

NOAA *Okeanos Explorer* Program

MAPPING DATA ACQUISITION AND PROCESSING REPORT

CRUISE EX-14-02 Leg 1

Mission System Shakedown and Patch Test

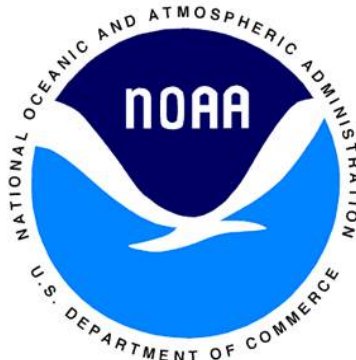
February 24 - March 15, 2014
N. Kingston, RI – N. Kingston, RI

Report Contributors:

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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 report is to briefly describe the mapping data collection and processing methods, and to report the initial results of the cruise. For a detailed description of *Okeanos Explorer* mapping capabilities, see the appendices section 'Kongsberg EM 302 Multibeam Sonar Description and Operational Specifications' and the ship's readiness report, which can be obtained by contacting the ships operations officer (ops.explorer@noaa.gov).

This report focuses on exploration expedition EX-14-02 Leg 1, during which a ship shakedown and patch test were conducted, as well as mapping of several Atlantic Shelf Edge Canyons.

The cruise objectives for EX-14-02 Leg 1 were defined in EX-14-02 Leg 1 Project Instructions and included the following. All objectives were achieved unless otherwise noted below.

3. Participating Mapping Personnel

NAME	ROLE	AFFILIATION
CDR Ricardo Ramos	Commanding Officer	NOAA Corps
LT Emily Rose	Field Operations Officer	NOAA Corps
Elizabeth “Meme” Lobecker	Expedition Coordinator / Mapping Team Lead	NOAA OER (ERT Inc.)
Derek Sowers	Physical Scientist, Mapping Watch	NOAA OER (ERT Inc.)
Lindsay McKenna	Physical Scientist, Mapping Watch	NOAA OER (ERT Inc.)
Jacklyn James	Survey Technician	NOAA OMAO
Kurt Mueller	Physical Scientist, Mapping Watch	NOAA Atlantic Hydrographic Branch
Erin Weller	Physical Scientist, Mapping Watch	NOAA Atlantic Hydrographic Branch
Danielle Ferraro	Intern, Mapping Watch	NOAA OER / UCAR

4. Summary of Major Findings

Cruise Map

Figure 1. Cruise map made in ArcMap 10 showing overall cruise track and key operational areas.

