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Mapping Data Acquisition and Processing Summary Report

EX-21-05: 2021 U.S. Blake Plateau Mapping 1 (Mapping)

Blake Plateau, Southeastern United States

Newport, Rhode Island, to Port Canaveral, Florida

August 15 - September 2, 2021

Authors: Sam Candio[1], Amanda Bittinger[2], Charlie Wilkins[3], Treyson Gillespie[2], Ryan Marr[2].

[1] NOAA Ocean Exploration (CNSP)

[2] University Corporation for Atmospheric Research

[3] NOAA Office of Marine and Aviation Operations

NOAA Ocean Exploration

1315 East-West Highway

Silver Spring, MD 20910

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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-21-05 U.S. Blake Plateau Mapping 1, and to present a summary of mapping results and mapping-related expedition activities.

A detailed description of Okeanos Explorer's mapping equipment and capabilities is available in the "NOAA Ship *Okeanos Explorer* Mapping Systems Readiness Report 2021," which is 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/qbjz-m470

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

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

Expedition Objectives

EX-21-05 consisted of a transit from Rhode Island to the primary mapping grounds on the Blake Plateau, with a strategically planned trackline aimed at collecting data over several seeps previously discovered by NOAA Ocean Exploration along the edge of the continental shelf. The remainder of the expedition focused on conducting systematic ocean mapping operations on the Blake Plateau region in U.S. waters deeper than 200 meters, providing high-resolution imagery of the seafloor and acoustic backscatter information about the seabed and water column. This region is home to the most extensive continuous cold-water coral mound reef ecosystem yet discovered, and closing the gaps in understanding within this region is of great national importance. This is the first of two expeditions in 2021 aimed at focused mapping operations on the Blake Plateau.

Atlantic 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 campaign 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. ASPIRE will also support the National Strategy for Mapping, Exploring, and Characterizing the United States Economic Zone[4] and Seabed 2030.

This expedition also aimed to further evaluate the efficacy of using a shore-based team of seafloor mapping experts for multibeam sonar data processing via internet-based cloud services. Shore-based personnel worked closely with the at-sea mission team to streamline these processes and enhance current telemapping capabilities.

The complete objectives for this expedition are detailed in "Project Instructions: EX-21-05 U.S. Blake Plateau Mapping 1 (Mapping)," which is archived in the NOAA Central Library.[5]

[4] https://oeab.noaa.gov/wp-content/uploads/2021/01/2020-national-strategy.pdf

[5] https://doi.org/10.25923/mkt5-d774

Operational Personnel

EX-21-05 included onboard operational personnel, inclusive of ship's force and mission team, who participated in operational execution (see **Table 1**), and shore-based personnel (who participated remotely via telepresence) (see **Table 2**).

Table 1. EX-21-05 Onboard Personnel.

Name	Role	Affiliation	Dates Aboard
Amanda Bittinger	Mapping Lead	UCAR[1]	8/13 - 10/1
Treyson Gillespie	Mapping Watch Lead	UCAR[1]	8/13 - 9/3
Ryan Marr	Explorer-in-Training	UCAR[1]	8/13 - 9/3
SST Charlie Wilkins	Senior Survey Tech	OMAO[2]	8/13 - 10/1
LT Bryan Pestone	Operations Officer	OMAO[2]	8/13 - 10/1
ENS Kevin Tarazona	Operations Officer (in training)	OMAO[2]	8/13 - 10/1
Chris Wright	GFOE Team Lead	GFOE[3]	8/13 - 10/1
Jim Meyers	GFOE Engineer	GFOE[3]	8/13 - 10/1
Mark Durbin	GFOE Engineer	GFOE[3]	8/13 - 10/1
Brian Doros	GFOE Engineer	GFOE[3]	8/13 - 9/3

[1]University Corporation for Atmospheric Research
[2]NOAA Office of Marine and Aviation Operations
[3]The Global Foundation for Ocean Exploration

Table 2. EX-21-05 Shore-based personnel.

Name	Role	Affiliation
Sam Candio	Expedition Coordinator	NOAA Ocean Exploration(CNSP)
Meme Lobecker	Cloud Coordinator	NOAA Ocean Exploration(CNSP)
Erin Heffron	Cloud Contractor	UCAR
Marcel Peliks	Cloud Intern	UCAR
Paola Santiago	Cloud Intern	UCAR
Anna Takagi-Berry	Cloud Intern	UCAR

Summary of Mapping Operations

NOAA Ocean Exploration mapped 14,245 square kilometers (sq km) of seafloor during the 15 days at sea for EX-21-05. Of the 14,245 sq km mapped, 14,122 sq km were 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**.

