



MAPPING DATA ACQUISITION AND PROCESSING SUMMARY REPORT

EX-19-07: 2019 Southeastern U.S. Deep-sea Exploration (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.



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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) and mapping expedition EX-19-07, 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 2019 NOAA Ship *Okeanos Explorer* Survey Readiness Report, available in the NOAA Central Library. A separate cruise report detailing the ROV activities of the cruise will be available in the NOAA Central Library.

3. Cruise Objectives

EX-19-07, 2019 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 North Atlantic Ocean plays a pivotal role to humankind, providing biological and geological resources, ecosystem services such as seafood production and climate regulation, and a route for trade and travel between Europe and the Americas. With the signing of the Galway Statement on Atlantic Ocean Cooperation by The European Union, Canada and the U.S., and the Atlantic Ocean Research Alliance's deep-sea science and exploration efforts, there is significant momentum within the international community to cooperate on integrated exploration and research of the North Atlantic Ocean.

EX-19-07 departed from Miami, Florida on October 31, 2019 and arrived in Key West, Florida on November 20, 2019, for a total of 21 days-at-sea. EX-19-07 operations mainly occurred in waters deeper than 200 meters (m) on the Blake Plateau of the Southeastern Coast of the U.S. for the first ~15 days of the cruise, which were followed by exploring the Straits of Florida. Mapping operations generally occurred overnight, utilizing the time in between ROV dives, unless ROV dives were not feasible due to prevailing conditions, in which case mapping occurred 24-hours per day. The complete objectives for this cruise are detailed in the EX-19-07 Project Instructions, which are archived in the NOAA Central Library.

4. Summary of Mapping Results

EX-19-07 collected 12,758 square kilometers (3719 square nautical miles) and 3972 linear kilometers of bathymetry and associated water column data. 11,829 square kilometers of this area were within the U.S. Exclusive Economic Zone (EEZ) in depths greater than 200 meter (Table 1). Multibeam bathymetry data coverage is shown in Figure 1.

