



# MAPPING DATA ACQUISITION AND PROCESSING SUMMARY REPORT:

## EX-17-01, Kingman/Palmyra, Jarvis (Mapping)

January 20, 2017 to February 11, 2017

Honolulu, Hawaii to Pago Pago, American Samoa

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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, and 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 mapping expedition EX-17-01 Kingman/Palmyra, Jarvis and to present a summary of the overall mapping results and mapping related cruise activities. A detailed description of the NOAA Ship *Okeanos Explorer* mapping capabilities are available in the 2017 NOAA Ship *Okeanos Explorer* Survey Readiness Report, archived in the NOAA Central Library.

## 3. Cruise Objectives

During EX-17-01 NOAA OER worked with the scientific and management community to characterize unknown and poorly-known areas of the central and western Pacific through telepresence-based exploration. Baseline information collected during the cruise will support and catalyze further exploration, research and management activities. EX-17-01 also collected data in preparation for the following *Okeanos Explorer* cruises: EX-17-03 and EX-17-05.

This cruise was part of the [Campaign to Address Pacific Science and Technology Needs \(CAPSTONE\)](#) (last accessed April 2020). CAPSTONE was a major multi-year foundational science effort focused on deepwater areas of U.S. marine protected areas in the central and western Pacific. The investment provided timely, actionable information to support decision making based on reliable and authoritative science. It also served as an opportunity for the nation to highlight the uniqueness and importance of these national symbols of ocean conservation.

As part of training the next generation of ocean explorers, two Explorer-in-Training (EiT) student trainees participated in the cruise as mapping watchstanders.

The complete objectives for this cruise are detailed in the EX-17-01 Project Instructions, which are archived in the NOAA Central Library here: <https://repository.library.noaa.gov/view/noaa/14217> (last accessed April 2020).

## 4. Summary of Mapping Results

The expedition commenced from Honolulu, Hawaii on January 20, 2017 and concluded in Pago Pago, American Samoa on February 11, 2017. EX-17-01 mapped

44,500 square kilometers (km) of seafloor during the 23 days at sea (Figure 1 and Table 1).

