doi:10.7289/V5/MDR-OER-EX1202L2

NOAA *Okeanos Explorer* Program

MAPPING DATA ACQUISITION AND PROCESSING REPORT

CRUISE EX1202 Leg 2

Exploration: Gulf of Mexico

March 19 – April 7, 2012
Tampa, FL to Pascagoula, MS

Report Contributors:
Elizabeth "Meme" Lobecker, John Doroba, Chris Pinero, Tara Smithee, Tom Kok, Brian Kennedy, Karl McLetchie

E-mail: oar.oer.exmappingteam@noaa.gov

December 1, 2017

NOAA Office of Ocean Exploration and Research
1315 East-West Hwy, SSMC3, #10210
Silver Spring, MD 20910

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.

Table of Contents

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-12-01 dataset. A detailed description of the setup of the various mapping equipment and sensors is provided in the 'NOAA Ship *Okeanos Explorer* 2012 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

EX1202 Leg 2 was a combination of Little Hercules ROV operations and mapping operations. The standard daily schedule of operations included mapping in the early morning, ROV dive operations from approximately 0730 to 1800 local, then mapping operations through the evening and into the following morning. ROV dive operations were based on EM 302 data obtained during Okeanos Explorer cruises EX1105, EX1106, EX1202 Leg 1, and the current cruise, EX 1202 Leg 2. Objectives of this cruise were to explore the Gulf of Mexico, specifically in the vicinity of the West Florida Shelf, DeSoto Canyon, Deepwater Horizon site, and Mississippi Canyon

Exploration mapping objectives included:

- Identify and explore the diversity of benthic habitats in the region, including seeps, deep corals, canyons;
- Locate and characterize underwater cultural heritage (UCH), including shipwrecks, in order to assess their eligibility for the National Register of Historic Places;
- Expand testing of EM 302 acoustic ability to detect gas seeps and measure flux in order to further understand the system's ability to explore the water column;
- Collect EM 302 bathymetric, seabed backscatter, and water column backscatter data as operational information for ROV dive planning;
- Provide EK 60 water column backscatter data as operational information for ROV dive planning;
- Collect Knudsen sub-bottom data as necessary;
- Conduct expendable bathythermograph (XBT) casts every 2 to 4 hours or more often as necessary for mapping operations.

On an as needed basis, raw files were transferred to shore for water column backscatter analysis of water column anomalies observed by multibeam watchstanders.

4. Participating Personnel

NAME	ROLE	AFFILIATION
CDR Robert Kamphaus	Commanding Officer	NOAA Corps
LT Megan Nadeau	Field Operations Officer	NOAA Corps
Jeremy Potter	Expedition Coordinator	NOAA OER
Elizabeth "Meme" Lobecker	Mapping Team Lead	NOAA OER (ERT Inc.)
John Doroba	Hydrographic Survey Technician	NOAA OMAO
Chris Pinero	Mapping Watch Lead	NOAA OER / UCAR
Tara Smithee	Mapping Intern	NOAA OER / UCAR Intern
Tom Kok	Mapping Watchstander (ROV)	NOAA OER / UCAR
Karl McLetchie	Mapping Watchstander (ROV)	NOAA OER / UCAR
LTJG Brian Kennedy	Mapping Watchstander (ROV)	NOAA Corps
Dr. Timothy Shank	Science Team Lead	WHOI
Pen Hsing	Scientist	Penn State University

