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# Mapping Data Acquisition and Processing Summary Report

## EX-22-01: 2022 ROV and Mapping Shakedown (ROV and Mapping)

Gulf of Mexico

Pascagoula, Mississippi to Key West, Florida

February 23 - March 3, 2022

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# Introduction

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

Using the latest tools and technology, NOAA Ocean Exploration 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, NOAA Ocean Exploration 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, NOAA Ocean Exploration 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.

# Report Purpose

The purpose of this report is to briefly describe the acoustic seafloor, water column, and subseafloor mapping data collection and processing methods used by NOAA Ocean Exploration on NOAA Ship *Okeanos Explorer* during EX-22-01, and to present a summary of mapping results and mapping-related expedition activities. A separate report detailing the remotely operated vehicle activities of the expedition will be available through the NOAA Central Library.

A detailed description of Okeanos Explorer's mapping equipment and capabilities is available in the "NOAA Ship *Okeanos Explorer* Mapping Systems Readiness Report 2022" which is (or will be) archived in the NOAA Central Library[1].

For further information about general equipment calibration procedures, data acquisition, processing, reporting, and archiving, see the "NOAA Ocean Exploration Deepwater Exploration Mapping Procedures Manual V1", which is archived in the NOAA Central Library[2] and also available from the website.[3]

[1] https://doi.org/10.25923/g2ep-ae34

[2] https://doi.org/10.25923/jw71-ga98

[3] https://oceanexplorer.noaa.gov/data/publications/mapping-procedures.html

# Expedition Objectives

EX-22-01 focused on conducting a shakedown of the ROV and mapping systems onboard the NOAA Ship *Okeanos Explorer* in preparation for the 2022 field season. The expedition began in Pascagoula, MS on February 23 and concluded in Key West, FL on March 3, 2022.

The mapping related objectives of EX-22-01 were to assess the mission readiness of the mapping systems through annual testing and calibration, to integrate and evaluate the newly installed Kongsberg Seapath 380-R3 positioning system as an alternative to the Applanix POS/MV positioning system, and to provide mapping support to the ROV team. Operations included a GNSS Azimuth Measurement Subsystem (GAMS) test for the POS/MV, a dockside antenna calibration of the Seapath, separate patch tests utilizing each positioning system to determine the residual angular offsets from the installation and survey of the systems, RX array speed-noise testing, swath-coverage testing, and accuracy reference surveys conducted at 3,400 m with each positioning system. Results of the mission readiness testing are provided in the "NOAA Ship *Okeanos Explorer* Mapping Systems Readiness Report 2022"[1].

Southeastern U.S. Deep-sea Exploration, contributes to NOAA's Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE), a major multi-year, multi-national, collaborative ocean exploration program focused on raising our collective knowledge and understanding of the North Atlantic Ocean. Building on previous work in the North Atlantic, including the 2011-2014 Atlantic Canyons Undersea Mapping Expeditions (ACUMEN), NOAA's ASPIRE campaign will provide data to inform research planning and management decisions in the region, by broadening both the geographic focus to include more of the U.S. Atlantic and Canada, and the scope of partnerships to include U.S. federal agencies, such as U.S. Geological Survey (USGS) and Bureau of Ocean Energy Management (BOEM), as well as international partners from Canada and Europe.

The complete objectives for this expedition are detailed in "Project Instructions: EX-22-01 2022 ROV and Mapping Shakedown (ROV and Mapping)", which is archived in the NOAA Central Library[4].

[4] https://doi.org/10.25923/s6p4-bj55

# Operational Personnel

EX-22-01 included onboard operational personnel, inclusive of ship's force and mission team, who participated in operational execution, and shore-based personnel (who participated remotely via telepresence) (see **Tables 1** and **2**).

**Table 1.** EX-22-01 Onboard Personnel.

| Name | Role | Affiliation |
|---|---|---|
| Kimberly Galvez | Expedition Coordinator | NOAA Ocean Exploration[1] |
| Sam Candio | Mapping Lead | NOAA Ocean Exploration[2] |
| Thomas Morrow | Mapping Lead (training) | NOAA Ocean Exploration[1] |
| SST Charlie Wilkins | Senior Survey Technician | OMAO[3] |
| LT Bryan Pestone | Operations Officer | OMAO[3] |
| LTJG Hunter Brendel | Operations Officer (training) | OMAO[3] |
| Karl McLetchie | ROV Team Lead | GFOE[4] |
| Chris Ritter | ROV Engineer | GFOE[4] |
| Lars Murphy | ROV Engineer | GFOE[4] |
| Todd Gregory | ROV Engineer | GFOE[4] |
| Bobby Mohr | ROV Engineer | GFOE[4] |
| Andrew O'Brien | Data Engineer | GFOE[4] |
| Chris Wright | Data Engineer | GFOE[4] |
| Andy Lister | Data Engineer | GFOE[4] |

| | | |
|---|---|---|
| Mark Durbin | Data Engineer | GFOE[4] |
| Art Howard | Videographer | GFOE[4] |
| Bailey, Caitlin | Videographer | GFOE[4] |
| Brian, Roland | Video Engineer | GFOE[4] |
| Spalding, Evan | Engineering Intern | GFOE[4] |
| Allen, Jonathan | Engineering Intern | GFOE[4] |
| Albano, Trish | Internship Program Coordinator | NOAA Ocean Exploration[5] |
| Rabenold, Christa | O&E Web Coordinator | NOAA Ocean Exploration[6] |
| Lienesch, Anna | Sample Data Manager | NCEI |