Cruise Overview Map

EX-19-07 Bathymetry

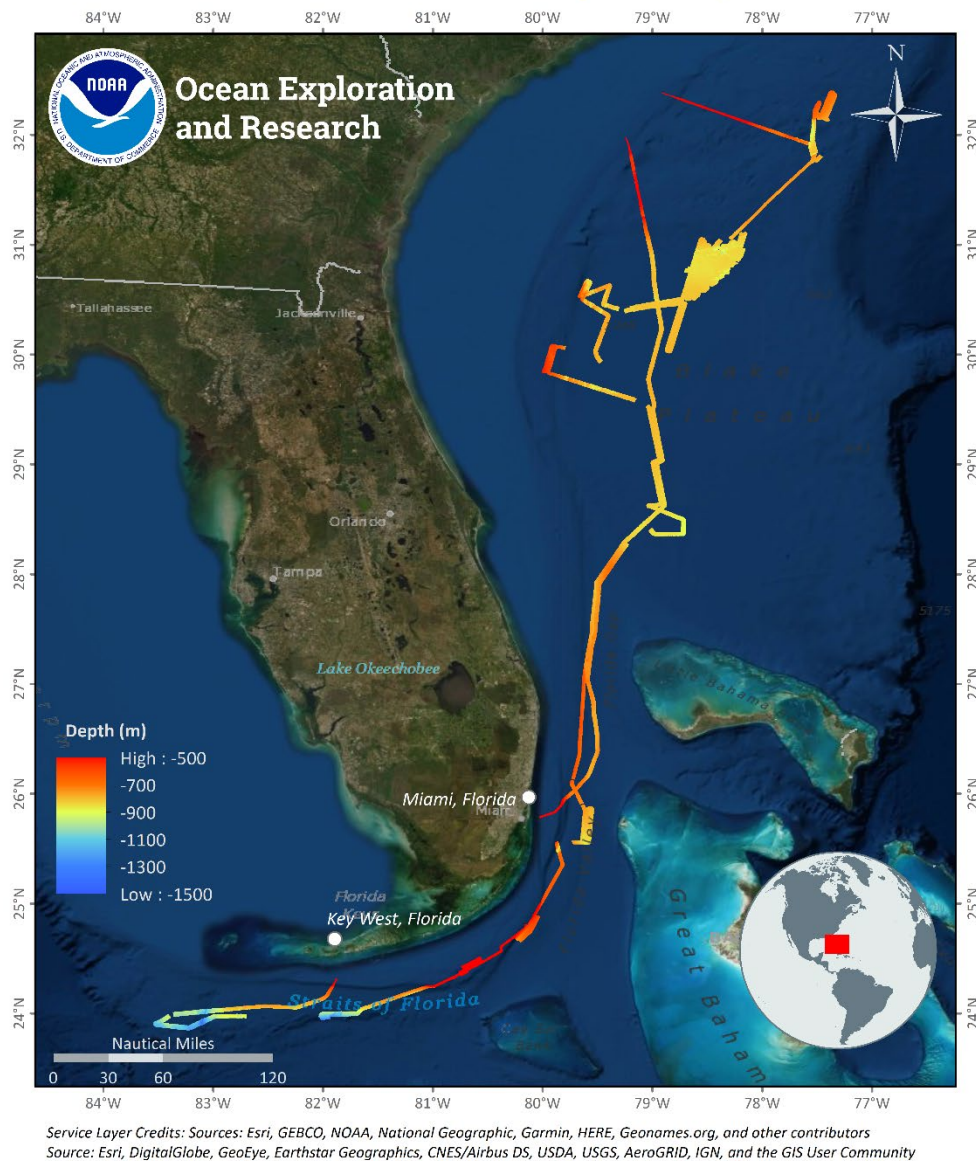


Figure 1. Overview map showing bathymetry mapping coverage completed during the 2019 Southeastern U.S. Deep-sea Exploration (EX-19-07). Map created by NOAA Office of Ocean Exploration and Research (NOAA-OER), generated in ArcMap.

5. Mapping Statistics

Table 1. Summary statistics of ocean mapping work completed during EX-19-07.

Dates of cruise	October 31 - November 20, 2019
Ship's draft Start of cruise (10/31/2019) End of cruise (11/20/2019)	Fore: 15' 2", Aft STBD: 14' 3.0" Fore: 14' 6.0"; Aft STBD: 14' 6.5"
Linear kilometers of survey with EM 302	3,972
Square kilometers mapped with EM 302	12,758
Square kilometers mapped with EM 302 in the US EEZ and deeper than 200 meters	11,829
Number / Data Volume of EM 302 raw bathymetric / bottom backscatter multibeam files (.all)	412 files / 35.4 GB
Number / Data Volume of EM 302 water column multibeam files	412 files / 62.3 GB
Number / Data Volume of EK 60 water column split beam files (.raw)	255 / 40 GB
Number / Data Volume of sub-bottom sonar files (.segy, .kea, .keb)	515 / 2.7 GB
Number of XBT casts	105
Number of CTD casts (including test casts)	0



6. Mapping Sonar Setup

Kongsberg EM 302 Multibeam Sonar

The NOAA Ship *Okeanos Explorer* is equipped with a 30 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 less than 3300 meters, the system is operated in multi-ping, or dual swath mode, and obtains up to 864 soundings per ping, by detecting two swaths per ping cycle. The multibeam sonar is used to collect seafloor bathymetry, seafloor backscatter, and water column backscatter. Backscatter represents the strength of the acoustic signal reflected from a target, such as the seafloor or bubbles in the water column. The system is patch tested annually and the results are reported in the annual readiness report. The 2019 NOAA Ship *Okeanos Explorer* Mapping Systems Readiness Report is available in the NOAA Central Library.

Simrad EK 60 Split-beam Sonars

The ship operated four Simrad EK 60 / EK 80 split-beam fisheries sonars: 18 kHz (EK 60), 70 kHz (EK 80), 120 kHz (EK 60), and 200 kHz (EK 60). These sonars 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. These sonars were calibrated on the EX-19-02 cruise, and calibration values from that cruise were applied to the EK sonars for EX-19-07. The 2019 EK 60 & EK Calibration Report (<https://doi.org/10.25923/wzk7-6d52>) is available in the NOAA Central Library. The 70 kHz is capable of operating in narrowband or wideband mode with a frequency modulated ping. The ship also has a 38 kHz EK 80 transducer, but it is in need of replacement and was not operated during this cruise.

Knudsen 3260 Sub-bottom Profiler

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

Teledyne ADCPs

The ship utilizes a 38 kHz Teledyne RDI Ocean Surveyor Acoustic Doppler Current Profiler (ADCP), with a ~1000 meter range; and a 300 kHz Teledyne RDI Workhorse Mariner ADCP, with a ~70 meter range. The ADCPs gather data prior to ROV deployments in order to assess currents at the dive site in support of safe



operations. They are kept running throughout the ROV dives. The ADCPs are typically not run concurrently with the other sonars while transiting due to interference issues.