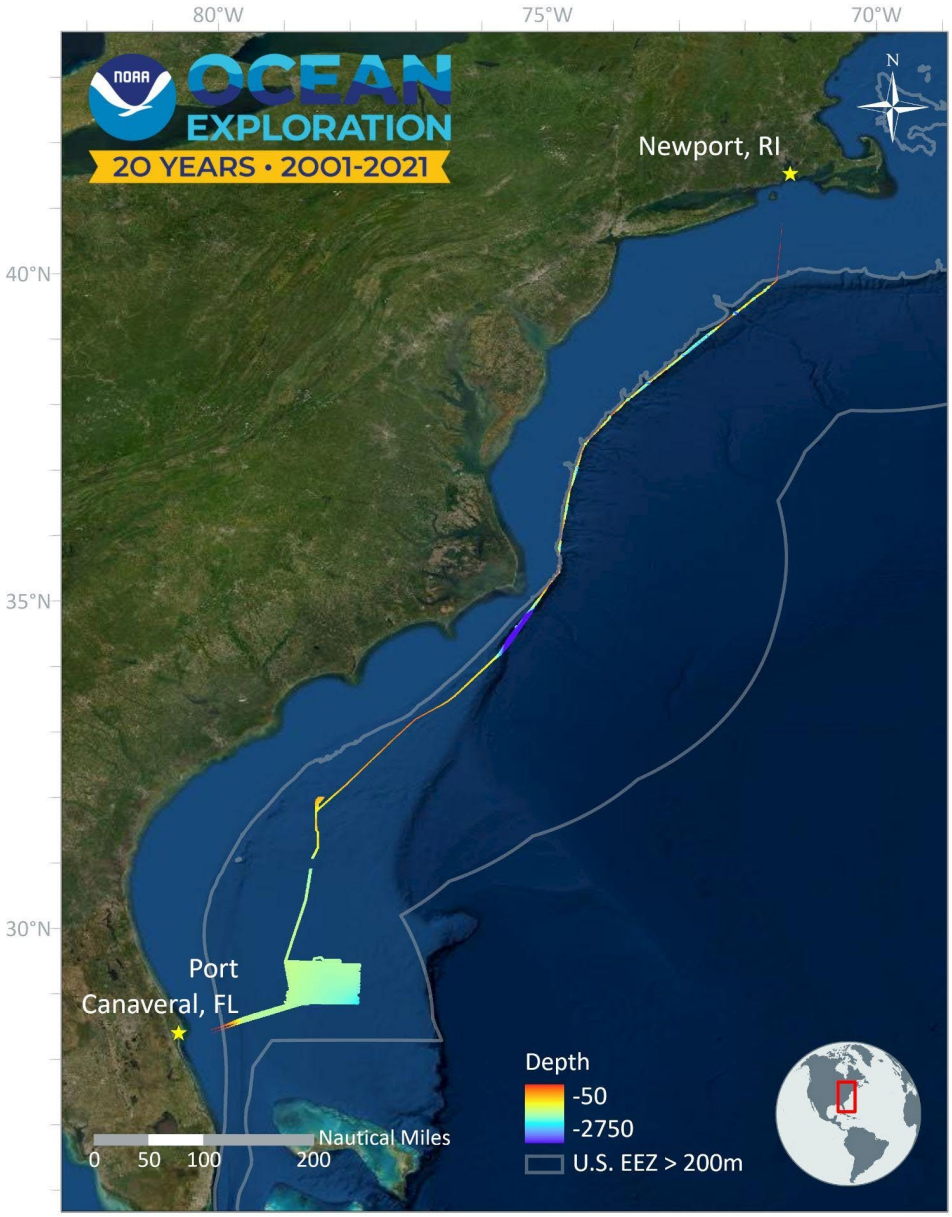

Figure 1. Overview of bathymetric mapping coverage completed during U.S. Blake Plateau Mapping 1 (EX-21-05).

Due to a failure of the port steering ram, the ship was forced to break operations on August 20 and head into Port Canaveral for repairs. Following a successful repair, the ship resumed operations on August 26, and transited back out to the survey area on the Blake Plateau.

Mapping Statistics

Table 3 provides summary statistics of ocean mapping work during EX-21-05 from August 15 - September 2, 2021 (UTC).

Table 3. Summary statistics of ocean mapping work during EX-21-05.