### Cruise Overview Map

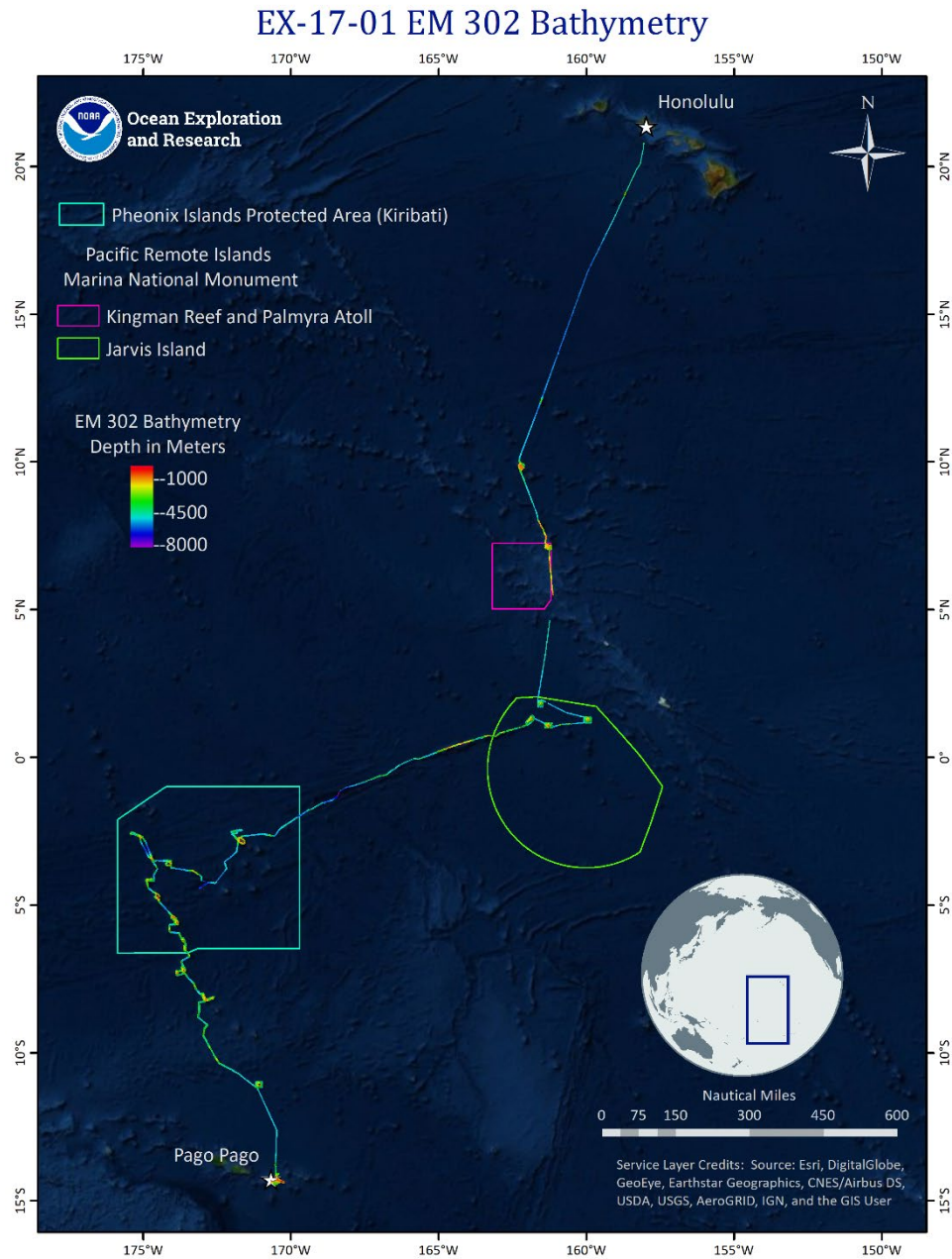


Figure 1. EM 302 bathymetry collected during EX-17-01.

## 5. Mapping Statistics

Table 1. Summary statistics of ocean mapping work completed during EX-17-01.

Dates of data collection	January 20 – February 11, 2017
Linear km of survey with EM 302	8,300
Square km mapped with EM 302	44,500
Number / Data Volume of EM 302 raw bathymetric / bottom backscatter multibeam files (.all)	660 files/ 33.9 GB
Number / Data Volume of EM 302 water column multibeam files	660 files / 116 GB
Number / Data Volume of EK60 water column split-beam files (.raw/.idx)	221 Files/ 35.9 GB
Number / Data Volume of sub-bottom sonar files (.segy, .kea, .keb)	680 Files / 8.65 GB
Number of XBT casts	58
Number of CTD casts (including test casts)	0

## 6. Mapping Sonar Setup

### *Kongsberg EM 302 Multibeam Sonar*

NOAA Ship *Okeanos Explorer* is equipped with a 30 kilohertz (kHz) Kongsberg EM 302 multibeam sonar capable of conducting mapping operations in up to 8,000m of water depth. The system generates a 150° beam fan containing up to 432 soundings per ping in waters deeper than 3300m. In waters shallower than 3300m the system is operated in dual swath mode, and obtains up to 864 soundings per ping by generating two swaths per ping cycle. The multibeam sonar is used to collect seafloor bathymetry, seafloor backscatter, and water column backscatter data. Backscatter represents the strength of the acoustic signal reflected

from a target, such as the seafloor or bubbles in the water column. System calibration to determine the angular offsets (via a patch test) is conducted annually and the results are reported in the annual readiness report. The 2017 NOAA Ship *Okeanos Explorer* Survey Readiness Report is available in the NOAA Central Library.

#### *Simrad EK60 Split-beam Sonars*

The ship operated four Simrad EK60 split-beam fisheries sonars: 18 kHz, 70 kHz, 120 kHz, and 200 kHz. 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-16-09 cruise, and calibration values from that cruise were applied to the EK sonars for EX-17-01. The 2017 EK60 Calibration Report is planned for archival in the NOAA Central Library.

#### *Knudsen 3260 Sub-bottom Profiler*

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 are 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 ~1000m range; and a 300 kHz Teledyne RDI Workhorse Mariner ADCP, with a ~70m 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 during mapping operations due to interference issues.

## **7. Data Acquisition Summary**

Mapping operations included data collection using the EM 302 multibeam sonar, EK60 split-beam (18, 70, 120, and 200 kHz) sonars, and Knudsen 3260 sub-bottom profiler. Data were

collected by each sonar concurrently during the transits. The 38 kHz split-beam sonar was not run due to interference with the EM 302.