7. Data Acquisition Summary

Mapping operations included EM 302 multibeam sonar, EK 60/80 split-beam (18, 70, 120, and 200 kHz) sonars, and Knudsen 3260 sub-bottom profile data collection. During ROV dives acoustic data were collected with the EK 60/80s and the ADCPs.

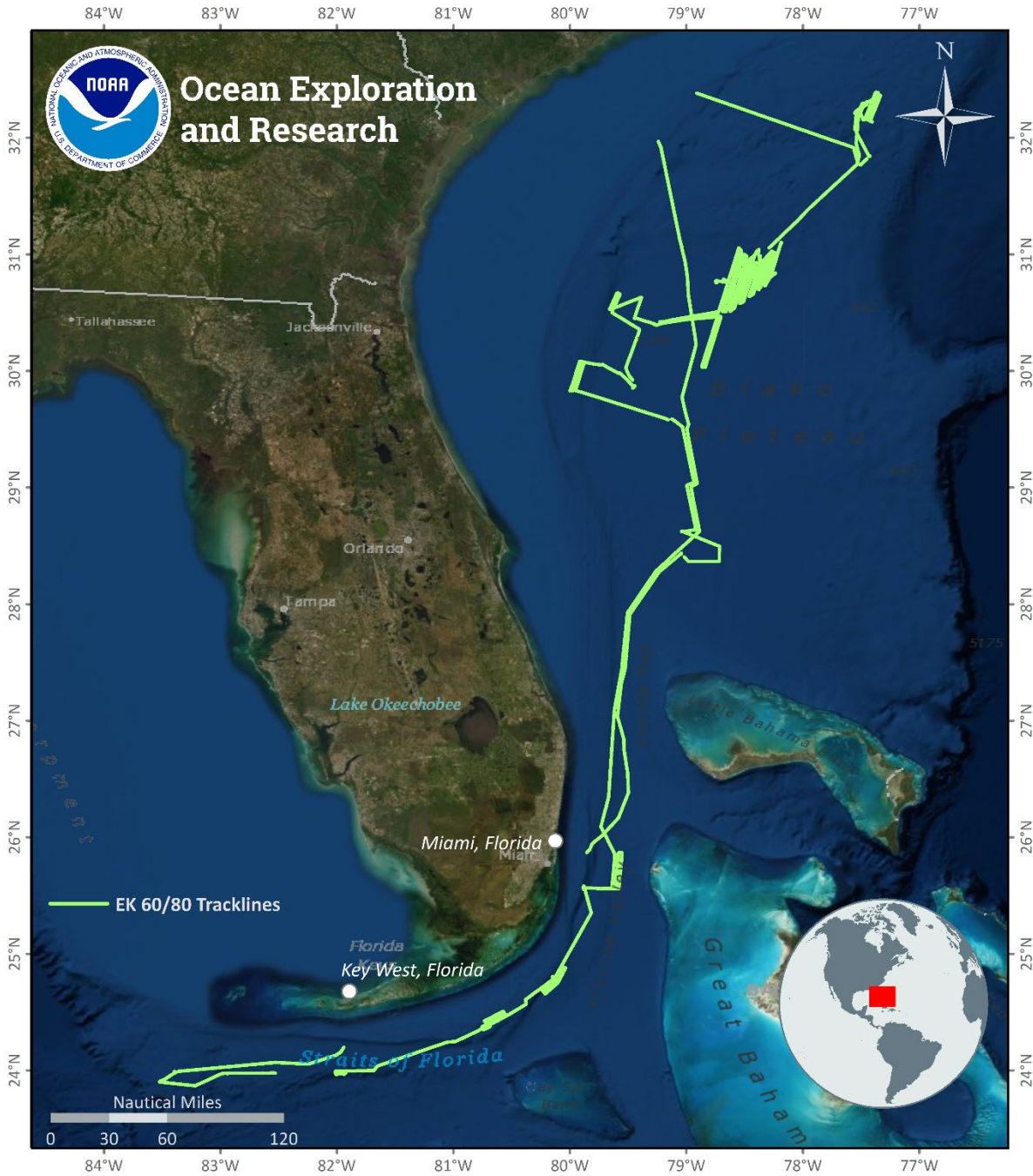
Survey lines were planned to maximize either bathymetry edge matching of existing data or data gap filling in areas where existing bathymetry coverage existed. In regions with no existing data, lines were planned to optimize potential exploration discoveries.