Statistic	Value
Ship's draft*: note: Start of expedition (08/15/2021) Mid expedition arrival (08/21/2021) Mid expedition departure (08/25/2021) End of expedition (09/02/2021)	 Fore: 16' 4.5''; Aft STBD: 15' 7"; Aft Port: 15' 7" Fore: 16' 4.5''; Aft STBD: 15' 6"; Aft Port: 15' 6" Fore: 16' 6.5"; Aft STBD: 15' 9"; Aft Port: 14' 5.4" Fore: 16' 6.5"; Aft STBD: 15' 7.5"; Aft Port: 15' 5.5"
Linear kilometers of survey with EM 304	4,789.4
Square kilometers mapped with EM 304	13,054
Square kilometers mapped with EM 304 within U.S. waters deeper than 200 m	12,989
Number/data volume of EM 304 raw multibeam files (.kmall)	410 files/93.0 GB
Number/data volume of EM 304 water column multibeam files (.kmwcd)	407 files/239.0 GB
Number/data volume of EK60/EK80 water column split-beam files (.raw)	1,077/69.7 GB
Number/data volume of sub-bottom sonar files (.segy, .kea, .keb)	479/2.68 GB
Number of expendable bathythermograph (XBT) casts	115
Number of conductivity, temperature, depth profiler (CTD) casts (including test casts)	0

*Prior to EX-21-01, and as a result of the full marine survey completed during the 2020/2021 drydock, it was discovered that the draft markers on the bow are referenced to the bottom of the original hull, not the sonar blister, which is 16.5" lower than the hull bottom, requiring that a +16.5" offset be applied to the draft measurements. The measurements listed in Table 3 include the +16.5" offset.

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 meters of water and conducting productive mapping operations in up to 8,000 meters 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-21-05 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 cruise to which they are relevant.[6]

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

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

approximately 80 meters 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.

During EX-21-01 the 38 kHz transducer experienced temperature spikes, and at the beginning of EX-21-03, the 38 kHz ADCP permanently failed and was not operational for the duration of the cruise. The 38 kHz will not be operational until the transducer is replaced.

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. Data acquisition then 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).

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 planned to optimize 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 in the SIS 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 with POS MV 320 version 5 inertial motion unit. 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.

On August 21, 2021 at approximately 4:20 UTC the Reson SV-70 probe experienced an abnormal drop of 7 m/s in surface sound speed in comparison to the thermosalinograph while transit mapping inbound to Port Canaveral, FL (**Figure 2**). After power cycling the SV-70 probe, the readings between the two sensors remained inconsistent.

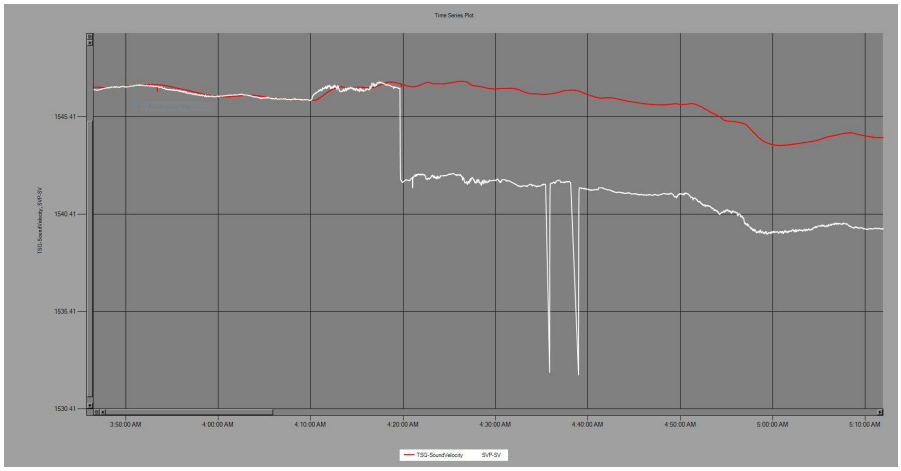

Figure 2. Observed discrepancy between the TSG (red) and the SV-70 (white).

On re-evaluation during departure from Port Canaveral, FL on August 26, 2021, the SV-70 probe, although trending more closely to the TSG, continued to show abnormal spikes in sound velocity (**Figure 3**). Due to the abnormal spikes, the TSG was switched to the primary sound velocity sensor at 15:00 UTC prior to logging EM 304 files. The TSG remained the primary sound velocity source for the duration of the cruise.