Survey lines were planned to either maximize edge matching of existing bathymetric data, or to fill data gaps in areas with existing bathymetric coverage. In regions with no existing data, lines were planned to optimize potential exploration discoveries. EX-17-01 mapping data consists of focused mapping over seafloor features of interest or potential ROV dive targets with large transits in between areas of interests. Multibeam data were collected within the Jarvis Island unit and the Kingman Reef and Palmyra Atoll unit of the U.S. Pacific Remote Islands Marine National Monument (PRIMNM) (Figures 2 and 3). Data were also collected in the Kiribati Phoenix Islands Protected Area (PIPA) (Figure 4). Deep water mapping data were also collected in and around the Swains Island Unit of the National Marine Sanctuary of American Samoa (NSMAS) (Figure 5). Backscatter data were processed over select seafloor features of interest (Figure 6).

Summary coverage numbers include: over 14,600 km<sup>2</sup> in the U.S. Exclusive Economic Zone (EEZ), over 14,800 km<sup>2</sup> with the Kiribati EEZ, 5,300 km<sup>2</sup> in the Tokelau EEZ, 5,700 km<sup>2</sup> with the Jarvis Unit PRIMNM, 600 km<sup>2</sup> in the Kingman/Palmyra unit of PRIMNM, 12,400 km<sup>2</sup> in the PIPA, and 4,100 km<sup>2</sup> in the American Samoa EEZ, including within the NMSAS.

Throughout the cruise multibeam data quality was monitored in real time by acquisition watch standers. Ship speed was adjusted to maintain data quality as necessary, and line spacing was planned to ensure at least ¼ swath width overlap between lines. Cutoff angles in the multibeam acquisition software Seafloor Information System (SIS) were generally left wide open for maximum exploration data collection and routinely adjusted on both the port and starboard side to ensure the best data quality and coverage.

Multibeam data received real time surface sound velocity corrections via the Reson SVP-70 probe at the sonar head, as well as through profiles generated from Expendable Bathythermographs (XBTs) conducted at intervals no greater than 9 hours or as dictated by local oceanographic conditions. Reson sound velocity values were constantly compared against secondarily derived sound speed values from the ship's onboard thermosalinograph flow-through system as a quality assurance measure.



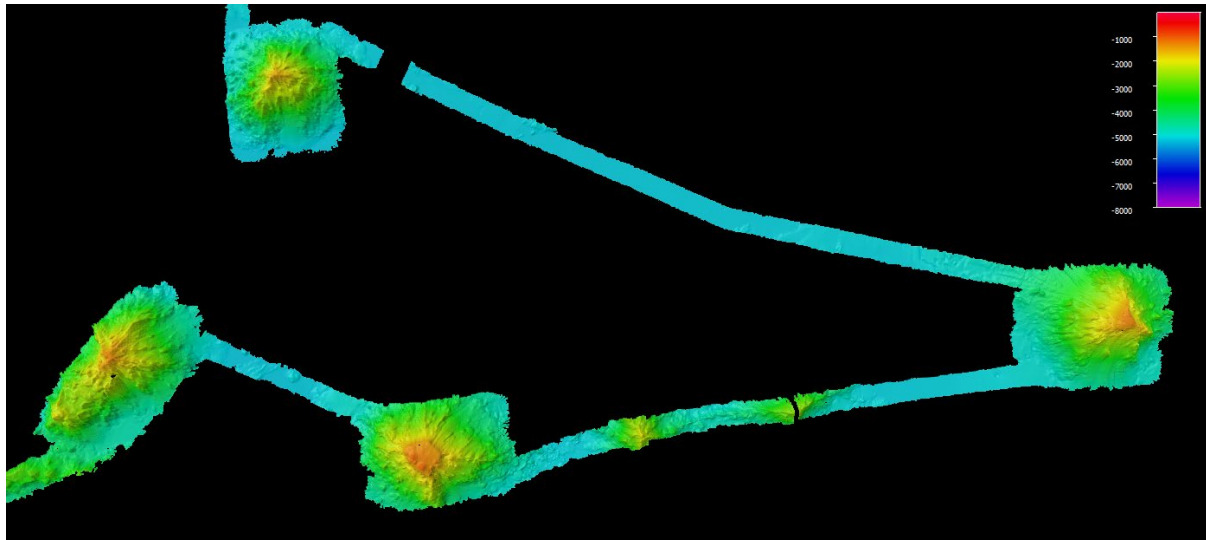


Figure 2. Focused EM 302 bathymetric data collected over 6 seamounts within the Jarvis Island unit of PRIMNM. Vertical exaggeration 3x, 80 m cell size, depth in meters.