Throughout the cruise multibeam data quality was monitored in real time by acquisition 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 Acquisition 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. Data were corrected for sound velocity in real time using the Reson SVP-70 data at the sonar head, and profiles from Expendable Bathythermographs (XBTs) that were conducted at intervals no greater than 6 hours, or as dictated by local oceanographic conditions (typically around every 2 hours in this region).

Simrad EK 60/80 split-beam water column sonar data were collected during the entire cruise (Figure 2). Primarily the EK 80 70 kHz was run in broadband mode when shallower than 800 meters, which was the majority of the cruise, and in narrowband mode when deeper than 800 meters.

Knudsen 3260 sub-bottom profiler data were also collected during the majority of the cruise. Figure 3 shows where sub-bottom data were collected during EX-19-07.

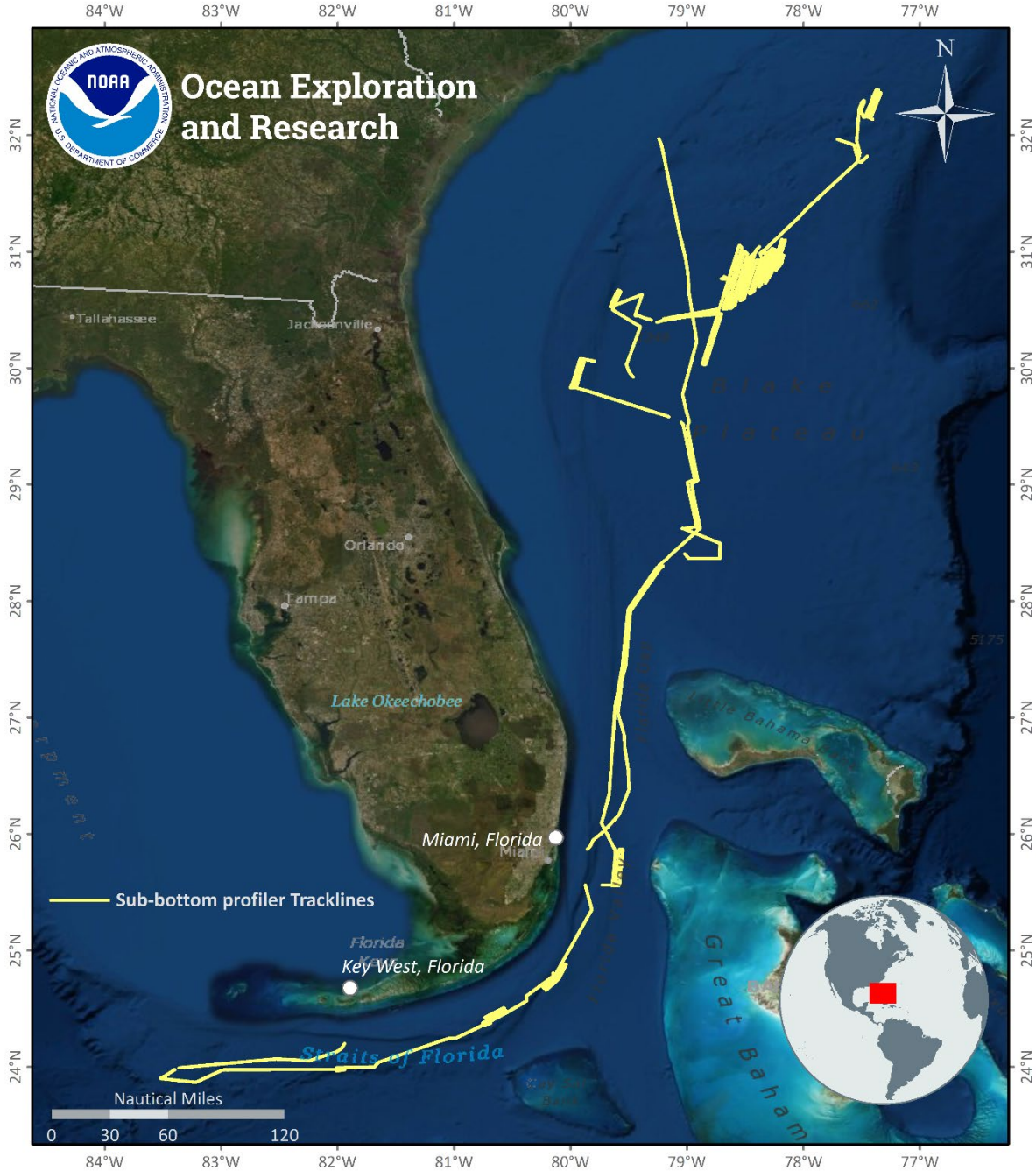
EX-19-07 EK Tracklines



Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 2. Overview showing tracklines of Simrad EK 60/80 split-beam sonar data (in green) collected during the first leg of the 2019 Southeastern U.S. Deep-sea exploration expedition (EX-19-07). Map created by NOAA Office of Ocean Exploration and Research (NOAA-OER), generated in ArcMap.