**Table 2.** EX-22-01 Shore-based personnel.

| Name | Role | Affiliation |
|---|---|---|
| Kevin Jerram | Mapping Support | UCAR[6] |

[1]Fedwriters
[2]Science and Technology Corporation
[3]NOAA Office of Marine and Aviation Operations
[4]The Global Foundation for Ocean Exploration
[5]National Marine Sanctuary Foundation
[6]University Corporation for Atmospheric Research

# Summary of Mapping Operations

NOAA Ocean Exploration mapped 4,926 square kilometers (sq km) of seafloor during the 9 days at sea for EX-22-01, entirely in areas deeper than 200 meters (m) and within the U.S. Exclusive Economic Zone and Territorial Sea. Multibeam bathymetry data coverage is shown in Figure 1.

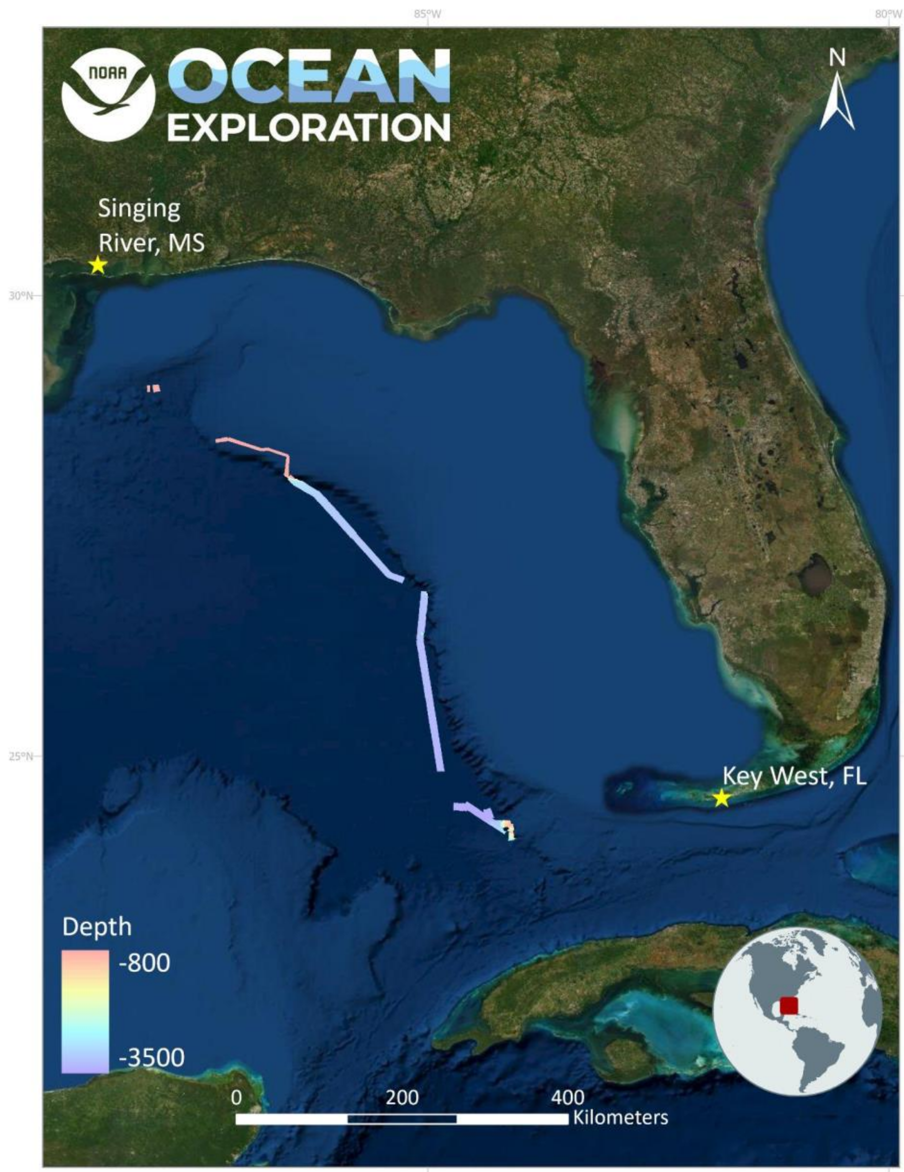


**Figure 1.** Overview of bathymetric mapping coverage completed during the 2022 ROV and Mapping Shakedown (EX-22-01).

# Mapping Statistics

**Table 3** provides summary statistics of ocean mapping work during EX-22-01, February 23 - March 03, 2022 (UTC).

**Table 3.** Summary statistics of ocean mapping work during EX-22-01.

| Statistic | Value |
|---|---|
| Ship's draft:<br>Start of expedition (02/23/2022)<br>End of expedition (03/03/2022) | <br>Fore: 16' 2.5''; Aft STBD: 16' 3"; Aft Port: 15' 11"<br>Fore: 15' 10.5"; Aft STBD: 16' 2"; Aft Port: 15' 8" |
| Linear kilometers of survey with EM 304 | 829 |
| Square kilometers mapped with EM 304 | 4,926 |
| Square kilometers mapped with EM 304 within U.S. waters deeper than 200 m | 4,926 |
| Number/data volume of EM 304 raw multibeam files (.kmall) | 78 files/9.71 GB |
| Number/data volume of EM 304 water column multibeam files (.kmwcd) | 78 files/21.9 GB |
| Number/data volume of EK60/EK80 water column split-beam files (.raw) | 52 files/9.26 GB |
| Number/data volume of sub-bottom sonar files (.segy, .kea, .keb) | 48/144 MB |
| Number of expendable bathythermograph (XBT) casts | 34 |
| Number of conductivity, temperature, depth profiler (CTD) casts (including test casts) | 0 |

# Mapping Sonar Setup

## Kongsberg EM 304 Multibeam Sonar

NOAA Ship *Okeanos Explorer* is equipped with a 26 kilohertz (kHz) Kongsberg EM 304 MKII multibeam sonar, capable of detecting the seafloor in up to 10,000 mof water and conducting productive mapping operations in up to 8,000 m of water. The nominal transmit (TX) alongtrack beamwidth is 0.5°, and the nominal receive (RX) acrosstrack beamwidth is 1.0°. The system generates a 140° beam fan (70° port/70° starboard maximum angles), containing 512 beams with up to 800 soundings per ping cycle when in high-density mode. In waters shallower than approximately 3,300 m the system is able to operate in dual-swath mode, where one nominal ping cycle includes two swaths, resulting in up to 1,600 soundings. The multibeam sonar is used to collect seafloor bathymetry, seafloor backscatter, and water column backscatter.

