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# MAPPING DATA ACQUISITION AND PROCESSING SUMMARY REPORT

## **CRUISE EX-13-03 New England Seamount Chain Exploration (Mapping)**

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# 1. Introduction

The NOAA Office of Ocean Exploration and Research (OER) is the only federal program dedicated to exploring our deep ocean, closing the prominent gap in our basic understanding of U.S. deep waters and seafloor and delivering the ocean information needed to strengthen the economy, health, and security of our nation.

Using the latest tools and technology, OER **explores** previously unknown areas of our deep ocean, making discoveries of scientific, economic, and cultural value. Through live video streams, online coverage, training opportunities, and real-time events, OER allows scientists, resource managers, students, members of the general public, and others to actively **experience** ocean exploration, expanding available expertise, cultivating the next generation of ocean explorers, and engaging the public in exploration activities. From this exploration, OER makes the collected data needed to **understand** our ocean publicly available, so we can maintain the health of our ocean, sustainably manage our marine resources, accelerate our national economy, and build a better appreciation of the value and importance of the ocean in our everyday lives.

## Contents

CRUISE EX-13-03 New England Seamount Chain Exploration	1
1. Introduction	2
2. Report Purpose	4
3. Cruise Objectives	4
4. Summary of Mapping Results	4

5. Mapping Statistics	4
6. Mapping Sonar Setup	6
7. Data Acquisition Summary	6
8. Multibeam Sonar Data Quality Assessment and Data Processing	8
9. Data Archival Procedures	11
10. Cruise Calendar	12
11. Daily Cruise Log Entries	13
12. References	17

## 2. Report Purpose

The purpose of this report is to briefly describe the acoustic seafloor and water column mapping data collection and processing methods used during exploration expedition EX-13-03, and to present a summary of the overall mapping results and mapping related cruise activities. A detailed description of the *Okeanos Explorer's* mapping capabilities is available in the 2013 NOAA Ship *Okeanos Explorer* Survey Readiness Report, available in the NOAA Central Library.

## 3. Cruise Objectives

The objectives for this cruise are fully detailed in the EX-13-03 Project Instructions, which are archived in the NOAA Central Library. Offshore operations were planned for June 11 – 29, 2013. Following is a brief summary of objectives as executed.

EX-13-03 focused on mapping the western extent of the New England Seamount Chain. Strategic transit mapping data was collected over Mytilus and Buell Seamounts in accordance with requests from the scientific community including the United States Extended Continental Shelf Program. Survey mapping operations focused on Asterias, Kiwi, Kelvin, and the Atlantis II group of seamounts. Several unnamed smaller seamounts were also mapped completely. Several canyon heads offshore from Massachusetts were identified as priority mapping areas pursuant to long term strategic Atlantic Canyon Undersea Mapping Expeditions (ACUMEN) goals.

Ancillary cruise objectives included training mapping personnel new to the ship including from NOAA Office of Coast Survey, US Army Corps of Engineers, and five Explorers-in-Training.

An objective was added mid-cruise after the Deep-ocean Assessment and Reporting of Tsunami (DART®) system detected a possible tsunami potentially originating near Hudson Canyon. The ship diverted from seamount mapping in order to remap this canyon, after having previously mapped it in 2012 during cruise EX-12-05 Leg 2. The availability of before and after datasets was expected to be very valuable in analysis of the DART® data.