5. Summary of Major Findings

Cruise Map

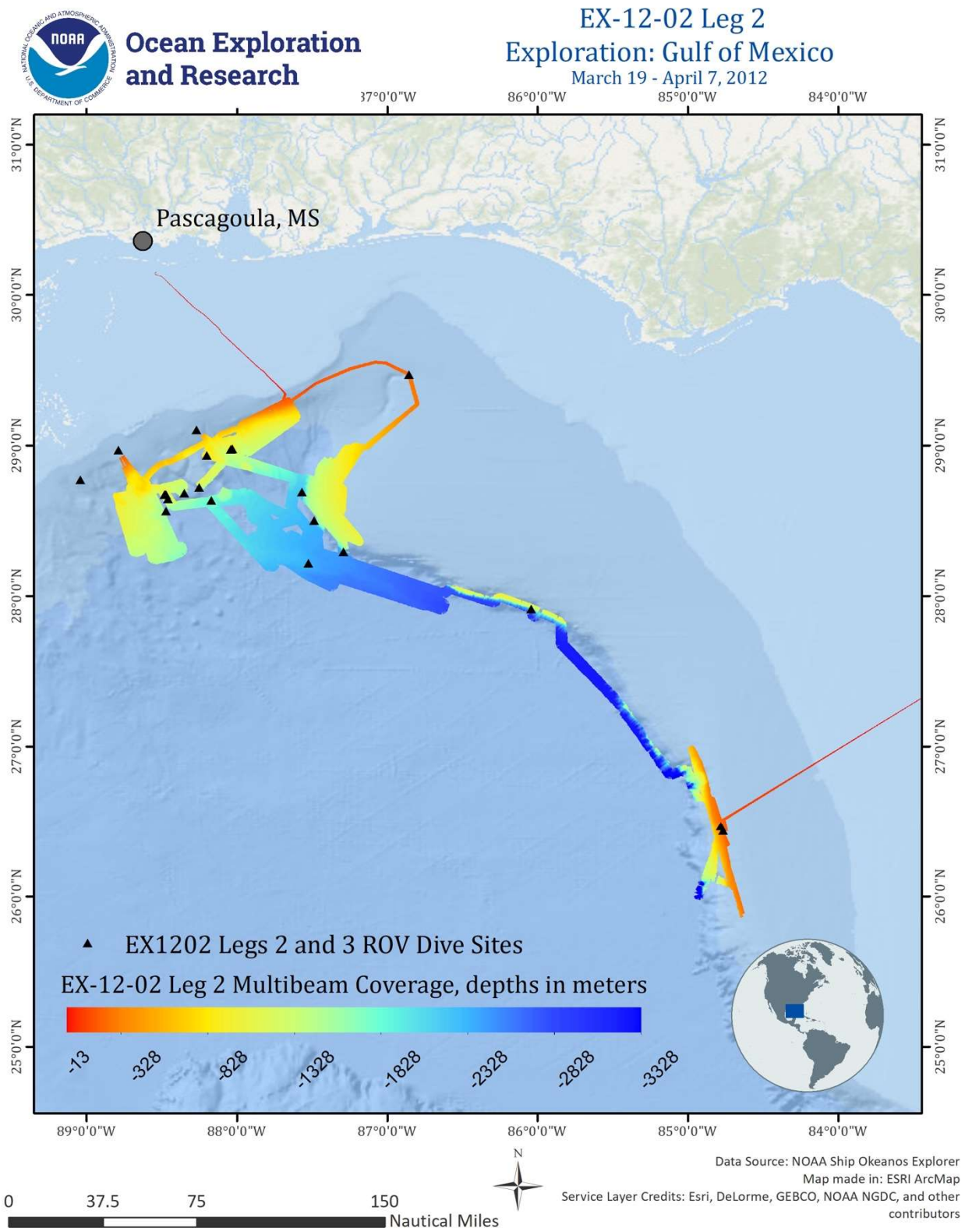

Figure 1. Cruise map showing new multibeam data collected during EX-12-02 Leg 2.

Features of Interest

West Florida Escarpment
Over the course of *Okeanos Explorer* cruises EX-11-05, EX-11-06, and EX-12-02 Legs 1 and 2, the West Florida Escarpment (WFL) was mapped extensively. Below is a screenshot taken in Fledermaus of cumulative coverage achieved by *Okeanos Explorer* by the end of EX1202 Leg 2. Additional coverage is anticipated during upcoming cruises EX-12-02 Leg 3 and EX-12-03.