## Simrad EK60/EK80 Split-Beam Sonars

The ship is equipped with a suite of Simrad EK60/EK80 split-beam fisheries sonars: 18 kHz (EK60), 38 kHz (EK80), 70 kHz (EK80), 120 kHz (EK60), and 200 kHz (EK60). These systems are quantitative scientific echosounders 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. In 2019, the 38 and 70 kHz transceivers were replaced with broadband units (WBTs). WBTs use frequency modulation to acquire higher resolution water column data allowing for the detection of finer features, improved depth capability without loss of range resolution, and support of broadband frequency response of targets.

These sonars were calibrated during EX-21-01, and calibration values from that expedition were applied to the EK sonars for EX-22-01 and will continue to be applied until the next calibration scheduled for early in 2022. The "2021 EK60/EK80 Calibration Report" is available in the NOAA Central Library and the calibration files are included with the dataset of each expedition to which they are relevant.[5]

## Knudsen 3260 Sub-Bottom Profiler

The ship is equipped with a Knudsen 3260 sub-bottom profiler (SBP) 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

[5] https://doi.org/10.25923/v5kz-ge28

approximately 80 m below the seafloor. The sub-bottom profiler is operated to provide information about sub-seafloor stratigraphy and features.

## Teledyne Acoustic Doppler Current Profilers

Two acoustic Doppler current profilers (ADCPs), a Teledyne Workhorse Mariner (300 kHz) and a Teledyne Ocean Surveyor (38 kHz), are installed on the ship. Depending on environmental conditions, the 300 kHz system provides ocean current data to approximately 70 m deep, and the 38 kHz system provides data to approximately 1,200 m deep. The 38 kHz system is capable of collecting data in narrowband and broadband frequency ranges. The ADCPs gather data prior to remotely operated vehicle (ROV) and conductivity, temperature, depth profiler (CTD) deployments in order to assess currents in support of safe operations. The ADCPs are typically not run concurrently with the other sonars during mapping operations due to issues of interference.

# Data Acquisition Summary

Following port departure, data are typically collected with the ADCPs until the sea buoy is reached, at which point the ADCPs are secured. Then, data acquisition begins with the EM 304, EK60/EK80 (18, 38, 70, 120, and 200 kHz), and the Knudsen 3260 sub-bottom profiler, with these sonars running concurrently using a Kongsberg Synchronization Unit (K-Sync). During CTD and ROV operations, the EM 304 multibeam and Knudsen sub-bottom profiler are secured to allow for the 300 kHz ADCP and the entire suite of EK split-beam sonars to acquire data.

Multibeam survey lines are planned to maximize either edge-matching of existing bathymetric data or data gap filling in areas with existing bathymetric coverage. In regions with no existing data, lines are optimized for potential discoveries and to complete relatively large contiguous areas to support interpretation of features from bathymetry and backscatter.