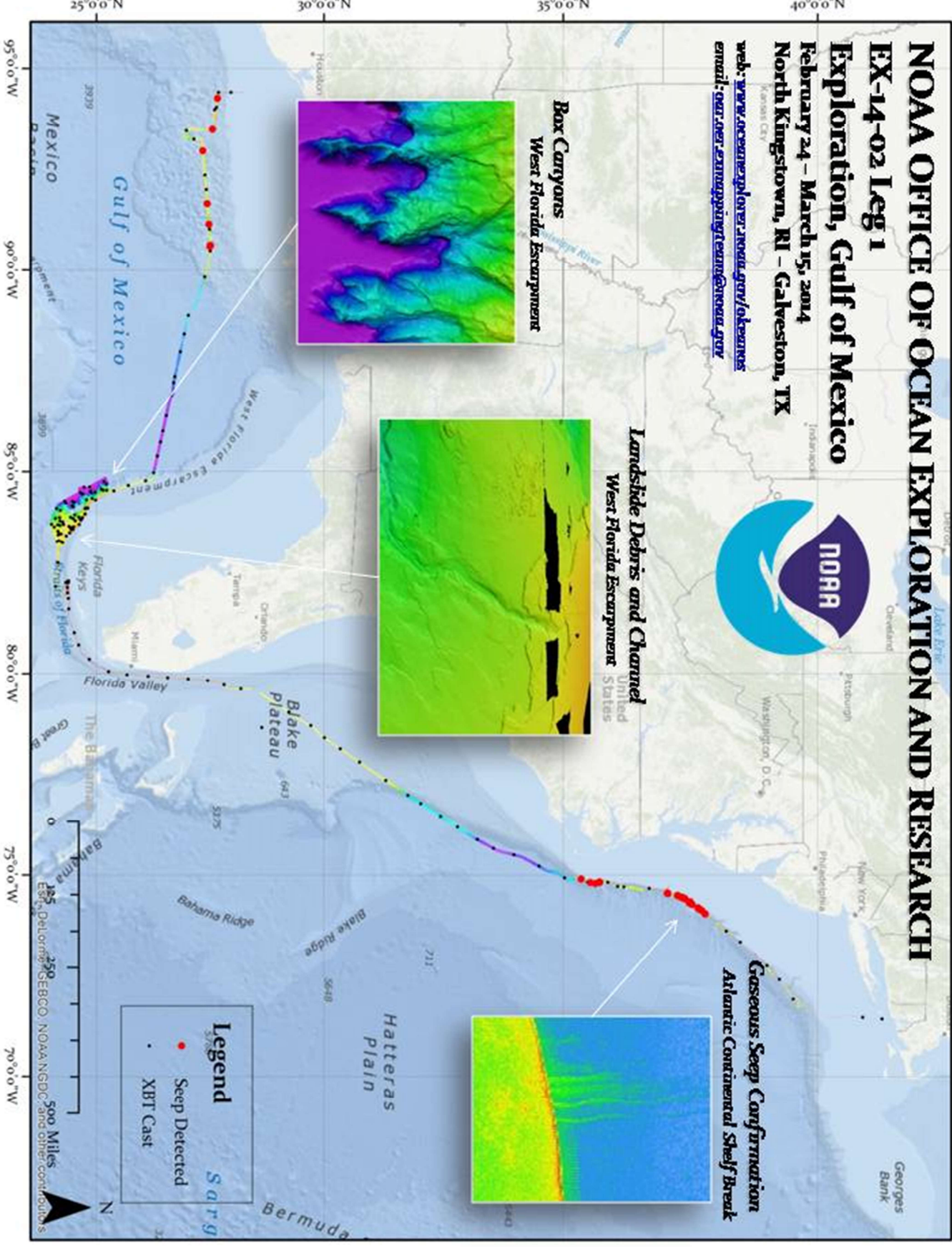
NOAA OFFICE OF OCEAN EXPLORATION AND RESEARCH

EX-14-02 Leg 1

Exploration, Gulf of Mexico

February 24 – March 15, 2014
North Kingstown, RI – Galveston, TX

web: www.oceanexplorer.noaa.gov/oceanexplorer
email: oer@noaa.gov



Box Canyons
West Florida Escarpment

Landslide Debris and Channel
West Florida Escarpment

Gaseous Seep Confirmation
Atlantic Continental Shelf Break

Legend

- Seep Detected
- XBT Cast

5. Mapping Statistics

Dates	February 24 - March 15, 2014
Days lost to weather	0 days
Total mapping days	20 days
Total non-mapping days	0 days
Line kilometers of survey	6845
Square kilometers mapped	24677
Number / Data Volume of EM 302 raw bathymetric / bottom backscatter multibeam files	361/53 gb
Number / Data Volume of EM 302 water column multibeam files	357/149 gb
Number / Data Volume of EK 60 water column singlebeam files	708 / 10.4 gb
Number / Data Volume of subbottom sonar files	697/3.7 gb
Number of XBT casts	156
Number of CTD casts (including test casts)	0
Beginning draft	Forward: 15' 2"; Aft: 14'
Ending draft	Forward: 14' 8"; Aft: 13'10"

6. Mapping Sonar Setup

The 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.

The sonars are further described in the 2014 Mapping Systems Readiness Report, which can be obtained by contacting the ship (ops.explorer@noaa.gov), or the mapping team (oar.oer.exmappingteam@noaa.gov).

7. Data Acquisition Summary

EX-14-02 Leg 1 operations included EM 302 multibeam, EK 60 singlebeam, and Knudsen subbottom profile data collection. The schedule of operations during transits included continuous 24 hour per day multibeam and singlebeam data collection, and subbottom data collection from 1000 – 1800 (local).

Expendable bathythermographs were collected every two to four hours to correct multibeam data for changes in sound speed in the water column, and were applied in real time using Seafloor Information Software (SIS). Sound speed at the sonar head was determined using a Reson SVP-70 probe and the

thermosalinograph. Data from these two systems was monitored for consistency throughout the cruise, and whichever was performing better was applied in realtime using SIS.

