262	4265
2	269 to 294	5614
3	303 to 334	7427
Total		17,306

Summary

Transits	13.0 days
Days in port	12.0 days
Weather delays	14.5 days
Misc delays	1 day
Medical evacuation	1.3 days
Compassionate evacuation	1.0 day
Total non-mapping days	42.8 days
Total mapping days	59.2 days

Table 2. Conversion table of NAVO raw.all file names to UNH and SAIC file names by Julian Day

JD	Data Folder	NAVO file name _raw.all	UNH file name _raw.all	SAIC GSF file name
243	**040830**	**0001_300804_042506l**	**Atlantic_line_patch1**	**63mba04243_p_100p.d02**
243	040830	0002_300804_053736	Atlantic_line_patch2	63mba04243_p_100p.d03
243	040830	0003_300804_085209	Atlantic_line_patch3	63mba04243_p_100p.d04
243	040830	0004_300804_100125	Atlantic_line_patch4	63mba04243_p_100p.d05
243	040830	0005_300804_111151	Atlantic_line_patch5	63mba04243_p_100p.d06
243 **244**	**040830**	0001_300804_151923	**Atlantic_line_1**	63mba04243_p_100p.d07 63mba04244_p_100p.d01
244	040831	0002_310804_030938	Atlantic_line_2	63mba04244_p_100p.d02
244	040831	0003_310804_175817	Atlantic_line_3	63mba04244_p_100p.d03 63mba04245_p_100p.d01
245	**040901**	**0004_010904_222617**	**Atlantic_line_4**	**63mba04245_p_100p.d02**
246	040902	0005_020904_000005	Atlantic_line_5	63mba04246_p_100p.d01
246	040902	0006_020904_112939	Atlantic_line_6	63mba04246_p_100p.d02
246	040902	0006_020904_123706	Atlantic_line_7	no GSF-combined in do2
246	040902	0007_020904_231519	Atlantic_line_8	63mba04246_p_100p.d03
247	**040903**	**0008_030904_000026**	**Atlantic_line_9**	**63mba04247_p_100.d01**
247	040903	0009_030904_011416	Atlantic_line_10	63mba04247_p_100.d02
247	040903	0010_030904_025625	Atlantic_line_11	63mba04247_p_100.d03
247	040903	0011_030904_052126	Atlantic_line_12	63mba04247_p_100.d04
247	040903	0012_030904_133332	Atlantic_line_13	63mba04247_p_100.d05
247	040903	0013_030904_164434	Atlantic_line_14	63mba04247_p_100.d06
247	040903	0014_030904_171831	Atlantic_line_15	63mba04247_p_100.d07
248	**040904**	**0015_040904_000111**	**Atlantic_line_16**	**63mba04248_100p.d01**
248	040904	0016_040904_035334	Atlantic_line_17	63mba04248_100p.d02
248	**040904**	**0017_040904_051805**	**Atlantic_line_18**	**63mba04248_100p.d03**
248	040904	0018_040904_064759	Atlantic_line_19	63mba04248_100p.d04
248	040904	0019_040904_090944	Atlantic_line_20	63mba04248_100p.d05
248	040904	0020_040904_113328	Atlantic_line_21	63mba04248_100p.d06
248	040904	0021_040904_155636	Atlantic_line_22	63mba04248_100p.d07
248	040904	0022_040904_194840	Atlantic_line_23	63mba04248_100p.d08
249	**040905**	**0023_050904_000643**	**Atlantic_line_24**	**63mba04249_100p.d01**
249	040905	0024_050904_040041	Atlantic_line_25	63mba04249_100p.d02
249	040905	0025_050904_082149	Atlantic_line_26	63mba04249_100p.d03
249	040905	0026_050904_122320	Atlantic_line_27	63mba04249_100p.d04
249	040905	0027_050904_170813	Atlantic_line_28	63mba04249_100p.d05
249	040905	0028_050904_225145	Atlantic_line_29 (corrupt)	63mba04249_100p.d06
250	**040906**	**0029_060904_000017**	**Atlantic_line_30**	**63mba04250_100p.d01**
250	040906	0030_060904_042818	Atlantic_line_31	63mba04250_100p.d02
250	040906	0031_060904_110131	Atlantic_line_32	63mba04250_100p.d03

JD	**Data Folder**	**NAVO file name _raw.all**	**UNH file name _raw.all**	**SAIC GSF file name**
250	040906	0032_060904_180754	Atlantic_line_33	63mba04250_100p.d04
250	040906	0033_060904_192459	Atlantic_line_34	63mba04250_100p.d05
250	040906	0034_060904_205513	Atlantic_line_35	63mba04250_100p.d06
251	**040907**	**0035_070904_000048**	**Atlantic_line_36**	**63mba04251_100p.d01**
251	090704	0036_070904_034537	Atlantic_line_37	63mba04251_100p.d02
251	040907	0037_070904_115921	Atlantic_line_38	63mba04251_100p.d03
251	040907	0038_070904_135326	Atlantic_line_39	63mba04251_100p.d04
251	040907	no raw.all file_	No Simrad data	63mba04251_100p.d05
252	**040908**	**no raw.all file**	**no Simrad data**	63mba04252_100p**.d01**
252	040908	0041_080904_071955	Atlantic_line_42	63mba04252_100p.d02
252	040908	0042_080904_111107	Atlantic_line_43	63mba04252_100p.d03
252	040908	0043_080904_153652	Atlantic_line 44	63mba04252_100p.d04
252	040908	0044_080904_193306	Atlantic_line_45	63mba04252_100p.d05
253	**040909**	**0045_090904_000015**	**Atlantic_line_46**	63mba04253_100p.d01
253	040909	0046_090904_075429	Atlantic_line_47	63mba04253_100p.d02
253	040909	0047_090904_180802	Atlantic_line_48a	---
253	040909	0047_090904_181031	Atlantic_line_48b	63mba04253_100p.d03
253	040909	0048_090904_231633	Atlantic_line_49a	---
253	040909	0048_090904_231636	Atlantic_line_49b	63mba04253_100p.d04
254	**040910**	**0049_100904_000159**	**Atlantic_line_50**	63mba04254_100p.d01
2540	040910	0050_100904_015901	Atlantic_line_51	63mba04254_100p.d02
254	040910	0051_100904_062954	Atlantic_line_52	63mba04254_100p.d03
254	040910	0052_100904_114732	Atlantic_line_53	63mba04254_100p.d04
254	040910	0053_100904_164402	Atlantic_line_54	63mba04254_100p.d05
254	040910	0054_100904_222514	Atlantic_line_55	63mba04254_100p.d06
255	**040911**	**0055_110904_000024**	**Atlantic_line_56**	**63mba04255_100p.d01**
255	040911	0056_110904_054400	Atlantic_line_57	63mba04255_100p.d02
255	040911	0057_110904_141610	turn data-not used	turn data-not used
255	040911	0057_110904_143005	Atlantic_line_58	63mba04255_100p.d03
255	040911	0058_110904_215602	Atlantic_line_59	63mba04255_100p.d04
256	**040912**	**0059_120904_000015**	**Atlantic_line_60**	**63mba04256_100p.d01**
256	040912	0060_120904_064320	Atlantic_line_61	63mba04256_100p.d02
256	040912	0061_120904_140319	Atlantic_line_62	63mba04256_100p.d03
256	040912	0062_120904_231845	Atlantic_line_63	63mba04256_100p.d04
257	**040913**	**0063_130904_000028**	**Atlantic_line_64**	**63mba04257_100p.d01**
257	040913	0064_130904_071643	Atlantic_line_65	63mba04257_100p.d03
257	040913	0065_130904_120051	Atlantic_line_66	63mba04257_100p.d04
257	040913	0066_130904_134602	Atlantic_line_67	63mba04257_100p.d05
257	040913	0067_130904_151731	Atlantic_line_68	63mba04257_100p.d06
257	040913	0068_130904_163421	Atlantic_line_69	63mba04257_100p.d07
257	040913	0069_130904_222419	Atlantic_line_70	63mba04257_100p.d08
259	**040915**	**0073_150904_043008**	**Atlantic_line_71**	**63mba04259_100p.d01**
259	040915	0074_150904_111838	Atlantic_line_72	63mba04259_100p.d02
JD	**Data**	**NAVO file name**	**UNH file name**	**SAIC**