EX-19-07 Sub-bottom Tracklines



Service Layer Credits: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 3. Overview showing tracklines of Knudsen sub-bottom profiler data (in yellow) collected during the first leg of the 2019 Southeastern U.S. Deep-sea exploration expedition (EX-19-07). Map created by NOAA Office of Ocean Exploration and Research (NOAA-OER), generated in ArcMap.

8. Multibeam Sonar Data Quality Assessment and Data Processing

EM 302 Built-in Self Tests (BISTs) were run throughout the cruise to monitor multibeam sonar system status and are available as ancillary files in the sonar data archives. Raw multibeam bathymetry data files were acquired by SIS, then imported into QPS Qimera for processing the multibeam sonar data. In Qimera, attitude and navigation data stored in each file were checked, and erroneous soundings were removed using 2-D and 3-D editors. Gridded digital terrain models were created and posted to the ship's ftp site for daily transfer to shore. Final bathymetry QC was completed post-cruise onshore at the Center for Coastal and Ocean Mapping at the University of New Hampshire.

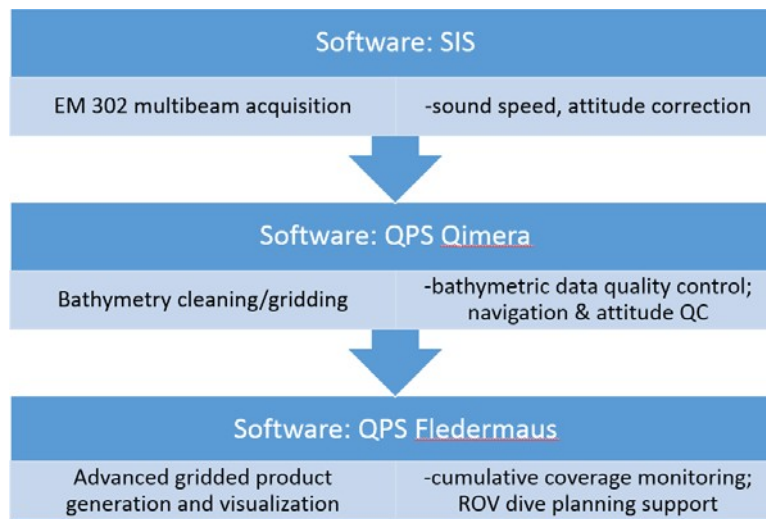


Figure 4. Shipboard multibeam data flow.

Crosslines

Comparing depth values from orthogonal survey lines is a standard hydrographic quality control measure to evaluate the consistency of the multibeam sonar data being collected during a cruise. Crossline analysis was conducted on data collected during EX-19-07 using the Cross Check Tool in QPS Qimera software (Figure 4). Mainscheme lines used for this analysis was 0148_20191108_072545_EX1907_MB.all and the crossline was 0153_20191108_140025_EX1907_MB.all. This check was conducted in an area with variable sound velocity and during very poor weather conditions, therefore, this analysis is conducting on data during challenging survey conditions. The results from the crossline comparison are in the table below (See Table 2). These results show that, even with the effect of the highly dynamic oceanographic conditions and poor weather experienced during EX-19-07, the data collected still meets International Hydrographic Organization (IHO) Order 2 data quality requirements.

Table 2. Statistics provided from QPS Qimera software Cross Check Tool, with depth values reported in meters.

Number of Points	1130739
Data Mean	-863.97
Reference Mean	-863.95
Mean	-0.022
Median	-0.022
Std. Deviation	1.606
Data Z – Range	-1029.82 : -834.42
Ref. Z – Range	-1021.67 : -837.04
Diff Z – Range	-17.92 : 20.21
Mean + 2*stddev	3.235
Median + 2*stddev	3.235
Ord 2 Error Limit	27.517876
Ord 2 P-Statistic	0.000001
Ord 2 - # Rejected	1
ORDER 2	ACCEPTED



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-19-07 project instructions which is available in the NOAA Central Library.

