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NOAA *Okeanos Explorer* Program

MAPPING DATA REPORT

CRUISE EX-11-06

Exploration Mapping: Pascagoula, Mississippi to Davisville, Rhode Island

September 15 - 28, 2011

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1. Introduction

The NOAA Office of Ocean Exploration and Research and the NOAA Ship *Okeanos Explorer*

Commissioned in August 2008, the NOAA Ship *Okeanos Explorer* is the nation's only federal vessel dedicated to ocean exploration. With 95% of the world's oceans left unexplored, the ship's combination of scientific and technological tools uniquely positions it to systematically explore new areas of our largely unknown ocean. These exploration cruises are explicitly designed in collaboration with the broad science community to provide a foundation of publicly accessible baseline data and information to support science and management needs. This baseline information often leads to further more detailed investigations by other parties.

The unique combination of mission capabilities including a high-resolution multibeam sonar deep water remotely operated vehicles, telepresence technology, and integrated data management system quicken the scientific discovery and dissemination process. These systems enable us to identify new targets in real time, dive on those targets shortly after initial detection, and then send this information back to shore for immediate near-real-time collaboration with scientists and experts at Exploration Command Centers around the world. The integrated data management system provides for the quick dissemination of information-rich products to the scientific community. This ensures that discoveries are immediately available to experts in relevant disciplines for research and analysis.

Through the operation and maintenance of the mission capabilities, NOAA's Office of Ocean Exploration and Research (OER) provides the nation with unparalleled capacity to discover and investigate new oceanic regions and phenomena, conduct the basic research required to document discoveries, and seamlessly disseminate data and information-rich products to a multitude of users. OER strives to develop technological solutions and innovative applications to critical problems in undersea exploration and to provide resources for developing, testing, and transitioning solutions to meet these needs.

Okeanos Explorer Management – a unique partnership within NOAA

The *Okeanos Explorer* mode of systematic telepresence-enabled exploration requires a robust shore-based high-speed network and infrastructure. The ship is operated, managed and maintained by NOAA's Office of Marine and Aviation Operations, which includes commissioned officers of the NOAA Corps and civilian wage mariners. OER owns and is responsible for operating and managing the cutting-edge ocean exploration systems on the vessel (ROV, mapping and telepresence) and ashore including Exploration Command Centers and terrestrial high-speed networks. The ship and shore-based infrastructure combine to be the only federal program dedicated to systematic telepresence-enabled exploration of the planet's largely unknown ocean.

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2. Report Purpose

The purpose of this mapping report is to describe the mapping data collection and processing methods to enable maximum usability of the EX-11-06 dataset. A detailed description of the setup of the various mapping equipment and sensors is provided in the 'NOAA Ship *Okeanos Explorer* 2011 Readiness Report' which can be obtained from the ship.

The crew of the NOAA Ship *Okeanos Explorer* is greatly appreciated for their efforts in helping make the cruise a success.

3. Cruise Objectives Summary

See the EX-11-06 Project Instructions (DOI: https://doi.org/10.7289/V5V40SFK) for the detailed cruise objectives.

Sonar Data Collection

- As with all transit cruises, the main objective for EX-11-06, the final cruise of the field season, was to conduct exploration mapping in support of the *Okeanos Explorer* Program's *Always Exploring* mission, while conducting safe transit from Pascagoula, Mississippi to Davisville, Rhode Island. Davisville is the location of the ship's home port facility at Quonset Point, and the cruise end marked the ship's inaugural arrival. This included 24-hour Kongsberg EM 302 (30 kHz) bathymetric multibeam data and Sippican expendable bathythermograph sound velocity profiles throughout the entire cruise, EM 302 water column data collection along the Florida Escarpment and the U.S. Atlantic Continental Shelf break, and Kongsberg EK 60 data collection along the Florida Escarpment.

- Generate cumulative daily multibeam products for transmittal to shore to provide updates to the Okeanos Explorer Digital Atlas and situational awareness to shoreside participants.

- Conduct ongoing mapping system familiarization and training, streamlining of standard operating procedures for underwater cultural heritage data collection and archival processes.

- In support of National Oceanographic Partnership Program (NOPP):
    - Map a planned trackline running along the continental shelf break from North Carolina to south of Rhode Island, covering portions of several shelf-indenting and slope canyons, adding to existing shallow (<1000 meters) multibeam data previously collected by the NOAA Ship *Nancy Foster* in the area, and providing site characterization to aid in further exploration in the area.
    - Conduct focused exploration mapping operations in the vicinity of:
        a. Battle of the Atlantic area offshore North Carolina
        b. Pamlico Canyon
        c. Hatteras Channel
        d. Keller Canyon
        e. Allan Jackson shipwreck (position approximate)
        f. San Demetrio shipwreck (position approximate)
        g. South Wilmington Canyon
        h. Baltimore Canyon

- Collect crossline data for long term multibeam data quality assessment and tracking.
- A representative from NCDDC was onboard to further understand ship operations, data pipeline, and product development.

Telepresence System Utilization

- Available bandwidth: VSAT 5 megabits per second (Mbps) ship-to-shore; 1.54 Mbps (T1) shore–to-ship

1. *Okeanos Explorer* FTP Site – utilize for transfer of standard daily multibeam product suite.
2. Utilize iChat Event Log for updates called for by key operations.
3. Broadcast one live feed of the multibeam data collection screen to Internet 1 and Internet 2 for system testing in the Gulf of Mexico and the western Atlantic Ocean.

- Conduct ongoing telepresence system familiarization and training of ship and mission personnel.

4. Participating Personnel

NAME	ROLE	AFFILIATION
CDR Robert Kamphaus	Commanding Officer	NOAA Corps
LT Megan Nadeau	Acting Executive Officer	NOAA Corps
LTjg Matthew O'Leary	Acting Field Operations Officer	NOAA Corps
Meme Lobecker	Expedition Manager / Mapping Team Lead	NOAA OER (ERT Inc.)
Adam Skarke	Mapping Watchstander	NOAA OER (ERT Inc.)
Colleen Peters	Senior Survey Technician	NOAA OMAO
Lillian Stuart	Senior Survey Technician (augmenting)	NOAA OMAO
Ash Harris	Mapping Watchstander	NOAA OER / UCAR
Gustav Kågesten	Mapping Watchstander	NOAA OER / UCAR
Brendan Philip	Mapping Watchstander (intern)	NOAA OER / UCAR Intern
Frank Cantelas	OER Maritime Archaeologist	NOAA OER
Denise Gordon	Data Manager	NOAA NCDDC (General Dynamics, Corp.)

5. Summary of Major Findings

Overall Cruise Map

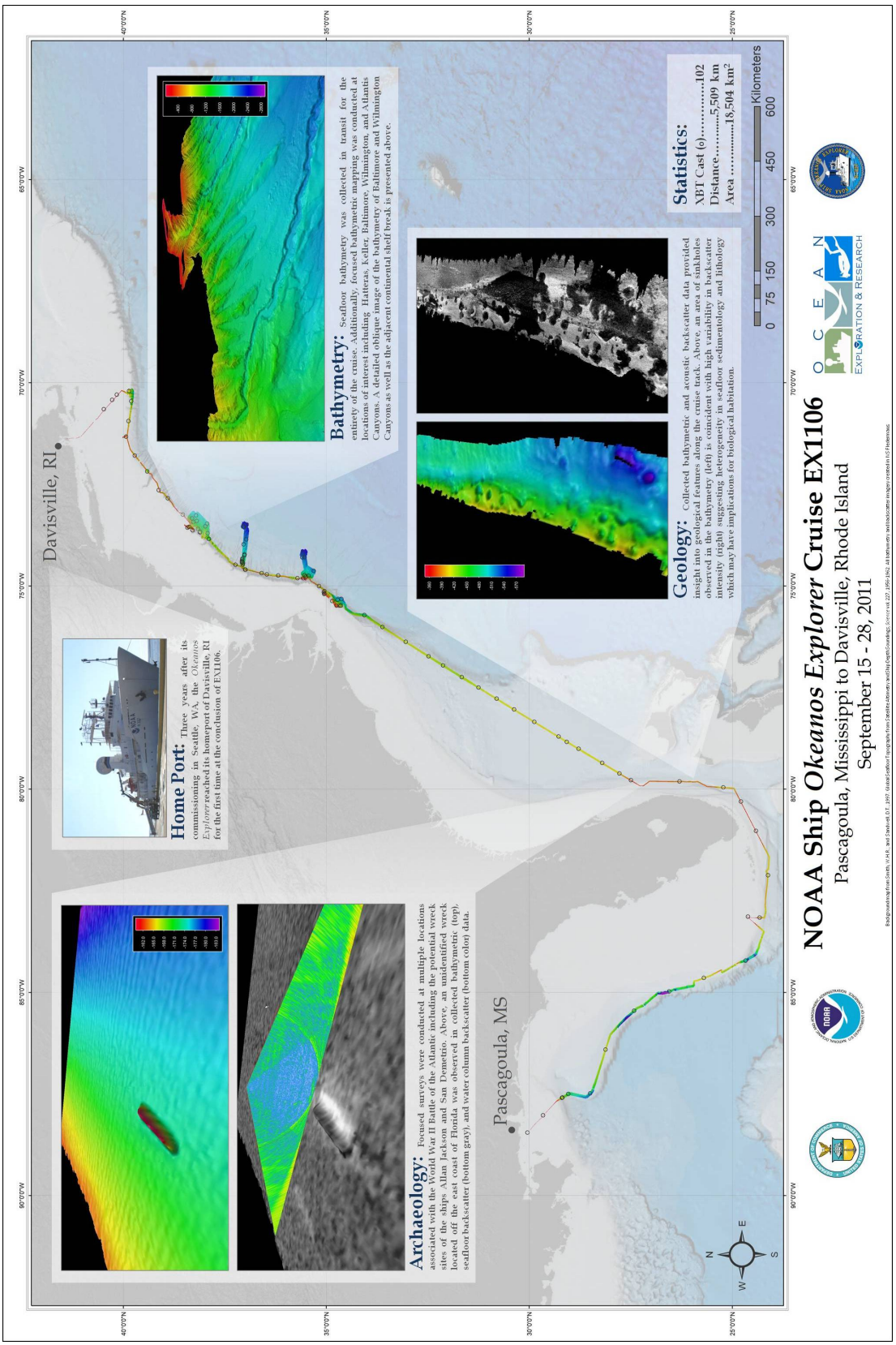

Figure 1. Map created by Adam Skarke, NOAA OER Physical Scientist, showing overall results of data collection during cruise.