Throughout the expedition, multibeam data quality was monitored in real time by acquisition watchstanders. Ship speed was adjusted to maintain data quality and sounding density as necessary, and line spacing was planned to ensure one-quarter to one-third swath-width overlap between lines, depending on the environmental conditions and impact on the quality of the outer swath regions. Angles were generally left open (70°/70°) during transits to maximize data collection and were adjusted on both the port and starboard sides to ensure the best data quality and coverage. If outer beams were returning obviously spurious soundings (e.g., due to attenuation or low grazing angle), beam angles were gradually reduced and monitored closely until a high-quality swath was obtained.

Real-time corrections to the data upon acquisition included: continuous application of surface sound speed obtained with a hull-mounted Reson SV-70 probe, application of water column sound speed profiles obtained with Sippican Deep Blue Expendable Bathythermographs (XBTs) and/or Seabird CTD 9/11, application of roll, pitch, and heave motion corrections obtained by either the POS MV 320 V5 or Seapath 320-R3 inertial position and orientation system (refer to the watch log to determine which system was the primary source used). No tidal corrections were applied to the raw or processed data. Sound speed profiles were conducted every four hours or more frequently as dictated by local oceanographic conditions (typically every two hours when operating near currents). Reson sound speed values were constantly compared against secondarily derived sound speed values from the ship's onboard thermosalinograph flow-through system as a quality assurance measure.

Simrad EK60/EK80 split-beam water column sonar data were collected throughout the majority of the expedition. Data were monitored in real time for quality but were not post-processed.

Knudsen 3260 sub-bottom profiler data were also collected during the majority of the expedition.

# Multibeam Sonar Bathymetric Data Processing and Quality Assessment

The bathymetry data were generated using a Kongsberg EM 304 MKII multibeam system, and recorded using Kongsberg's Seafloor Information System (SIS) software as *.kmall files. Collocated to the bathymetric data, bottom backscatter data were collected and stored within the *.kmall files, both as beam averaged backscatter values, and as full time series values (snippets) within each beam. Water column backscatter data were recorded separately within *.kmwcd files.

The full-resolution multibeam .kmall files (Level-00 data) were imported into QPS Qimera, and then processed and cleaned of noise and artifacts. Outlier soundings were removed using multiple methods including automatic filtering and/or manual cleaning with the swath and subset editing tools. The default sound speed scheduling method used was "Nearest-in-Time." If another method was implemented, it will be noted in the associated log. Gridded digital terrain models were created using the weighted moving average algorithm and were exported in multiple formats using QPS Fledermaus software. Daily bathymetric surfaces were created and sent to shore. **Figure 2** shows the onboard multibeam data processing workflow.

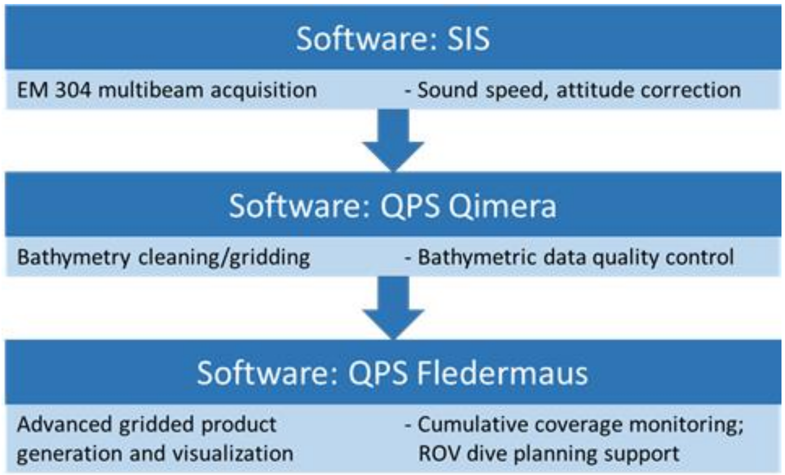


**Figure 2.** Shipboard multibeam data processing workflow.

On shore, the Mapping Team performed a final quality check of the data using QPS Qimera and Fledermaus software. This involved additional fine cleaning of soundings and minimization of residual artifacts from sound speed biases and field-cleaning errors. Depth values were compared from orthogonal lines (crosslines) to evaluate the consistency of the multibeam sonar data collected during the expedition.

A crossline analysis was completed using the Crosscheck Tool in QPS Qimera software to evaluate the data against the Order 1 S-44 standards set by the International Hydrographic Organization (IHO, 2008).

Each line of cleaned full resolution data was exported to a *.gsf file (Level-01 data). The processed and cleaned files were used to create a static surface in QPS Qimera. This final surface was re-projected into the field geographic WGS84 reference frame in QPS Fledermaus software and saved as a .sd file for archiving. Using QPS Fledermaus, this *.sd bathymetric grid file was then exported into ASCII XYZ text file (*.xyz), color *.tif, floating point *.tif, and Google Earth *.kmz file formats. The *.gsf files were used to create daily backscatter mosaics using QPS FMGT. All products maintain horizontal referencing to WGS84 (G1762) and vertical referencing to the assumed mean waterline. There is a complete accounting of each individually archived multibeam data file and of each bathymetric surface product in the multibeam data acquisition and processing logs archived with the dataset.

# Crossline Analysis

A crossline was run on March 1, 2022, as shown in **Figure 3.** and the results are presented in **Table 4**.