	Folder	_raw.all	_raw.all	GSF file name
259	040915	0075_150904_200420	Atlantic_line_73	63mba04259_100p.d03
260	**040916**	**0076_160904_000010**	**Atlantic_line_74**	**63mba04260_100p.d01**
260	040916	0077_160904_040313	Atlantic_line_75	63mba04260_100p.d02
260	040916	0078_160904_130852	Atlantic_line_76	63mba04260_100p.d03
260	040916	0079_160904_212118	Atlantic_line_77	63mba04260_100p.d04
261	**040917**	**0080_170904_000011**	**Atlantic_line_78**	**63mba04261_100p.d01**
261	040917	0081_170904_062120	Atlantic_line_79	63mba04261_100p.d02
261	040917	0082_170904_120018	Atlantic_line_80	63mba04261_100p.d03
261	040917	0083_170904_124257	Atlantic_line_81	63mba04261_100p.d04
261	040917	0084_170904_131739	Atlantic_line_82	63mba04261_100p.d05
261	040917	0085_170904_144936	Atlantic_line_83	63mba04261_100p.d06
261	040917	0086_170904_181341	Atlantic_line_84	63mba04261_100p.d07
262	**040918**	**0087_180904_000146**	**Atlantic_line_85**	**63mba04271_100p.d01**
262	040918	0088_180904_032321	Atlantic_line_86	63mba04271_100p.d02
262	040918	0089_180904_122142	Atlantic_line_87	63mba04271_100p.d03
		END OF LEG 1	**END OF LEG 1**	**END OF LEG 1**
		START OF LEG 2	**START OF LEG 2**	**START OF LEG 2**
269	**040925**	**0001_250904_101005**	**Atlantic_line_88**	**63mba04269_p_100.d01**
270	**040926**	**0002_260904_024509**	**Atlantic_line_89**	**63mba04270_p_100.d01**
270	040926	0004_260904_125804	Atlantic_line_90	63mba04270_p_100.d03
270	040926	0005_260904_175851	Atlantic_line_91	63mba04270_p_100.d04
271	**040927**	**0006_270904_000017**	**Atlantic_line_92**	**63mba04271_p_100.d01**
271	040927	0007_270904_015109	Atlantic_line_93	63mba04271_p_100.d02
271	040927	0008_270904_121924	Atlantic_line_94	63mba04271_p_100.d03
271	040927	0009_270904_222828	Atlantic_line_95	63mba04271_p_100.d04
272	**040928**	**0010_280904_000015**	**Atlantic_line_96**	**63mba04272_p_100.d01**
272	040928	0011_280904_082907	Atlantic_line_97	63mba04272_p_100.d02
272	040928	0012_280904_141724	Atlantic_line_98	63mba04272_p_100.d03
275	**041001**	**0013_011004_000955**	**Atlantic_line_99**	**63mba04275_p_100p.d01**
275	041001	0014_011004_055610	Atlantic_line_100	63mba04275_p_100p.d02
275	041001	0015_011004_163132	Atlantic_line_101	63mba04275_p_100p.d03
275	041001	0016_011004_174132	Atlantic_line_102	63mba04275_p_100p.d04
276	**041002**	**0017_021004_000008**	**Atlantic_line_103**	**63mba04276_p_100p.d01**
276	041002	0018_021004_041009	Atlantic_line_104	63mba04276_p_100p.d02
276	041002	0019_021004_143850	Atlantic_line_105	63mba04276_p_100p.d03
276	041002	0020_021004_184457	Atlantic_line_106	63mba04276_p_100p.d04
276	041002	0021_021004_214328	Atlantic_line_107	63mba04276_p_100p.d05
277	**041003**	**0022_031004_000009**	**Atlantic_line_108**	**63mba04277_p_100p.d01**
JD	**Data**	**NAVO file name**	**UNH file name**	**SAIC**

	Folder	**_raw.all**	**_raw.all**	**GSF file name**
277	041003	0023_031004_081542	Atlantic_line_109	63mba04277_p_100p.d02
277	041003	0024_041003_223903	Atlantic_line_110	63mba04277_p_100p.d01
278	**041004**	**0025_041004_0000011**	**Atlantic_line_111**	**63mba04278_p_100p.d01**
278	041004	0026_041004_090317	Atlantic_line_112	63mba04278_p_100p.d02
278	041004	0027_041004_193303	Atlantic_line_113	63mba04278_p_100p.d03
279	**041005**	**0028_051004_000007**	**Atlantic_line_114**	**63mba04279_p_100p.d01**
279	041005	0029_051004_055958	Atlantic_line_115	63mba04279_p_100p.d02
279	041005	0030_051004_164426	Atlantic_line_116	63mba04279_p_100p.d03
280	**041006**	**0031_061004_000008**	**Atlantic_line_117**	**63mba04280_p_100p.d01**
280	041006	0032_061004_033124	Atlantic_line_118	63mba04280_p_100p.d02
280	041006	0033_061004_144354	Atlantic_line_119	63mba04280_p_100p.d03
281	**041007**	**0034_071004_000011**	**Atlantic_line_120**	**63mba04281_p_100p.d01**
281	041007	0035_071004_013904	Atlantic_line_121	63mba04281_p_100p.d02
281	041007	0036_071004_123215	Atlantic_line_122	63mba04281_p_100p.d03
281	041007	0037_071004_225436	Atlantic_line_123	63mba04281_p_100p.d04
282	**041008**	**0038_081004_000006**	**Atlantic_line_124**	**63mba04282_p_100p.d01**
282	041008	0039_081004_100408	Atlantic_line_125	63mba04282_p_100p.d02
282	041008	0040_081004_175803	Atlantic_line_126	63mba04282_p_100p.d03
282	041008	0041_081004_220840	Atlantic_line_127	63mba04282_p_100p.d04
283	**041009**	**0042_091004_000013**	**Atlantic_line_128**	**63mba04283_p_100p.d01**
283	041009	0043_091004_084340	Atlantic_line_129	63mba04283_p_100p.d02
283	041009	0044_091004_192850	Atlantic_line_130	63mba04283_p_100p.d03
284	**041010**	**0045_101004_000006**	**Atlantic_line_131**	**63mba04284_p_100p.d01**
284	041010	0047_101004_071325	Atlantic_line_132	63mba04284_p_100p.d03
284	041010	0048_101004_182428	Atlantic_line_133	63mba04284_p_100p.d04
285	**041011**	**0049_111004_000007**	**Atlantic_line_134**	**63mba04285_p_100p.d01**
286	**041012**	**0050_121004_042445**	**Atlantic_line_135**	**63mba04286_p_100p.d01**
286	041012	0051_121004_215021	Atlantic_line_136	63mba04286_p_100p.d02
287	**041013**	**0052_131004_000006**	**Atlantic_line_137** (dipline, corrupted)	**63mba04287_p_100p.d01**
287	041013	0053_131004_161932	Atlantic_line_138	63mba04287_p_100p.d02
288	**041014**	**0054_141004_000004**	**Atlantic_line_139**	**63mba04288_p_100p.d01**
288	041014	0055_141004_033145	Atlantic_line_140	63mba04288_p_100p.d02
288	041014	0056_141004_114918	Atlantic_line_141	63mba04288_p_100p.d03
288	041014	0057_141004_160313	Atlantic_line_142	63mba04288_p_100p.d04
288	041014	0058_141004_232300	Atlantic_line_143	63mba04288_p_100p.d05
289	**041015**	**0059_151004_000004**	**Atlantic_line_144**	**63mba04289_p_100p.d01**
289	041015	0060_151004_130418	Atlantic_line_145	63mba04289_p_100p.d02
289	041015	0062_151004_155321	Atlantic_line_146	63mba04289_p_100p.d04
289	041015	0063_151004_182855	Atlantic_line_147	63mba04289_p_100p.d05
JD	**Data Folder**	**NAVO file name _raw.all**	**UNH file name _raw.all**	**SAIC GSF file name**