Tables listing all sonar files collected and products created during the cruise are provided in the appendices of this report. Tables listing all sound velocity files collected during the cruise are also provided.

8. Sonar Data Quality Assessment and Data Processing

EM 302 Multibeam Bathymetry Data

A patch test was run on February 6, 2014. The offsets were determined to have not changed from previous years.

Offset Test	Offset
Timing	0 seconds
Pitch	-.725°
Heading	0°
Roll	0°

Table 1. EM 302 transducer offset values determined during EX-14-01.

Throughout the cruise, multibeam data quality was monitored in realtime by acquisition watchstanders. XBTs were conducted every two to four hours as necessary to maintain data quality. Ship speed was adjusted to maintain data quality as necessary. Line spacing during focused mapping surveys was planned to ensure ¼ to ½ overlap between lines at all times. Cutoff angles in SIS were generally set to 75° on both the port and starboard sides.

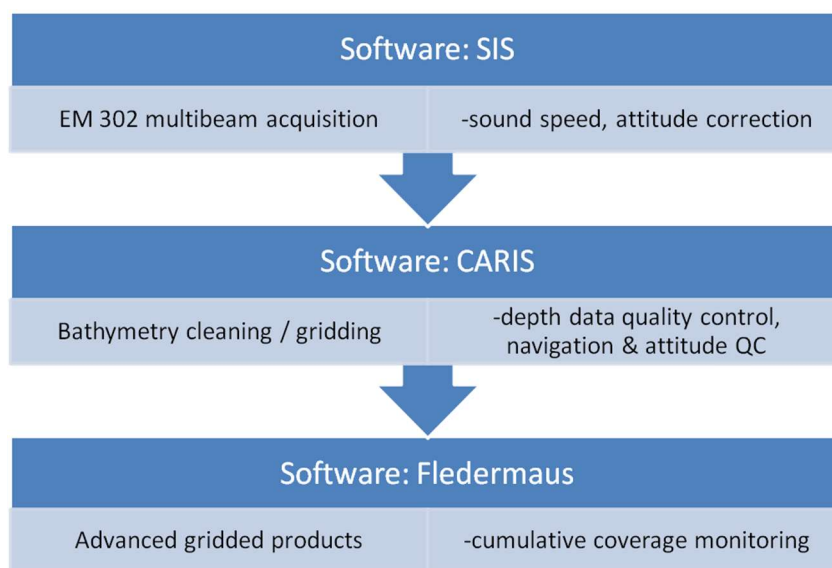


Figure 2. Shipboard multibeam data flow.

Raw multibeam bathymetry data files were acquired by SIS, and were imported into CARIS. In 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 bathymetric data were exported to ASCII text files (y,x,z) at 50 meter cell size in WGS84 datum. The ASCII files were then used to create Fledermaus SD objects. These SD objects were then exported to geotiff and Google Earth KMZ, which were copied to the shoreside FTP on a daily basis for shoreside scientist participation.

EM 302 Multibeam Water Column Backscatter Data Processing

Water column data was examined using Fledermaus Midwater to inspect for the presence of seeps and other water column anomalies.

EM 302 Built In System Tests(BISTs)

BISTs were run throughout the cruise to monitor multibeam sonar system status. These are provided as ancillary files with the multibeam dataset.

EM 302 Multibeam Crossline Analysis

A crossline was run at the Southwest Florida Escarpment survey. The mainscheme and crosslines were compared in 2017 using Crosscheck function of Qimera v1.5.4 build 959. The results show the data would be accepted for an International Hydrographic Organization order 1 survey in terms of depth accuracy.

The crossline data files were:

0303_20140311_123350_EX1402L1_MB.all
 0304_20140311_143351_EX1402L1_MB.all.