Key Features

Wreck observed on 9/18/11

The NOAA Office of National Marine Sanctuaries (ONMS) provided the point locations of several other World War II wrecks that were sunk as acts of war in 1942, three of which were incorporated into the planned transit line through the Strait of Florida and northward up the Florida east coast. The positions provided were understood to be very approximate due to available technology at the time of wreckage. Two of the reported positions were disproved: that given for the Managua, a 289 foot freighter carrying general cargo; and that given for the W.D. Anderson, a 500 foot tanker carrying 133,360 barrels of crude oil. No evidence of wreckage or debris was observed in the multibeam data at either reported position.

At the third reported position, however, a wreck was found. At the time of writing this report, the identity of this wreck was undetermined. The Potrero Del Llano, a 110 meter tanker sunk on May 14, 1942 carrying 35,000 barrels of diesel oil, was reported to be at this location. The center of the wreck found was observed to be within twenty meters of the Potrero Del Llano's reported position. The found wreck sits in 175 meters of water, and rises 20 meters above the bottom. It is 160 meters long, and 25 meters abeam at its widest point, and is 50 meters longer than the reported dimensions of the Potrero Del Llano. Below are images of multibeam data of the wreck.

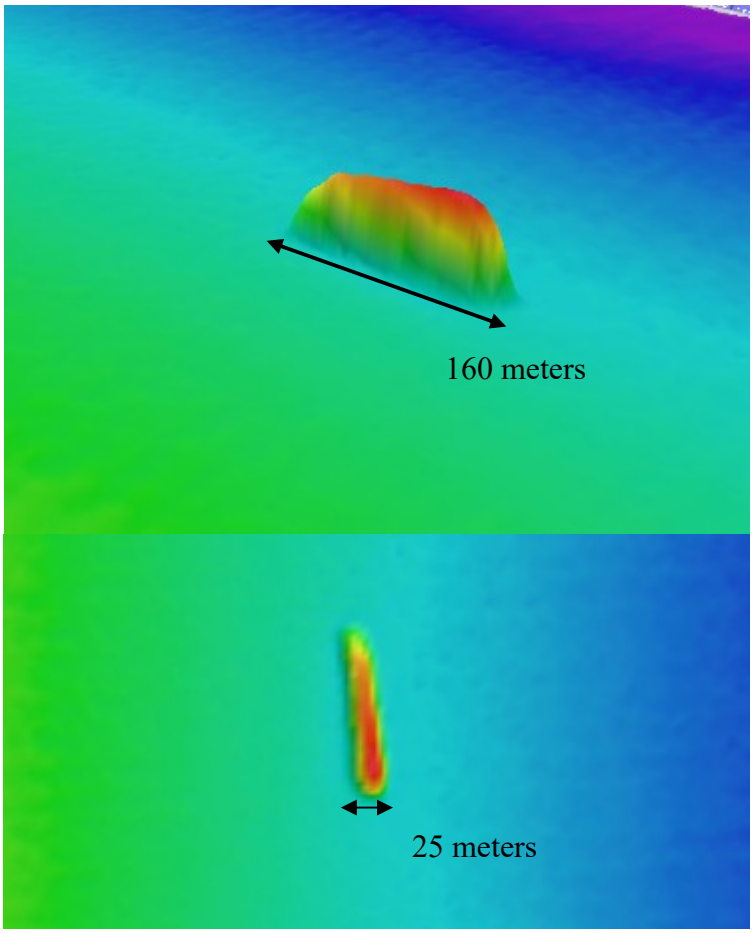

Figure 2. Two screen grabs showing EM 302 multibeam bathymetry data collected over the wreck surveyed on 9/18/11. Image created in Fledermaus.

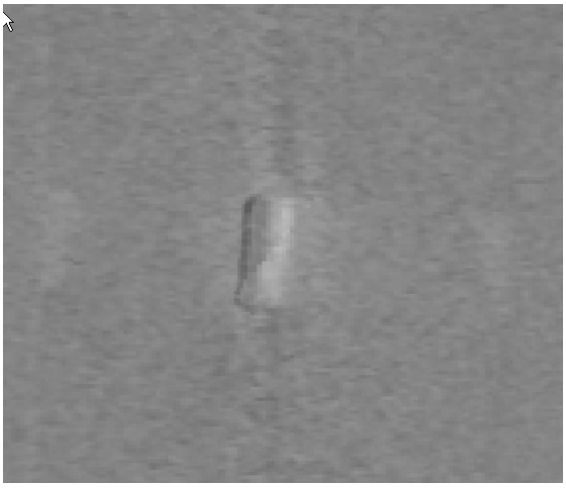

Figure 3. Screen grab showing EM 302 seabed backscatter data collected over the wreck surveyed on 9/18/11. Image created in IVS FMGT.

Underwater Cultural Heritage (UCH) Surveys

While transiting north along the U.S. Atlantic Continental Shelf break, the ship had the opportunity to conduct mapping surveys over several UCH sites in support of NOAA's participation in the NOPP with the Bureau of Ocean Energy Management (BOEM). The partnership addresses the NOAA Next Generation Strategic Plan objective of comprehensive coastal planning and management, and also certain aspects of the National Marine Sanctuary Act. BOEM is the federal agency responsible for the regulation of renewable and nonrenewable energy development and production on the Outer Continental Shelf. Such activities have the potential to impact offshore historical resources, and BOEM is obligated under the National Historic Preservation Act to consider the effect of its regulatory actions on sites eligible for the National Register of Historic Places. Data collected by the *Okeanos Explorer* during EX-11-06 will help efforts to locate, identify and research sensitive natural and cultural resources before they are impacted by offshore development. The data will also support BOEM's mandate to protect cultural and natural resources on the Outer Continental Shelf (OCS) from energy development.

Specifically, the ship conducted three surveys in support of this partnership:

- (1) General site survey of a sub-area of the Battle of the Atlantic (BOTA), referred to in this report as Area 6; (2-3)Wreck searches for the Allan Jackson and the San Demetrio, two WWII merchant ships sunk during the German campaign "Operation Drumbeat" during BOTA.

These surveys support the Monitor National Marine Sanctuary's (MNMS) multi-year study of the history and archaeology of the Battle of the Atlantic. While naval actions between Axis and Allie powers occurred across the entire Atlantic basin from 1939 to 1945, a significant portion took place off the U.S. East Coast, including the area around Cape Hatteras, NC. In the U.S., most of the merchant ship losses to German U-boats occurred at the beginning of America's involvement in the war, from January to July 1942. There are 125 known losses from both sides during BOTA off North Carolina. During this period, Germany brought the war to the America, engaging in battle within sight of those ashore. The loss of merchant shipping impacted our ability to wage war. Collectively, the ships lying on the bottom are historically significant, representing a crisis period in American history.

MNMS requested a survey in the vicinity of where the Battle of Convoy KS-520 occurred from July 14 to 19,1942. Ultimately, four vessels were lost including two thought to be in the vicinity of BOTA. A GIS analysis of historical records and casualty reports was used to create a probability map off the Atlantic coast where the battle likely occurred. Over the past several years OER has provided assets to assist MNMS in conducting surveys of opportunity to map portions of the area, primarily limited to the relatively shallow water on the Atlantic Continental Shelf, including a 2011 autonomous underwater vehicle (AUV) survey. EX-11-06 represents the first time deeper portions of the area have been surveyed to find cultural resources.

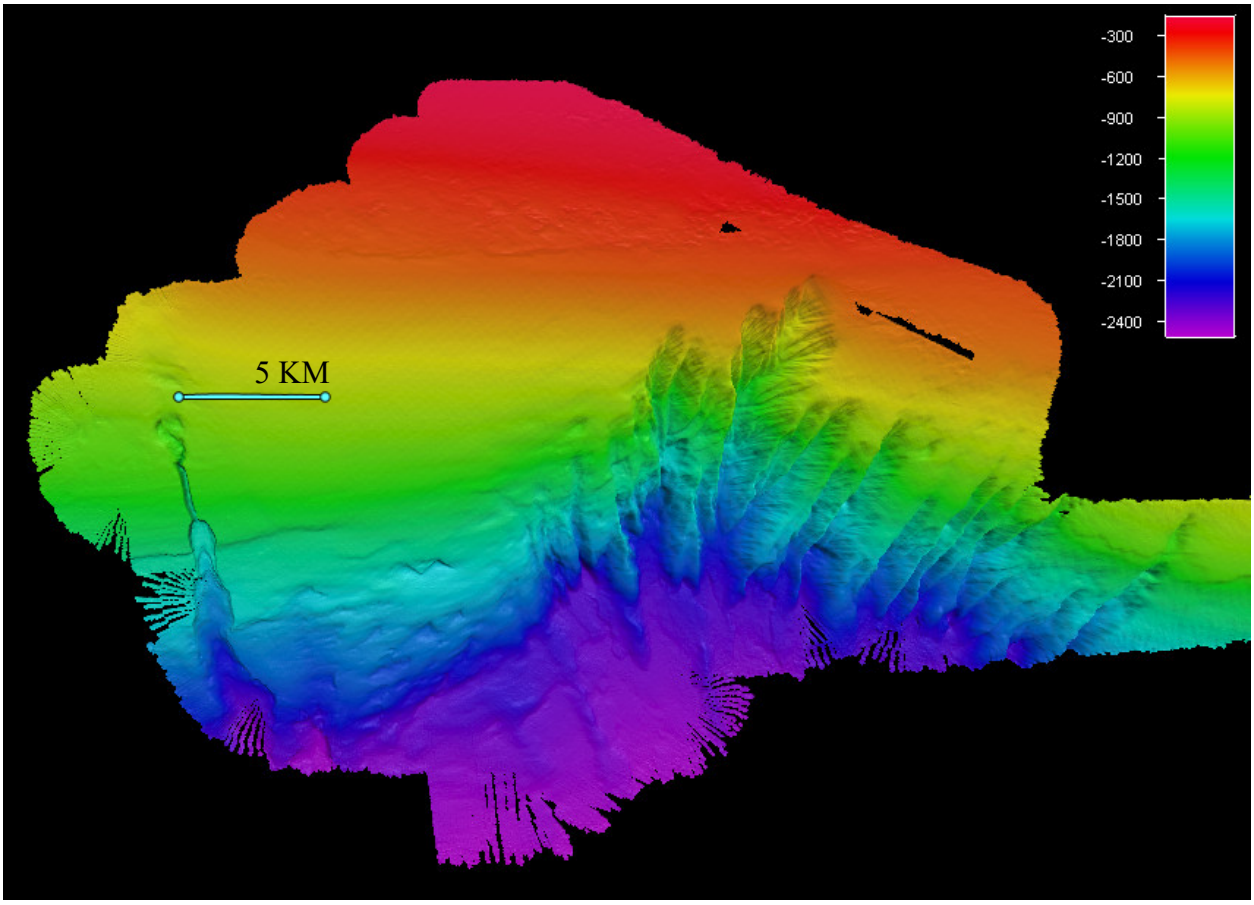

Figure 4. Plan view looking west, showing EM 302 multibeam bathymetry of the Battle of the Atlantic exploration area. Data gridded at 25 meter cell size, screen shot taken in Fledermaus. Color scale bar showing depth in meters. Vertical exaggeration 6x. 5 KM scale bar shown for reference.