290	**041016**	**0064_161004_000004**	**Atlantic_line_148**	**63mba04290_p_100p.d01**
290	041016	0065_161004_013457	Atlantic_line_149	63mba04290_p_100p.d02
290	041016	0066_161004_095218	Atlantic_line_150	63mba04290_p_100p.d03
290	041016	0067_161004_214810	Atlantic_line_151 (backscatter not used)	63mba04290_p_100p.d04
291	**041017**	**0068_171004_000014**	**Atlantic_line_152** (backscatter not used)	**63mba04291_p_100p.d01**
291	041017	0069_171004_142130	Atlantic_line_153	63mba04291_p_100p.d02
291	041017	0070_171004_233856	Atlantic_line_154	63mba04291_p_100p.d03
292	**041018**	**0071_181004_000009**	**Atlantic_line_155**	**63mba04292_p_100p.d01**
292	041018	0072_181004_042932	Atlantic_line_156	63mba04292_p_100p.d02
292	041018	0073_181004_182753	Atlantic_line_157	63mba04292_p_100p.d03
292	041018	0074_181004_220643	Atlantic_line_158	63mba04292_p_100p.d04
293	**041019**	**0075_191004_000006**	**Atlantic_line_159**	**63mba04293_p_100p.d01**
293	041019	0076_191004_020603	Atlantic_line_160	63mba04293_p_100p.d02
293	041019	0077_191004_063110	Atlantic_line_161	63mba04293_p_100p.d03
293	041019	0078_191004_110317	Atlantic_line_162	63mba04293_p_100p.d04
293	041019	0079_191004_154113	Atlantic_line_163	63mba04293_p_100p.d05
293	041019	0080_191004_174846	Atlantic_line_164	63mba04293_p_100p.d06
293	041019	0081_191004_200654	Atlantic_line_165	63mba04293_p_100p.d07
294	**041020**	**0082_201004_000005**	**Atlantic_line_166**	**63mba04294_p_100p.d01**
294	041020	0083_201004_071830	Atlantic_line_167 (backscatter not used)	63mba04294_p_100p.d02
294	041020	0084_201004_201004	Atlantic_line_168	63mba04294_p_100p.d03
294	041020	0085_201004_211328	Atlantic_line_169	63mba04294_p_100p.d04
295	**041021**	**0086_211004_000006**	**Atlantic_line_170**	**63mba04295_p_100p.d01**
		END OF LEG 2	**END OF LEG 2**	**END OF LEG 2**
		START OF LEG 3	**START OF LEG 3**	**START OF LEG 3**
305	**041031**	**0001_311004_003912**	**Atlantic_line_171**	**63mba04305_p_100p.d01**
305	041031	0002_311004_135945	Atlantic_line_172	63mba04305_p_100p.d02
305	041031	0003_311004_183316	Atlantic_line_173	63mba04305_p_100p.d03
306	**041101**	**0004_011104_001823**	**Atlantic_line_174**	**63mba04306_p_100.d02**
306	041101	0005_011104_070429	Atlantic_line_175	63mba04306_p_100.d03
306	041101	0006_011104_195241	Atlantic_line_176	63mba04306_p_100.d04
306	041101	0007_011104_205629	Atlantic_line_177	63mba04306_p_100.d05
307	**041102**	**0007_021104_000013**	**Atlantic_line_178 (Z)**	**not used**
307	041102	0007_021104_000033	Atlantic_line_179 (Z)	not used
307	041102	0008_021104_000211	Atlantic_line_180	63mba04307_p_100.d01
307	041102	0009_021104_061227	Atlantic_line_181	63mba04307_p_100.d02
307	041102	0010_021104_095209	Atlantic_line_182	63mba04307_p_100.d03
307	041102	0011_021104_224201	Atlantic_line_183	63mba04307_p_100.d04
JD	**Data Folder**	**NAVO file name _raw.all**	**UNH file name _raw.all**	**SAIC GSF file name**

308	**041103**	**0012_031104_000322**	**Atlantic_line_184**	**63mba04308_p_100.d01**
308	041103	0013_031104_111454	Atlantic_line_185	63mba04308_p_100.d02
309	**041104**	**0014_041104_004016**	**Atlantic_line_186**	**63mba04309_p_100.d01**
309	041104	0015_041104_132017	Atlantic_line_187	63mba04309_p_100.d02
310	**041105**	**0016_051104_000016**	**Atlantic_line_188**	**63mba04310_p_100.d01**
310	041105	0017_051104_014327	Atlantic_line_189	63mba04310_p_100.d01
311	**041106**	**0018_061104_000302**	**Atlantic_line_190**	**63mba04311_p_100.d01**
311	041106	0019_061104_030639	Atlantic_line_191	63mba04311_p_100.d02
311	041106	0020_061104_152026	Atlantic_line_192	63mba04311_p_100.d03
311	041106	0021_061104_170636	Atlantic_line_193	63mba04311_p_100.d04
312	**041107**	**0022_071104_000009**	**Atlantic_line_194**	**63mba04312_p_100.d01**
312	041107	0023_071104_040524	Atlantic_line_195	63mba04312_p_100.d02
312	041107	0024_071104_170126	Atlantic_line_196	63mba04312_p_100.d03
313	**041108**	**0025_081104_0000074**	**Atlantic_line_197**	**63mba04313_p_100.d01**
313	041108	0026_081104_045020	Atlantic_line_198	63mba04313_p_100.d02 &3
313	041108	0027_081104_161304	Atlantic_line_199	63mba04313_p_100.d04
313	041108	0028_081104_172745	Atlantic_line_200	63mba04313_p_100.d05
314	**041109**	**0029_091104_000024**	**Atlantic_line_201**	**63mba04314_p_100.d01**
314	041109	0030_091104_051621	Atlantic_line_202	63mba04314_p_100.d02
315	**041110**	**0031_101104_163109**	**Atlantic_line_203**	**63mba04315_p_100.d01**
315	041110	0032_101104_000017	Atlantic_line_204	63nba04315_p_100.d02
315	041110	0033_101104_044424	Atlantic_line_205	63nba04315_p_100.d03
315	041110	0034_101104_153214	Atlantic_line_206	63nba04315_p_100.d04
316	**041111**	**0035_111104_000017**	**Atlantic_line_207**	**63nba04316_p_100.d01**
316	041111	0036_111104_033609	Atlantic_line_208	63nba04316_p_100.d02
316	041111	0037_111104_141924	Atlantic_line_209	63nba04316_p_100.d03
316	041111	0038_111104_213757	Atlantic_line_210	63nba04316_p_100.d04
317	**041112**	**0039_121104_000043**	**Atlantic_line_211**	**63nba04317_p_100.d01**
		Line 40 is GAMS	calibration - no data	No do2--
317	041112	0041_121104_025846	Atlantic_line_212	63nba04317_p_100.d03
317	041112	0042_121104_031224	Atlantic_line_213	63nba04317_p_100.d04
317	041112	0043_121104_045705	Atlantic_line_214 (dip)	63nba04317_p_100.d05
317	041112	0044_121104_152916	Atlantic_line_215	63nba04317_p_100.d07
318	**041113**	**0045_131104_000008**	**Atlantic_line_216**	**63nba04318_p_100.d01**
318	041113	0046_131104_012048	Atlantic_line_217	63nba04318_p_100.d02
318	041113	0047_130411_110832	Atlantic_line_218	63nba04318_p_100.d03
318	041113	0048_130411_135720	Atlantic_line_219	63nba04318_p_100.d04
319	**041114**	**0049_141104_183923**	**Atlantic_line_220`**	**63mba04319_p_100.do1**
320	**041115**	**0050_151104_001055**	**Atlantic_line_221**	**63mba04320_p_100.d01**
JD	**Data Folder**	**NAVO file name _raw.all**	**UNH file name _raw.all**	**SAIC GSF file name**
320	041115	0051_151104_060826	Atlantic_line_222	63mba04320_p_100.d02