## 4. Summary of Mapping Results

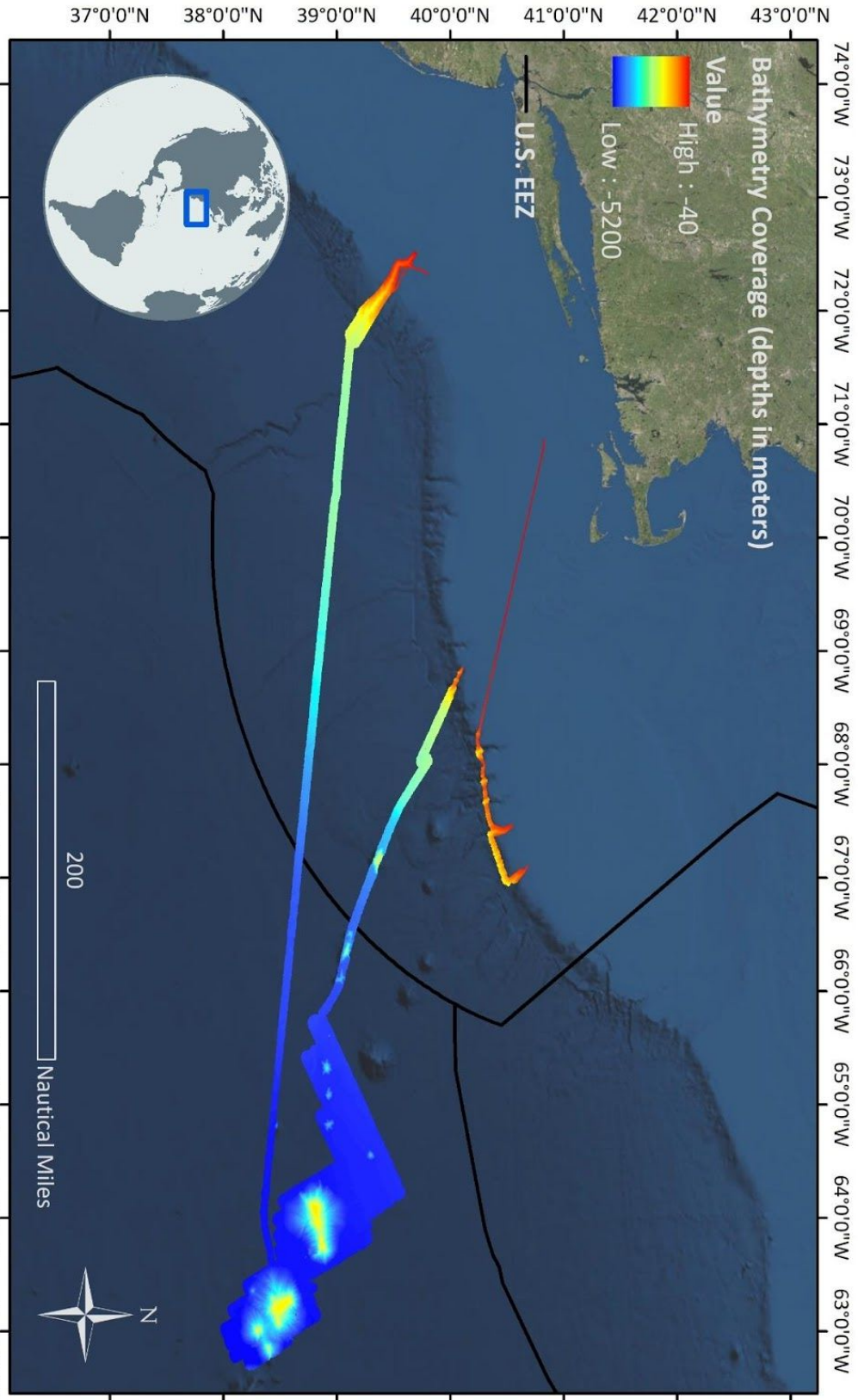
### Cruise Overview Map



# Ocean Exploration and Research

## New England Seamount Chain Exploration (Mapping) Cruise Summary Map

EX-13-03  
June 11 - 29, 2013



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 1. Cruise map showing overall EX-13-03 bathymetry coverage. 50 meter resolution. Generated in ArcMap.

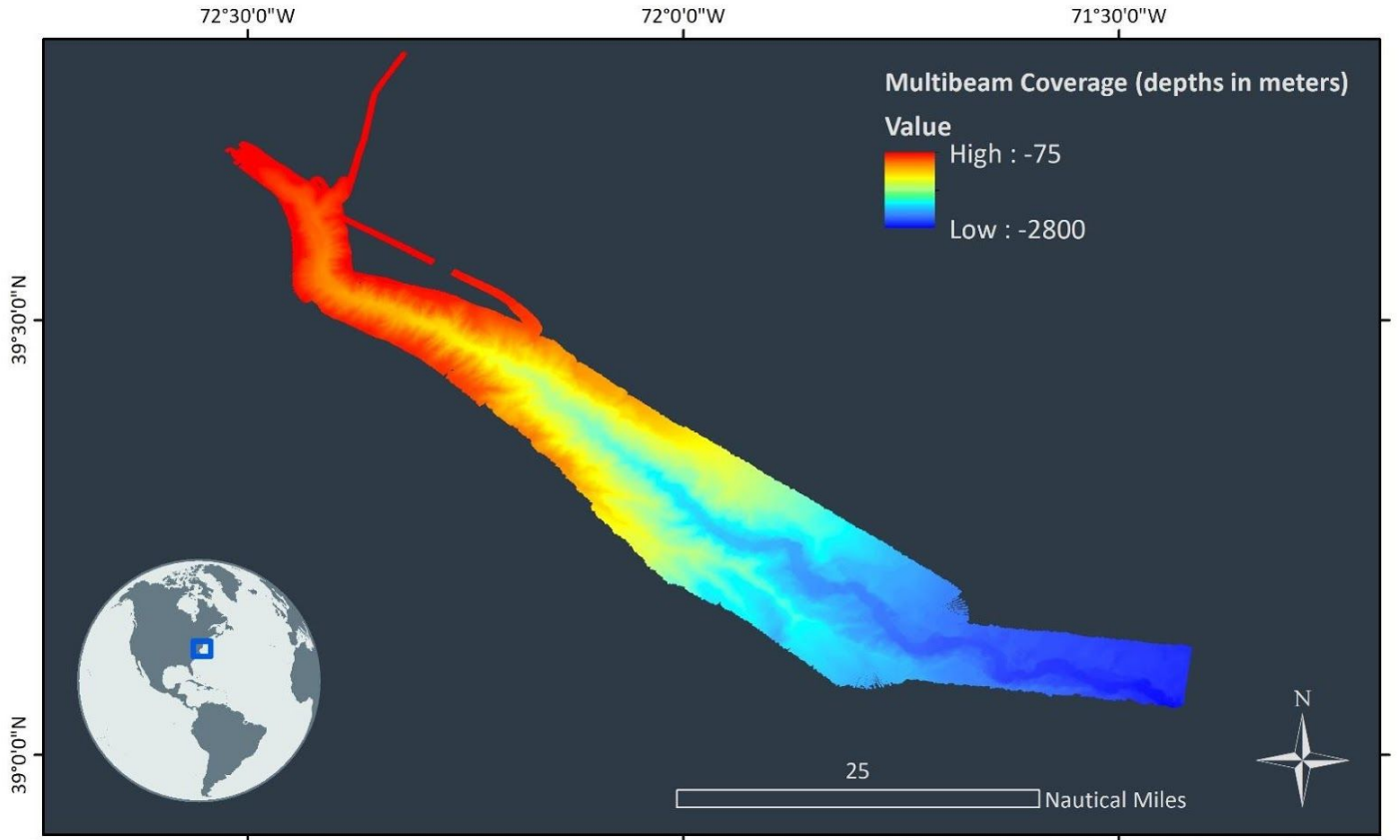
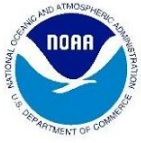


Figure 2. Map showing bathymetry data collected at Hudson Canyon. 30 meter resolution. Generated in ArcMap.