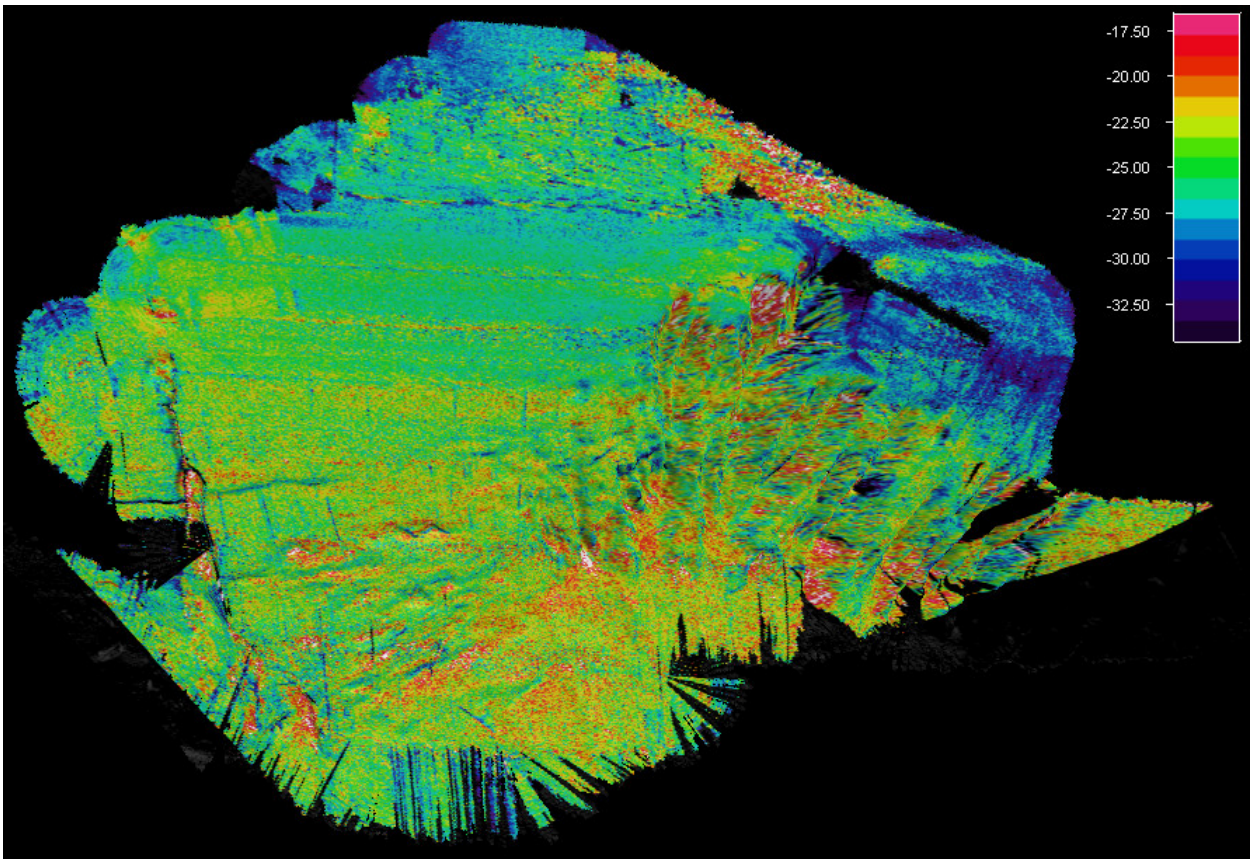

Figure 5. Plan view looking west, showing EM 302 multibeam bottom backscatter mosaic of "Area 6" in the Battle of the Atlantic area offshore North Carolina. Mosaic cell size 25 meters, screen shot taken in Fledermaus. Color scale bar showing acoustic strength return in decibels (dB), with warmer colors indicating stronger return signals.

Wreck searches 17 km x 17 km were conducted over the approximate locations of the Allen Jackson and the San Demetrio. A survey line spacing of 2 kilometers was used during both surveys, achieving greater than 200% coverage over the search areas. The ship speed was held to 6 knots during these surveys. During field data processing, neither wreck was observed in the EM 302 bathymetry or bottom backscatter data. Each survey revealed that the surrounding seabed at each reported (unverified) wreck location is uniform in terms of bottom type, and slopes gently seaward at a slope of less than 1°. At the time of writing of this report, OER marine archeologists were reviewing the data for evidence of the wrecks.

The Allan Jackson was lost on January 18, 1942 in 2400 meters of water approximately 128 kilometers off Cape Hatteras, North Carolina. It was one of the first victims of Germany's Operation Drumbeat. Attempting to find such a deep shipwreck is considered a challenging exercise for wreck search using a hull-mounted sonar.

EM 302 multibeam files 0080 to 0092 encompass the Allan Jackson survey. EM 302 multibeam files 0113 to 0127 encompass the San Demetrio survey. Further details regarding these files are provided in the multibeam data log in the appendices section of this report.

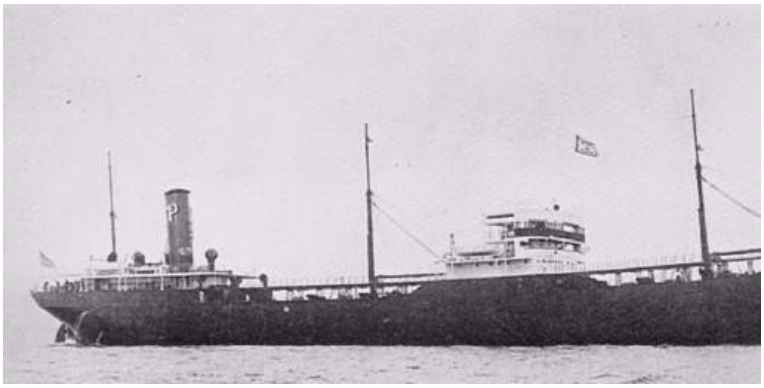

Figure 6. The Allan Jackson, image courtesy www.sunkenshipsouterbanks.com.

The San Demetrio was lost on March 17, 1942, in 2700 meters of water approximately 208 kilometers off the Virginia coast. The wreck is a key subject of BOEM's Mid-Atlantic Canyons study, and was also identified during the 2011 Ocean Exploration Advisory Working Group (OEAWG) Atlantic Basin Workshop as an exploration target of interest.

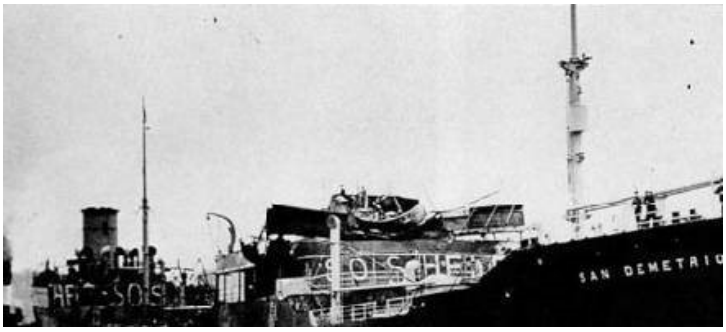

Figure 7. San Demetrio showing damage from being attacked by German vessel Admiral Scheer. Image courtesy www.wrecksite.eu.

Mid-Atlantic Canyons Transect and Surveys

The ship followed a strategic transit line up the U.S. Atlantic coast, largely adjacent to multibeam data recently collected by the NOAA Ship *Nancy Foster*, and mapping portions of numerous smaller shelf breaking canyons.

Exploration mapping surveys were also conducted over portions of Pamlico Canyon, Keller Canyon, Baltimore Canyon, and South Wilmington Canyon, as well as Hatteras Channel. These data will be used in BOEM's Mid-Atlantic Canyons study.