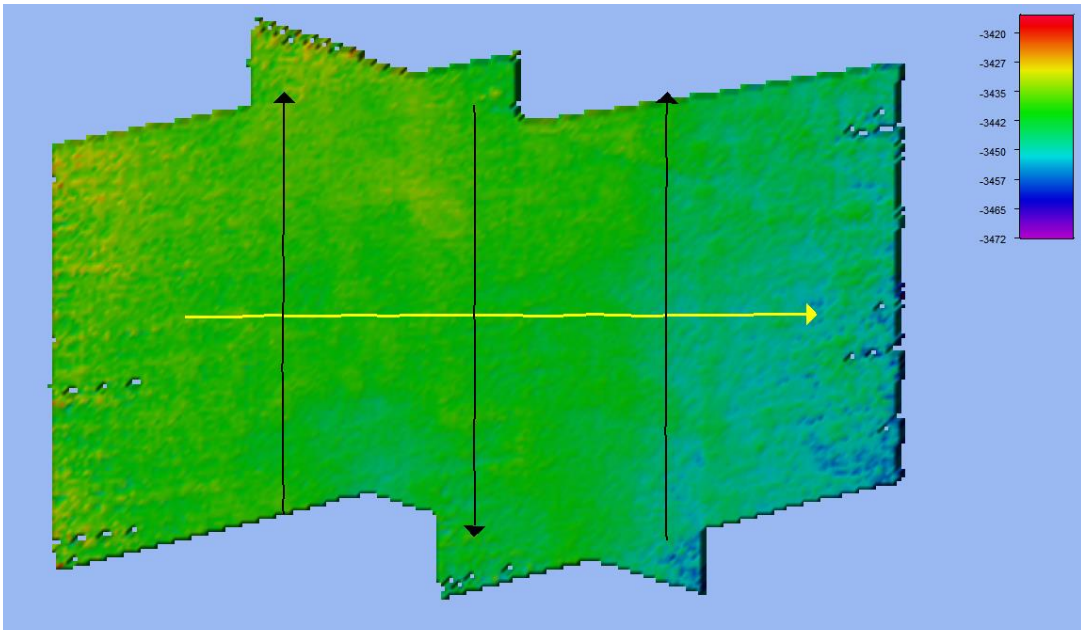


**Figure 3.** EX-22-01 crossline (shown in yellow) used for comparison against the bathymetric grid generated via orthogonal multibeam survey lines.

Crossline file: 0052_20220301_002342_EX2201_MB.kmall

Mainscheme line files:

- 0056_20220301_044333_EX2201_MB.kmall
- 0057_20220301_054327_EX2201_MB.kmall
- 0060_20220301_084143_EX2201_MB.kmall

**Table 4.** Crosscheck results.

| Statistic | Value |
|---|---|
| Number of points of comparison | 266,550 |
| Grid cell size (m) | 75 |
| Difference mean (m) | -0.061 |
| Difference median (m) | -0.284 |
| Difference standard deviation (m) | 4.68 |
| Difference range (m) | [-28.47, 34.37] |
| Mean + 2* standard deviation (m) | 9.974 |
| Median + 2* standard deviation (m) | 9.645 |
| Data mean (m) | -3442.129 |
| Reference mean (m) | -3441.516 |
| Data z-range (m) | [-3474.89, -3410.01] |
| Reference z-range (m) | [-3457.44, -3428.48] |
| Order 1 error limit (m) | 44.743 |
| Order 1 # rejected | 0 |
| Order 1 p-statistic | 0.000 |
| Order 1 survey | ACCEPTED |

These results confirm that the data collected meet International Hydrographic Organization Order 1 specifications for data quality.

# Acquisition and Processing Software

**Table 5** provides a list of the acquisition and processing software versions that were used during EX-22-01.

**Table 5.** Versions of acquisition and processing software used during EX-22-01.

| Software | Purpose | Version |
|---|---|---|
| SIS | EM 304 | 5.7.0 |
| EK80 | EK suite | 21.15 |
| EchoControl | Knudsen | 4.09 |
| UHDAS | ADCPs | 14.04 |
| AMVERSEAS | Autolaunch XBT | 9.3 |
| WinMK22 | XBT | 3.0.2 |
| K-Sync | Synchronization | 1.9.0 |
| Qimera | Bathymetry | 2.3.4 |
| FMGT | Backscatter | 7.9.5 |
| FMMidwater | Water Column | 7.9.3 |
| Sound Speed Manager | Sound Velocity Profiles | 2022.1.6 |
| NRCan (SegJp2) | Sub-bottom | 1.0 |
| Fledermaus 7 | Visualization/Data Analysis | 7.8.11 |

# Data Archiving Procedures

All mapping data collected by NOAA Ocean Exploration on *Okeanos Explorer* are archived and publicly available within 90 days of the end of each expedition 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 expedition) is available as an appendix in the "Project Instructions: EX-22-01 2022 ROV and Mapping Shakedown (ROV and Mapping", which is archived in the NOAA Central Library. For each data type, raw data (Level 00), processed data (Level 01), derived products (Level 02), and ancillary files may be available, depending on the dataset and the level of staffing for the expedition. **Tables 6-10** describe the data archived for each dataset. For further information about proprietary software and freeware that can handle the varying data types, refer to the "NOAA OER Deepwater Exploration Mapping Procedures Manual."