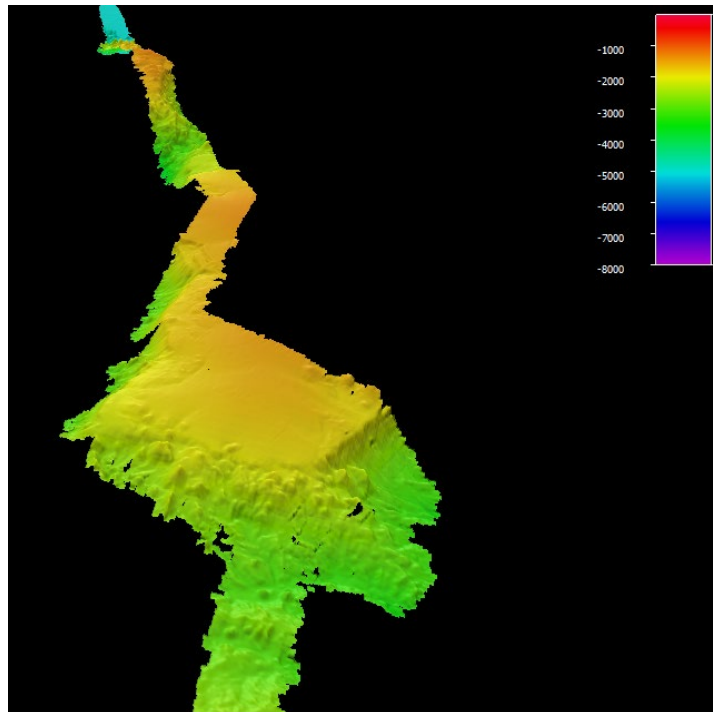


Figure 3. Focused EM 302 bathymetric data collected in the northeastern corner of Kingman Reef and Palmyra Atoll unit of PRIMNM. Vertical exaggeration 3x, 80 m cell size, depth in meters.