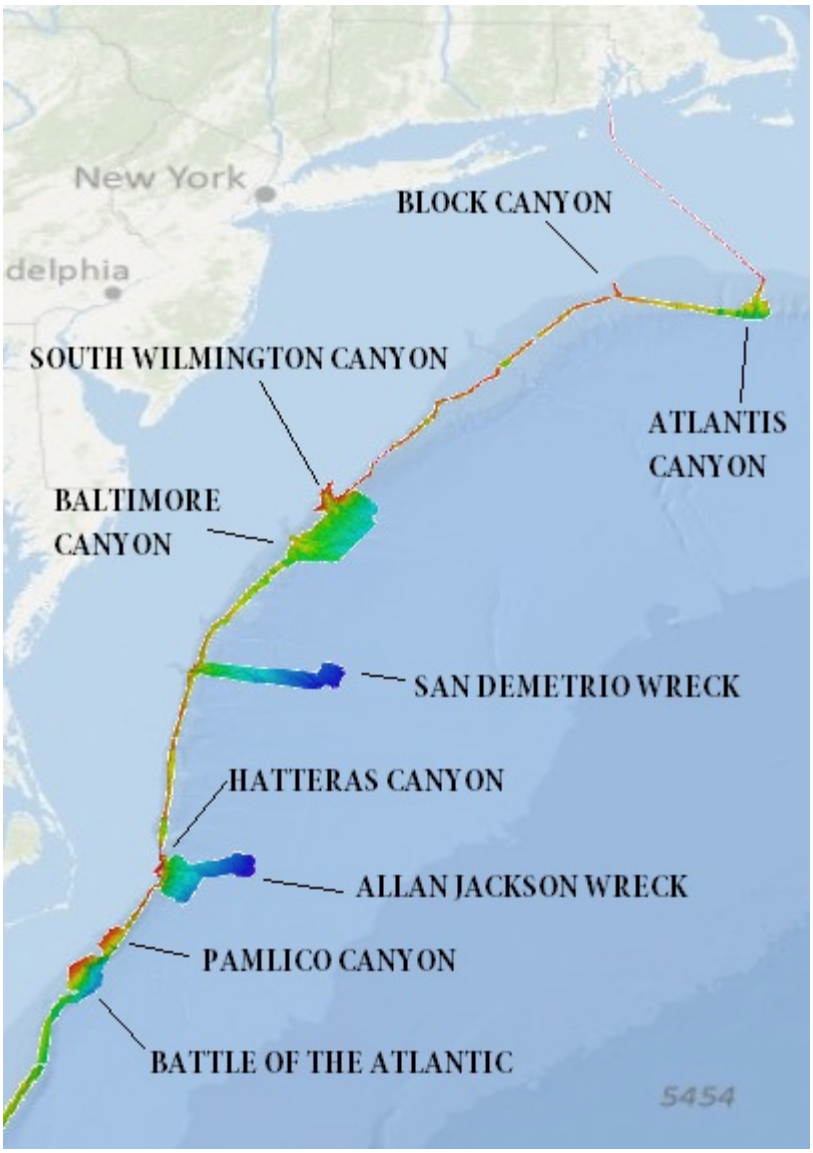

Figure 8. Screen shot from ArcMap showing EM 302 multibeam data collected during transit along northeast continental shelf break during EX-11-06.

Baltimore Canyon and South Wilmington Canyon

The figure below shows the complete EM 302 dataset collected over South Wilmington and Baltimore Canyons, encompassed by files 0133 to 0179. Further data file details are provided in the multibeam data log in the appendices section of this report.

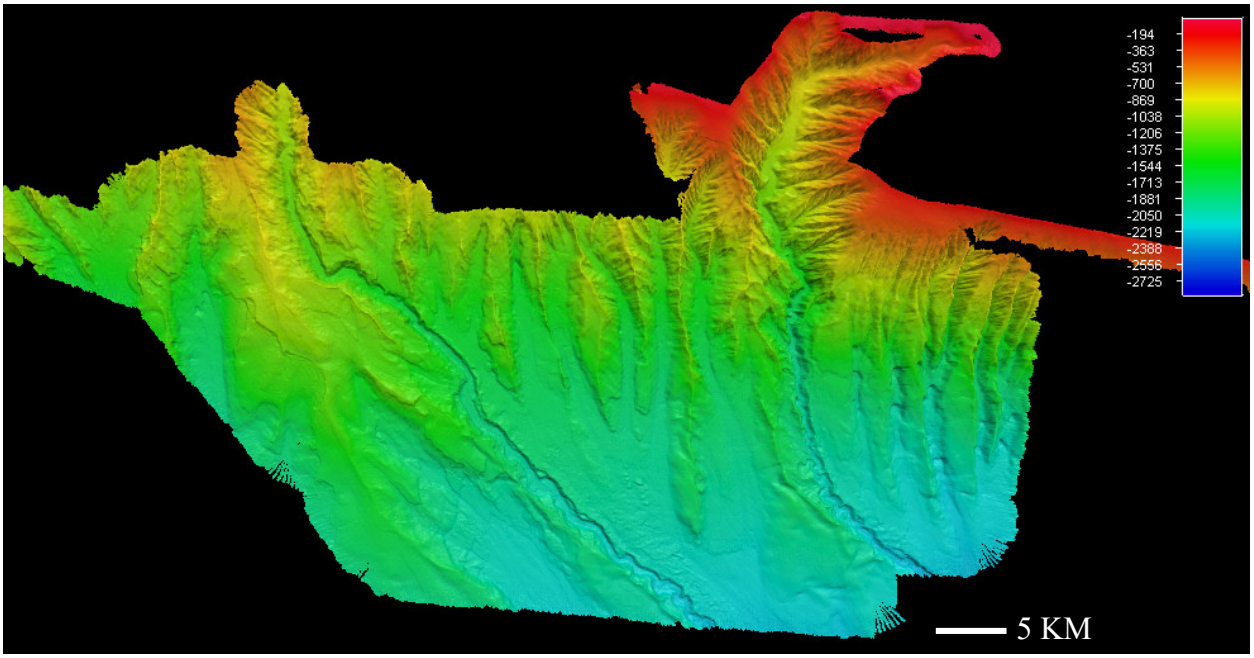

Figure 9. Plan view looking west, showing EM 302 multibeam bathymetry of South Wilmington (left) and Baltimore (right) Canyons. Data gridded at 50 meter cell size, screen shot taken in Fledermaus. Color scale bar showing depth in meters. Vertical exaggeration 6x. 5 kilometer scale bar shown for reference.

Pamlico Canyon

The figure below shows the complete EM 302 dataset collected over Pamlico Canyon, encompassed by files 0056 to 0069. Further data file details are provided in the multibeam data log in the appendices section of this report.

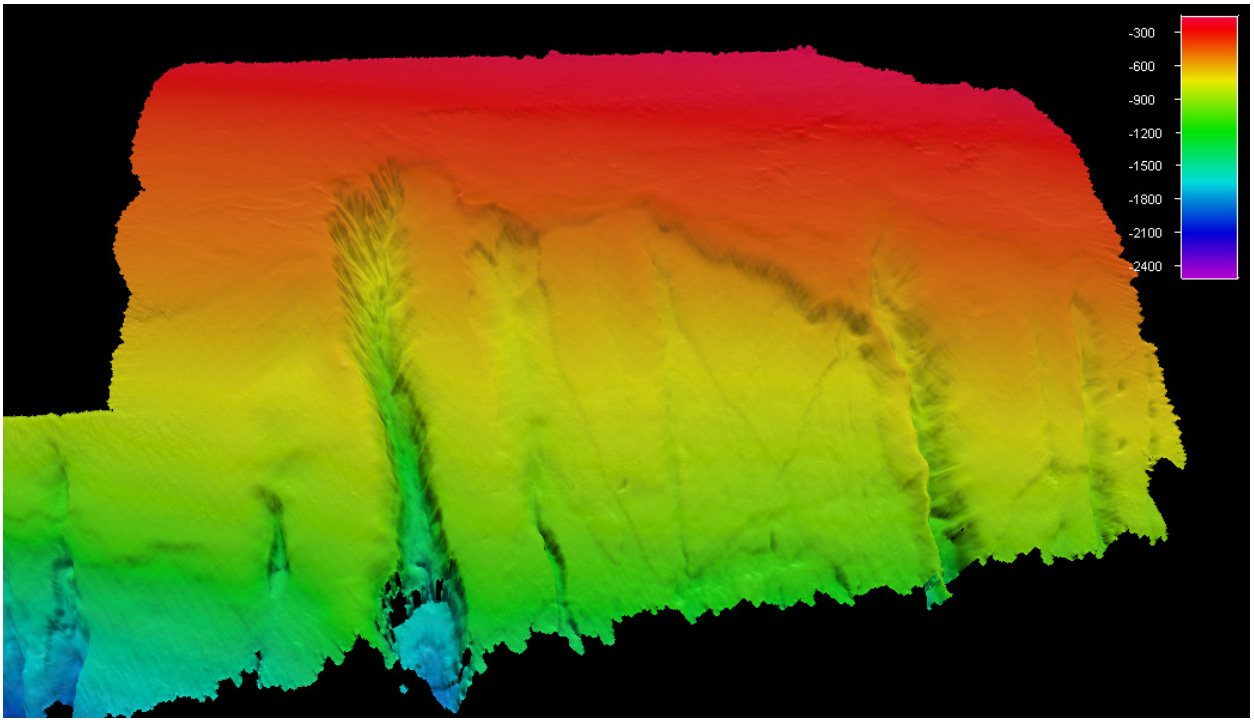

Figure 10. Oblique view looking west, showing EM 302 multibeam bathymetry of Pamlico Canyon. Data gridded at 50 meter cell size, screen shot taken in Fledermaus. Color scale bar showing depth in meters. Vertical exaggeration 6x.

Keller Canyon and Hatteras Channel

The figure below shows the complete EM 302 dataset collected over Keller Canyon and Hatteras Channel, encompassed by files 0071 to 0108. Further data file details are provided in the multibeam data log in the appendices section of this report.

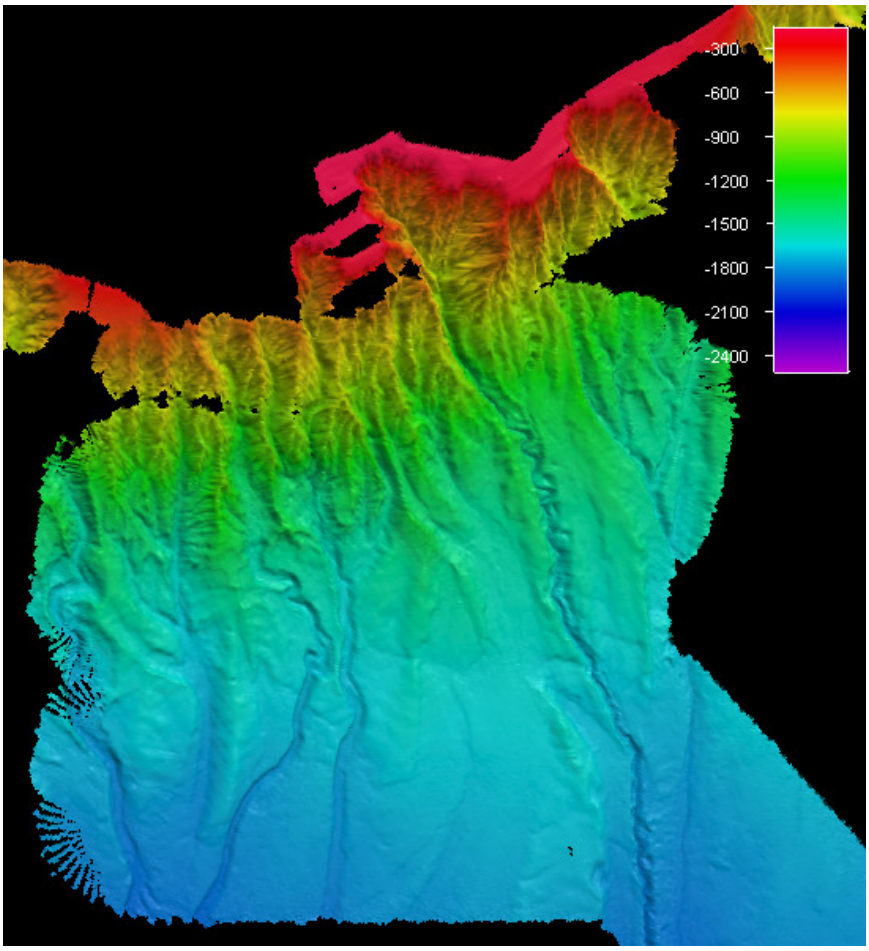

Figure 11. Plan view looking west, showing EM 302 multibeam bathymetry of Hatteras Channel (left) and Keller Canyon (right). Data gridded at 50 meter cell size, screen shot taken in Fledermaus with vertical exaggeration set to 6. Color scale bar showing depth in meters.