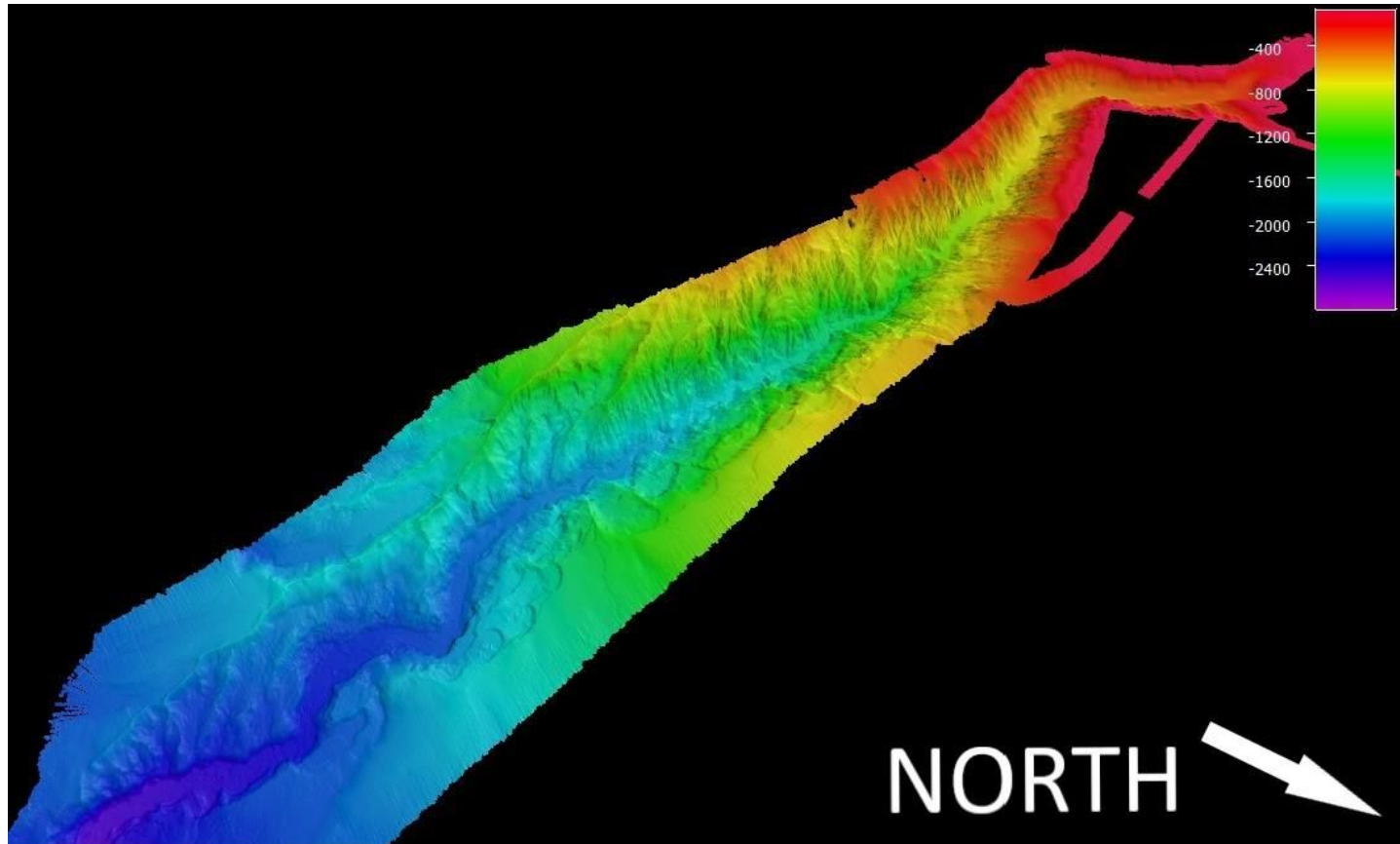


Figure 3. Screenshot of 30 meter resolution gridded bathymetry data collected at Hudson Canyon. Color depth scale values in meters. Vertical exaggeration 3. Created in QPS Fledermaus.

## 5. Mapping Statistics

Dates of cruise	June 11 – June 29, 2013
Ship's draft Start of cruise End of cruise	Fore: 14' 10", Aft: 13' 8" Fore: 14' 6"; Aft: 13' 10"
Linear kilometers of survey with EM 302	5,815
Square kilometers mapped with EM 302	26,821
Number / Data Volume of EM 302 raw bathymetric / bottom backscatter multibeam files (.all)	276 files/ 32.8 GB
Number / Data Volume of EM 302 water column multibeam files	276 files / 107 GB
Number / Data Volume of EK 60 water column split beam files (.raw)	504 / 5.4 GB
Number / Data Volume of sub-bottom sonar files (.segy, .kea, .keb)	111 / 1.7 GB
Number of XBT casts	117
Number of CTD casts (including test casts)	0

## 6. Mapping Sonar Setup

### *Kongsberg EM 302 Multibeam Sonar*

The NOAA Ship *Okeanos Explorer* is equipped with a 30 kHz Kongsberg EM 302 multibeam sonar capable of detecting the seafloor in up to 10,000 meters of water. The system generates a 150° beam fan containing up to 432 soundings per ping in waters deeper than 3300 meters. In waters less than 3300 meters, the system is operated in multi-ping, or dual swath mode, and obtains up to 864 soundings per ping, by generating two swaths per ping cycle. The multibeam sonar is used to collect seafloor bathymetry, seafloor backscatter, and water column backscatter. Backscatter represents the strength of the acoustic signal reflected from a target, such as the seafloor or bubbles in the water column.

### *Kongsberg EK-60 Split-Beam Sonar*

The ship is also equipped with one Kongsberg EK 60 split-beam fisheries sonar. The 18 kHz transducer and transmits a 7° beam fan. This sonar is a quantitative scientific echosounder calibrated to identify the target strength of water column acoustic reflectors - typically biological scattering layers, fish, or gas bubbles – providing additional information about water column characteristics and anomalies.

### *Knudsen Sub-bottom Profiler*

Additionally, the ship is equipped with a Knudsen 3260 sub-bottom profiler that produces a frequency-modulated chirp signal with a central frequency of 3.5 kHz. This sonar is used to provide echogram images of shallow geological layers underneath the seafloor to a maximum depth of about 80 meters below the seafloor. The sub-bottom profiler is normally operated to provide information about sub-seafloor stratigraphy and features while the bottom bathymetry is simultaneously being mapped by the multibeam sonar. The data generated by this sonar is fundamental to helping geologists interpret the shallow geology of the seafloor.

## 7. Data Acquisition Summary

Mapping operations included EM 302 multibeam, EK 60 split-beam, and Knudsen 3260 sub-bottom profile data collection.