320	041115	0052_151104_190512	Atlantic_line_223	63mba04320_p_100.d03
321	**041116**	**0053_161104_000010**	**Atlantic_line_224**	**63mba04321_p_100.d01**
321	041116	0054_161104_072711	Atlantic_line_225	63mba04321_p_100.d02
321	041116	0055_161104_163139	Atlantic_line_226	63mba04321_p_100.d03
321	041116	0056_161104_200409	Atlantic_line_227	63mba04321_p_100.d04
321	041116	0057_161104_225217	Atlantic_line_228	63mba04321_p_100.d05
322	**041117**	**0058_171104_000009**	**Atlantic_line_229**	**63mba04322_p_100.do1**
322	041117	0059_171104_043642	Atlantic_line_230	63mba04322_p_100.d02
322	041117	0060_171104_142918	Atlantic_line_231	63mba04322_p_100.d03 & d99
323	**041118**	**0061_181104_003306**	**Atlantic_line_232**	**63mba04323_p_100.d01**
323	041118	0062_181104_104117	Atlantic_line_233	63mba04323_p_100.d02
323	041118	0063_181104_215029	Atlantic_line_234	63mba04323_p_100.d03
324	**041119**	**0064_191104_001534**	**Atlantic_line_235**	**63mba04324_p_100.d01**
325	**041120**	**0065_201104_025034**	**Atlantic_line_236**	**63mba04325_p_100.d01**
325	041120	0066_201104_121134	Atlantic_line_237	63mba04325_p_100.d02
325	041120	0067_201104_211209	Atlantic_line_238	63mba04325_p_100.d03
326	**041121**	**0068_211104_000008**	**Atlantic_line_239**	**63mba04326_p_100.d01**
326	041121	0069_211104_062545	Atlantic_line_240	63mba04326_p_100.d02
326	041121	0070_211104_152410	Atlantic_line_241	63mba04326_p_100.d03
326	041121	0071_211104_234227	Atlantic_line_242	63mba04326_p_100.d04
327	**041122**	**0072_221104_000005**	**Atlantic_line_243**	**63mba04327_p_100.d01**
327	041122	0073_221104_081217	Atlantic_line_244	63mba04327_p_100.d02
327	041122	0074_221104_163635	Atlantic_line_245	63mba04327_p_100.d03
328	**041123**	**0075_231104_003603**	**Atlantic_line_246**	**63mba04328_p_100.d01**
328	041123	0076_231104_084816	Atlantic_line_247	63mba04328_p_100.d02
328	041123	0077_231104_174311	Atlantic_line_248	63mba04328_p_100.d03
329	**041124**	**0078_241104_000013**	**Atlantic_line_249**	**63mba04329_p_100.d01**
329	041124	0079_241104_024035	Atlantic_line_250	63mba04329_p_100.d02
329	041124	0080_241104_113020	Atlantic_line_251	63mba04329_p_100.d03
329	041124	0081_241104_214123	Atlantic_line_252 (dip line)	63mba04329_p_100.d04
330	**041125**	**0082_251104_000008**	**Atlantic_line_253 (dip line continued)**	**63mba04330_p_100.d01**
330	041125	0083_251104_025500	Atlantic_line_254 (bad data, not used)	63mba04330_p_100.d02
331	**041126**	**0084_261104_155104**	**Atlantic_line_255**	**63mba04331_p_100.d01**
JD	**Data Folder**	**NAVO file name _raw.all**	**UNH file name _raw.all**	**SAIC GSF file name**
332	**041127**	**0085_271104_000019**	**Atlantic_line_256**	**63mba04332_p_100.d01**

332	041127	0086_271104_041654	Atlantic_line_257	63mba04332_p_100.d02
332	041127	0087_271104_080308	Atlantic_line_258	63mba04332_p_100.d03
332	041127	0088_271104_095108	Atlantic_line_259	63mba04332_p_100.d04
332	041127	0089_271104_105440	Atlantic_line_260	63mba04332_p_100.d05
332	041127	0090_271104_122148	Atlantic_line_261	63mba04332_p_100.d06
332	041127	0091_271104_233438	Atlantic_line_262	63mba04332_p_100.d07
333	**041128**	**0092_281104_000013**	**Atlantic_line_263**	**63mba04333_p_100.d01**
333	041128	0093_281104_041707	Atlantic_line_264	63mba04333_p_100.d02
333	041128	0094_281104_134649	Atlantic_line_265	63mba04333_p_100.d03
333	041128	0095_281104_191824	Atlantic_line_266	63mba04333_p_100.d04
334	**041129**	**0096_291104_000009**	**Atlantic_line_267 (chopped)**	**63mba04334_p_100.d01**
		END OF LEG 3	**END OF LEG 3**	

Appendix 1. Cruise Calendar

leap year

AUGUST 2004

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	JD236 23 depart Gulfport, MS 1500 L (2000Z)	JD237 24 transit	JD238 25 transit	JD239 26 transit	JD240 27 transit	JD241 28 transit
JD242 29 arrived at calibration site 0800L	JD243 30 mapping in NAVO Area 1	JD244 31 mapping in NAVO Area 1				

SEPTEMBER 2004

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			JD245 1 mapping in NAVO Area 1	JD246 2 mapping in NAVO Area 1	JD247 3 mapping in NAVO Area 1	JD248 4 mapping in NAVO Area 1
JD249 5 mapping in NAVO Area 1	JD250 6 mapping in NAVO Area 1	JD251 7 mapping in NAVO Area 1	JD252 8 mapping in NAVO Area 1	JD253 9 mapping in NAVO Area 2	JD254 10 mapping in NAVO Area 2	JD255 11 mapping in NAVO Area 2
JD256 12 mapping in NAVO Area 2	JD257 13 mapping in NAVO Area 2 – medical evac	JD258 14 medical evac	JD259 15 transit back to area– resume mapping in NAVO Area 2	JD260 16 mapping in NAVO Area 2	JD261 17 mapping in NAVO Area 2	JD262 18 stopped mapping NAVO Area 2 0915L weather
JD263 19 at Newport buoy	JD264 20 arrive Newport, RI	JD265 21 in port Newport, RI	JD266 22 in port Newport, RI	JD267 23 in port Newport, RI	JD268 24 depart Newport, RI 1600 L	JD269 25 started mappin in NAVO Area 3
JD270 26 mapping in NAVO Area 3	JD271 27 mapping in NAVO Area 3	JD272 28 mapping in NAVO Area 3	JD273 29 weather day	JD274 30 weather day		

OCTOBER 2004

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					JD275 1 mapping in NAVO Area 2	JD276 2 mapping in NAVO Area 3
JD277 3 mapping in NAVO Area 3	JD278 4 mapping in NAVO Area 3	JD279 5 mapping in NAVO Area 3	JD280 6 mapping in NAVO Area 3	JD281 7 mapping in NAVO Area 3	JD282 8 mapping in NAVO Area 3	JD283 9 mapping in NAVO Area 3
JD284 10 mapping in NAVO Area 3	JD285 11 mapping in NAVO Area 3	JD286 12 mapping in NAVO Area 4	JD287 13 mapping in NAVO Area 3	JD288 14 mapping in NAVO Area 3	JD289 15 mapping in NAVO Area 4	JD290 16 mapping in NAVO Area 4
JD291 17 mapping in NAVO Area 4	JD292 18 mapping in NAVO Area 4	JD293 19 mapping in NAVO Area 3	JD294 20 mapping in NAVO Area 4	JD295 21 weather day	JD296 22 Arrive Little Creek, Va	JD297 23 in port
JD298 24 in port	JD299 25 in port	JD300 26 in port	JD301 27 in port	JD302 28 in port	JD303 29 depart Little Creek, VA 1700 L	JD304 30 mapping in NAVO Area 4
JD305 31 mapping in NAVO Area 4						