**Table 6.** EM 304 bathymetry and seabed backscatter dataset.

| Level | Description | File Type |
| --- | --- | --- |
| Level 00 | Raw multibeam files (in native sonar format) that include both raw bathymetry and backscatter (horizontal referencing = WGS84) | .kmall |
| Level 01 | Processed multibeam files in generic sensor format that include bathymetry and backscatter (horizontal referencing = WGS84) | .gsf |
| Level 02 | Gridded multibeam data and backscatter mosaics (horizontal referencing = WGS84) | .xyz, .tif, .tif (floating point GeoTIFF, .kmz, .sd, .scene |
| Ancillary files | Mapping watchstander log, weather log, sound speed profile log, multibeam acquisition and processing log, backscatter correction file, built-in self test logs, processing unit parameters, telnet session records | .xlsm, .xlsx, .txt |

**Table 7.** EM 304 water column backscatter dataset.

| Level | Description | File Type |
| --- | --- | --- |
| Level 00 | Raw multibeam files (in native sonar format) that include water column | .kmwcd |

| | | |
|---|---|---|
| | backscatter (horizontal referencing = WGS84) | |
| Level 01 | n/a | n/a |
| Level 02 | QPS Fledermaus objects such as beam fan, beam line, volume and/or track line; produced if time and staffing allows (horizontal referencing = WGS84) | .sd, .scene |
| Ancillary files | Mapping watchstander log, weather log, sound speed profile log, multibeam acquisition and processing log, water column data log, built-in self test logs, processing unit parameters, recorded telnet sessions | .xlsm, .xlsx, .txt |

**Table 8.** EK60/EK80 split-beam echosounder dataset.

| Level | Description | File Type |
|---|---|---|
| Level 00 | Raw water column files provided in native sensor format (horizontal referencing = WGS84) | .raw, .idx |
| Level 01 | n/a | n/a |
| Level 02 | n/a | n/a |
| Ancillary files | Mapping watchstander log, weather log, EK data log, EK calibration report, calibration files and the raw files used for calibration | .xlsm, .xlsx, .txt, .pdf, .xml, .raw, .idx |

**Table 9.** Knudsen 3260 sub-bottom profiler dataset.

| Level | Description | File Type |
|---|---|---|
| Level 00 | Raw sub-bottom files provided in native sonar format (horizontal referencing = WGS84) | .sgy, .kea, .keb |
| Level 01 | Raw sub-bottom files converted to images and shapefiles of the tracklines; produced as time and staffing levels allow | .jpg, .shp |

| | | |
|---|---|---|
| Level 02 | n/a | n/a |
| Ancillary files | Mapping watchstander log, weather log, sub-bottom profiler data log | .xlsm, .xlsx |

**Table 10.** Sound speed profiles dataset.

| Level | Description | File Type |
|---|---|---|
| Level 00 | Raw profile data for any XBT or CTD cast | .txt, .hex, .cnv |
| Level 01 | Processed sound speed profiles created for multibeam data acquisition | .asvp |
| Level 02 | n/a | n/a |
| Ancillary Files | Mapping watchstander log, sound speed profile log, profile locations as a shapefile and in Google Earth format, any associated calibration files | .xlsm, .xlsx, .shp, .kml, .cal, .xml, .pdf |

All sonar data is permanently discoverable within the NCEI archives[6] and searchable through the Ocean Exploration Digital Atlas,[7] which provides access to all of the data collected during an expedition. The locations for specific data types (at the time of writing this report) are detailed in **Table 11**. For any challenges accessing data, send an inquiry to NCEI,[8] or contact the Ocean Exploration Mapping Team.[9]

6 https://www.ngdc.noaa.gov/
7 https://www.ncei.noaa.gov/maps/oer-digital-atlas/mapsOE.htm
8 ncei.info@noaa.gov
9 oar.oer.exmappingteam@noaa.gov

**Table 11.** Locations of data collected during EX-22-01 (at the time of writing this report).

| Data Type | Description | Location |
|---|---|---|
| EM 304 bathymetry and backscatter data | EM 304 bathymetric and backscatter data, supporting informational logs, and ancillary files are available through the NCEI Bathymetry Data Viewer | https://www.ncei.noaa.gov/maps/bathymetry/<br><br>Request raw sonar data (Kmalls) from ncei.info@noaa.gov with oer.info.mgmt@noaa.gov cc'd<br><br>POSPac and BS correction files can be requested from oar.oer.exmappingteam@noaa.gov |
| Water column data (EM 304 and EK60/EK80) | EM 304 and EK60/EK80 water column data, supporting data, and informational logs are available through the NCEI Water Column Sonar Data Viewer | https://www.ngdc.noaa.gov/maps/water_column_sonar/index.html |
| Knudsen 3260 sub-bottom profiler data | Sub-bottom data, supporting data, and informational logs are available in the NCEI data archives | https://www.ncei.noaa.gov/maps/trackline-geophysics/ |
| Sound speed profiles | Ancillary sound speed profiles are available along with all mapping data per expedition in the NCEI data archives, or within the oceanographic archive for the expedition. | https://www.ncei.noaa.gov/maps/bathymetry/<br>or through the oceanographic archives at:<br>https://www.ncei.noaa.gov/ |
| Reports | Reports are archived in the NOAA Central Library's Ocean Exploration Program (OEP) institutional repository | NOAA Central Library home:<br>https://library.noaa.gov/<br>OEP institutional repository:<br>https://repository.library.noaa.gov/cbrowse?pid=noaa%3A4&parentId=noaa%3A4 |