Survey lines were planned to maximize either bathymetry edge matching of existing data or data gap filling in areas with existing bathymetry coverage. In regions with no existing data, lines were planned to optimize potential exploration discoveries.

Throughout the cruise, multibeam data quality was monitored in real-time by acquisition watch standers. Ship speed was adjusted to maintain data quality as necessary and line spacing was planned to ensure at least ¼ swath width overlap between lines. Cutoff angles in SIS were generally left wide open (70 – 75 degrees on each side) for maximum exploration data collection and were adjusted on both the port and starboard side to ensure the best data quality and coverage. Data were corrected for sound velocity in real-time using the Reson SVP-70 data at the sonar head, and profiles from Expendable Bathythermographs (XBTs) that were conducted every 2 to 4, or as dictated by local oceanographic conditions.



Simrad EK 60 18 kHz split-beam water column sonar data were collected continuously during the cruise. Data were monitored in real time for quality but were not post-processed. The screenshot below shows data holdings in [www.ncei.noaa.gov](http://www.ncei.noaa.gov) (last accessed 4 April 2019).

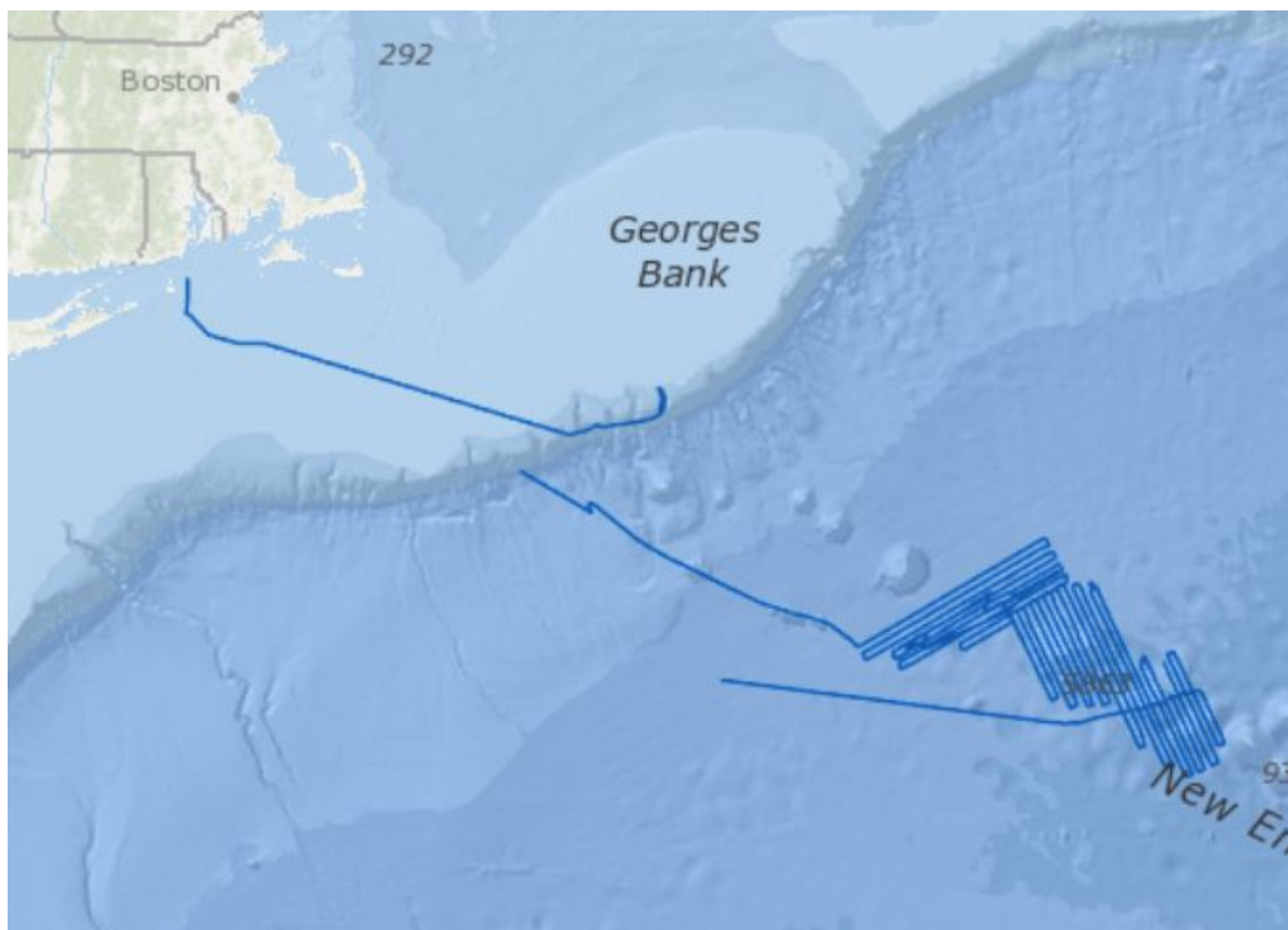


Figure 4. Screenshot of Simrad EK 60 18 kHz split-beam sonar data track lines in blue collected during EX-13-03.

Knudsen 3260 sub-bottom profiler data were initially collected daily from 1000 – 18000 local ship time, and then later in the cruise for 20 hours per day. Data were monitored in real-time for quality. Data were not post-processed. The screenshot below shows data holdings in [www.ncei.noaa.gov](http://www.ncei.noaa.gov) (last accessed 4 April 2019).