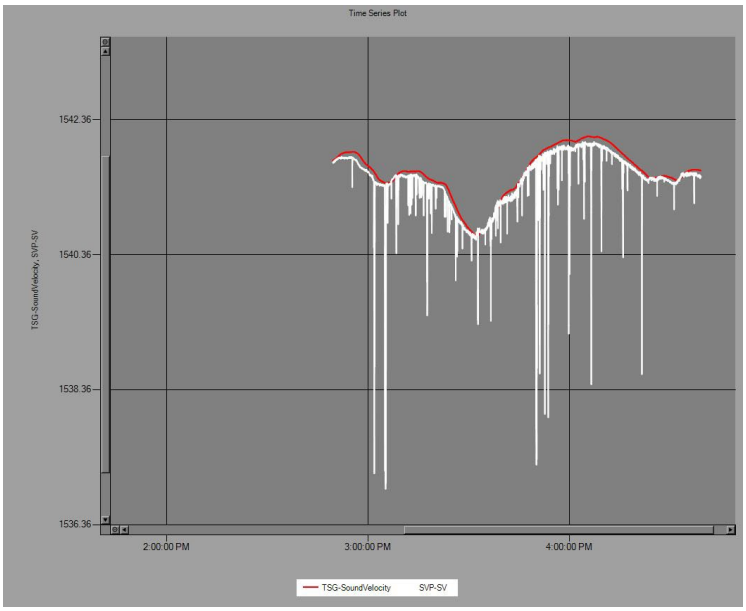

Figure 3. Abnormal spikes in the SV-70 (white) plotted against data collected with the TSG (red).

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. **Figure 3** shows the EK60/EK80 data collected during EX-21-05. Several instances of new and historically located seeps were recorded.

Knudsen 3260 sub-bottom profiler data were also collected during the majority of the expedition (**Figure 4**).

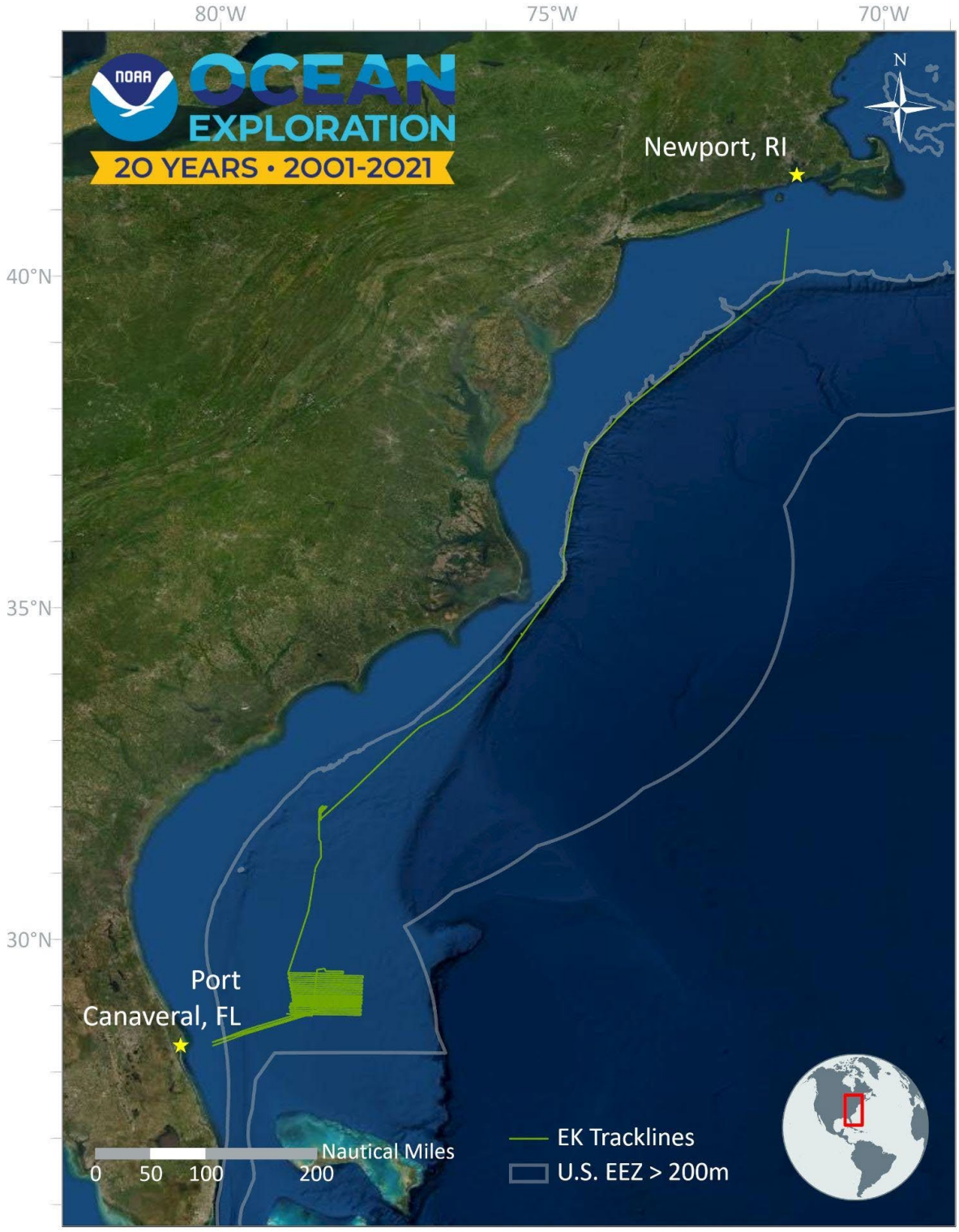

Figure 3. Simrad EK60/EK80 split-beam sonar data collection tracklines (in green) collected during EX-21-05.