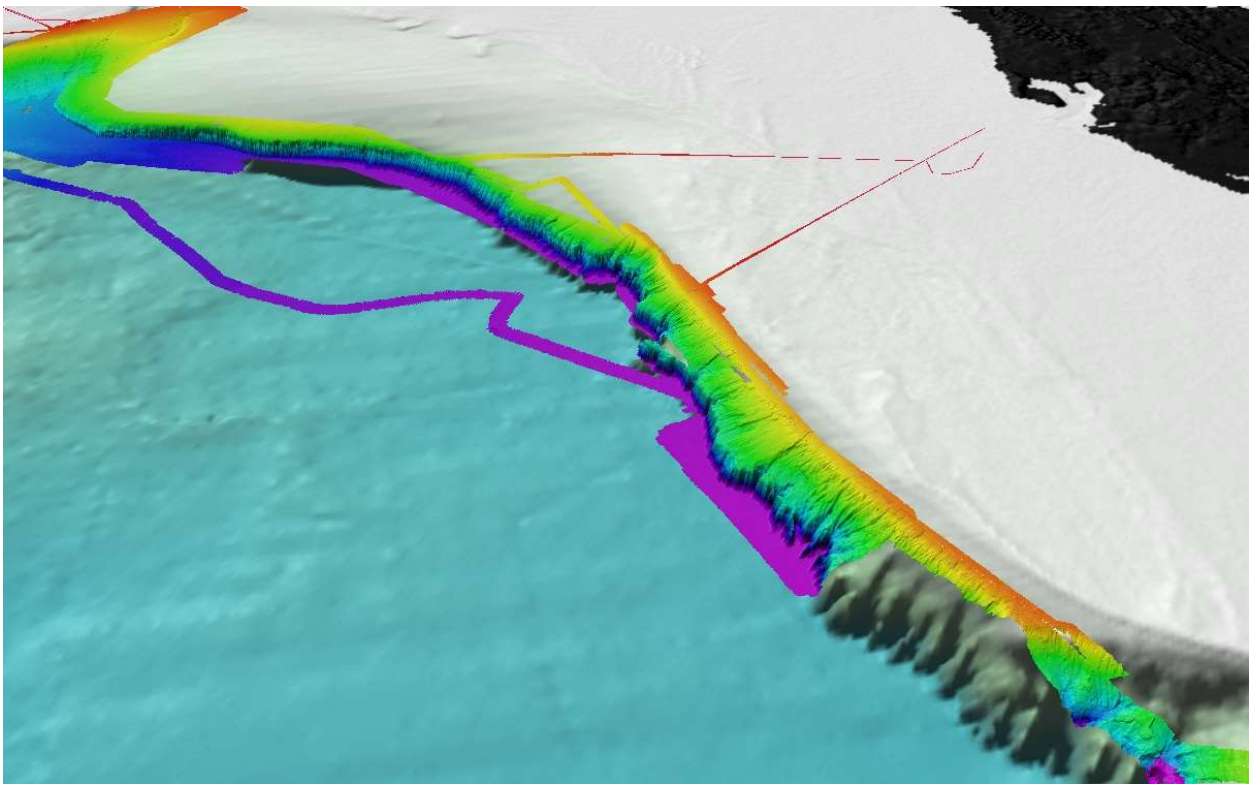

Figure 2. Cumulative EM 302 multibeam data over the West Florida Escarpment collected during EX1202 Legs 1 and 2, EX1106, and EX1105. Screenshot taken in Fledermaus, view north up, vertical exaggeration 4. Sandwell and Smith satellite altimetry displayed as background data.

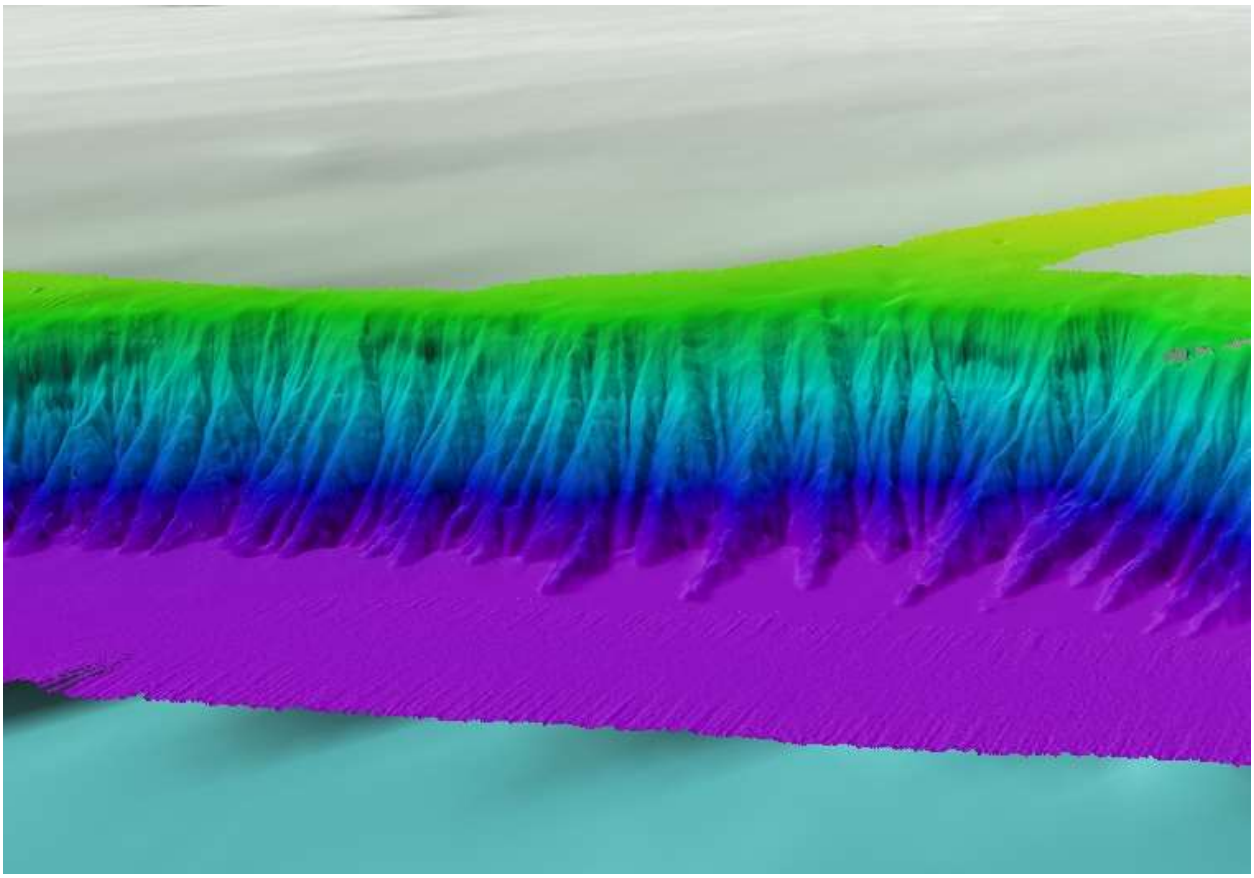

Figure 3. EM 302 multibeam data collected during EX1203 Legs 1 and 2, EX1106, and EX1105 showing canyons typical of WFL. Screenshot taken in Fledermaus looking east towards FLorida, vertical exaggeration 4, EM 302 data gridded at 50 meter cell size. Sandwell and Smith satellite altimetry displayed as background data.