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

EM 302 Multibeam bathymetry and bottom backscatter dataset:

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

Simrad EK split-beam water column dataset:

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

Knudsen 3260 Sub-bottom Profiler dataset:

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

EM 302 Multibeam water column dataset:

- Mapping watch stander log
- Weather log



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

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

At the time of writing this report,

EM 302 and EK 60 water column data, supporting data, and informational logs were/will be available in the NCEI Water Column Sonar Archives:

https://www.ngdc.noaa.gov/maps/water_column_sonar/index.html (last accessed 12/11/2019).

Sub-bottom data, supporting data, and informational logs will be available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/>. For any challenges accessing SBP data, send an inquiry to ncei.info@noaa.gov requesting access to EX-19-07 Knudsen 3260 sub-bottom raw and processed data.

EM 302 bathymetry data, supporting informational logs, and ancillary files were/will be available in the NCEI Data Archives accessible at <https://maps.ngdc.noaa.gov/viewers/bathymetry/>(last accessed 12/11/2019).



10. Cruise Calendar

All times listed are local ship time. As there was a time change observed for Daylight Savings, the difference between local and UTC is denoted for any time entries.

October 29 – November 21, 2019

Sun	Mon	Tues	Wed	Thur	Fri	Sat
		29 Mission Personnel arrived in Miami, FL. Mobilization began.	30 Mobilization continued.	31 Departed Miami, FL. Transited to Blake Plateau and first ROV dive location.	1 ROV Dive 1. Overnight multibeam edge-matched EX-19-06 data.	2 ROV Dive 2. Overnight multibeam expanded coverage to the west of the "Million Mounds" area.
3 ROV Dive 3. Overnight multibeam filled data gaps to the west of existing data.	4 ROV Dive 4. Overnight multibeam expanded coverage eastward of existing data.	5 ROV Dive 5. Overnight multibeam expanded coverage eastward of existing data.	6 ROV Dive 6. Overnight multibeam expanded coverage eastward of existing data.	7 ROV Dive 7. Overnight multibeam continued building bathymetric coverage.	8 Dive cancelled due to poor weather. 24/hour mapping. Filled in an area connecting three <i>Okeanos Explorer</i> surveys. Transited north.	9 Dive cancelled due to poor weather. 24/hour mapping. Transited north and added coverage to the east of "North Richardson Hills."
10 Dive cancelled due to strong currents. Due to a medical emergency, overnight the ship transited to Charleston, SC.	11 Arrived in Charleston, SC.	12 Departed Charleston, SC at 1300 (UTC -5). Transited to next dive location. Poor weather.	13 Dive cancelled due to poor weather 24/hour mapping. Transited South and edge-matched EX-19-06.	14 Poor weather. Continued transit south (leaving the Blake Plateau). Collected a few survey lines outside of Miami and within the Bahamas EEZ.	15 ROV Dive 8. Collected bathymetric data overnight aimed to identify a suitable location for Dive 9.	16 ROV Dive 9. Overnight multibeam expanded coverage of the Portales Terrace boundary.
17 ROV Dive 10. Overnight multibeam edge-matched existing data.	18 ROV Dive 11. Overnight multibeam edge-matched existing data.	19 ROV Dive 12. Overnight multibeam edge-matched existing data.	20 Arrived in Key West, FL. Began demobilization.	21 Finished demobilization. Mission personnel depart ship.		



11. Daily Cruise Log Entries

Generated from the daily expedition situation reports. All times listed are in local ship time, as there was a time change observed for Daylight Savings, the difference between local and UTC is denoted for each daily entry.

October 30 (-4 UTC)

Mobilization continued for mapping operations. New surveys were created for all of the acquisition systems and a ping test for the EM 302 was successful. EX-19-07 logs were created. The Mapping Lead finished setting up the Hypack, ArcGIS, and Fledermaus projects and planned the transit to Dive 01.

Between EX-19-06 and EX-19-07, the Senior Survey Technician (SST) thoroughly cleaned the XBT AutoLauncher.

October 31 (-4 UTC)

Shortly after departing all mapping sonars were started (EM 302, Knudsen, and EKs with the 38 kHz not installed). All systems started up normally. Seas were calm and the data quality was good. While transiting in shallow depths, synthetic profiles from the World Ocean Atlas (WOA) version 13 were utilized sent via the Sound Speed Manager in server mode. The real-time Seafloor Mosaic Display is receiving datagrams and working properly after adjusting the IP address that automatically populates Data Distribution at start up.