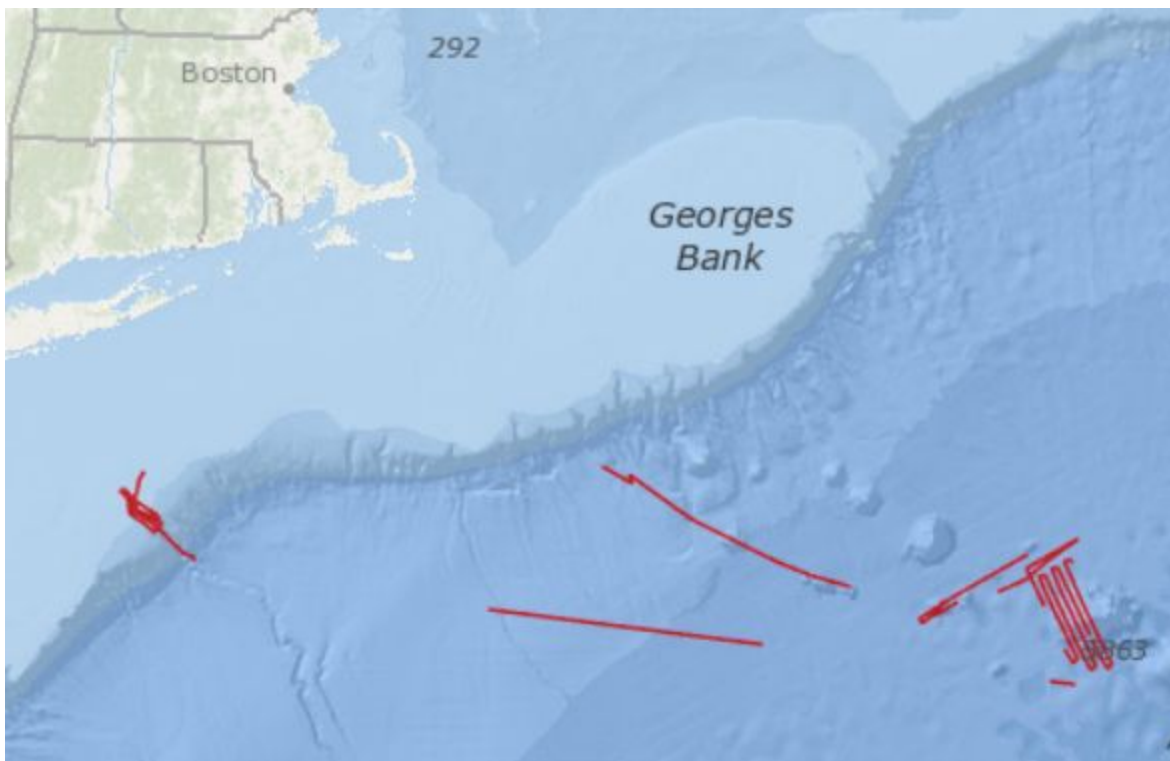
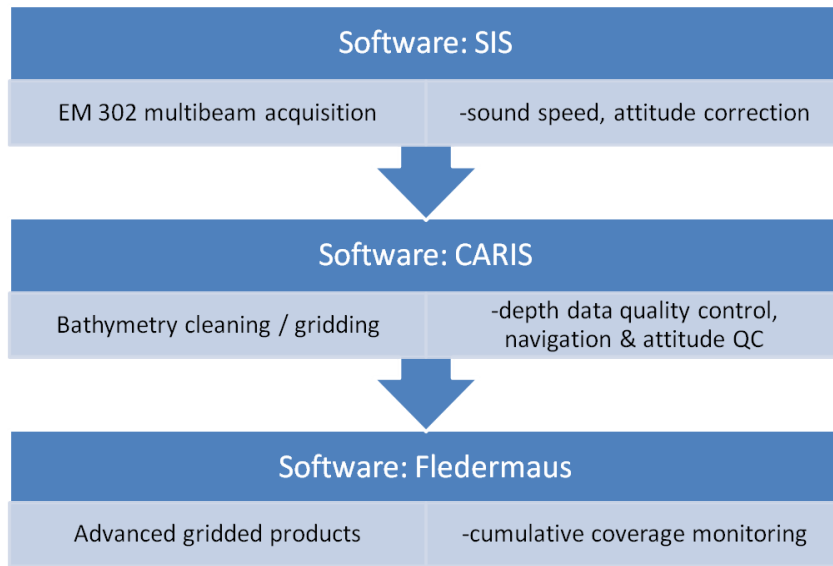


Figure 5. Screenshot of sub-bottom profiler data track lines in red collected during EX-13-03.

## 8. Multibeam Sonar Data Quality Assessment and Data Processing

EM 302 Built-in Self Tests (BISTs) were run throughout the cruise to monitor multibeam sonar system status and are available as ancillary files in the sonar data archives. Raw multibeam bathymetry data files were acquired by SIS, then imported into Caris HIPS and SIPS for processing. In Caris, attitude and navigation data stored in each file were checked, and erroneous soundings were flagged off. Gridded digital terrain models were created and posted to the ship's file transfer protocol (FTP) site for daily transfer to shore. Final bathymetry QC was completed post-cruise onshore at the Center for Coastal and Ocean Mapping at the University of New Hampshire. With the vast majority of surveying completed in deep water, depth measurements were not adjusted for tides, as they are an essentially insignificant percent of the overall water depth.



**Figure 16. Shipboard multibeam data flow.**

### *Crosslines*

Comparing depth values from orthogonal survey lines is a standard hydrographic quality control measure to evaluate the consistency of the multibeam sonar data being collected during a cruise. Crossline analysis was conducted using the Crosscheck Tool in QPS Qimera software.

A crossline was run on June 25. Crossline analysis was completed using Qimera Crosscheck, and the results against the requirements for an International Hydrographic Order 1 survey are shown below, with depth values (z) in meters. The crossline was comprised of line files 0214-0216; the mainscheme lines were lines 0158, 0159, 0162, 0170, 0171, 0175, 0176, 0183, 0188, 0189, 0191, 0196, 0199, 0200, 0204, 0205, 0207, and 0212.