NOVEMBER 2004

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	JD306 1 mapping in NAVO Area 4	JD307 2 mapping in NAVO Area 4	JD308 3 mapping in NAVO Area 4	JD309 4 mapping in NAVO Area 4	JD310 5 0.5 day mapping - weather	JD311 6 mapping in NAVO Area 4
JD312 7 mapping in NAVO Area 4	JD313 8 mapping in NAVO Area 4	JD314 9 mapping in NAVO Area 4	JD315 10 mapping in NAVO Area 4	JD316 11 finished mapping in NAVO Area 4	JD317 12 started NAVO Area 5	JD318 13 mapping in NAVO Area 5 6 hr weathered out
JD319 14 weathered out 12 hr	JD320 15 mapping in NAVO Area 5 and Area 6	JD321 16 mapping in NAVO Area 6	JD322 17 mapping in NAVO Area 6 and Area 5	JD323 18 mapping in NAVO Area 5	JD324 19 round trip to Norfolk	JD325 20 mapping in NAVO Area 5
JD326 21 mapping in NAVO Areas 5 and 6	JD327 22 mapping in NAVO Area 6	JD328 23 mapping in NAVO Area 5	JD329 24 finished mapping in NAVO Area 5 started NAVO Area 6	JD330 25 weathered out	JD331 26 0.5 day transit and mapping in AVO Area 6	JD332 27 mapping in NAVO Area 6 0.5 day weater
JD333 28 mapping in NAVO Area 6 0.5 day weater	JD334 29 transit to Norflok arrive in port 1330L	JD335 30				
JD305						

Appendix 2. Cruise Personnel

Name	Position	Legs
Capt. Marvin Butcher,	Ship's Master	1
Capt. Alan Gillotte,	Ship's Master	2 & 3
Mr. John Iwachiw,	NAVOCEANO, Senior NAVO Representative	1 & 2
Mr. David Somers,	NAVOCEANO, Senior NAVO Representative	1
Dr. James V. Gardner,	Univ. of New Hampshire, UNH/NOAA Representative	1 & 3
Mr. Doug Cartwright,	Mosaic Hydrographic Services, UNH/NOAA representative	2
Mr. Paul Donaldson,	SAIC, bathymetry processing	1 & 3
Mr. Gary Davis,	SAIC, bathymetry processing	2
Ms. Debra Smith,	SAIC, bathymetry processing and database manager	1
Mr. Jason Infantino,	SAIC, bathymetry processing and database manager	2
Ms. Meme Lobecker,	SAIC, bathymetry processing and database manager	3
Mr. Stephen Farr,	NAVOCEANO, Hydrographer	1 & 2
Mr. David Brazier,	NAVOCEANO, Hydrographer	3
Ms. Katie Reser,	NAVOCEANO, Hydrographer	1 , 2 & 3
Mr. Thomas Wissing,	NAVOCEANO, Hydrographer	1 , 2 & 3
Mr. Michael Garrison,	NAVOCEANO, Gravity & 3.5 kHz	1 & 2
Mr. Jack Vice,	NAVOCEANO, Gravity & 3.5 kHz	3
Ms. Diane Meadows,	NAVOCEANO, database manager	1 & 2
Mr. Harold Littles,	NAVOCEANO, database manager	3

Appendix 3. Color shaded-relief bathymetry and acoustic backscatter maps of northern region of U.S. Atlantic continental margin.

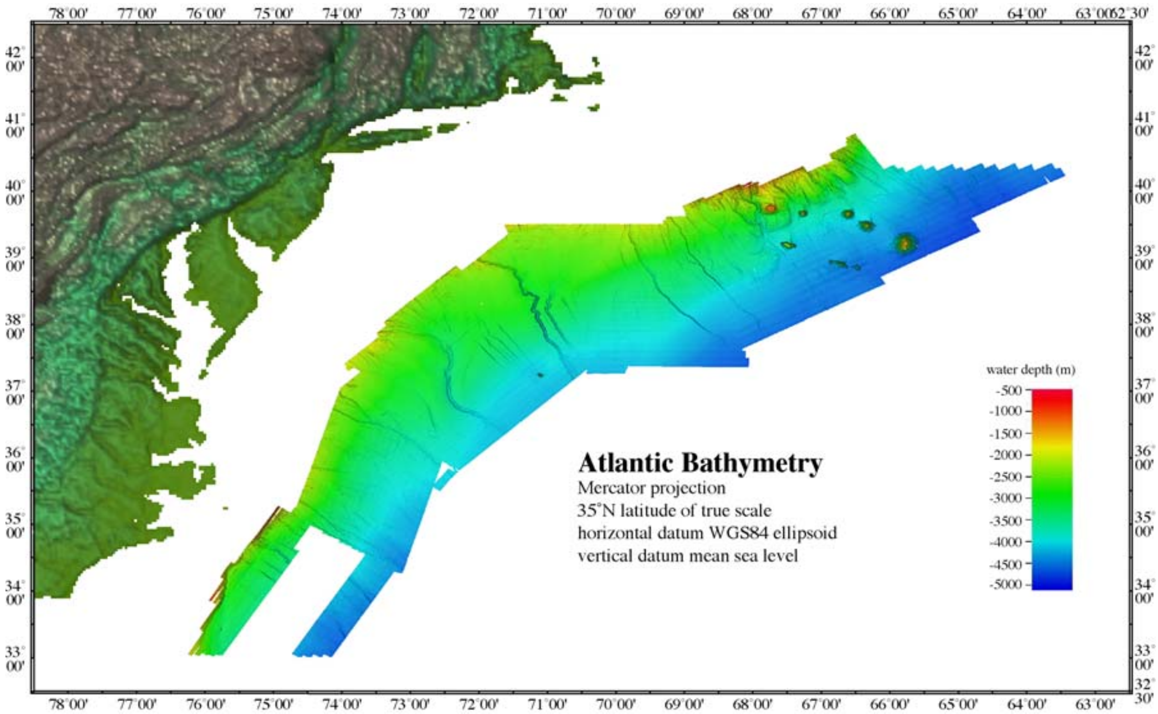


Figure 18. Color shaded relief map of entire mapped area.