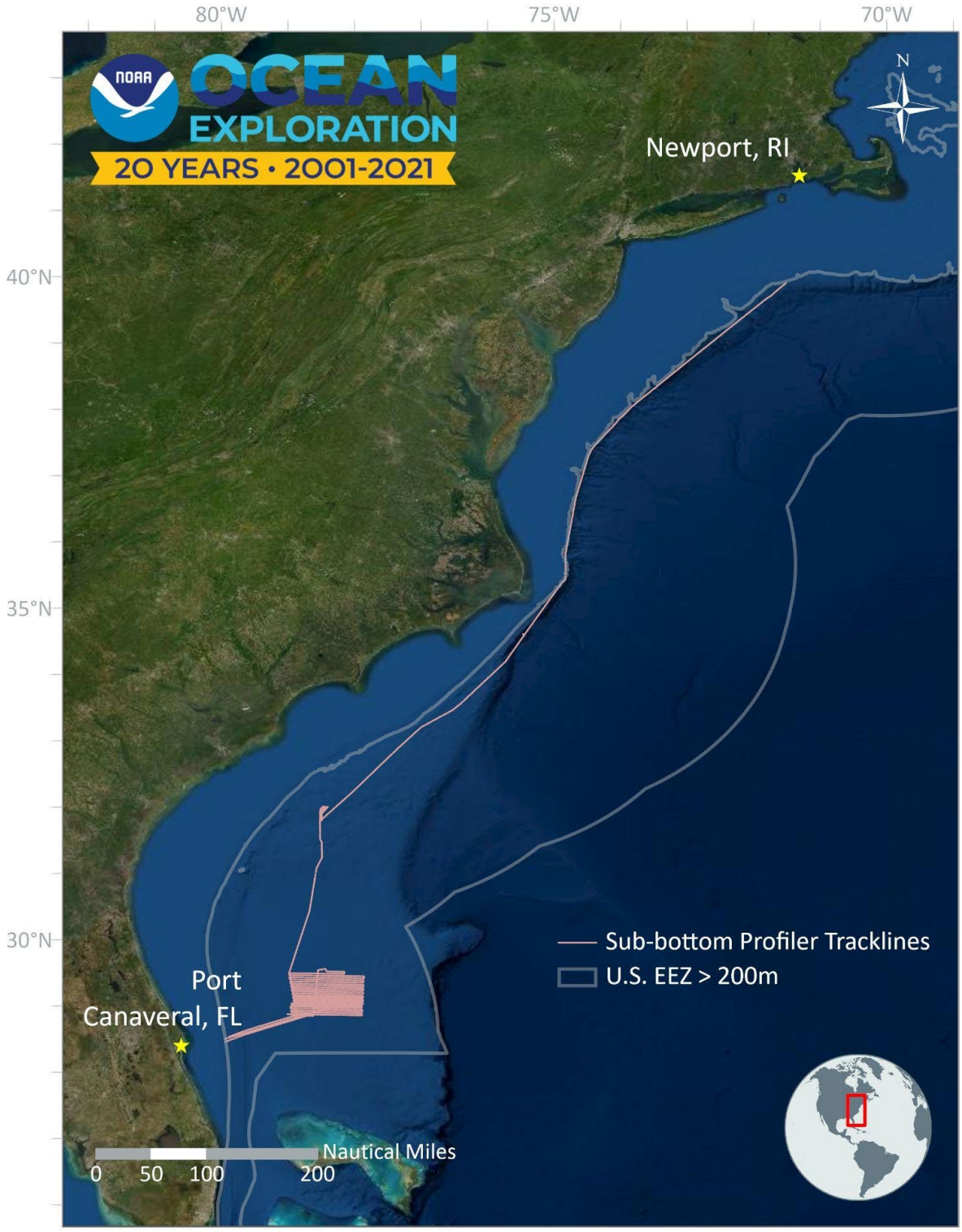

Figure 4. Knudsen sub-bottom profiler data collection tracklines (in pink) collected during EX-21-05.

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 5** shows the onboard multibeam data processing workflow.

