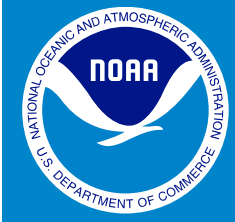


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# MAPPING DATA ACQUISITION AND PROCESSING SUMMARY REPORT

## CRUISE EX-11-02: ROV Shakedown *(ROV/Mapping)*

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# 1. Introduction

The NOAA Office of Ocean Exploration and Research 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

## 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 the remotely operated vehicle (ROV) shakedown expedition EX-11-02, 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 2011 NOAA Ship *Okeanos Explorer* Survey Readiness Report, available in the NOAA Central Library

## 3. Cruise Objectives

EX-11-02 focused on the integration of the new OER camera platform into *Okeanos Explorer* systems and the ROV control room, as well as the subsequent shakedown cruise to evaluate the performance and operation of this tandem system utilizing the Institute for Exploration (IFE) Little Hercules ROV as the main vehicle. The results of this testing are not included in this report.

Limited opportunistic mapping operations were conducted during times ROV operations were secured as staffing levels allowed. This cruise commenced and concluded in San Diego, CA, with mapping data collected between April 23 and April 26, 2011.

The complete objectives for this cruise are detailed in the EX-11-02 Project Instructions, which are archived in the NOAA Central Library.

## 4. Summary of Mapping Results

EX-11-02 mapped 328 square kilometers of seafloor in the vicinity of the Channel Islands, CA, during the ROV shakedown expedition (Figure 1 and Table 1).