At 700 meters the 70 kHz EK 80 started showing Deep 1 mode interference in the upper water column, when in frequency modulated (FM) mode. The 70 kHz EK 80 was switched to continuous wave (CW) mode and data will be collected in CW mode when in depths deeper than 700 meters for the rest of this expedition.

New mapping contract personnel were trained in overnight watchstanding for ROV expeditions.

There have been some issues with saving to the Public Drive as it is slow and occasionally gets hung up. The Global Foundation for Ocean Exploration (GFOE) team is investigating this issue.

November 1 (-4 UTC)

Overnight mapping included continuing to transit to Dive 01 and mapping the EEZ border. The data looks good. Applying a few degrees of forward Along Tilt helps to mitigate nadir artifacts.

Despite thorough cleaning of the Autolauncher in between expeditions, Tube 1 is not working. The SST will continue to troubleshoot. The Autolauncher has been experiencing a higher rate of issues and is fortunately due for scheduled maintenance during the upcoming repair period.

The Acoustic Doppler Current Profilers (ADCPs) were taken out of external trigger mode (1,1) and placed into standalone mode (0,0), as random noise is much easier to remove with University of Hawaii Data



Acquisition System's (UHDAS) algorithms. At this time, ADCPs should always be set to internally trigger (0,0), until another operational reason to synchronize is identified.

The Daily Product SOP was updated to fix projection issues associated with the previous method. The new methodology is to export full resolution soundings as an ASCII text file from Qimera with a WGS84 projection and then to grid them in Fledermaus at the desired resolution.

While post processing the sound velocity profiles, the "Nearest in Time" option was unable to be used. It was found out that this was due to the associated synthetic profiles from WOA 13 that have the same timestamp. Investigating these profiles showed that they were similar to the first XBT profile and therefore it was decided to remove them from the Qimera project and simply use the XBT data. The resulting data looked good. This has implications for future use of Sound Speed Manager's synthetic profiles.

November 2 (-4 UTC)

Overnight mapping operations included edge mapping with EX-19-06 data and data gap fills. Data quality is good. XBTs are conducted every 2 hours. There was one instance of the keyboard-video-mouse (KVM) system locking up the Multibeam workstation. GFOE quickly fixed the issues and will continue to monitor to see if the issues persist.

November 3 (-5 UTC)

Overnight coverage was added to the west of the "Million Mounds" area. Highly dynamic sound velocity conditions were experienced as data were collected across and within the Gulf Stream. The small survey had large sound velocity artifacts. The Delft Sound Speed Inversion Tool using the 'Full Search' and 'Very Fine' options were utilized and the data looks much better. While surveying overnight, the EM 302 intermittently experienced interference.

The Backscatter standard operating procedure (SOP) was updated so that the naming convention of the backscatter daily products matches the naming convention of the multibeam daily products to avoid confusion.

November 4 (-5 UTC)

Overnight data gaps were filled and new bathymetry was collected on the western side of existing NOAA Ship *Okeanos Explorer* (EX) data on the Blake Plateau. For approximately 30 minutes, intermittent POS Dropouts were observed. The positioning lamp turned red and the longitudinal accuracy drops to ~1 meter. Also, the positioning status is frequently switching between Marinestar GNSS and Primary DGPS. This has been observed on multiple headings and the cause is unknown at this time. CET is investigating potential antenna obstructions.

The SST was able to get Tube 1 on the Autolauncher operational.

November 5 (-5 UTC)

Overnight two survey lines were collected that expanded bathymetric coverage eastward. Towards the end of mapping operations, three AXBTs were unsuccessful due to the high tailwind. The upcast from the

previous day's ROV dive was reapplied. Tomorrow the hand launched XBTs will be used, to ensure they are operational.

No positioning dropouts were observed.

November 6 (-5 UTC)

Overnight coverage was added eastward of the existing data. Data looks good. Qimera 2.0 has been crashing frequently, this may be because the Delft tool was previously utilized. This will be investigated tomorrow evening

The sub-bottom processing SOP was updated.

November 7 (-5 UTC)

Bathymetric coverage continued to build eastward. Frequent crashes in Qimera persisted. A new project was started overnight and no crashes were witnessed. The Mapping Lead investigated the corrupted project during the day and found that removing both the dynamic and static surfaces from the Qimera project seemed to fix the crashing. It is assumed that one of the surfaces was corrupted. In the future, removing surfaces should be attempted prior to starting a new project, as there are limitations to working with multiple projects, especially in the middle of an overlapping survey. The Watch Leads have been briefed on this protocol.