Meandering Leveed Meandering Channel at base of West Florida Escarpment

A meandering leveed channel at the base of the WFL Escarpment was mapped. The channel lies in 2400 to 2700 meters of water. The channel has meanders with belt widths (measured outer bank to outer bank) of up to 4.5 kilometers. The channel width was generally 300 to 500 meters, as measured from outer bank to outer bank, and was surrounded by a levee rising approximately 20 to 30 meters from the surrounding flat seafloor. The channel was observed to be from 8 to 25 meters deep.

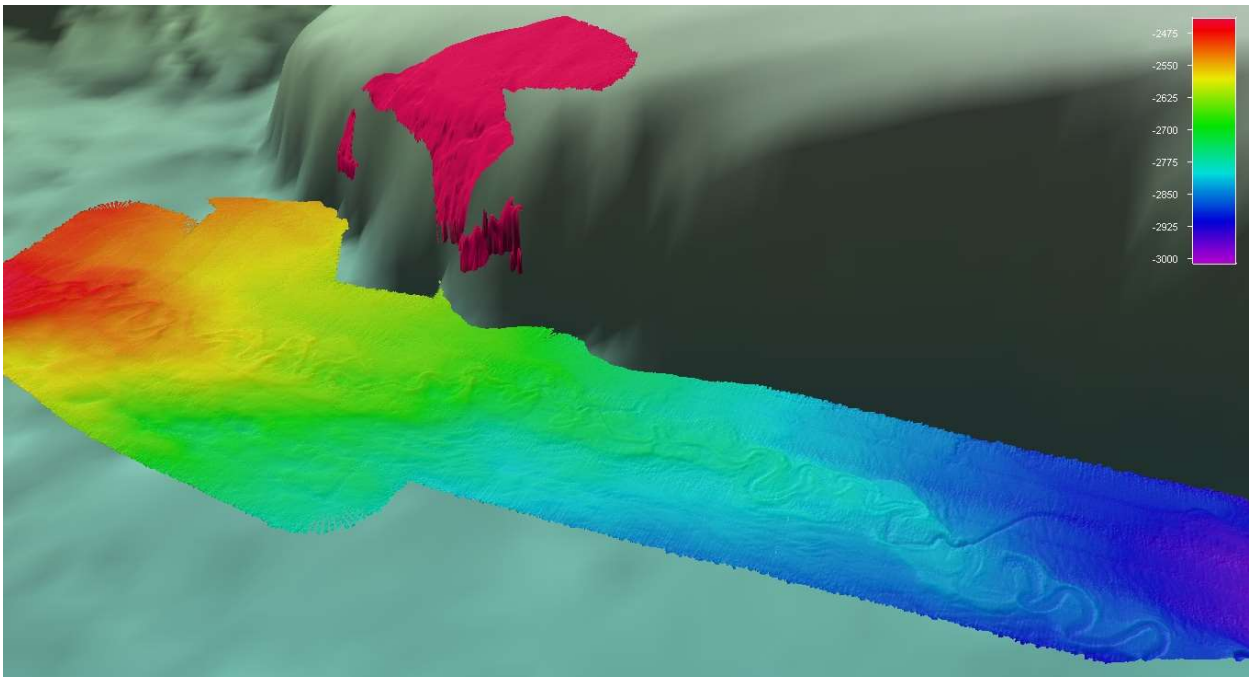

Figure 4. EM 302 multibeam data collected of leveed meandering channel during EX1203 Leg 2. Screenshot taken in Fledermaus, view north up, vertical exaggeration 15. Sandwell and Smith satellite altimetry displayed as background data.

Mississippi Canyon

Targeted water column mapping was conducted over areas in the Mississippi Canyon lease block where seeps were found during EX1105 and EX1202 Leg 1. Lines selected in partnership with scientists from the University of New Hampshire data were run three times each to establish a baseline understanding of the seep's signal flux seeps, and in order to choose ideal ROV dive targets for EX1202 Leg 3.

DeSoto Canyon

Additional mapping data complementary to previous *Okeanos Explorer* data was obtained in the DeSoto Canyon lease block.