**Cruise Overview Map**

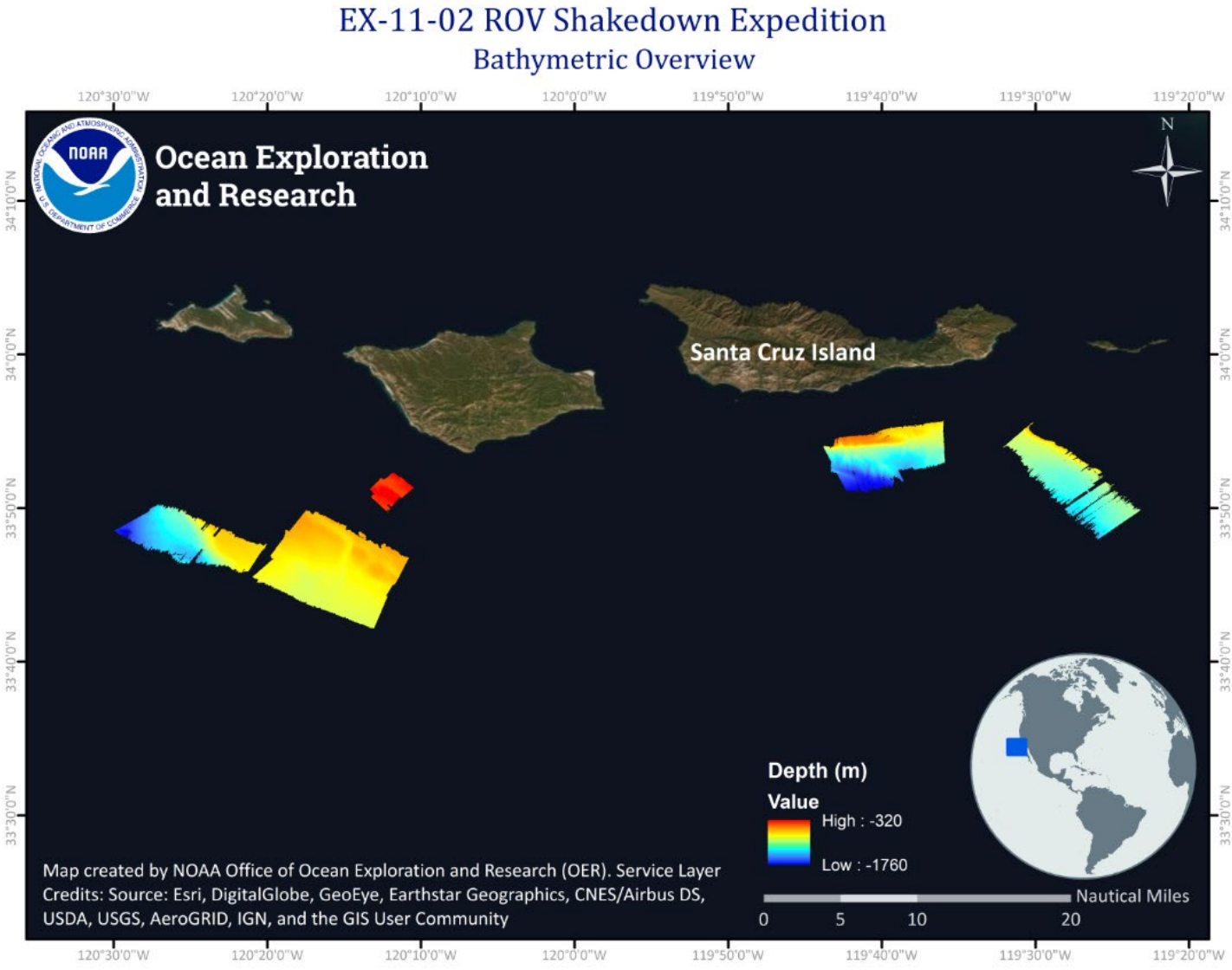


**Figure 1.** Overview of bathymetric mapping coverage completed during the ROV shakedown expedition (EX-11-02).

## 5. Mapping Statistics

**Table 1. Summary statistics of ocean mapping work completed during EX-11-02.**

| | |
|---|---|
| **Dates of data collection** | **April 23 – April 26, 2011** |
| **Linear kilometers of survey with EM 302** | **94.8** |
| **Square kilometers mapped with EM 302** | **328** |
| **Number / data volume of EM 302 raw bathymetric / bottom backscatter multibeam files (.all)** | **11 files/ 1.09 GB** |
| **Number / data volume of EM 302 water column multibeam files** | **4 files / 0.71 GB** |
| **Number / data volume of EK 60 water column split beam files (.raw)** | **0 / 0 GB** |
| **Number / data volume of sub-bottom sonar files (.segy, .kea, .keb)** | **0 / 0 GB** |
| **Number of XBT casts** | **5** |
| **Number of CTD casts (including test casts)** | **3** |

## 6. Mapping Sonar Setup

*Kongsberg EM 302 Multibeam Sonar*

NOAA Ship *Okeanos Explorer* is equipped with a 30 kilohertz (kHz) Kongsberg EM 302 multibeam sonar capable of detecting the seafloor in up to 10,000 meters of water and conducting productive mapping operations in 8,000 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 shoaler than 3300 meters the system is operated in 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 data. Backscatter represents the strength of the acoustic signal reflected from a target, such as the seafloor or bubbles in the water column. The system is patch tested annually and the results are reported in the annual readiness report. The 2011 NOAA Ship *Okeanos Explorer* Mapping Systems Readiness Report is available in the NOAA Central Library

## 7. Data Acquisition Summary

Mapping operations included data collection via the EM 302 multibeam sonar.

Survey lines were planned to either maximize edge matching of existing bathymetric data, or to fill data gaps in areas with existing bathymetric coverage. In regions with no existing data, lines were planned to optimize potential exploration discoveries. Limited focused operations were conducted over an anomalous feature previously detected by the R/V Shearwater, which was subsequently disproved via an ROV dive.

Throughout the cruise multibeam data quality was monitored in real time by acquisition watchstanders. 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 the multibeam acquisition software Seafloor Information System (SIS) were generally left wide open for maximum exploration data collection and routinely adjusted on both the port and starboard side to ensure the best data quality and coverage.

Multibeam data received real time surface sound velocity corrections via the Reson SVP-70 at the sonar head, as well as through profiles generated from Expendable Bathythermographs (XBTs) conducted at intervals no greater than 6 hours, as dictated by local oceanographic conditions. Reson sound velocity values were constantly compared against secondary derived sound speed values from the ship's onboard thermosalinograph flow-through system as a quality assurance measure.

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

Figure 2 shows the multibeam data processing workflow for this cruise. 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, and were imported into CARIS. In CARIS, attitude and navigation data stored in each file were checked, and erroneous soundings were manually removed using CARIS Swath Editor and Subset Editor. 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. Data cleaning projects were in UTM zone projections for the operations area. Final data products were exported and archived as field geographic WGS84 coordinate reference frame (i.e., unprojected).

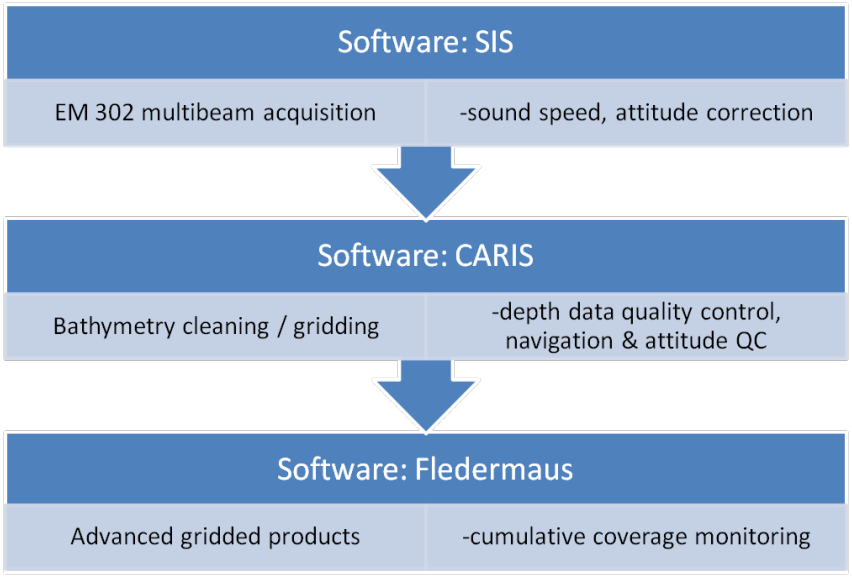


**Figure 2.** Shipboard multibeam data processing workflow.

## 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-11-02 project instructions, 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 (TRU)