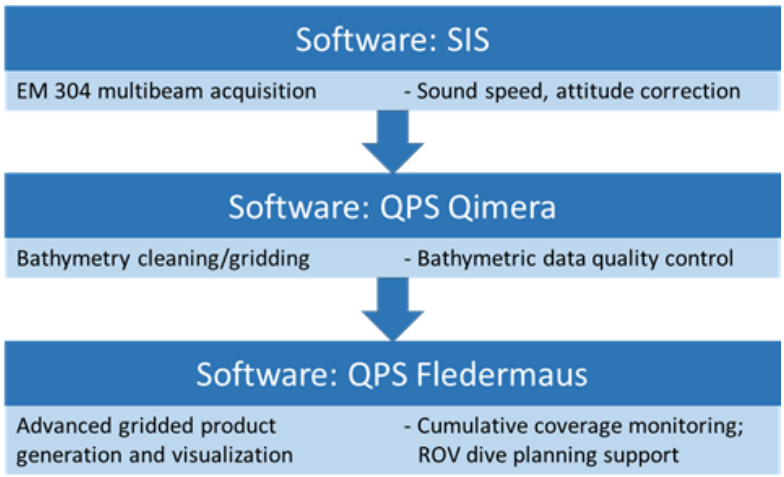

Figure 5. Shipboard multibeam data processing workflow.

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. 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 September 1, 2021, as shown in **Figure 6**, and the results are presented in **Table 4**.

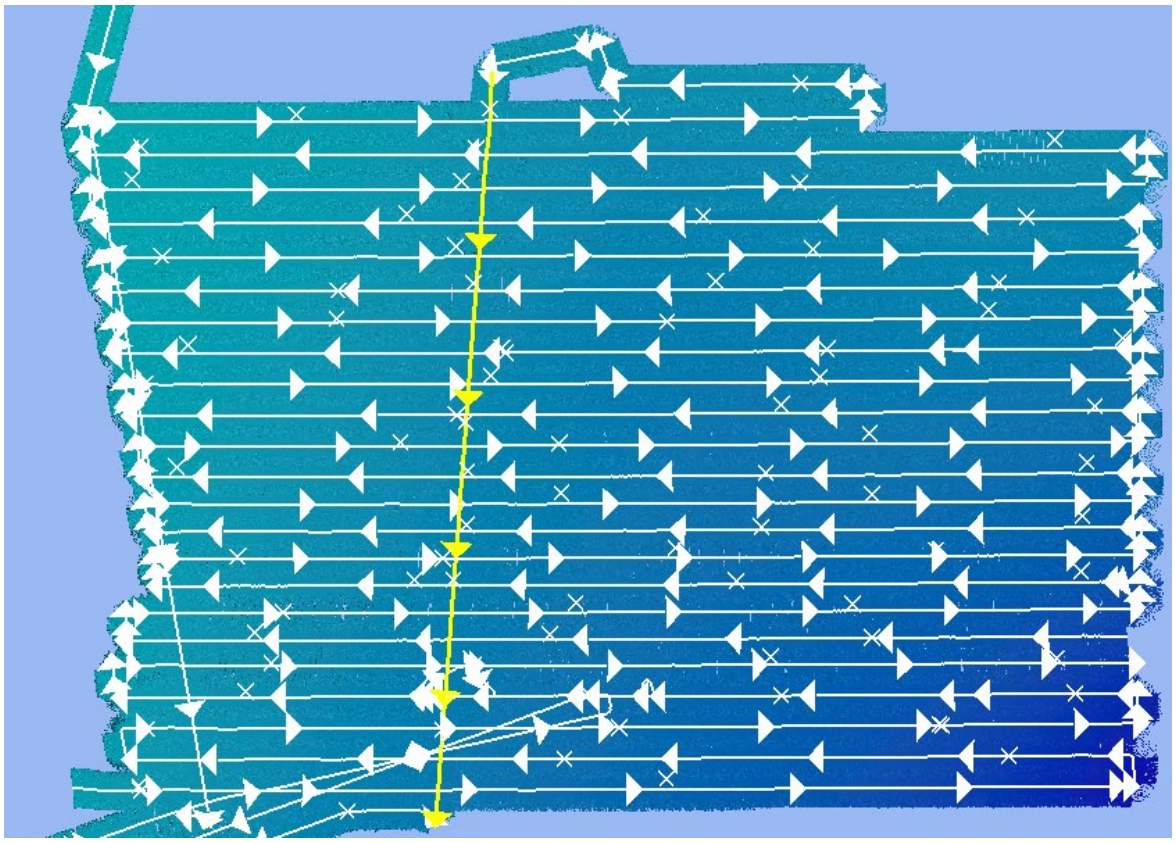

Figure 6. EX-21-05 crossline (shown in yellow) used for comparison against the bathymetric grid generated via orthogonal multibeam survey lines.

Crossline files:

0389_20210901_182412_EX2105_MB.kmall

0390_20210901_192412_EX2105_MB.kmall

0391_20210901_202412_EX2105_MB.kmall

0392_20210901_212412_EX2105_MB.kmall

0393_20210901_222412_EX2105_MB.kmall

Table 4. Crosscheck results.