#### Crossline segment 0214

Number of Points of Comparison 346224

Data Mean -3063.652488

Reference Mean-3064.208687

Mean 0.556198

Median -158.234947

Std. Deviation 13.282672

Data Z – Range -5242.56 -1637.89

Ref. Z – Range -5064.42 -1640.20

Diff Z – Range -821.50 494.74

Mean + 2\*stddev 27.121542

Median + 2\*stddev 184.800290

Special Order Error Limit 22.982925

Special Order P-Statistic 0.028955

Special Order - Rejected 10025

**Special Order Survey ACCEPTED**

#### Crossline segment 0215

Number of Points of Comparison 364933

Data Mean -2851.577964  
Reference Mean -2855.272973  
Mean 3.695009  
Median 171.929954  
Std. Deviation 13.853494  
Data Z – Range -4642.12 -1628.50  
Ref. Z – Range -4631.75 -1634.42  
Diff Z – Range -205.70 555.51  
Mean + 2\*stddev 31.401996  
Median + 2\*stddev 199.636941  
Special Order Error Limit 21.416006  
Special Order P-Statistic 0.031452  
Special Order - Rejected 11478  
**Special Order Survey ACCEPTED**

#### Crossline segment 0216

Number of Points of Comparison 105004  
Data Mean -4747.864698  
Reference Mean -4751.154111  
Mean 3.289412  
Median 150.178871  
Std. Deviation 10.350006  
Data Z – Range -5034.96 -4027.69  
Ref. Z – Range -5511.72 -4049.70  
Diff Z – Range -204.23 504.59  
Mean + 2\*stddev 23.989423  
Median + 2\*stddev 170.878882  
Special Order Error Limit 35.634533  
Special Order P-Statistic 0.003343  
Special Order - Rejected 351  
**Special Order Survey ACCEPTED**

#### *EM 302 Patch Test*

A multibeam patch test was conducted during EX-13-01. The results are briefly described in the mapping data report for that cruise, as well as in the 2013 *Okeanos Explorer* Survey Readiness Report.

## **9. Data Archival Procedures**

All mapping data collected by the NOAA Ship *Okeanos Explorer* are archived and publicly available within 90 days of the end of each cruise via the National Centers for Environmental Information (NCEI) online archives. The complete data management plan (which describes the raw and processed data formats produced for this cruise) is available as an appendix in the EX-13-03 project instructions which is available in the NOAA Central Library.

Ancillary and supporting files are archived with the sonar datasets. These include:

*EM 302 Multibeam bathymetry and bottom backscatter dataset:*

- Mapping watch stander log
- Weather log
- Sound velocity profile log
- Multibeam acquisition and processing log
- Built-In-System-Tests (BISTs)
- Processor Unit Parameters
- Text files of telnet sessions on the EM 302 transceiver unit

*Simrad EK split-beam water column dataset:*

- Mapping watch stander log
- Weather log
- EK data log

*Knudsen 3260 Sub-bottom Profiler dataset:*

- Mapping watch stander log
- Weather log
- Sub-bottom data log

*EM 302 Multibeam water column dataset:*

- Mapping watch stander log
- Weather log
- Sound velocity profile log
- Multibeam acquisition and processing log
- Built-In-System-Tests (BISTs)
- Processor Unit Parameters
- Text files of telnet sessions on the EM 302 transceiver unit
- MB WCD review log if data were reviewed for presence of seeps in Fledermaus MidWater

At the time of writing this report, the following DOIs were available as permanent links to sonar datasets:

EM 302 water column data <http://doi.org/10.7289/V55D8PSD>

EK 60 data <http://doi.org/10.7289/V56D5QXS>

Sub-bottom data, supporting data, and informational logs are available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/> (last accessed 3/21/2019).

EM 302 bathymetry data, supporting informational logs, and ancillary files are available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/> (last accessed 3/21/2019).

## 10. Cruise Calendar

June 2013						
Sun	Mon	Tues	Wed	Thur	Fri	Sat
		11. Depart from Davisville, RI for survey working grounds. Sonar data collection begins	12. Mapping at contingency areas Munson and Powell Canyons due to heavy weather at New England Seamounts.	13. Standing by near Martha's Vineyard until heavy weather passes.	14. Evening departure towards New England Seamounts, strategic transit mapping.	15. Arrive New England Seamounts. Answer mariner distress call.
16. New England Seamounts mapping.	17. New England Seamounts mapping.	18. New England Seamounts mapping.	19. New England Seamounts mapping.	20. New England Seamounts mapping.	21. New England Seamounts mapping.	22. New England Seamounts mapping.
23. New England Seamounts mapping.	24. New England Seamounts mapping.	25. New England Seamounts mapping, then transit mapping to Hudson Canyon for possible tsunami response mapping.	26. Transit mapping to Hudson Canyon.	27. Hudson Canyon mapping.	28. Complete Hudson Canyon mapping. Transit mapping to Davisville, RI.	29. Alongside Davisville, RI.
30						

## 11. Daily Cruise Log Entries

*Generated from the daily expedition situation reports. All times listed are in local ship time which was Eastern Daylight Savings Time (EDT) (-4 hours from Universal Coordinated Time (UTC)).*

*June 11*

*Okeanos Explorer (EX) departed Davisville, North Kingstown, RI at 0911 bound for the Atlantic Ocean and cleared the Narragansett Bay sea buoy at approximately 1300. Multibeam sonar data collection commenced at 1600 in approximately 50 meters of water. EX collected multibeam and split-beam mapping data for the remainder of the day while transiting across the continental shelf to the southeast of*

Nantucket, Massachusetts. Initial mapping watches were focused on training mission personnel in control room operations as well as the acquisition of multibeam data and sound velocity profiles.

Wind (15-25 knots) and sea conditions (3-5 feet) were moderate and the ship made a nominal speed of 10 knots while conducting survey and transit mapping operations. The EM 302 and EK 60 sonars are fully operational and data quality is moderate to high.

Multibeam bathymetry data quality is moderate to good with occasional loss of bottom detection resulting from bubble sweep down. Due to observed water mass variability, Expendable Bathythermograph (XBT) profiles are being collected every two to three hours.

The EK 60 sonar acquisition software is functional, however it has exhibited some minor instability which will be investigated by the expedition coordinator.

Mapping operations are planned in priority areas as defined by the scientific community through the OER North Atlantic Basin Workshop and subsequent calls for exploration priorities.

#### *June 12*

Due to poor weather and high wave conditions at the primary New England Seamount survey area, *Okeanos Explorer* conducted survey mapping operations at a contingency survey area on the continental shelf break southeast of Cape Cod, Massachusetts. Multibeam and split-beam sonar data were collected continuously.