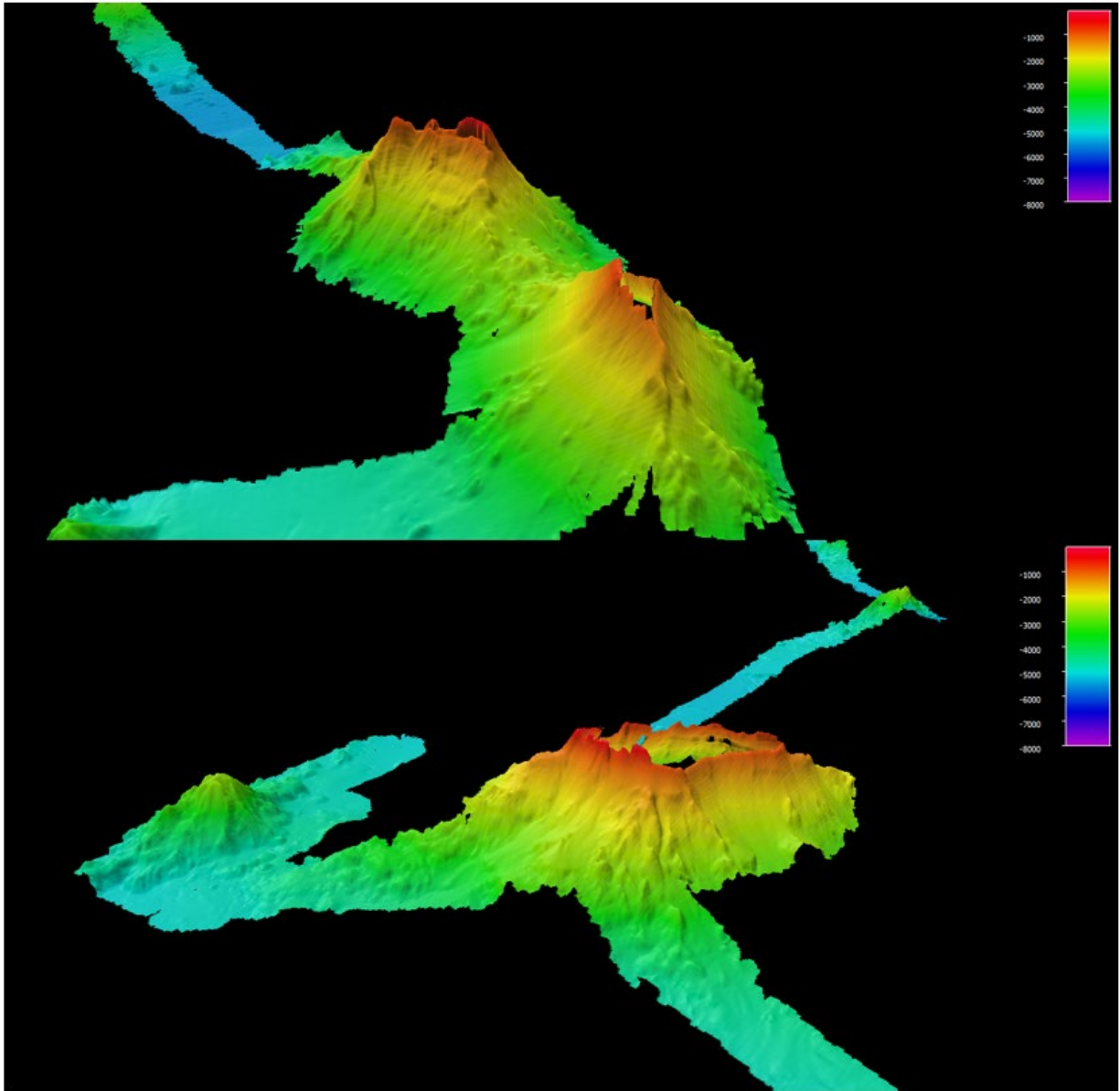


Figure 4. Oblique 3D perspective view of transit and focused bathymetric mapping data around reefs (top), seamounts and Canton Island (bottom) within PIPA. Vertical exaggeration 3x, 80 m cell size, depth in meters.

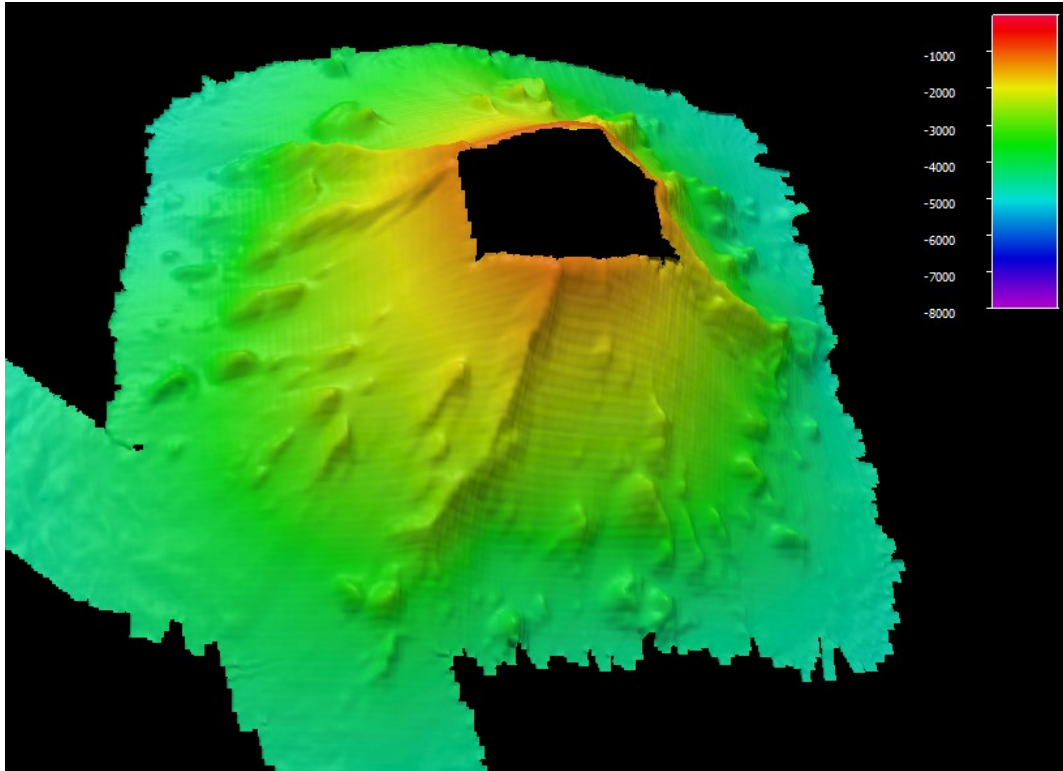


Figure 5. Oblique 3D perspective view of EM 302 data collected around Swains Island (NSMAS). Vertical exaggeration 3x, 80 m cell size, depth in meters.