Statistic	Value
Number of points of comparison	6376720
Grid cell size (m)	20
Difference mean (m)	0.102054
Difference median (m)	0.063225
Difference standard deviation (m)	1.656725
Difference range (m)	[-13.54, 12.10]
Mean + 2* standard deviation (m)	3.415504
Median + 2* standard deviation (m)	3.376675
Data mean (m)	-859.512411
Reference mean (m)	-859.614465
Data z-range (m)	[-902.50, -763.68]
Reference z-range (m)	[-896.04, -763.68]
Order 1 error limit (m)	11.186168
Order 1 # rejected	12
Order 1 p-statistic	.000002
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-21-05.

Table 5. Versions of acquisition and processing software used during EX-21-05.

Software	Purpose	Version
SIS	EM 304	5.7.0
EK80	EK suite	2.0.1
EchoControl	Knudsen	4.09
UHDAS	ADCPs	14.04
AMVERSEAS	Autolaunch XBT	9.3
WinMK21	XBT	3.0.2
K-Sync	Synchronization	1.9.0
Qimera	Bathymetry	2.4.0
FMGT	Backscatter	7.9.7
FMMidwater	Water Column	7.9.3
Sound Speed Manager	Sound Velocity Profiles	2021.2.0
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-21-05, 2021 U.S. Blake Plateau Mapping 1 (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[7] and searchable through the Ocean Exploration Digital Atlas,[8] 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,[9] or contact the Ocean Exploration Mapping Team.[10]

Table 11. Locations of data collected during EX-21-05 (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://maps.ngdc.noaa.gov/viewers/bathymetry/
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	https://www.ngdc.noaa.gov/maps/water_column_sonar/index.html

[7] https://www.ngdc.noaa.gov/

[8] https://www.ncei.noaa.gov/maps/oer-digital-atlas/mapsOE.htm

[9] ncei.info@noaa.gov

[10] oar.oer.exmappingteam@noaa.gov

	Water Column Sonar Data Viewer	
Knudsen 3260 sub-bottom profiler data	Sub-bottom data, supporting data, and informational logs are available in the NCEI data archives	May be requested directly from NCEI: https://www.ncei.noaa.gov/ National Centers for Environmental Information (NCEI) E/NE42 325 Broadway Boulder, Colorado USA 80305 ncei.info@noaa.gov (828) 271-4800
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://maps.ngdc.noaa.gov/viewers/bathymetry/ or through the oceanographic archives at: 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: https://library.noaa.gov/ OEP institutional repository: https://repository.library.noaa.gov/cbrowse?pid=noaa%3A4&parentId=noaa%3A4

Expedition Schedule

Table 12. EX-21-05 schedule.

Date (UTC)	Activity
08/13	Mission personnel joined the ship in Newport, RI. Mapping mobilization began.
08/14	Mobilization continued.
08/15	Departure from Newport, RI. Underway 09:00.
08/16	Transit mapping southward along the continental shelf to the Blake Plateau. Seeps detected.
08/17	Continued transit mapping southward. Seeps detected.
08/18	Arrival to Blake Plateau Priority 1 area.
08/19	Transit to Priority 2 area d/t tropical storm Henri.
08/20	Continuation of mapping Priority 2 area. Emergency port call to Cape Canaveral, FL d/t steering issue. Transit mapping at 16:00.
08/21	Transit mapping toward Port Canaveral, FL. Sonars secured at 05:00. Arrive Port Canaveral, FL at 11:30.
08/22	In port Port Canaveral, FL.
08/23	In port Port Canaveral, FL.
08/24	In port Port Canaveral, FL.
08/25	In port Port Canaveral, FL.
08/26	Underway to Priority 2 working area. Transit mapping.
08/27	Priority 2 mapping
08/28	Priority 2 mapping
08/29	Priority 2 mapping
08/30	Priority 2 mapping
08/31	Priority 2 mapping
09/01	Priority 2 mapping and inbound transit to Port Canaveral, FL.
09/02	Sonars secured at 04:00. Arrive to 12NM limit by 07:00. Arrival to pier approximately 11:00.

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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 cruise. All times are in local ship time (-4 hours from UTC).

August 13

Mission personnel joined the ship in Newport, Rhode Island and mapping mobilization began.

HYPACK Projects were created in 18N for the transit, and 17N for the priority areas on the Blake Plateau.

August 14

Pierside preparations for sailing tomorrow. Successful ping testing of sonars. Review of operations from SST Wilkins for survey team. Completed planned updates on network systems. Short term outage in VSAT due to weather.

August 15

Difficulty getting the EM304 to connect due to a TX issue. Pressed boards into slots in TX topside unit, and the issue was resolved. Telnet records indicate details. Initial issue getting SSM to connect to EM304. Resolved after restart of CTD computer. All sonars online and running smoothly by approximately 1530.