Following the dive, a successful manual XBT cast was conducted to keep the manual launches operational and train new Watch Leads on the procedure. In the future, testing of the XBT manual launches will occur more frequently throughout the field season.

November 8 (-5 UTC)

The sea state was unfavorable and the dive was cancelled. Data were unable to be collected of suitable quality heading south. Therefore, reciprocal lines were performed to mitigate the weather. Even with the poor conditions, an area was completed that connected three EX surveys (EX-19-03 Leg 1, EX-19-03 Leg 2, and EX-19-06).

November 9 (-5 UTC)

Weather continues to be unfavorable while finishing the survey in this area and during the transit north. The max angles have been set to 60 - 65 degrees to mitigate the poor conditions. Late afternoon the weather abated somewhat and we were able to open the angles to 70/70.

The EK stopped pinging overnight and it was not discovered by watchstanders until the morning. After restarting the EK, no further issues were observed.

November 10 (-5 UTC)

The ship transited north overnight and coverage was added to the east of the "North Richardson Hills" area. XBTs were performed every 90 minutes to mitigate highly dynamic sound velocity conditions. Due to a medical emergency, the ship headed to Charleston, South Carolina



November 11 (-5 UTC)

The ship arrived in Charleston, SC. All mapping products are up-to-date (bathymetry, backscatter, and sub bottom).

November 12 (-5 UTC)

The ship departed Charleston, SC. Transit data were collected overnight. As the seas are following, data are of reasonable quality.

November 13 (-5 UTC)

Mapping occurred all day, transiting South and edge-matching EX-19-06's coverage. As the seas are following, data are of reasonable quality.

November 14 (-5 UTC)

The ship continued transiting toward Miami, building coverage along the US EEZ border. Bathymetric data are of reasonable quality. The backscatter data are frequently blown out due to weather.

November 15 (-5 UTC)

During the day the ship continued its transit towards Miami against the Gulf Stream. Overnight a few survey lines were collected outside of the 25 nautical mile buffer of Miami, as requested for water making, and within the Bahamian EEZ.

November 16 (-5 UTC)

Overnight the mapping team conducted a targeted survey aimed to find a dive location by 0430. The conditions are favorable and the data quality is high.

November 17 (-5 UTC)

A few lines of coverage were added to the area straddling the Pourtales Terrace boundary. Data quality is high. Both of the bathymetry and backscatter data show interesting features.

November 18 (-5 UTC)

Overnight mapping edge-matched existing transit data while transiting to Dive Site 11. Data quality is high.

After the dive, when switching to multibeam operations the mapping team was unable to get the EM 302 to ping, even though a Built-in Self Tests (BIST) at the end of the dive showed that all tests passed. The ML first ensured that it this was not due to a K-Sync issue by setting the EM 302 to internally trigger. The topside unit (TRU) was then restarted and another BIST test was performed and all passed, however the EM 302 would still not ping, and warned a "Beam Forming and Signal Processing (BSP) Sample Timeout" and "bspWaitRow" timeout. The TRU was then powered down and the BSP boards were reseated. After restarting the TRU, SIS was unable to connect to the sonar. Advanced BIST tests through the telnet session indicated a communication error with transmit board 3 (Tx3). A few of the errors observed were low voltage failures, receive (Rx) board tests not completing, and no communication with Tx3. The TRU was again shutdown and the Tx3 board was reseated. A BIST revealed that all tests passed, however the Tx3 was not recognized. At this point SIS was able to connect to the sonar and run, though with a sonar head



error (the Tx3). The TRU was powered down and the Tx3 board was once again reseated and finally pinging was restored.

Many thanks to the SST and WLs who persisted with troubleshooting to restore functionality to the EM 302.

November 19 (-5 UTC)

Edge mapping continues to the south and west of Key West, building EX coverage.

November 20 (-5 UTC)

Edge-matching continues while the ship transits to Key West. The mapping team noticed that following the EM 302 troubleshooting there seemed to be less 'Erik's Horns' artifacts at nadir. It could be that they were previously seen due to the issue with Tx board 3. If so, in the future if these artifacts are frequently seen they could be diagnostic of Tx board issues.

All EX-19-07 bathymetry data have been through final quality control and is ready for final product generation once back on shore.



12. References

The 2019 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-19-07 Project Instructions can be obtained from the NOAA Central Library. The EX-19-07 Data Management Plan is an appendix of the project instructions.

EX-19-02 EK 60 / 80 Calibration Report can be obtained in the NOAA Central Library
<https://doi.org/10.25923/wzk7-6d52>.