The mainscheme lines were:

0160_20140304_155747_EX1402L1_MB.all
 0166_20140304_233552_EX1402L1_MB.all
 0171_20140305_071704_EX1402L1_MB.all
 0177_20140305_171043_EX1402L1_MB.all
 0182_20140305_233524_EX1402L1_MB.all
 0187_20140306_071954_EX1402L1_MB.all
 0294_20140311_024929_EX1402L1_MB.all
 0298_20140311_090124_EX1402L1_MB.all

000000722591	# Number of Points of Comparison
-1773.339413	# Data Mean
-1778.113132	# Reference Mean
4.773719	# Mean
932.067559	# Median
73.682678	# Std. Deviation
-3588.28 -417.14	# Data Z - Range
-4028.25 -414.22	# Ref. Z - Range
-354.84 2280.75	# Diff Z - Range
152.139076	# Mean + 2*stddev
1079.432916	# Median + 2*stddev
5.408022	# Ord 1 Error Limit
0.022642	# Ord 1 P-Statistic
16361	# Ord 1 - # Rejected
1	# Order 1 Survey ACCEPTED

EK 60 Splitbeam Sonar Data

An EK 60 calibration was conducted from March 2nd and 3rd.

XBT files applied for casts were EX1402L1_XBT049_140302 and EX1402L1_XBT054_140303.

Knudsen 3260 Subbottom Profiler Data

Subbottom data was collected continuously throughout the cruise. Data collection holidays occurred in due to inclement weather and while personnel were attempting to input attitude data from the POS/MV into the acquisition software.

Knudsen acquisition software was updated mid-cruise. SEG-Y files up to and including 113 were written with Knudsen firmware 3.80, Knudsen Client 2.71, and Knudsen Server 2.73. SEG-Y files from 114 (inclusive) and later were written with Knudsen firmware 3.85, Knudsen Client 2.73, and Knudsen Server 2.77.

9. Telepresence

A 5 mb/s ship-to-shore connection was available throughout the cruise.

A telepresence event was conducted on March 8th in coordination with the "How Do We Explore" education training conducted by the OER education team at the University of New Hampshire's Center for Coastal and Ocean Mapping.

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-14-02 Leg 1 project instructions doi:10.7289/V5PN93N1

- EX-14-02 Leg 1 sonar datasets:
 - EK 60 18 kHz water column data [doi:10.7289/V5PC308T](https://doi.org/10.7289/V5PC308T)
 - EM 302 water column backscatter <http://doi.org/10.7289/V5NC5Z42>
 - Subbottom profile – www.ncei.noaa.gov
 - EM 302 bathymetry and bottom backscatter dataset – www.ncei.noaa.gov

11. Cruise Calendar.

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

February / March 2014						
Sun	Mon	Tues	Wed	Thur	Fri	Sat
						22 Expedition Coordinator

						arrives to ship
23 Mission personnel arrive to ship	24 Depart dock North Kingstown, RI for working grounds	25 Exploration transit to Gulf of Mexico along US Atlantic Shelf Break.	26 Exploration transit to Gulf of Mexico along US Atlantic Shelf Break.	27 Exploration transit to Gulf of Mexico along US Atlantic Shelf Break and Blake Plateau	28 Exploration transit to Gulf of Mexico along Blake Plateau	1 Exploration transit to Gulf of Mexico along Stetson Mesa and Atlantic South Florida
2 Arrive Key West, Kongsberg embarks, begin EK60 calibration	3 Complete EK60 calibration, Kongsberg disembarks	4 Transit and exploration mapping - Florida Escarpment	5 Exploration mapping - Florida Escarpment	6 Exploration mapping - Florida Escarpment	7 Exploration mapping - Florida Escarpment	8 Exploration mapping - Florida Escarpment Telepresence/Edu cation Event: How Do We Explore?
9 Exploration mapping - Florida Escarpment	10 Explorati on mapping - Florida Escarpment	11 Exploration mapping - Florida Escarpment	12 Exploration mapping - Florida Escarpment; Commence transit to Galveston	13 Transit to Galveston; mapping of area in prep for Legs 2/3	14 Mapping of area in prep for Legs 2/3	15 Arrive in port - Galveston, Texas
16 In port - Galveston, Texas						

12. Daily Cruise Log

All times listed are local ship time, which was -5 hours from UTC.

February 23, 2014

The ship was alongside the pier in Quonset, Rhode Island. Mission personnel boarded the ship. NETAPPS storage was freed up in preparation for data collection throughout the field season. 16 TB of data storage on the Drobo was made available by data management team. Survey software and hardware were prepared for data collection. SCS software has been updated and is ready to start collecting data when the cruise begins.

February 24, 2014

The ship departed the pier in North Kingstown, RI at 1030 and steamed towards the continental shelf break to begin transit south to the Gulf of Mexico. After leaving Narragansett Bay, the seas became heavy as the ship transited southward.