Wind (15-25 knots) and sea conditions (3-5 feet) were moderate and the ship made a nominal speed of 8.5 knots while conducting survey and transit mapping operations. The EM 302 and EK 60 sonars are fully operational and data quality is moderate to high.

Multibeam bathymetry data quality is high, with consistent bottom detection and wide swath coverage. Due to significant observed variability in sea water salinity and temperature, XBT profiles are being collected every three hours, or more often as dictated by physical oceanographic conditions.

Surveys were completed at the heads of Powell and Munson Canyons. Both locations are priority exploration areas for scientists partnering with OER on cruises EX-13-04 Leg 1 and Leg 2.

#### *June 13*

Due to deteriorating weather conditions in the region, mapping operations were curtailed at 0030 and *Okeanos Explorer* spent the remainder of the day transiting towards Vineyard Sound. At approximately 1530 *EX* took up station six nautical miles south of Martha's Vineyard to wait out the passing storm system and remained there through the end of the day.

Mapping data products for the June 12 survey of Powell and Munson Canyons were generated and delivered to OER partner scientists Martha Nizinski and Tim Shank, who are currently conducting deep water coral research on NOAA Ship *Henry Bigelow*. They will use the newly created maps to guide tow camera video sampling operations at Powell Canyon on June 14 and 15.

#### *June 14*

Due to inclement weather conditions in the region, mapping data ceased and *Okeanos Explorer* loitered six nautical miles south of Martha's Vineyard until 1800. At 1800 the ship departed for the primary survey area and proceeded to the southeast across the continental shelf under clearing conditions for the remainder of the day.

#### *June 15*

*Okeanos Explorer* conducted transit and survey mapping from the continental shelf break offshore of New England towards the New England Seamount Chain throughout the day. Transit mapping operations commenced at 0500 and continued until *EX* reached the New England Seamount Chain survey area at 2100. At 2100 the ship commenced survey mapping operations, which continued for the duration of the day. At approximately 2230 the *EX* surveyed a seabed feature that does not appear in global bathymetric data sets. The feature is approximately 500 meters tall and as such does not meet the criteria to be formally called a "seamount."

The five mapping interns onboard have been trained in water column, backscatter, and sub-bottom data processing. They are currently working on a joint project to process and image bathymetric, sub-bottom, and backscatter data from select seamounts.

The Commanding Officer (CO) has provisionally allowed collection of sub-bottom data 12 hours a day (0800-2000)

Wind (10-25 knots) and sea conditions (4-6 feet) were moderate and the ship made a nominal speed of 11 knots while conducting transit mapping operations, and 8.5 knots while conducting survey mapping operations. The EM 302, EK 60, and sub-bottom 3260 sonars are fully operational and data quality is high.

At approximately 0930 *EX* received a VHF radio call from a mariner on a disabled sailboat seeking to notify the United States Coast Guard of his position. *EX* relayed his position to the Coast Guard and upon further discussion with the mariner diverted to the position of the sailboat. The *EX* transferred food, and 10 gallons of diesel fuel to the sailboat via small boat. *EX* rejoined the transit survey line at approximately 1130.

#### *June 16*

Continuous multibeam and split-beam data collection was conducted during survey mapping operations. Multibeam bathymetry data quality is moderate, with intermittent bottom detection due to elevated sea state conditions. Due to significant observed variability in seawater salinity and temperature, XBT profiles are being collected every three hours, or more often as dictated by physical oceanographic conditions.

The five mapping interns onboard have been trained in water column, backscatter, and sub-bottom data processing. They are currently working on a joint project to process and image bathymetric, sub-bottom, and backscatter data from select seamounts.

Full surveys of Kiwi and Asterias Seamounts have been completed and summary maps will be forthcoming.

The CO has provisionally allowed collection of sub-bottom data 12 hours a day (0800-2000).

Wind (20-30 knots) and sea conditions (7-9 feet) were marginal and the ship made a nominal speed of 7.5 knots while conducting transit mapping operations. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars are fully operational and data quality is moderate to good depending on ship heading.

#### *June 17*

Continuous multibeam and split-beam data collection was conducted during survey mapping operations. Multibeam bathymetry data quality is moderate, with intermittent bottom detection due to elevated sea state conditions. Due to significant observed variability in seawater salinity and temperature, XBT profiles are being collected every three hours, or more often as dictated by physical oceanographic conditions.

Wind (10-30 knots) and sea conditions (3-9 feet) were variable and the ship made a nominal speed of 8.5 knots while conducting transit mapping operations. The EM 302, EK 60, and Knudsen 3260 sub-bottom



profiler sonars are fully operational and data quality is moderate to good depending on ship heading and sea state.

The CO has requested continuous collection of sub-bottom data across a 24 hour period during the cruise to assess impact of 24 hour/day chirp sub-bottom sonar operations on the crew.

### *June 18*

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day. Multibeam and split-beam sonar data were collected continuously, and sub-bottom sonar data were collected between 0800 and 2000 ship time.

Continuous multibeam and split-beam data collection was conducted during survey mapping operations. Multibeam bathymetry data quality is good. Due to significant observed variability in seawater salinity and temperature, XBT profiles are being collected every three hours, or more often as dictated by physical oceanographic conditions

Wind (10-15 knots) and sea conditions (3-5 feet) were moderate and the ship made a nominal speed of 8.5 knots while conducting transit mapping operations. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

Chief Electronics Technician Conway completed a sound survey of the ships working spaces and determined that the Knudsen 3260 sub-bottom profiler is measurably quieter inside the ship as a result of the recent sound dampening modifications during the recent dry dock. The CO has requested continuous collection of sub-bottom data across a 24 hour period during the cruise to assess impact of 24 hour/day chirp sub-bottom sonar operations on the crew.

Telepresence Event: At 1100 EDT a telepresence event was held with Naval Research Lab interns at the Stennis Space Center. The event was hosted by the OER Data Management team based there. The Mapping Team Lead / Expedition Coordinator provided an overview of *EX* and the current cruise plan including a fly-through of collected data and took approximately five questions from the onshore interns.

### *June 19*

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day. Multibeam and split-beam sonar data were collected continuously, and sub-bottom sonar data were collected between 0800 and 2000 ship time.