Atlantis Canyon and Block Canyon

Excellent survey conditions experienced throughout the cruise provided an unexpected 12 hours available at the end of the cruise, which was utilized to opportunistically map the shelf break portions of Atlantis and Block Canyons, located south of Rhode Island Sound. Atlantis Canyon is identified on the OEAWG list of exploration targets of interest. Block Canyon was partially included in the original BOEM strategic canyon trackline.

The figures below show the complete EM 302 dataset collected over Atlantis Canyon, encompassed by 0186 to 0192. Further data file details are provided in the multibeam data log in the appendices section of this report.

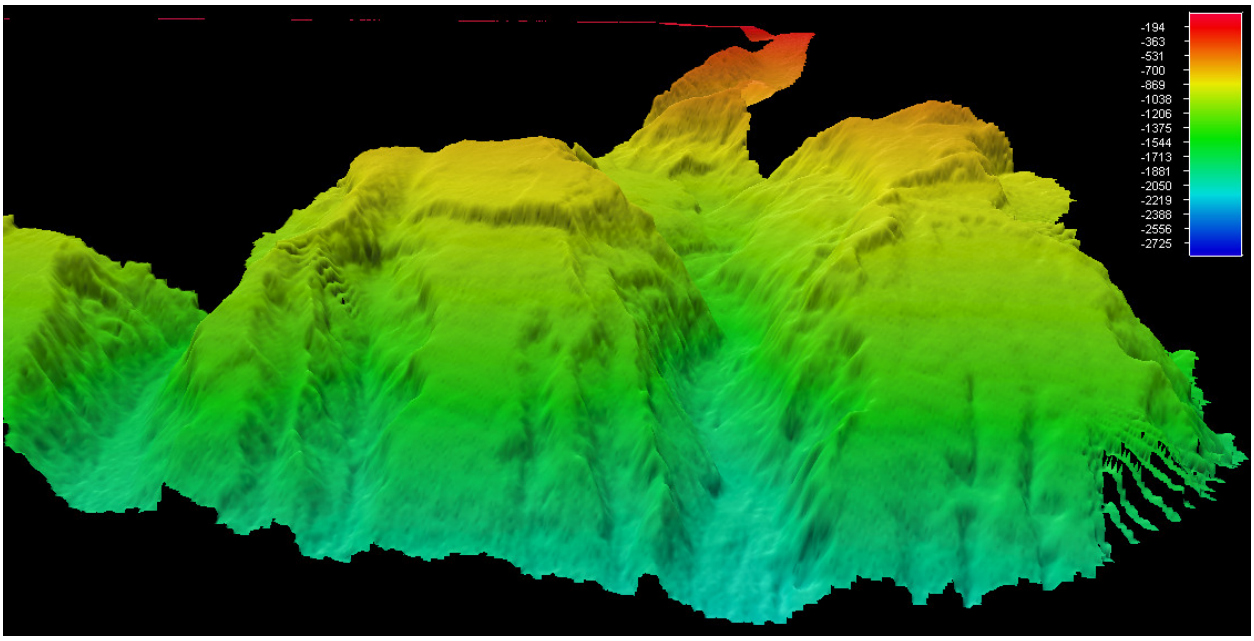

Figure 12. Oblique view looking north, showing EM 302 multibeam bathymetry of Atlantis Canyon. Data gridded at 50 meter cell size, screen shot taken in Fledermaus with vertical exaggeration set to 4. Color scale bar showing depth in meters.

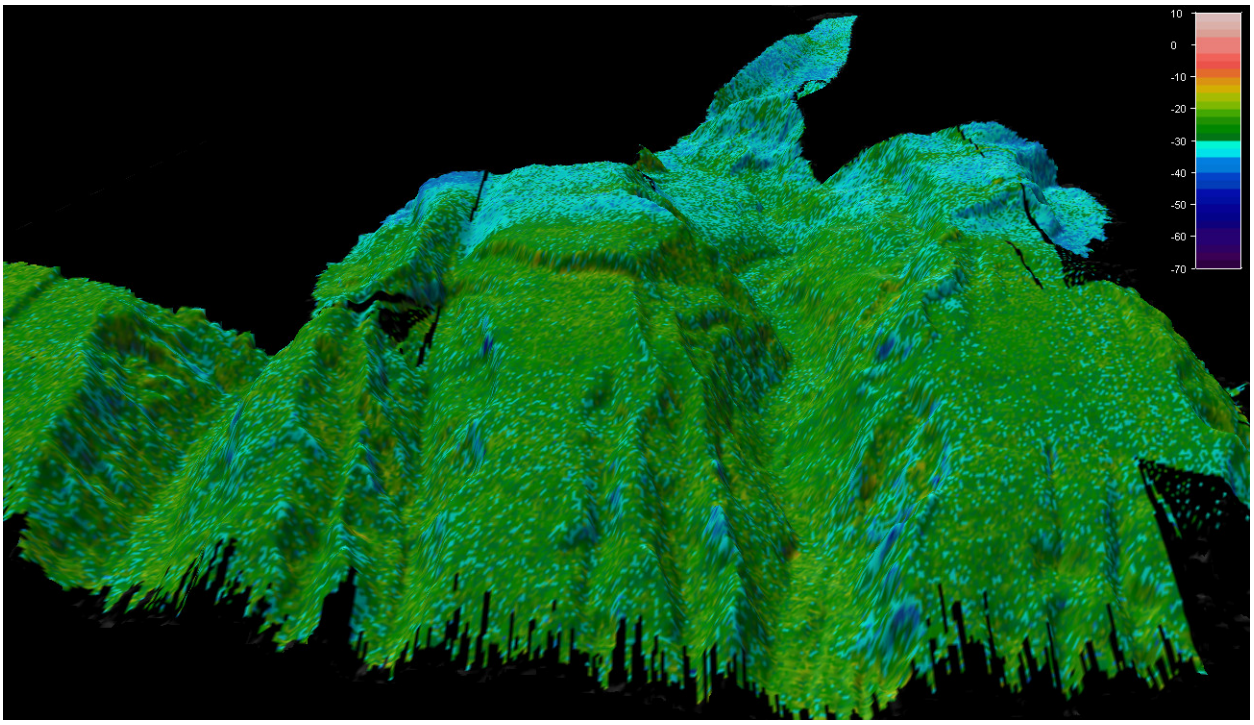

Figure 13. Oblique view looking north, showing EM 302 multibeam bottom backscatter data of Atlantis Canyon. Mosaic cell size 50 meters. Color scale bar showing acoustic strength return in decibels (dB), with warmer colors indicating stronger return signals.

The figures below show the complete EM 302 dataset collected over Block Canyon, encompassed by files 0183 to 0185. Further data file details are provided in the multibeam data log in the appendices section of this report.

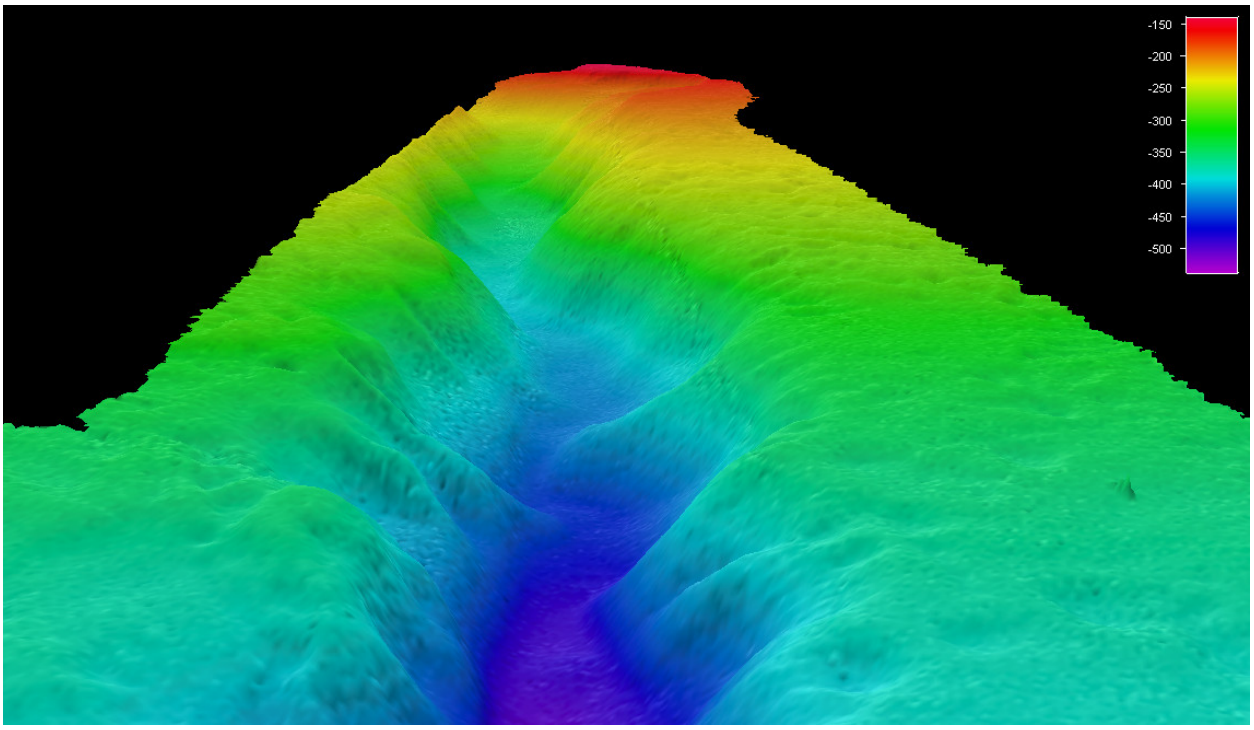

Figure 14. Oblique view looking northwest, showing EM 302 multibeam bathymetry data collected over Block Canyon. Data gridded at 5 meter cell size, screen shot taken in Fledermaus with vertical exaggeration set to 4. Color scale bar showing depth in meters.