# Expedition Schedule

**Table 12.** EX-22-01 schedule.

| Date (UTC) | Activity |
|---|---|
| 2/22 | Mission personnel arrived in Pascagoula, MS. Mobilization began. |
| 2/23 | Ship got underway at 0930. Positional testing of Applanix POS MV and Seapath Systems. GAMS calibration conducted. Patch test initiated. |
| 2/24 | Dive 01. Patch test continued. Transit mapping to Dive 02. |
| 2/25 | Dive 02.  RX speed/noise testing. Transit mapping to Dive 03. |
| 2/26 | Dive 03. Transit mapping to Dive 04. |
| 2/27 | Dive 04. Further RX noise testing. Transit mapping to Dive 05. |
| 2/28 | Dive 05. 3,400 m reference surface. Transit mapping to Dive 06. |
| 3/1 | Dive 06. Mapping operations over Dive 07 site. Deep roll verification. |
| 3/2 | Dive 07. ADCP transects over the loop current. |
| 3/3 | Arrival in Key West. |

# References


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# Appendix A: Daily Log Entries

The following entries were excerpted from each of the daily expedition situation reports provided by the onboard team to the onshore support team, and therefore are somewhat informal in language. These are included to provide situational awareness for future users of the data collected during this expedition. All times are in local ship time (-5 hours from UTC).

## February 22

The mapping lead joined the ship's complement and began mobilization. Initial runthrough of sonar configurations and offsets completed. Familiarization/refamiliarization of onboard systems.

## February 23

The ship got underway at 0930 from Singing River, MS. During the initial transit out, scientists from the University of Southern Mississippi used a laser ranging system to do positional testing of the outputs generated by the POS MV and the newly installed Seapath positioning/attitude system. GAMS calibration conducted. Patch test initiated over the Pascagoula Dome.

## February 24

The POS/MV positioned patch test was completed. Preliminary results appear to suggest only minor adjustments to the previously determined angular offsets (if any), indicating no significant changes in the system geometry. This pleased the onboard mappers.

Team survey continued to work with GFOE to shake out downstream effects of the network configuration changes initiated to integrate the SeaPath system. These changes had adverse effects on the ADCPs, which prevented the generation of the plots within the UHDAS ADCP acquisition software. This displeased everyone involved. The issues were ultimately resolved through correspondence with UHDAS. Levels of displeasure were abated.

The SeaPath positioned patch test began at approximately 1930 CST on the Pascagoula Dome site, and continued through the night. Weather and sea conditions were good, and data quality was high. This pleased the onboard mappers.

## February 25

The SeaPath enabled patch test was completed prior to transiting to the second dive site. Preliminary results indicate a successful integration with small-magnitude angular offsets, and measured offsets appear to be largely correct. A quick comparison surface was generated between the SeaPath and POS patch test data to ensure that no major funny business was experienced between the two systems. They appeared to be in good agreement, and a more formal set of reference survey data collection was planned for later in the cruise. S

Following the dive, RX speed-noise testing was conducted as the ship slowly increased speed from a drift up to max RPMs. The results were assessed via Multibeam Advisory Council tools by the Mapping Lead overnight.

The update to the EK80 software provided a host of challenges, which were resolved thanks in large part to the SST communicating with Kongsberg/SIMRAD technicians ashore. The EKs were fully functional and happily pinging away.

KSync functionality was established with all sonar systems with no major headaches. Potential testing of refinement of synchronization schemes may be worked into overnight transit plans as time/bandwidth allows.

The transit line to the Dive 03 site was adjusted to edge map existing coverage northeast of the Florida Escarpment due to an unexpected surplus of mapping time prior to the dive.

Held thought-provoking discussions on alternate colormaps for bathymetry visualization to increase scientific interpretation and accessibility/inclusivity.

# February 26

Transit mapping sandwiched Dive 03, including data collection in deeper water off the Florida Escarpment. Both transits included brief periods of data collection over areas without previous bathymetric data, getting the exploration juices flowing. Weather conditions remain good, and data quality is high.

Shortly before securing mapping operations in anticipation of reaching Dive 04, the Seapath positioning system lost its ability to position our systems. This failure to receive satellite corrections was resolved by restarting the system, and it slowly came back online. During this time the POS/MV was the primary system used for positioning/attitude, and suffered no such dropouts.