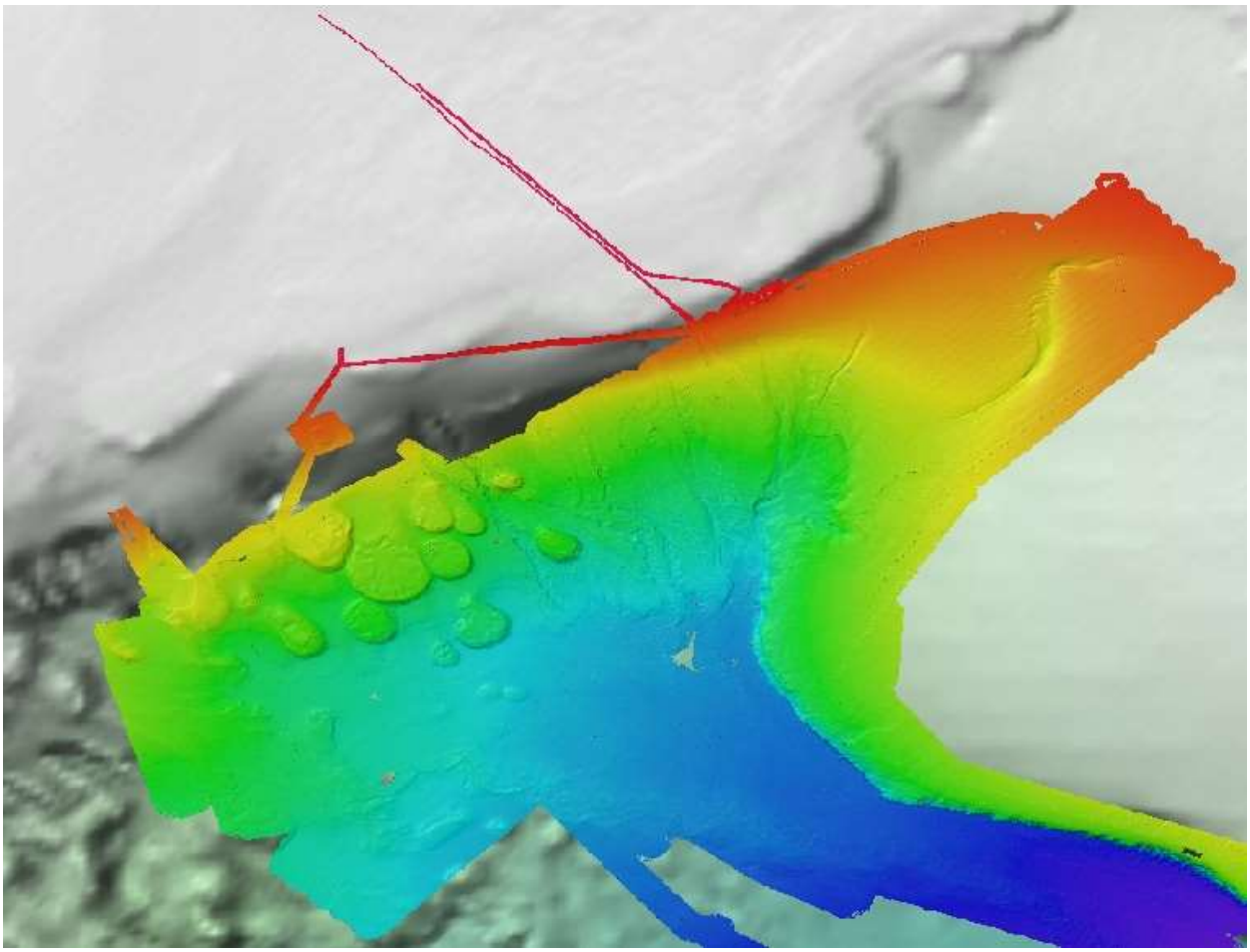

Figure 5. Cumulative EM 302 multibeam data collected in the Mississippi Canyon and DeSoto Canyon lease blocks during EX-12-02 Legs 1 and 2, EX-11-06, and EX-11-05. Screenshot taken in Fledermaus, EM 302 data gridded at 50 meter cell size, view north up, vertical exaggeration 4. Sandwell and Smith satellite altimetry displayed as background data.

ROV Dive Sites

Locations of ROV dive sites for EX-12-02 Legs 2 and 3 are shown in the cruise map in Figure 1. Access to ROV dive data can be obtained through http://oceanexplorer.noaa.gov/okeanos/data.html.

General Character of Area

6. Mapping Statistics

Dates	March 19 – April 7, 2012
Weather delays	0 days
Total non-mapping days	0 days
Total survey mapping days	12 partial, 2 full
Linear kilometers of survey	4,153 km
Square kilometers mapped	14,600 km^2

Number of EM 302 raw bathymetric / bottom backscatter multibeam files	337
Data volume of raw EM 302 multibeam / bottom backscatter data files (gigabytes)	29 GB
Number of EM 302 water column multibeam files	337
Data volume of EM 302 water column multibeam files (gigabytes)	83 GB
Number of EK 60 water column singlebeam files	176
Data volume of EK 60 water column singlebeam files (megabytes)	9 GB
Number of subbottom sonar files	6
Data volume of subbottom sonar files (megabytes)	13 MB
Number of XBT casts	61
Number of CTD casts	1
Number of ROV dives	16
Beginning draft	Fwd: 14' 9" Aft: 14' 6"
Ending draft	Fwd: 14' 3" Aft: 15' 0"
Average ship speed for survey	8.5 kts

7. Mapping Sonar Setup

NOAA Ship *Okeanos Explorer* is equipped with a 30 kHz Kongsberg EM 302 multibeam sonar capable of mapping the seafloor in 0 to 8000 meters of water. The system generates 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.