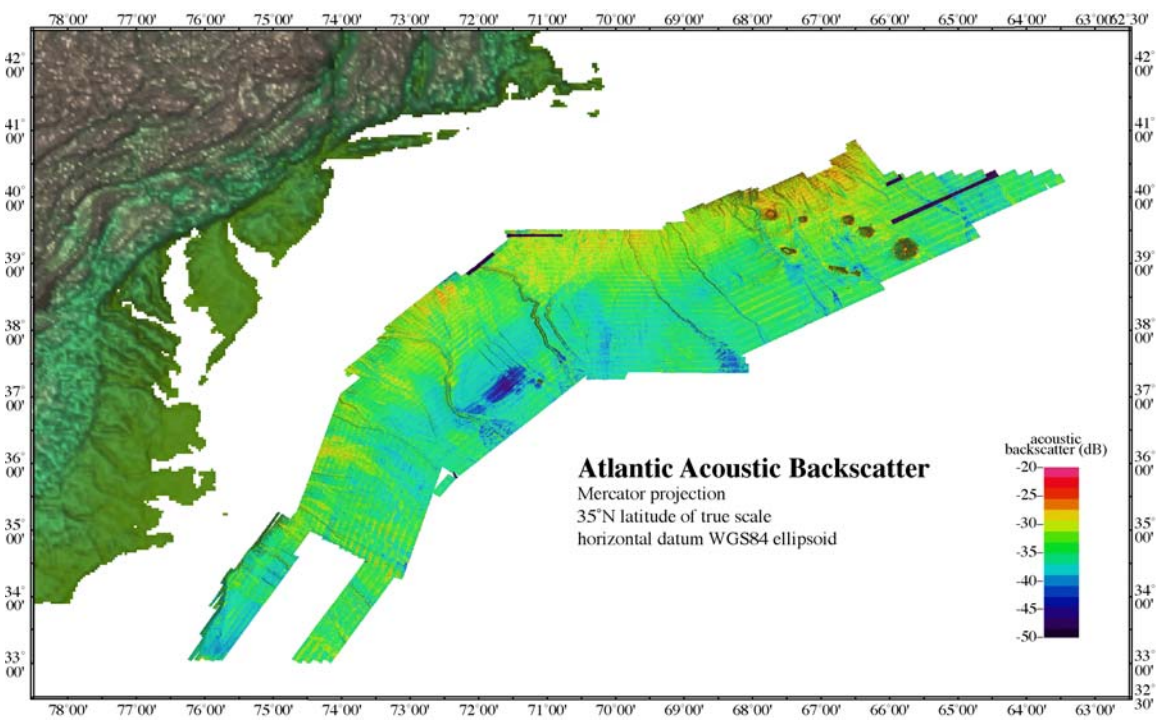


Figure 19. Color-coded acoustic backscatter map of entire mapped area.

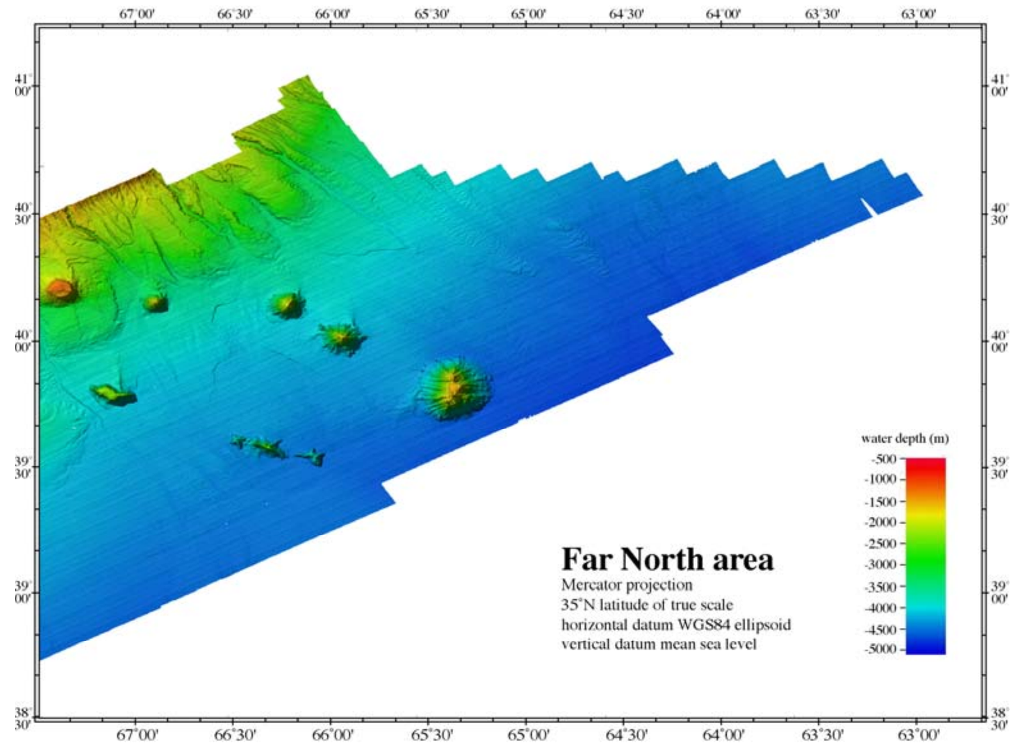


Figure 20. Color shaded relief map of Far North area.

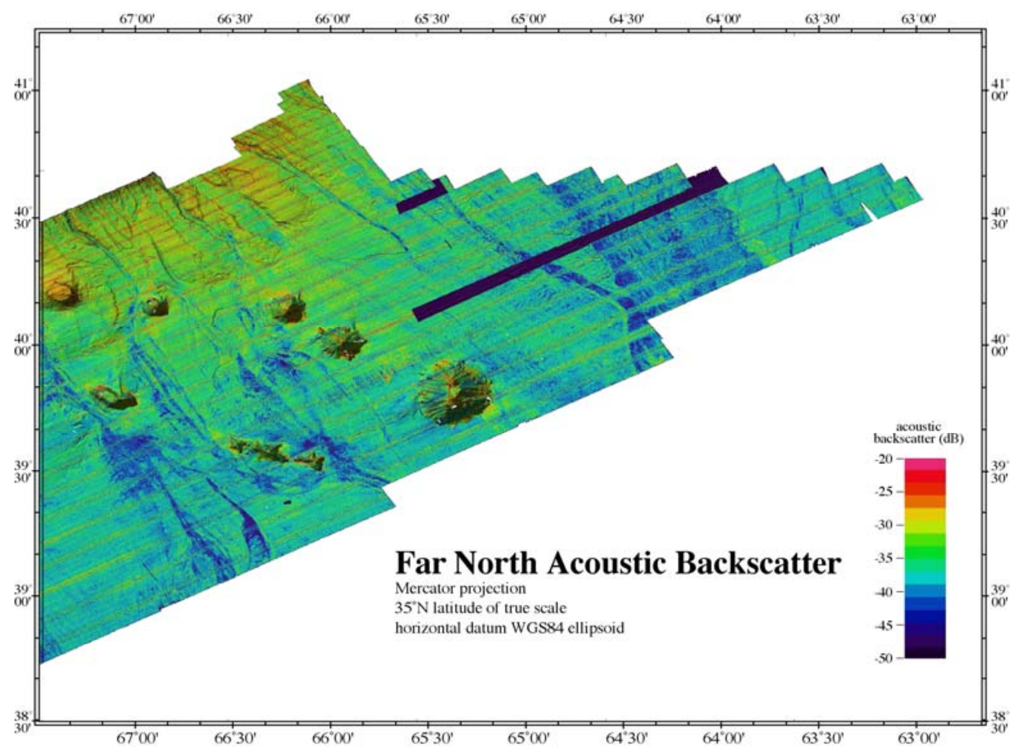


Figure 21. Color-coded acoustic backscatter map of Far North area.