Watch schedules were assigned, cruise plans were discussed, and ship introduction was conducted. Multibeam, EK 60, and Knudsen subbottom data were collected in transit across the continental shelf. Subbottom data and EK 60 were secured when seas became heavy.

SCS is fully up and running. Mailers are sending to shore, shiptracker is updating. Barometer data is being sent to ship tracker as of 1700 local.

February 25, 2014

The seas were heavy with winds 25-30 kts in the very late evening 2/24 and early morning 2/25 and the ship adjusted course to provide a decent ride overnight. The seas calmed during the day and data quality was high as we conducted transit mapping offshore Long Island, New Jersey, and the Mid-Atlantic states. Drills were conducted including fire and abandon ship.

Survey of opportunity transit continued along a track following seeps on the shelf break. Data is under review for presence of seeps. Survey data quality was high for the majority of the day.

NMFS guidance for sonar operation in the presence of marine mammal was reviewed with bridge and survey. Within 2 hrs, a whale (species not available) and large pod of dolphins (species not available) were spotted in the safety zone and sonars were secured according to NMFS guidance. In total the sonar was secured for marine mammals 3 times.

Scientific sea water system has been running since 12:00 24 Feb 2014 without any errors. Shiptracker now displays correct barometer and depth fields as they going out from our ship. The SCS windbird is not displaying correct wind direction. The windbird unit will be adjusted to display correct data, once when we get to some safe sea area and good weather.

February 26, 2014

The ship continued southward transit to the Gulf of Mexico, today passing by the Carolinas and northern Georgia. Several previously detected seeps were present. The seas were cooperative in the 3-5 ft range, winds generally around 15 kts, and sea smoke. Data quality on all sonars was high. Speed was actively monitored to assure on time arrival for Kongsberg pickup March 2 in Key West.

Survey of opportunity transit continued along a track following seeps and diapirs on the shelf break. Data is under review for presence of seeps. Survey data quality was high for the majority of the day.

Sonars were secured several times throughout the day due to approach of dolphins into the designated 750 m safety zone. SOP for sonar operation in the presence of marine mammals was reviewed in consultation with OER Program Manager and others and the SOP was revised to allow for operating sonars in presence of dolphins.

The first set of multibeam daily products were produced and transferred to shore.

February 27, 2014

The ship continued southward transit to the Gulf of Mexico along a survey of opportunity track following diapirs on the Blake Plateau in pursuit of potential water column anomalies. The Gulf of Mexico current is slowing our speed at times to as slow as 6-7 knots, greatly decreasing the amount of transit each day. Seas were moderate and data quality for all three sonars was high.

February 28, 2014

Transit continued southward to the Gulf of Mexico over the Blake Plateau. Seas were moderate and data quality for all three sonars was high. USGS scientists followed subbottom data collection from shore. Initial processing conducted by Jason Chaytor is provided in subbottom data collection section. Data quality was excellent and useful in areas lacking subbottom data.

March 1, 2014

Transit southward continued, passing by West Palm Beach and other southern Atlantic Florida communities, and through the Straits of Florida. We diverted from the planned trackline to avoid the

strongest area of the Gulf Stream in order for on time pick up of Kongsberg engineers in Key West on March 2. Seas were moderate and data quality for all three sonars was high.

March 2, 2014

The Key West sea buoy was reached in the late morning. Multibeam, split beam, and subbottom data collection continued until approximately the sea buoy. Sonars were secured as the ship stood by during the small boat pick up of Kongsberg technicians in Key West. The small boat was deployed at 1100 and Kongsberg engineers were retrieved from the Florida Keys National Marine Sanctuary piers and were onboard by 1200.

Kongsberg technicians came onboard ready to get started with the EK 60 calibration. Three outriggers were attached to the 01 deck rails, the ship steamed to the EK 60 calibration site about 50 km southwest of Key West, local current and sea conditions were good, and calibration commenced. Calibration continued until the late evening when nocturnal plankton migration prevented adequate data collection. Gear was recovered and plan was made to complete final calibrations in the morning.

A section of Pourtales Terrace near the EK 60 calibration site was opportunistically mapped overnight at the request of Florida Atlantic University Professor/Coral Researcher John Reed. Reed indicated the area is potential coral habitat.