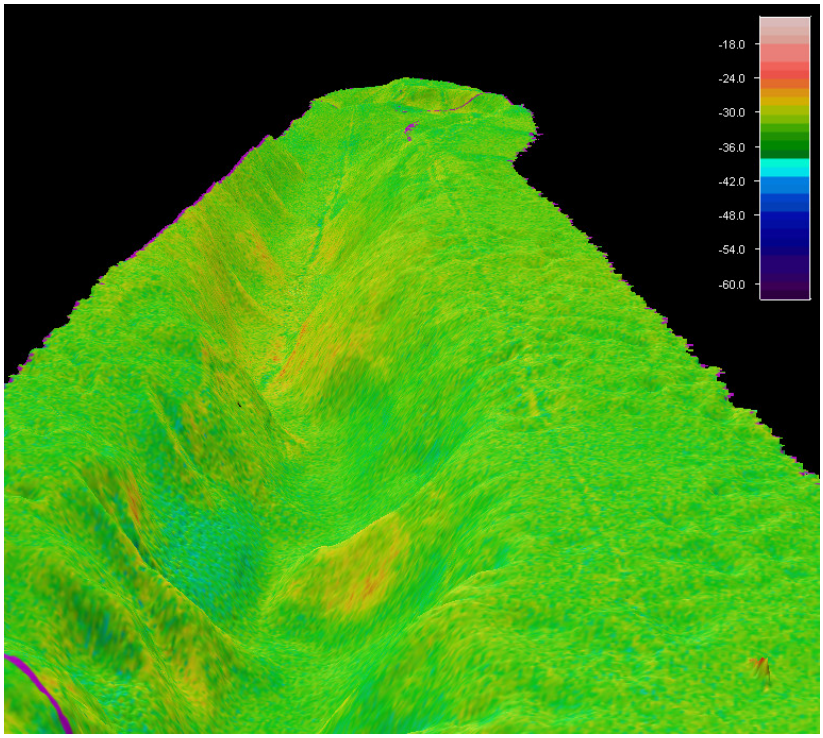

Figure 15. Oblique view looking northwest, showing EM 302 multibeam bottom backscatter data collected over Block Canyon. Mosaic cell size 5 meters. Color scale bar showing acoustic strength return in decibels (dB), with warmer colors indicating stronger return signals.

During the Block Canyon survey, a 22 meter by 100 meter by 12 meter high feature was detected. It is hypothesized the feature is a shipwreck, although further exploration is required to confirm. Nautical charts of the area show unexploded ordinance and several wrecks with approximate positions, as well as indications the area was previously used as a dumping ground.

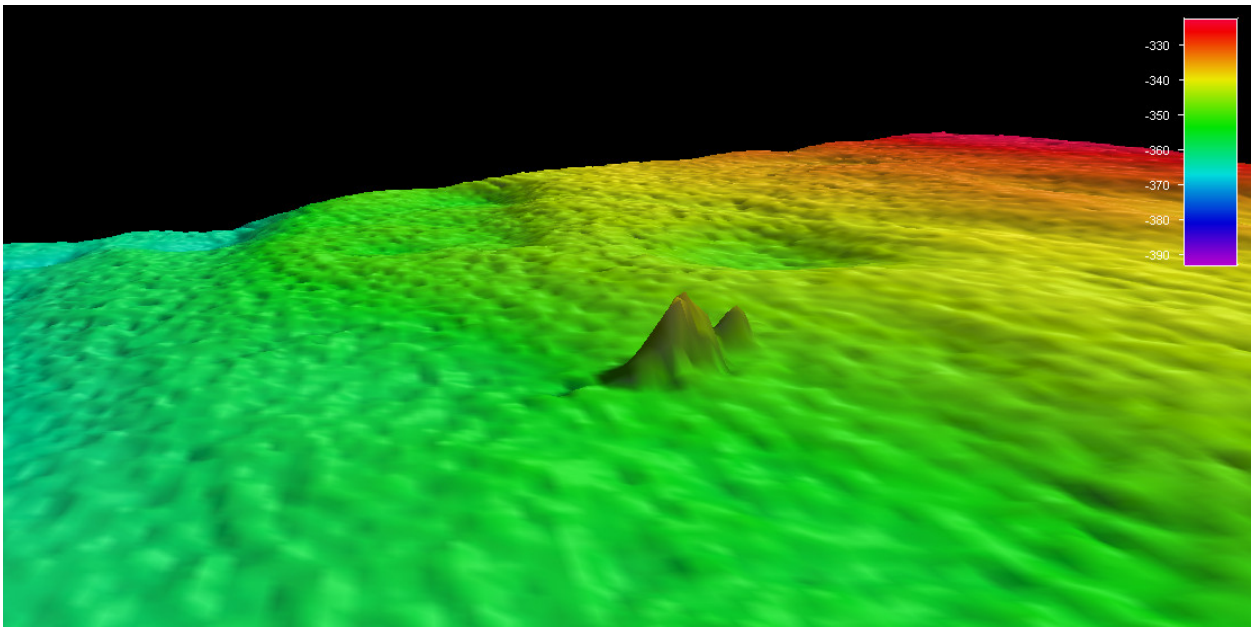

Figure 16. Oblique view looking west, showing EM 302 multibeam bathymetry of a possible shipwreck in Block Canyon. Data gridded at 5 meter cell size, screen shot taken in Fledermaus. Color scale bar showing depth in meters. Vertical exaggeration 3x.

Figure 17. Oblique view looking southwest, showing EM 302 multibeam bottom backscatter data of a possible wreck in Block Canyon. Mosaic cell size 5 meters. Red indicates stronger acoustic return signal.

6. Mapping Statistics

Dates	September 15 – 28, 2011
Weather delays	0 days
Total non-mapping days	0 days
Total survey mapping days	4.8 days
Total transit mapping days	8 days
Line kilometers of survey	5509 km
Square kilometers mapped	17,499 km^2
Number of bathymetric multibeam files	195
Data volume of raw multibeam data files	37 GB
Number of water column multibeam files (EM 302)	179
Data volume of water column multibeam files (EM 302)	72 GB
Number of water column multibeam files (EK 60)	10
Data volume of water column multibeam files (EK 60)	610 MB
Number of XBT casts	102
Number of CTD casts	0
Beginning draft	Fwd: 4.37 m Aft: 4.42 m
Ending draft	Fwd: 4.32 m Aft: 4.37 m
Average ship speed for survey	10.3 kts

7. Mapping Sonar Setup

The NOAA Ship *Okeanos Explorer* is equipped with the following sonars, calibrated annually as required and detailed in the 2011 readiness report. Following is a summary of the operating sonars:

- A 30 kHz Kongsberg EM 302 multibeam sonar capable of mapping the seafloor in 0 to 8000 meters of water. The system generates up to a 150° beam fan containing up to 432 soundings per ping in waters deeper than 3000 meters. In waters less than 3000 meters, the system is operated in multiping, or dual swath mode, and obtains up to 864 soundings per ping, by generating two swaths per ping cycle.
- A Knudsen 3260 sub-bottom profiler, which produces a 3.5 kHz chirp signal and can penetrate the seabed up to 80 meters, depending on water depth and seabed type. This sonar was not operated during EX-11-06.

8. Data Acquisition Summary

Around the clock (24 hr) EM 302 multibeam bathymetry and bottom backscatter data collection operations occurred throughout the cruise. EM 302 water column data was collected continuously along the Florida Escarpment and along U.S. east coast continental shelf break due to the possibility of seeps. Additionally, EK 60 data was collected along a portion of the Florida Escarpment. Logs are provided in the appendices section of this report to list each file that was collected for each data type. Also, the Data Archival section of this report describes the location of public archives of all mapping data collected by the *Okeanos Explorer.*

Engineers from Kongsberg Maritime were onboard during the previous cruise, EX-11-05, and updated the multibeam data acquisition software SIS from version 3.6.4 to 3.8.3, Build 89.

9. Multibeam Data Quality Assessment and Data Processing

Built In System Tests (BIST)

BISTs were run periodically throughout the cruise to monitor the integrity and performance of the multibeam echosounder electronics. All BISTs passed showing good multibeam system integrity. The full results of one BIST run during EX-11-06 is provided in the appendices of this report. A BIST Log is also provided in the appendices section of this report with key results from each test run.