The ship is also equipped with a Kongsberg EK 60 singlebeam fisheries sonar. The transducer operates at 18 kHz and transmits a 7° beam fan.

Additionally the ship is equipped with a Knudsen 3260 subbottom profiler. The transducers produce a 3.5 kHz chirp signal.

8. Data Acquisition Summary

EM 302 bathymetry, seabed backscatter, and water column backscatter, and EK 60 data (18 kHz) were collected at all times during survey operations. Knudsen subbottom profiler data was briefly collected on March 27 and 28 at ROV dive sites at the request of the shore-based science party.

Expendable bathythermographs were collected every two to four hours to correct multibeam data for changes in sound speed in the water column. A Reson SVP-70 probe mounted on the hull

near the EM 302 transducers was used to determine sound speed at the sonar head and was applied in realtime in Seafloor Information Software (SIS).

Tables listing all sonar files and products collected and created during the cruise are provided in the ancillary files archived with the multibeam dataset. Tables listing all sound velocity files collected during the cruise are also provided.

Multibeam watchstanders provided hourly updates throughout each night's survey operations to provide situation awareness to shore. Hourly updates were given using the ship's telepresence capabilities, specifically, vocally through the EX party line on the RTS communication unit, and visually through the iChat event log.

9. Sonar Data Quality Assessment and Data Processing

The *Okeanos Explorer's* annual multibeam patch test was conducted during the annual shakedown cruise EX-12-01. The full results of the patch test can be found in the EX-12-01 mapping data report.

Multibeam data quality was monitored during realtime by watchstanders. Expendable bathythermographs (XBTs) were conducted every two to four hours as necessary to maintain data quality. Ship speed was adjusted to maintain data quality as necessary. Raw multibeam data files were imported into CARIS. Attitude and navigation data stored in each file were checked, and erroneous soundings were removed using CARIS Swath Editor and Subset Editor. Once per day, cleaned, gridded data were exported to ASCII text files (y,x,z) at 50 meter cell size in geographic WGS84 coordinate system. The ASCII files were then used to create Fledermaus SD objects. These SD objects were then exported to geotiff and Google Earth KMZ.

Multibeam backscatter and bathymetry data from EX-11-05, EX-11-06, and EX-12-02 Leg 1 were analyzed during dive target and trackline planning. Small Fledermaus scene files were provided to shore with a summary of the results. These scene files included gridded bathymetry, mosaiced bottom backscatter, and dive track start and end points.

10. Data Archival Procedures

All mapping data collected by *Okeanos Explorer* is archived and publically available in raw and processed data formats within 90 days of the end of each cruise. The data management plan is available in the appendix of the EX-12-02 Leg 2 project instructions
DOI: https://doi.org/10.7289/V5QC01RP.

EM 302 bathymetry / bottom backscatter dataset www.ncei.noaa.gov
EM 302 water column backscatter dataset doi.org/10.7289/V5P26W1G
EK 60 water column dataset doi.org/10.7289/V52B8VZ3
Subbottom dataset www.ncei.noaa.gov

11. Cruise Calendar

M A R C H 2012

Sun	Mon	Tues	Wed	Thur	Fri	Sat
						17 Mission mapping personnel arrive to ship in Tampa F.L
18 Mapping training	19 Depart dock for working grounds. Commence mapping ops.	20 Mapping morning/evening. ROV dive 01.	21 Mapping entire day. ROV dive 02 cancelled (WX).	22 Mapping morning/evening. ROV dive 02.	23 Mapping morning/evening. ROV dive 03.	24 Mapping morning/evening. ROV dive 04.
25 Mapping morning/evening. ROV dive 05.	26 Mapping operations morning/evening. ROV dive 06.	27 Mapping morning/evening. ROV dive 07.	28 Mapping morning/evening. ROV dive 08.	29 Mapping morning/evening. ROV dive 09. Potentially sensitive mapping data over UCH was collected.	30 Mapping morning/evening. ROV dive 10. Potentially sensitive mapping data over UCH was collected.	31 Mapping morning/rvening. ROV dive 11.
A P R I L 2012						
1 Mapping morning/evening. ROV dive 12.	2 Mapping morning/evening. ROV dive 13.	3 Mapping morning/evening. ROV dive 14.	4 Mapping all day. ROV launch cancelled due to weather.	5 Mapping morning/evening. ROV dive 15.	6 Mapping morning/evening. ROV dive 16.	7 Lobecker departs the ship from Pascagoula MS.
8 Mapping personnel Smithee and Pinero depart the ship.						

12. Daily Cruise Log

All times listed are in UTC. Local ship time was -4 hours from UTC.

Weather is discussed only when notable in terms of sonar data quality. A full weather log is provided in the appendices, detailing observed weather conditions every 3 hours.