*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 (TRU)
- Multibeam water column data review log if data were reviewed for presence of seeps in Fledermaus MidWater

All sonar data is permanently discoverable at https://www.ngdc.noaa.gov/

At the time of writing this report,

EM 302 water column data, supporting data, and informational logs are available in the NCEI Water Column Sonar Archives:

http://doi.org/10.7289/V5GH9FXH (last accessed 03/19/2020).

EM 302 bathymetry data, supporting informational logs, and ancillary files are available in the NCEI Data Archives accessible at https://maps.ngdc.noaa.gov/viewers/bathymetry/ (last accessed 03/19/2020).

## 10. Cruise Calendar

***All times listed are local ship time, -7 hours from UTC***

**April 2011**

| Sun | Mon | Tues | Wed | Thur | Fri | Sat |
|---|---|---|---|---|---|---|
| | | 19<br>Ship underway from San Diego, CA. | 20<br>First offshore ROV test dives conducted. | 21<br>ROV and camera platform deployed. USBL calibrated. | 22<br>ROV and camera platform deployed on Gull Island Canyon. | 23<br>ROV dive conducted. CTD cast conducted. Focused mapping operations completed over "10 story mystery". |
| 24<br>Mapping operations conducted south of the Channel Islands. | 25<br>ROV dive conducted. Limited mapping operations conducted. | 26<br>ROV dive conducted. | 27<br>ROV dive conducted. | 28<br>Ship alongside in San Diego. | | |

## 11. Daily Cruise Log Entries

***Generated from the daily expedition situation reports. All times listed are in local ship time (-7 hours from UTC)***

*April 19*
The ship got underway from San Diego at 1130 PDT. The first ROV dive is scheduled for tomorrow morning. No mapping operations were conducted.

*April 20*
*Little Hercules* and *Seirios* successfully completed their first offshore test dives. Evidence of a leak of non-toxic biodegradable oil was observed, and a SCUBA dive is planned for tomorrow to investigate. No mapping operations were conducted.

*April 21*
SCUBA dives were conducted on the ship's hull to investigate a potential oil leak. No evidence of a leak was detected. The ROV and camera platform were deployed, however the dive was called off due to a software glitch. The USBL was successfully calibrated. No mapping operations were conducted.

*April 22*
An ROV dive was conducted on Gull Island Canyon. No mapping operations were conducted.

*April 23*
An ROV dive and CTD cast were conducted to a depth of 4000 meters on a site to the west of the San Juan Seamount. A small survey was conducted over the "10 story mystery" to further investigate the anomaly. The anomaly was potentially detected in one of six lines collected during EX-11-01 and EX-11-02.

*April 24*
ROV dives were cancelled due to mechanical issues on both vehicles. Mapping data were collected to expand on existing data south of the Channel Islands. The CTD was relocated to the fantail to test an alternative setup if the J-Frame is unavailable.

*April 25*
Poor weather conditions in the morning delayed to ROV dive. Limited mapping operations were conducted south of the Channel Islands to fill in gaps in existing data.

*April 26*
An ROV dive was conducted on a site to the south of Santa Cruz Island to a depth of 900 meters. The vehicles were recovered early due to high winds. The multibeam and single beam sonars were synced.

*April 27*
The final ROV dive was conducted on a site south of Santa Cruz Island to a depth of 1100 meters. No mapping operations were conducted.

*April 28*
The ship arrived at Quay Wall North, Pier 8 at the San Diego Naval Base early this morning. A working dive was conducted in the afternoon to investigate a potential oil leak.

## 12. References

The 2011 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.

The EX-11-02 Project Instructions can be obtained from the NOAA Central Library. The EX-11-02 Data Management Plan is an appendix of the project instructions.


- Tozer, B. , D. T. Sandwell, W. H. F. Smith, C. Olson, J. R. Beale, and P. Wessel, Global bathymetry and topography at 15 arc seconds: SRTM15+, Accepted Earth and Space Science, August 3, 2019. https://doi.org/10.1029/2019EA000658
- NOAA Nautical Charts
- Various datasets downloaded from the NCEI archives via NOAA AutoChart.