Bottom Backscatter Outer Beams

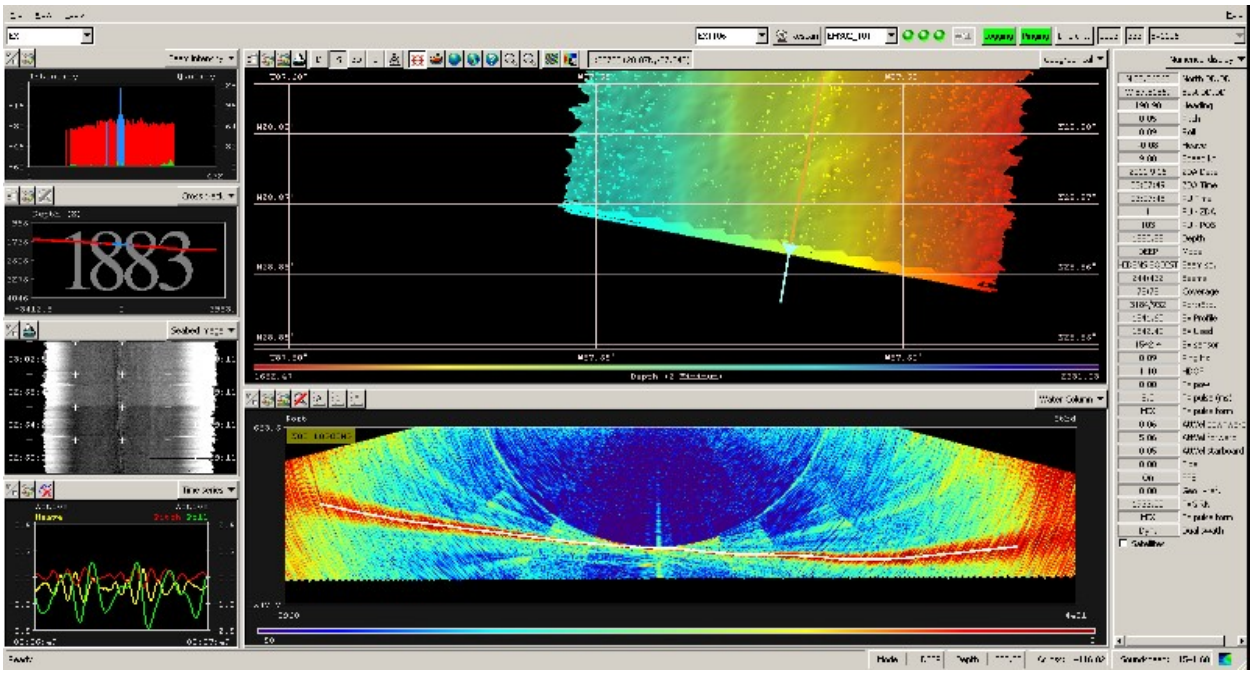

Figure 18. Screen grab taken in SIS multibeam acquisition software showing bottom backscatter outer beam artifact. This resulted from setting the angular coverage mode in manual (5000 meters port and starboard, and 75 degrees port and starboard), rather than auto.

Shallow Water Sound Velocity

As the ship transited through the shallow Straits of Florida, and up the U. S. east coast working around and within the Gulf Stream and likely various eddies, it was determined that the standard procedure on board of collecting one XBT every six hours was insufficient to compensate for sound velocity variations in the rapidly changing water column. The decision was made to conduct XBTs at 3 hour intervals and more often as necessary for most of the cruise. However, there are still instances of sound velocity artifacts in outer beam data, specifically in the Straits of Florida and in the shallower areas of the canyon surveys.

Multibeam Crossline Analysis

Crosslines are collected as a data quality control measure for multibeam sonar data control. Crosslines are run perpendicular to mainscheme survey lines, allowing for the comparison of most reliable near nadir beams to less reliable outer beams in the sonar swath.

A crossline running up the continental slope was collected on September 26th and compared to six mainscheme lines running parallel to the slope. The crossline was run just north of Wilmington Canyon.

Crossline:
0160_20110926_092442_EX-11-06_MB.all (heading 315°)

Mainscheme lines:

0134_20110925_024615_EX-11-06_MB.all (39°)
0136_20110925_062633_EX-11-06_MB.all (216°)
0138_20110925_100100_EX-11-06_MB.all (39°)
0140_20110925_133245_EX-11-06_MB.all (216°)
0156_20110926_034828_EX-11-06_MB.all (216°)
0158_20110926_070812_EX-11-06_MB.all (39°)

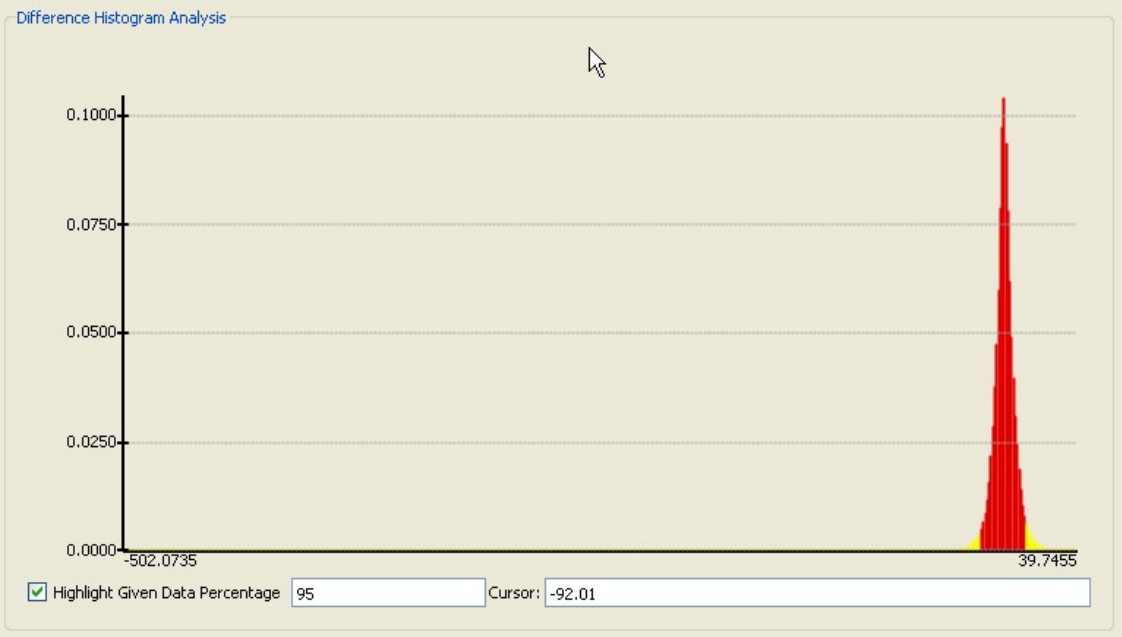

Figure 19. Screen grab showing Fledermaus CrossCheck results of continental slope crossline analysis. Data falling within the 95% confidence level is highlighted in red.

An offshore crossline was run on September 23rd during the offshore San Demetrio wreck search survey.

Crossline:
0092_20110923_053929_EX-11-06_MB.all (heading 291°)

Mainscheme lines:
0080_20110922_235358_EX-11-06_MB.all (18°)
0082_20110923_004832_EX-11-06_MB.all (203°)
0084_20110923_014614_EX-11-06_MB.all (18°)
0086_20110923_024050_EX-11-06_MB.all (203°)
0088_20110923_033749_EX-11-06_MB.all (18°)
0090_20110923_043517_EX-11-06_MB.all (203°)

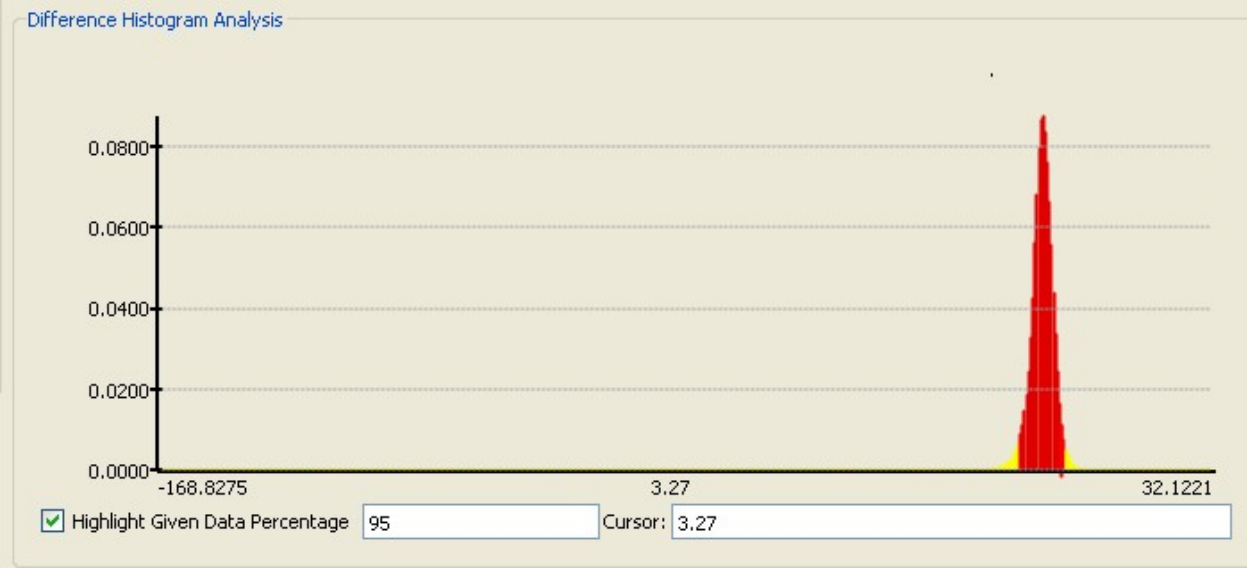

Figure 20. Screen grab showing Fledermaus CrossCheck results of offshore crossline analysis. Data falling within the 95% confidence level is highlighted in red.

The statistics from running the Fledermaus Crosscheck routine were as follows (values in meters):

510280	Number of Points of Comparison
-2728.596394	Data Mean
-2728.482101	Reference Mean
-0.114290	Mean
-0.029789	Median
2.205500	Std. Deviation
-2978.26 -2576.68	Data Z - Range
-2858.91 -2584.02	Ref. Z - Range
-168.83 32.12	Diff Z - Range
4.525266	Mean + 2*stddev
4.440763	Median + 2*stddev

10. Data Archival Procedures

All data collected on the *Okeanos Explorer* is publically available via the National Geophysical Data Center website www.ngdc.gov. All data collected during the cruise was archived in partnership with the National Coastal Data Development Center in adherence to NAO 212-15 "Management of Environmental and Geospatial Data and Information". The full Data Management Plan is available in the EX-11-06 Project Instructions DOI: https://doi.org/10.7289/V5V40SFK.