March 17, 2012
Mapping mission and science personnel arrive to the ship, including Tara Smithee, Chris Pinero, Jeremy Potter, Tim Shank, Pen Singh, and Meme Lobecker.

March 18, 2012
Mapping personnel received training on mapping systems. The cruise plan was reviewed.

March 19, 2012
After swinging the compass in the harbor, the ship officially departed the dock in Tampa, Florida at 1650 for the working grounds. An EM 302 built in system test (BIST) was run showing excellent system integrity. Multibeam bathymetry data acquisition commenced at 2156 and continued through the night. Multibeam water column data collection commenced at 2205 and

continued through the night. EK 60 data collection commenced at 2235 and continued through the night.

For each day after March 19, all data collection (EM 302 bathymetry and water column backscatter, EK 60) began at approximately the same time.

March 20, 2012
Survey operations continued in the morning until 0908, when the sonars were secured as the ship reached the ROV dive location. After the day's ROV dive, survey operations resumed at 2211 and continued through the night. Winds were 20-23 knots throughout the day, and seas were a 5 to 6 foot swell with a 3 to 5 foot wind wave, creating unfavorable survey conditions. Data quality heading in the southerly direction suffered accordingly. Decreasing ship speed increased data quality minimally.

Safety drills were conducted, including fire and emergency, and abandon ship.

The first set of daily multibeam products was sent to shore.

March 21, 2012
Survey operations continued in the morning until 1104, when the sonars were secured as the ship reached the ROV dive location. Due to prevailing wind and wave conditions in combination with the Gulf of Mexico Loop Current, it was determined that the ROV launch was not possible. Mapping operations resumed at 1315 and continued through the remainder of the day. Winds were 20 knots throughout the day. ROV team personnel augmented mapping team personnel in order to be able to successfully conduct mapping operations during the day.

March 22, 2012
Survey operations continued in the morning until 1140, when the sonars were secured as the ship reached ROV dive site 02. Wind and seas in the morning caused degradation of multibeam data quality. Mapping resumed at 2128 and continued through the night towards ROV dive site 03.

March 23, 2012
Survey operations continued in the morning until 1127, when the sonars were secured as the ship reached ROV dive site 03. Mapping operations resumed with the ROV secure on deck at 2241 and continued through the night.

March 24, 2012
Survey operations continued in the morning until 1055, when the sonars were secured as the ship reached ROV dive site 04. Mapping operations resumed with the ROV secure on deck at 2108 and continued through the night.

March 25, 2012
Survey operations continued in the morning until 1053, when the sonars were secured as the ship reached ROV dive site 05. Mapping operations resumed at 2300 and continued through the night. An EM 302 built in system test (BIST #2) was run showing excellent system integrity.

March 26, 2012
Survey operations continued in the morning until 1049, when ROV dive site 06 was reached. In addition to a transect along the seafloor, the ROV conducted an experiment in conjunction with NE Fisheries Science Center (Mike Vecchione) to examine the presence of sperm whale food (squid, other invertebrates) at decreasing water depths along a 1.38 kilometer straight transect. EM 302 (bathymetry and water column) and EK 60 data were collected during the test for possible correlation to ROV camera footage. Mapping operations resumed at 2114 with the ROV secure on deck and continued through the night.

March 27, 2012
Survey operations continued in the morning until 1103 when ROV dive site 07 was reached. Mapping operations resumed at 2053 with the ROV secure on deck. Four subbottom lines were run over ROV dive site 07, then mapping continued through the night in transit to dive site 08.

March 28, 2012
Survey operations continued in the morning until 1100 when ROV dive site 08 was reached. Mapping operations resumed at 2115 with the ROV secure on deck and continued through the night. Two 5 kilometer subbottom lines were run over ROV dive site 08 to obtain more information about the substrate observed at the site, then mapping continued through the night in transit to dive site 09. Minor penetration at nadir was observed in the multibeam data.

March 29, 2012
Survey operations continued in the morning until 1059 when ROV dive site 09, an underwater cultural heritage (UCH) site, was reachedMultibeam lines containing data within 3 nautical miles of the UCH site are 0145 – 0149. These files were stored apart from the regular dataset and were gridded as a separate BASE surface in CARIS. These files were not added to the daily products created offshore. Minor penetration at nadir was observed in the multibeam data. The beta program "SVP Server" produced by Dr. Jonathan Beaudoin of UNH-CCOM was in use from 0442 through end of survey in the morning due to a high degree of flux seen in sound velocity. XBT casts conducted every 2 hours were not enough to keep up with observed sound velocity variations.

Mapping operations resumed with the ROV on deck at 2051 and continued through the night.

March 30, 2012
Survey operations continued in the morning until 1105 when ROV dive site 10, a UCH site, was reached. Multibeam data collected within 3 miles of the dive target was stored in a separate directory marked sensitive, and these data were not added to the daily products. Multibeam files containing data within 3 miles of the UCH are 0162 to 0167. Mapping operations resumed at 2116 and continued through the night.

March 31, 2012
Survey operations continued in the morning until 1051 when ROV dive site 11 was reached. Mapping operations resumed at 2238 and continued through the night.