August 16

Transit mapping in a southerly direction along the continental shelf. Encountering various historically mapped seeps and some new ones. Data quality is good.

Updated the Qimera version to 2.4.1 on MBPROC1 and MBPROC2. Marinestar corrections issue resolved with change in frequency to the SBAS settings in POS MV.

August 17

Transit mapping in a southerly direction along the continental shelf. Encountering various historically mapped seeps and some new ones. Data quality is excellent.

POSMV SBAS settings returned back to “auto” caused loss in Marinestar corrections. SBAS settings reset back to custom frequency and baud rate.

Cloud team is up and running in their Amazon Workspaces and adjusting to their watch schedules and learning expectations. Sam Candio also now has cloud access. The team is editing multibeam data, examining water column data for seeps, keeping up processing logs, and communicating well with a watch pass down log. The processing pipeline to import field GSFs and ensure all ping edits and ray tracing are preserved is being troubleshot with QPS.

August 18

Arrival to Priority 1 mapping area on the Blake Plateau. Excellent weather and data. In preparation for tropical storm Henri the ship will divert to the southwestern most area of Priority 2 at approximately 2000 tonight.

POSMV data drop outs for about 10 seconds every 2 to 3 minutes started approximately 1800 (2200 UTC). Instances are being logged in the Watch Log.

Cloud based processing is going smoothly. EiTs settling into their independent watches with excellent guidance from Cloud Data Lead. The GSF ingest, clean, and reexport pipeline has been ironed out and is working nicely. EiTs were very interested in processing seep data collected during transit over the previously known seeps along the shelf break.

August 19

Mapping operations were conducted on the western and southern edges of the Priority 2 area to the southwestern most point to avoid wind and seas from TS Henri. Netmeeting testing for live interaction prep. VSAT performed as expected.

August 20

Mapping southern portion of Priority 2 area to avoid wind and seas from TS Henri. Emergency port call to Port Canaveral, FL due to steering test failure. Network and VSAT are performing as expected.

August 21

Emergency port call to Port Canaveral, FL due to steering test failure. Dockside at approximately 1100. Transit mapping occurred to 50m water depth. Possible sound velocity sensor issue. Network systems operating as expected. VSAT operating as expected. No issues found during inspection.

August 22

Dockside in Port Canaveral, FL awaiting emergency repairs. Current expected departure is Tuesday. Minor network outage of 3 minutes. No VSAT issues to report.

August 23

Dockside in Port Canaveral, FL awaiting emergency repairs. Current expected departure is Wednesday 0900.

August 24

Dockside in Port Canaveral, FL awaiting emergency repairs. New estimated departure is Thursday morning.

SST troubleshooted the AXBT launcher Tube 1 malfunction. Communications with AOML revealed a motor issue. The AXBT will be removed and sent to AOML during the winter for maintenance. Operations will resume without the use of Tube 1 currently.

August 25

Dockside in Port Canaveral, FL awaiting emergency repairs. Estimated departure is still Thursday morning. Data and network testing. VSAT performing as expected.

August 26

Departure from Port Canaveral, FL at 9:30AM. Port ram repairs completed, installed and tested successfully. Transit mapping to Priority 2 area. SV sensor switched to TSG on EM304. Data network operating as expected. Short VSAT outage due to weather. All systems were normal afterward.

August 27

Transit mapping to Priority 2 working area, followed by east-west mapping lines. Data is reduced quality due to weather. AXBT Tube 3 failure. Data and VSAT performing as expected.

August 28

Mapping Priority 2 area. Weather is 4 to 6 ft, 15-20 knot winds. Data quality is trending weather, very slowly improving in the late afternoon. Running lines at 270° with the wind and swell provides better data quality with a speed of 8.5 knots. Averaging of 7.5 knots in the 090° direction. Weather is expected to improve on Sunday. POS MV drop outs occurred the last two days at ~2100 UTC.

August 29

Mapping Priority 2 area. Data quality has improved drastically over the last 24 hours. Coverage is regularly 68° port/68° starboard with a 4200m swath in 870m of water. Weather is 10 knots with 3 feet seas.

Sunny skies for sun photometer readings this afternoon.

August 30

Mapping Priority 2 area. Data quality is great! Wind is 5 knots, seas 1-2ft. Saw a few bumps in the surface for the first time in days!

Sunny skies for sun photometer readings today.

August 31

Mapping Priority 2 area. Data quality is great! Wind is less than 5 knots, seas <1ft.

September 1

Mapping Priority 2 area. Data quality is great! Wind is 15 knots, seas 1-3ft. Finishing up a crossline before the transit into Port Canaveral, FL.

September 2

Sonars were secured inbound to Cape Canaveral, FL at 04:00. Arrival to Port Canaveral, FL at approximately 11:00.