11. Cruise Calendar

S E P T E M B E R 2011						
Sun	Mon	Tues	Wed	Thurs	Fri	Sat

		13 Mission personnel arrived to ship: Lobecker, Skarke, Philip, Harris	14 Mission personnel arrived to ship: Cantelas, Kågesten.	15 Departed dock from Pascagoula MS to begin mapping transit exploration to Davisville RI. 24 hour multibeam data collection commenced.	16 Continued mapping exploration transit through Gulf of Mexico along EX1105 data collected along Florida Escarpment. Ship time change: 1800 became 1900.	17 Continued mapping exploration transit through Gulf of Mexico along EX1105 data collected along Florida Escarpment. NOAA diver proficiency dive conducted near Dry Tortugas, FL.
18 Continue 24 hour exploration mapping transit.	19 Continue 24 hour exploration mapping transit.	20 Continue 24 hour exploration mapping transit.	21 Conduct Battle of the Atlantic exploration mapping. Transit to focused exploration area #3.	22 Complete focused exploration area #3. Complete mapping exploration of wreck Allan Jackson.	23 Continue 24 hour exploration mapping. Focused ops over Keller Canyon and Allen Jackson wreck (not found).	24 Continue 24 hour exploration mapping. Focused ops near Norfolk and Baltimore Canyons and San Demetrio wreck (not found).
25 Continue 24 hour exploration mapping ops over Baltimore Canyon.	26 Continue 24 hour exploration mapping, including focused ops over Wilmington Canyon.	27 Continue 24 hour exploration mapping, including focused ops of Block and Atlantis Canyons.	28 Continue mapping exploration operations. Ship arrived at home port in Quonset Point / Davisville, RI at 1000.	29 Mission personnel depart ship.		

12. Daily Cruise Log

***ALL TIMES LISTED ARE LOCAL SHIP'S TIME*.**

Conversion from ship's time to UTC time for 9/15/11 – 9/16/11 1800 was –5 hrs (Central Daylight Savings Time). Conversion from ship's time to UTC time for 9/16/11 1900 through the end of the cruise was –4 hrs (Eastern Daylight Savings Time). The full multibeam watchstander data collection log is available upon request.

September 13, 2011

The following mission personnel arrived to the ship in Pascagoula, Mississippi: Meme Lobecker, Adam Skarke, Denise Gordon, Brendan Philip, Ash Harris.

September 14, 2011
The following mission personnel arrived to the ship in Pascagoula, Mississippi: Frank Cantelas, Gustav Kågesten.

September 15, 2011
The ship departed the dock at 1000. A BIST was conducted (BIST 01) and showed no errors in the EM 302 TRU. Multibeam data collection commenced at 1405 in 30 meters of water. A T-6 XBT was conducted. Despite more frequent XBT casts, velocity data artifacts were observed in the form of "frowns" across the swath as the ship continued transit through shallow waters less than 100 meters.

Mr. TJ Moran, Field Representative for Congressman Steven Palazzo (R-Mississippi, 4th District) and Mr. Win Ellington, Field Representative for Senator Thad Cochran (R-Mississippi) arrive to the ship at 0900, and remained onboard for the short ride out to the sea buoy. Mr. Moran and Mr. Palazzo departed the ship at in the afternoon and were returned to shore via the R/V HST.

Training of new watchstanders on the following topics: control room equipment (telepresence, KVM, network storage, multibeam sonar operation and data collection, record keeping, and multibeam data quality control and cleaning.

Ship safety drills were conducted in the afternoon, including fire and emergency, and abandon ship.

Throughout this cruise, one live video stream is being sent shore via the ship's telepresence system (VSAT). This video stream could be viewed on Internet 1 at http://oceanexplorer.noaa.gov/okeanos/media/exstream/exstream.html, and on Internet 2 at all Exploration Command Centers around the country. Additionally, one daily update was provided via the iChat event log to provide situational awareness to shore. Additional updates were provided as focused exploration mapping areas were approached.

September 16, 2011
The ship continued transit southward through the Gulf of Mexico, running along a line parallel to data collected during EX1105. Water column data (EK 60, EM 302) was logged due to expected observation of seeps in the area.

The weather has been excellent and the ship is making 10-11 knots.

At 1355 the ship veered off course to investigate a floating object, which ended up being a mylar balloon.

The local ship time was adjusted in the evening: 1800 became 1900, and the ship is now on U.S. EDT (UTC -4).

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September 17, 2011

The ship continued transit southward through the Gulf of Mexico, continuing along a line on the Florida Escarpment parallel to data collected during EX1105. Water column data (EK 60, EM 302) was logged due to expected observation of seeps in the area, however seeps were not observed in realtime either water column dataset over the escarpment.

In the afternoon, a proficiency dive in the vicinity of Dry Tortugas was conducted for four NOAA divers onboard. The location of the dive was 24° 40'N, 83° 04'W.

The weather has been excellent and the ship is making 10-11 knots.

September 18, 2011

Three wrecks positions provided by ONMS were mapped during transit. Two positions were disproved, with no wreck observed at the location provided. One wreck was observed, the Potrero Del Llano. The center of the wreck was observed to be ~80 meters off of the predicted location.

The ship made 11-13 kts throughout the day, aided by following currents.

September 19, 2011

In the morning, the ship began heading offshore towards the start of the trackline riding along the continental shelf break.

The weather picked up gradually throughout the day to 2-4 feet, and in the evening multibeam data quality degraded slightly due to occasional bubble sweep down events. The ship slowed to 10 kts throughout the day.

In the evening, Frank Cantelas, a Maritime Archaeologist with the NOAA Office of Ocean Exploration and Research, gave two presentations on the Battle of the Atlantic and other WWII shipwrecks that were mapped during the cruise. He also provided insight into the overall field of maritime archaeology.

September 20, 2011

The weather picked up gradually throughout the day as the ship continued transit up the U.S. east coast. In the early afternoon, the starting waypoint over the canyons trackline offshore from North Carolina was reached, and EM 302 water column data logging recommenced for possible seeps along the shelf break. XBTs are being collected every three hours.

September 21, 2011

The Battle of the Atlantic exploration area was conducted from 0300 to 1900. Speed was reduced to 8 kts to maximize data quality. The ship then transited along the Canyons Trackline to reach the canyons exploration area.

September 22, 2011

The ship continued northward along the continental shelf break. The survey in the vicinity of Pamlico Canyon was completed. In the morning, the ship maneuvered around longliner fishing vessels who were not answering radio calls prior to starting survey. Survey was completed, and the ship moved offshore to search for the Allan Jackson wreck. The wreck was not observed in the multibeam bathymetry or bottom backscatter data, during the field data review process.

September 23, 2011
Focused mapping exploration over Keller Canyon were completed by noon, and the ship headed north on the continental shelf break / canyons mapping transit line.

The OER archaeologist onboard reviewed the seabed backscatter data of sites of the Battle of the Atlantic and wreck of the Allan Jackson. IVS FMGT was utilized to review the data line by line for evidence of wrecks or other cultural artifacts.

After several failed XBT casts showing bad data points, it was determined that the electrical system integrity was intact, but likely a bad box of XBTs was in use. A new box of XBTs was opened and all casts have been satisfactory.

The seas were 4 – 6 feet throughout the day.

September 24, 2011
Mapping operations over the San Demetrio wreck in 2700 meters of water were completed. The wreck was not definitively located in the bathymetry or backscatter data, despite a thorough search pattern of 25 square nautical miles around the reported location. Transit mapping over the floor of Norfolk Canyon was conducted to compliment recent data collected by the NOAA Ship *Nancy Foster*. Mapping operations offshore Baltimore and Wilmington Canyons commenced at 2200, also complimenting recent data collected by the *Nancy Foster.* Commercial fishing boats with estimated 20 miles of long lines deployed directly over Baltimore Canyon delayed running of a portion of the survey plan until daylight hours on September 25th.

The weather was rainy and overcast throughout the day.

September 25, 2011
Focused exploration mapping operations continued over Baltimore Canyon. Lines over the canyon itself were run during daylight hours. In the evening, the final offshore lines were run, and a crossline was run during transit to Wilmington Canyon.

In the afternoon, a chance crossing with the the USCG S/V Eagle provided the opportunity for a photo opportunity. The EX deployed a small boat with a camera person onboard.

At 2215, the CNAV controller required a system restart. The positional accuracies in the POSMV controller software were larger than 3 meters, and all CNAV values on the SCS display were reading errors as well. All positional values were back to normal within less than a minute of the restart.

September 26, 2011

Focused mapping exploration operations occurred over Wilmington Canyon. Survey conditions were excellent for data quality. However, generally overcast skies and intermittent fog in combination with commercial long lining fisherman created difficulty efficient running of lines over the canyon.

The focused survey concluded at approximately 1800 and transit mapping commenced along the continental shelf break towards the final focused mapping areas over Atlantis Canyon, located offshore from RI.

September 27, 2011
The weather was overcast and foggy through the morning. The ship lost steerage in the afternoon for approximately 10 minutes. Transit mapping was conducted along the continental shelf break, followed by focused mapping at the Atlantis Canyon survey area. Focused mapping concluded at approximately 2000 and the ship began a transit to port in Davisville, Rhode Island.

September 28, 2011
Transit mapping was conducted between the Atlantis Canyon survey area and Narragansett Bay, Rhode Island. The ship reached the Narragansett Bay sea buoy at approximately 0800 and arrived at the Quonset Point/Port of Davisville at 1000. The EM 302 multibeam sonar was secured at approximately 0900 in the vicinity of the Claiborne Pell (Newport) Bridge.

September 29, 2011
Mission personnel departed the ship.

13. References

2011 *Okeanos Explorer* Ship Readiness Report, contact ops.explorer@noaa.gov or oar.oer.exmappingteam@noaa.gov to obtain an electronic copy
EX-11-06 Project Instructions and Data Management Plan
DOI: https://doi.org/10.7289/V5V40SFK

EM 302 bathymetry / bottom backscatter dataset
https://www.ngdc.noaa.gov/ships/okeanos_explorer/EX1106_mb.html
EM 302 water column data doi: 10.7289/V5ZK5DMK
EK 60 – no EK data collection occurred on this cruise

14. Appendices

The following files are archived with the EX-11-06 multibeam sonar dataset

- Mapping Watchstander Log
- EM 302 Multibeam Sonar Data Acquisition and Bathymetry Processing Log
- EM 302 Multibeam Sonar Water Column Data Acquisition Log
- EM 302 Built In System Test (BIST) results
- EM 302 Processor Unit (PU) Parameters in use during cruise
- Weather Log