Water column lines were run over seeps seen in EX1105 data in preparation for EX1202 Leg 3 ROV dives focusing on seeps. UNH scientists are analyzing the raw water EM 302 column data on shore.

April 1, 2012
Survey operations continued in the morning until 1056 when ROV dive site 12 was reached. Survey operations resumed at 2040 and continued through the night. Additional passes of the water column lines from the previous night were collected. UNH scientists are interested in exploring the variability of seep flow. These lines will demonstrate seep flow flux rates, and will be used to determine ROV dive sites for Leg 3 to further the work and ground truth the EM 302 water column backscatter data.

April 2, 2012
Survey operations continued in the morning until 1112 when ROV dive site 13 was reached. Water column files of the seep areas were pushed to shore for analysis by UNH scientists. Raw multibeam files of the leveed channel of the WFL were pushed to shore for further analysis by UNH scientists.

April 3, 2012
Survey operations continued in the morning until 1039 when ROV dive site 14 was reached. A seismic vessel was operating in the area so the ROV dive 14 was moved to site 'MC 255'. Survey operations included completing NW coverage of the leveed channel.

April 4, 2012
Survey operations continued in the morning until 1048 when ROV dive site 15 was reached. Intense electrical storms prevented safe launching of the ROV and the ROV dive was cancelled for the day. Mapping operations resumed in the morning and continued for the remainder of the day.

April 5, 2012
Survey operations continued in the morning until 1100 when ROV dive site 15 was reached. Intense electrical storms delayed the ROV launch for 3 hours. The ship stood by at the ROV dive site until the weather settled down enough to launch. Mapping operations resumed at 2331 with the ROV securely on deck and continued through the night.

April 6, 2012
Survey operations continued in the morning until 1100 when ROV dive site 16 was reached. The dive was over a strong seep signal observed in the EM 302 water column data during EX1202 Leg 1 on the southern edge of Pascagoula Dome. EK 60 data logging during the dive commenced at 1624 and continued throughout the dive. Mapping operations resumed at 1645 with the ROV securely on deck and continued through the night.

April 7, 2012
Survey operations continued in the morning until the ship reached the sea buoy at 1128. All sonars were secured and field data processing was finalized.

April 8, 2012
Mapping personnel disembarked from the ship.

13. References

2012 *Okeanos Explorer* Ship Readiness Report, contact ops.explorer@noaa.gov or oar.oer.exmappingteam@noaa.gov to obtain an electronic copy.

EX-12-02 Leg 2 Project Instructions and Data Management Plan
DOI: https://doi.org/10.7289/V5QC01RP.

EM 302 bathymetry / bottom backscatter dataset
https://www.ngdc.noaa.gov/ships/okeanos_explorer/EX1202Leg2_mb.html

EM 302 water column backscatter dataset doi.org/10.7289/V5P26W1G
EK 60 water column dataset doi.org/10.7289/V52B8VZ3
Subbottom dataset www.ncei.noaa.gov

14. Appendices

The following files are included in the archived as ancillary files with the multibeam 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

Acronyms

- ACUMEN - Atlantic Canyons Undersea Mapping Expeditions
- ASCII – American Standard Code for Information Interchange
- AUV – autonomous underwater vehicle
- BIST – built in system test
- CDR – Commander
- CO – Commanding Officer
- CTD – conductivity, temperature, depth
- Cu - Copper
- dB - decibel
- CW – continuous wave
- DNP – do not process
- DO - dissolved oxygen
- DP - dynamic position(ing)
- ECS – Extended Continental Shelf

- ERT – Earth Resources Technology Inc.
- ET – Electronics Technician
- EX – NOAA Ship *Okeanos Explorer*
- FM – frequency modulated / modulation
- FTP – file transfer protocol
- GB - gigabytes(s)
- KB - kilobytes(s)
- kHz – kilohertz
- km – kilometer
- kts – knots
- LT – Lieutenant
- LSS - light scattering sensor
- m - meters
- MB – multibeam sonar
- MB – megabytes(s)
- NCDDC – National Coastal Data Development Center
- NGDC – National Geophysical Data Center
- NMEA – National Marine Electronics Association
- NOAA – National Oceanic and Atmospheric Administration
- NODC – National Oceanographic Data Center
- NOPP – National Ocean Partnership Program
- OER – NOAA Office of Ocean Exploration and Research
- OMAO – NOAA Office of Marine and Aviation Operations
- OPS – Operations Officer
- ORP - oxygen reduction potential
- ROV – remotely operated vehicle
- SBP – subbottom profiler
- SCS – scientific computer system
- SIS – Seafloor Information System
- SVP – sound velocity profile
- TRU – transceiver unit
- TSG - thermosalinograph
- UCAR – University Corporation for Atmospheric Research
- UPS – uninterruptable power supply
- USBL – ultrashort baseline
- USGS – United States Geological Survey
- XBT – expendable bathythermograph
- XO – Executive Officer
- WD – water depth
- WHOI – Woods Hole Oceanographic Institution