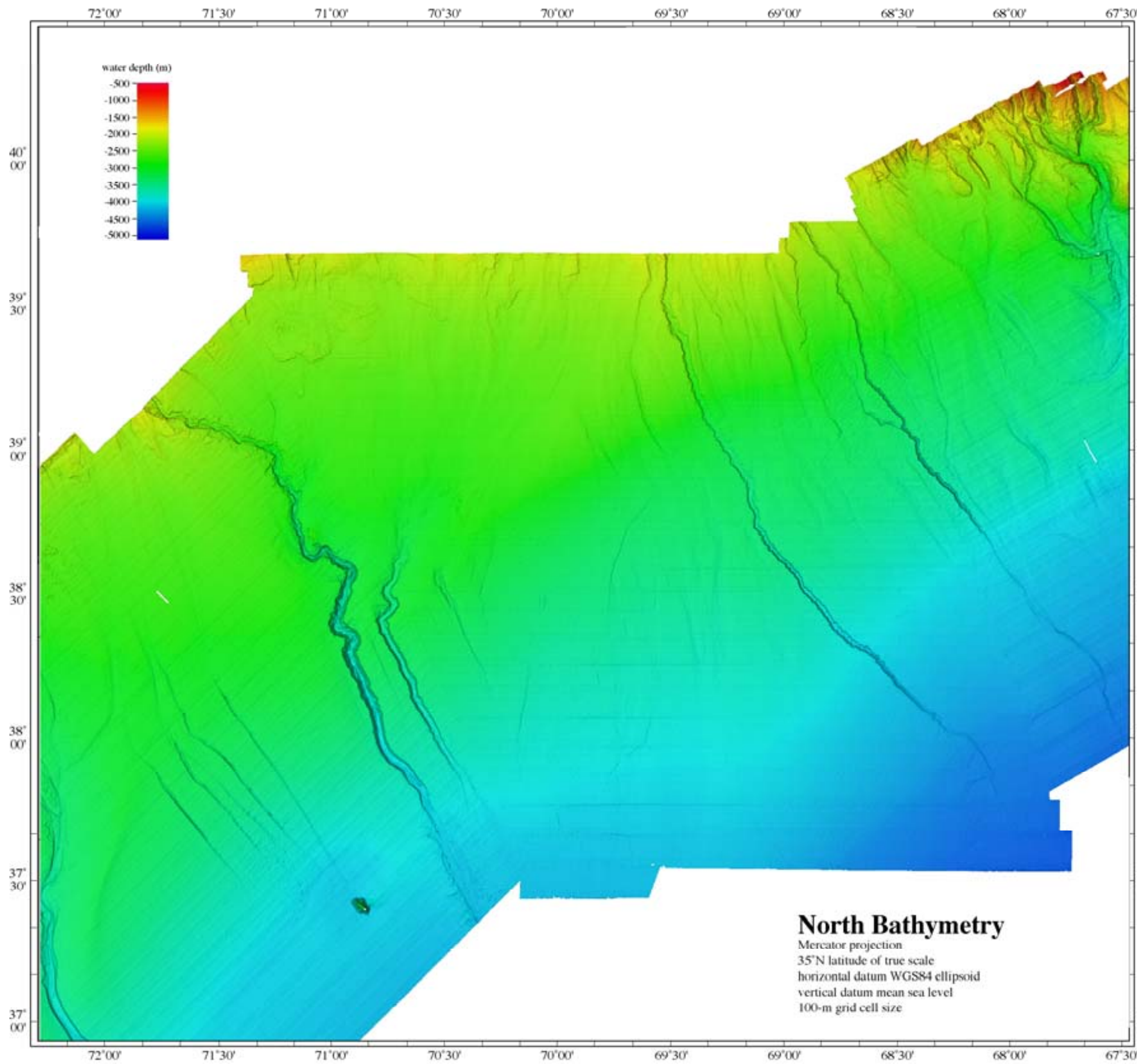


Figure 22. Color shaded relief map of North area.

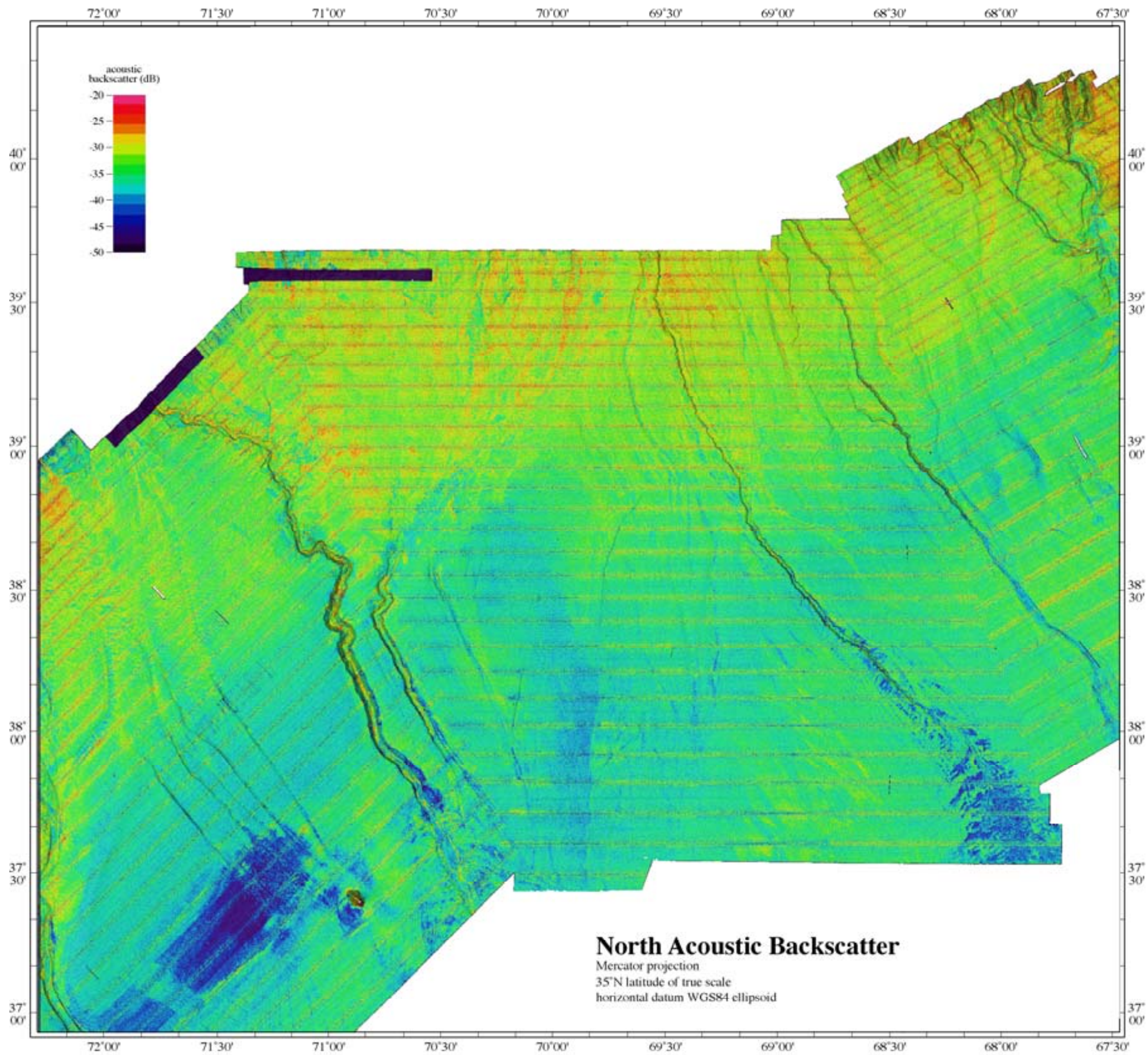


Figure 23. Color-coded acoustic backscatter map of North area.

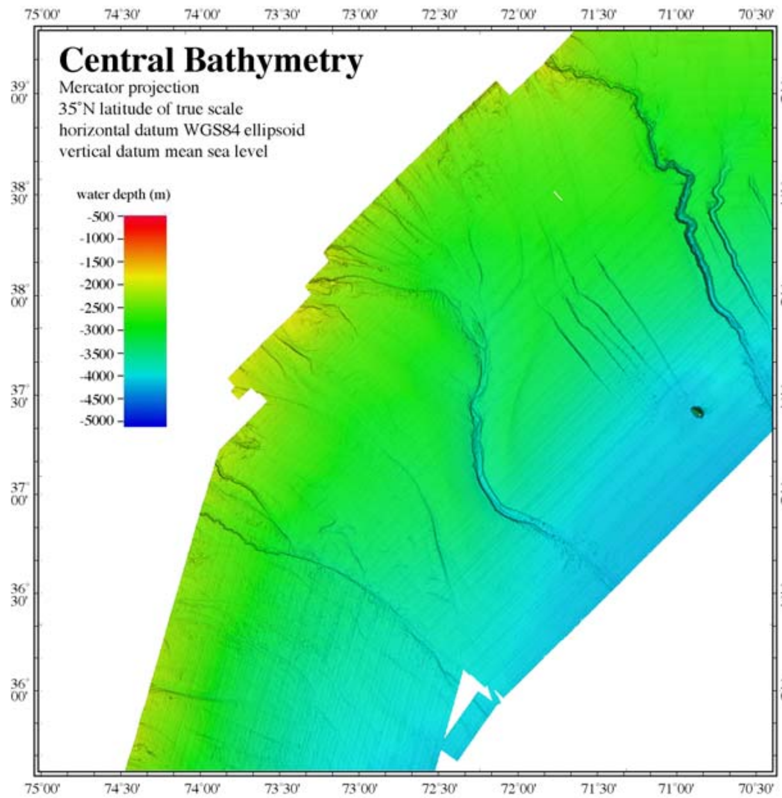


Figure 24. Color shaded relief map of Central area.