The mapping team aboard settled into a more standard mode of operations, shaking out the acquisition and processing procedures to get into a nice rhythm that can be carried on through EX-22-02 and beyond.

## February 27

Transit mapping continued en route to Dive 04, with data collection by the entire suite of sonars. Prior to arrival, some further RX noise testing was conducted to assess the noise floor of the ship with all sonars secured.

Following the dive the ship resumed transit mapping towards Dive 05. The EM 304 was less than pleased upon startup, and a BIST determined failures of the TX unit test and TX channels. A reset of the system including a reset of the breakers resolved the issue, and data acquisition recommenced. The magic of cycling power struck again.

Periodic failures of tubes on the AOML AXBT Autolauncher had been occurring, and a log was started to document any trends to report back to AOML. While occasional failures are not uncommon due to various reasons, this unit was serviced during the repair period and documenting any recurrent failures may be valuable feedback to AOML.

## February 28

Transit mapping continued southward towards Dive 05. Since the location of this dive site could be flexible, the bathymetry west of the Florida Escarpment in this area is relatively homogeneous, and there was some uncertainty with the currents in the area, the mission team opted to transit as far as possible while monitoring the current conditions to determine the location of the dive site. All sonars were secured at ~0500 and the ADCP was energized to assess the magnitude of the currents while continuing in the direction of the deep reference surface area. Ultimately conditions allowed for the dive to occur within a one hour transit of the reference survey site, which was greatly appreciated by the mapping team.

Immediately prior to the drift test, the OS38 ADCP had a brief failure that was resolved by restarting the transducers within the UHDAS software. While it appears that this was just a small hiccup in the system, the mapping team will be monitoring the health of this newly replaced transducer to ensure there are no larger issues.

Multibeam data acquisition on the 3,400m reference survey site utilized during EX-21-01 was initiated after a brief transit from Dive 05. This year's survey consists of reciprocal lines, alternating the positioning/attitude system between the Seapath and the POS/MV. These data should provide a good comparison between prior data collected by the EM 304 MKII, data collected using the Seapath as the primary positioning system, and data collected using the POS/MV as the primary positioning system. It also provided the mapping team with multiple opportunities to switch back and forth between the two positioning/attitude systems to assess how this is handled by the acquisition software and find any kinks in the transition procedure.

While running the reference survey, the mapping team sat with the Internship Program Coordinator to start giving a run-down and demonstrations of the expectations/responsibilities of EiT's while underway. This hands-on experience should hopefully prove to be valuable in the selection of and communication with future applicants, and it allowed the mapping team to start thinking about how to effectively communicate with incoming EiTs and answer questions they will likely have.

## March 1

The 3,400 meter reference surfaces were completed at ~0930 UTC, and the transit to Dive 06 commenced. There was a considerable amount of current in the area, however sound velocity conditions remained relatively constant and the bridge team was able to handle the resultant ship's set well. To maximize efficiency in the collection of the reference surface data, reciprocal lines were run and the positioning/attitude systems were swapped for each line. This also served as a good test of the process of switching between the two systems, and was designed to see what kind of stress this placed on the SIS acquisition software. The mapping team experienced no major hangups in this procedure, and the preliminary data evaluation showed good agreement between the two surfaces generated from these data. This sparked much joy.

Following the ROV dive the mapping team set out to complete a number of objectives in the general vicinity, as Dive 07 is planned to be in close proximity to Dive 06. The first objective was to remap the ridge where Dive 07 aims to explore, to somewhat simulate the process of a map-and-dive as a training opportunity/refresher. This also provided a little more confidence in the bathymetry associated with the dive site. More joy was sparked.

The ship then transited a short distance to the most gradually sloping section of the Florida Escarpment in the area to collect swath coverage data while transiting into deeper water. Once in the deeper, generally flat area west of the escarpment, mapping operations focused on the collection of data to be used in a deep-roll comparison to verify the offsets determined during the patch tests. Tune in tomorrow to see if joy sparking will continue as further objectives are completed prior to Dive 07.

## March 2

Following the completion of the two sets of reciprocal lines - one with each positioning system set as the primary - used for roll verification in deep(er) water, further testing of the RX noise was conducted. The ship then collected data transiting back up the Florida Escarpment en route to Dive 07.

Prior to the dive the WH300 ADCP experienced a failure on startup. After multiple attempts at restarting various parts of the system, digging deeply into the UHDAS documentations, and asking really, really nicely for it to work, the mapping lead and dive supervisor determined it was likely a cabling issue and had to throw in the towel and await assistance from the technicians in Hawaii. The UHDAS technicians came to the same hypothesis when they awoke, however the WH300 came back on line at ~1400 and was operational for the ROV recovery. The mapping lead plans to work with the CET and SST to ensure all connections are secure and there are no apparent issues with the cables during the inport.

Following the dive, the mapping team decided to run both ADCPs in transects across the predicted axis of the loop current to collect data and see if any further issues were experienced with the WH300. No issues were apparent, and the team still plans to check the physical connections while in Key West.

## March 3

All sonars were secured prior to reaching the sea buoy. Data were QC'd and moved off the network. The ship arrived in Key West, FL at 0900.