March 3, 2014

Mapping of Pourtales Terrace continued in the morning. EK 60 calibration resumed at 0830 and was completed in the afternoon. Kongsberg personnel transferred to shore at Key West with help of Florida Keys National Marine Sanctuaries personnel. The ship then conducted mapping transit exploration en route westward to SW Florida Escarpment mapping area.

EK 60 calibration values were applied for the 2014 field season in the Gulf of Mexico. The current was ~.5 kts, water depth was 100-200 meters.

March 4, 2014

The day was spent conducting exploration mapping of the Southwest Florida Escarpment. 24 hr multibeam, split beam, and subbottom data collection were conducted over the southwest section of Florida Escarpment. Weather was fair and data quality was high for all sonars. ETs continued to work on feeding attitude data to Knudsen data in realtime. USGS Tsunami Hazards is interested in subbottom data collected over submarine landslides at the Escarpment.

Drills were conducted for medical emergency, abandon ship, and man overboard.

March 5, 2014

24 hr multibeam, split beam, and subbottom data collection were conducted at the SW Florida Escarpment. The weather was fair and data quality was high for all sonars. Plumbing attitude data into Knudsen is on hold until port, due to high importance of data SBP data collection.

March 6, 2014

24 hr multibeam, split beam, and subbottom exploration mapping of the SW Florida Escarpment continued. Weather was fair into the early afternoon and data quality was high for all sonars. The presence of a large squall caused rapid weather deterioration in the afternoon with winds gusts in the 50's, and data quality deteriorated.\

March 7, 2014

24 hr multibeam, split beam, and subbottom exploration mapping of the SW Florida Escarpment continued. The seas were heavy throughout the day, but data quality on all sonars remained acceptable. Alternate line plans were made at a heading to best work with the NW winds and waves. The EM 302 computer required a restart when it seemed like keyboard keys were being depressed remotely. Training of new physical scientists continues to go very well.

March 8, 2014

Exploration mapping of the Southwest Florida Escarpment continued. The seas came down from previous day and data quality was high on all sonars. The hull dive was cancelled due to large swells. A telepresence interaction was conducted in conjunction with 'How the We Explore' teacher workshop at UNH CCOM.

March 9, 2014

Exploration mapping of the Southwest Florida Escarpment continued. Holiday lines commenced. The hull dive to inspect props and transducers was conducted successfully. Transducers were clean, props were not fouled, seachest cover was cleaned.

March 10, 2014

The weather was fair and data quality on all sonars was high. Multibeam, split beam, and subbottom data collection were conducted at the SW Florida Escarpment, continuing holiday fill lines completing overlap with previous transit data from 2011-2012 cruises. Data quality for all sonars was high. Training of new personnel continues to go very well.

March 11, 2014

Holiday fill lines on the Southwest Florida Escarpment continued. The weather was fair and data quality on all sonars was high. Transit westward towards Galveston commenced in the evening.

March 12, 2014

Transit westward towards Galveston continued. Data quality from all sonars remained high. Abandon ship drill was conducted. Work on final summary map was started. Training of new personnel continues to go well.

March 13, 2014

The western Gulf of Mexico survey area was reached in the late afternoon, and preliminary mapping commenced in preparation for Legs 2 and 3. Weather was relatively fair and data quality on all sonars was high.

March 14, 2014

Exploration mapping continued in the western Gulf of Mexico survey area. Weather was fair and data quality on all sonars was high. Sonars were secured when a water depth of 50 meters was reached in the traffic separation scheme. Mapping data projects were finalized. Cruise wrap up meetings were held.

13. References

The 2014 Survey Readiness Report can be obtained by contacting NOAA Ship *Okeanos Explorer* at ops.explorer@noaa.gov.

- EX-14-02 Leg 1 sonar datasets:
 - EK 60 18 kHz water column data [doi:10.7289/V5PC308T](https://doi.org/10.7289/V5PC308T)
 - EM 302 water column backscatter <http://doi.org/10.7289/V5NC5Z42>
 - Subbottom profile – www.ncei.noaa.gov
 - EM 302 bathymetry and bottom backscatter dataset
https://www.ngdc.noaa.gov/ships/oceanos_explorer/EX1402L1_mb.html

The following data was used as background data throughout the cruise:

1) 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.

2) NOAA Nautical Charts

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