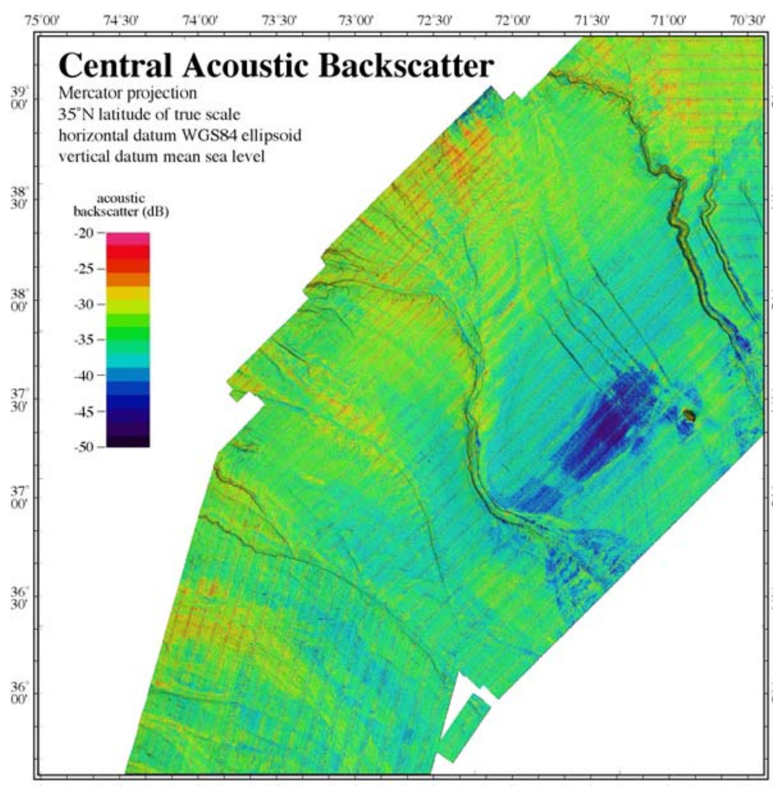


Figure 25. Color-coded acoustic backscatter map of Central area.

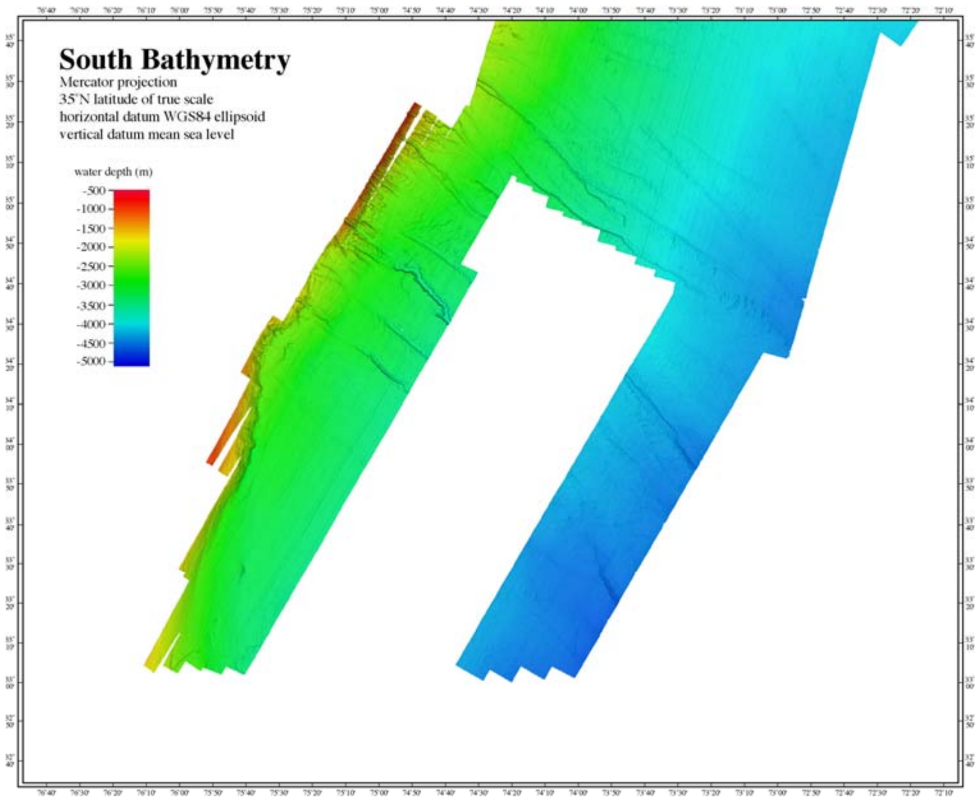


Figure 26. Color shaded relief map of South area.

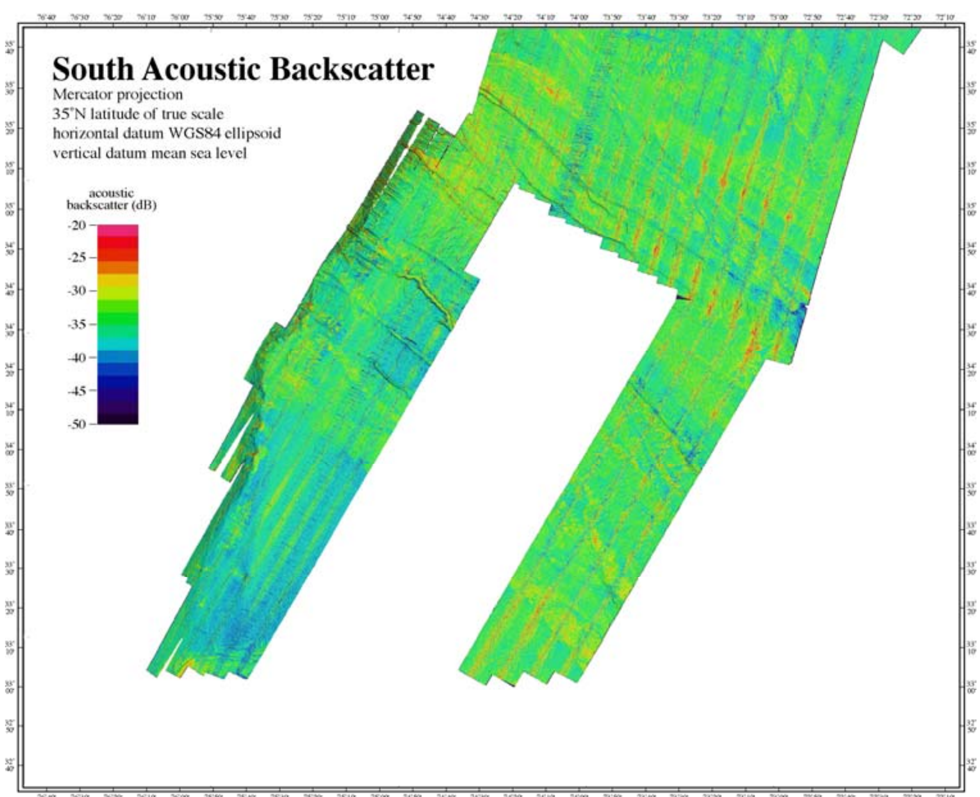


Figure 27. Color-coded acoustic backscatter map of Central area.