Wind (20-30 knots) and sea conditions (10-12 feet) were high and the ship made a nominal speed of 7 knots while conducting survey mapping operations. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was fair to poor.

### *June 20*

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day. Multibeam and split-beam sonar data were collected continuously, and sub-bottom sonar data were collected between 0800 and 0000 ship time.

Wind (15-25 knots) and sea conditions (4-9 feet) diminished throughout the day and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations over Kelvin Seamount. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

## June 21

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day.

Multibeam, split-beam, and sub-bottom sonar data were collected continuously throughout the day. The impact of extended sub-bottom profiler operation on the crew will be assessed in coming days to determine if 24 hour/day sub-bottom data collection is feasible.

Wind (5-15 knots) and sea conditions (2-5 feet) were calm and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations over Kelvin Seamount. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

Telepresence Events: Two telepresence events were held. The first was a call-in with a group of VIPs at the ISC, including Senator Whitehouse (Rhode Island) and a reporter from the Providence Journal. The second was an operations report from the ship that was part of a live broadcast for the Exploration Now website. Both events went well.

## June 22

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day.

Multibeam, split-beam, and sub-bottom sonar data were collected continuously and sub-bottom data were collected between 0000 and 2000.

Wind (5-15 knots) and sea conditions (2-5 feet) were calm and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations over Kelvin Seamount and the Atlantis II Seamount Group. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

## June 23

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day.

Multibeam, split-beam, and sub-bottom sonar data were collected continuously and sub-bottom data were collected between 0800 and 2000.

Wind (5-15 knots) and sea conditions (2-5 feet) were calm and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations over the Atlantis II Seamount Group. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

## June 24

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain throughout the day.

Multibeam, split-beam, and sub-bottom sonar data were collected continuously and sub-bottom data were collected between 0800 and 2000.

Wind (5-15 knots) and sea conditions (2-5 feet) were calm and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations over the Atlantis II Seamount Group. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

Hollings Scholar intern Mali'o Kodis completed a map of all gas plumes recorded by the *Okeanos Explorer* on the US Atlantic Margin and delivered it to scientists involved in planning remotely operated vehicle (ROV) and mapping targets for EX1304 Legs 1 and 2.

## June 25

*Okeanos Explorer* conducted survey mapping at the New England Seamount Chain until 0945 and then commenced a transit west towards Hudson Canyon. Multibeam, split-beam, and sub-bottom sonar data were collected continuously.

Wind (10-30 knots) and sea conditions (2-6 feet) were variable and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations over the Atlantis II Seamount Group and 7 knots while conducting transit mapping operations. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

At 0945 survey mapping operations at the Atlantis II Seamount Group were curtailed and the ship began transit mapping operations en route to Hudson Canyon. The ship was diverted to Hudson Canyon in order to collect survey data that may aid in the investigation of a US East Coast tsunami event that took place on June 13. The decision to divert to Hudson Canyon was made by the OER program and approved by the Commanding Officers of the *Okeanos Explorer* and the OMAO Marine Operations Center-Atlantic.

#### *June 26*

*Okeanos Explorer* conducted transit mapping towards Hudson Canyon throughout the day. Multibeam, split-beam, and sub-bottom sonar data were collected continuously and sub-bottom data were collected between 0800 and 2000.

Wind (10-30 knots) and sea conditions (2-6 feet) were variable and the ship made a nominal speed of 9.5 knots while conducting transit mapping operations between the Atlantis II Seamount Group and Hudson Canyon. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

#### *June 27*

*Okeanos Explorer* conducted survey mapping operations at Hudson Canyon throughout the day. Multibeam, split-beam, and sub-bottom sonar data were collected continuously and sub-bottom data were collected between 0800 and 2000. The ship is surveying at Hudson Canyon in order to collect survey data that may aid in the investigation of a US East Coast tsunami event that took place on June 13. The decision to divert to Hudson Canyon was made by the OER program and approved by the Commanding Officers of the *Okeanos Explorer* and the OMAO Marine Operations Center-Atlantic.

Wind (10-15 knots) and sea conditions (2-3 feet) were calm and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations at Hudson Canyon. The EM 302, EK 60, and Knudsen 3260 sub-bottom profiler sonars were fully operational and data quality was good.

Telepresence Event: At 1435 the expedition coordinator participated in a call-in event with the Exploration Now program. The call-in was recorded and consisted of answering questions about the EX's current operations in Hudson Canyon.

#### *June 28*

*Okeanos Explorer* conducted survey mapping operations at Hudson Canyon until 1190 on June 28 and then immediately proceeded to Narragansett Bay.

Wind (15-20 knots) and sea conditions (4-7 feet) were moderate and the ship made a nominal speed of 8.5 knots while conducting survey mapping operations at Hudson Canyon on June 28. The EM 302 and EK 60 sonars were fully operational and data quality was good.

#### *June 29*

The ship was alongside at 1130 at the NOAA pier at Quonset Industrial Park in Davisville, Rhode Island.  
Mapping mission personnel depart ship.

## 12. References

The 2013 NOAA Ship *Okeanos Explorer* Survey Readiness Report can be obtained in the NOAA Central Library or by contacting the NOAA OER mapping team at [oar.oer.exmappingteam@noaa.gov](mailto:oar.oer.exmappingteam@noaa.gov).

The EX-13-03 Project Instructions can be obtained from the NOAA Central Library. The EX-13-03 Data Management Plan is an appendix of the project instructions.

EM 302 water column data <http://doi.org/10.7289/V55D8PSD>

EK 60 data <http://doi.org/10.7289/V56D5QXS>

Sub-bottom data, supporting data, and informational logs are available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/> (last accessed 3/21/2019).

EM 302 bathymetry data, supporting informational logs, and ancillary files are available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/> (last accessed 3/21/2019).

The following was used for reference throughout the cruise:

Sandwell, D. T., and W. H. F. Smith, Global marine gravity from retracked Geosat and ERS-1 altimetry: Ridge Segmentation versus spreading rate, *J. Geophys. Res.*, 114, B01411, doi:10.1029/2008JB006008, 2009.

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