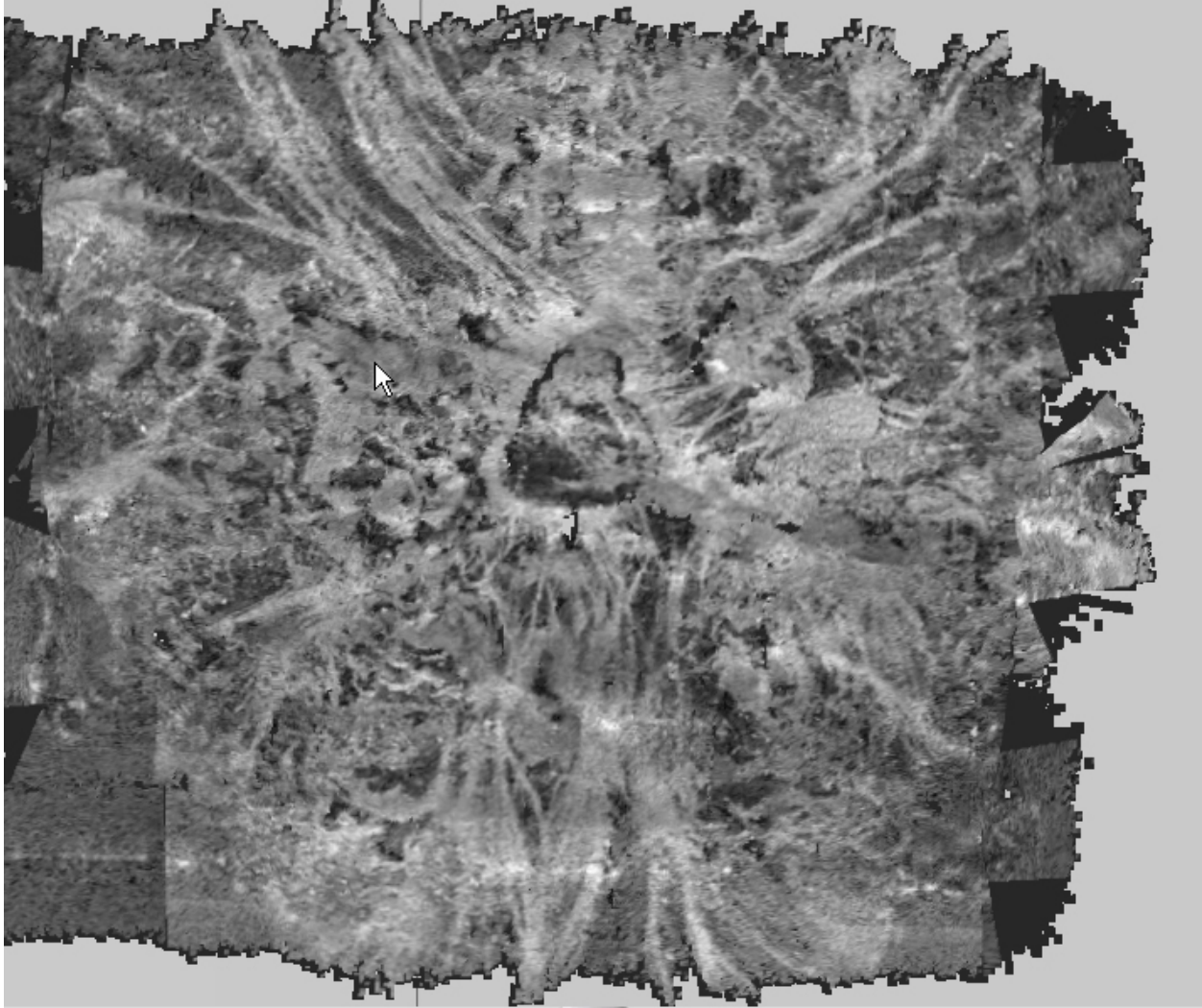


Figure 6. Processed EM 302 seafloor backscatter data collected over an unnamed seamount in the Jarvis Island unit of PRIMNM. Darker areas are less intense sonar signal returns and brighter areas are more intense signal returns.

Simrad EK60 split-beam water column sonar data were collected throughout the majority of the cruise. Data were monitored in real time for quality but were not post-processed. At the time of writing this report, some of the tracklines from the EK 60 \*.raw files were not being extracted correctly and the data was resubmitted to the archives.

Knudsen 3260 sub-bottom profiler data were also collected during the majority of the cruise. Figure 7 shows where sub-bottom data were collected during EX-17-01 (<https://maps.ngdc.noaa.gov/viewers/geophysics/> last accessed April 2020)

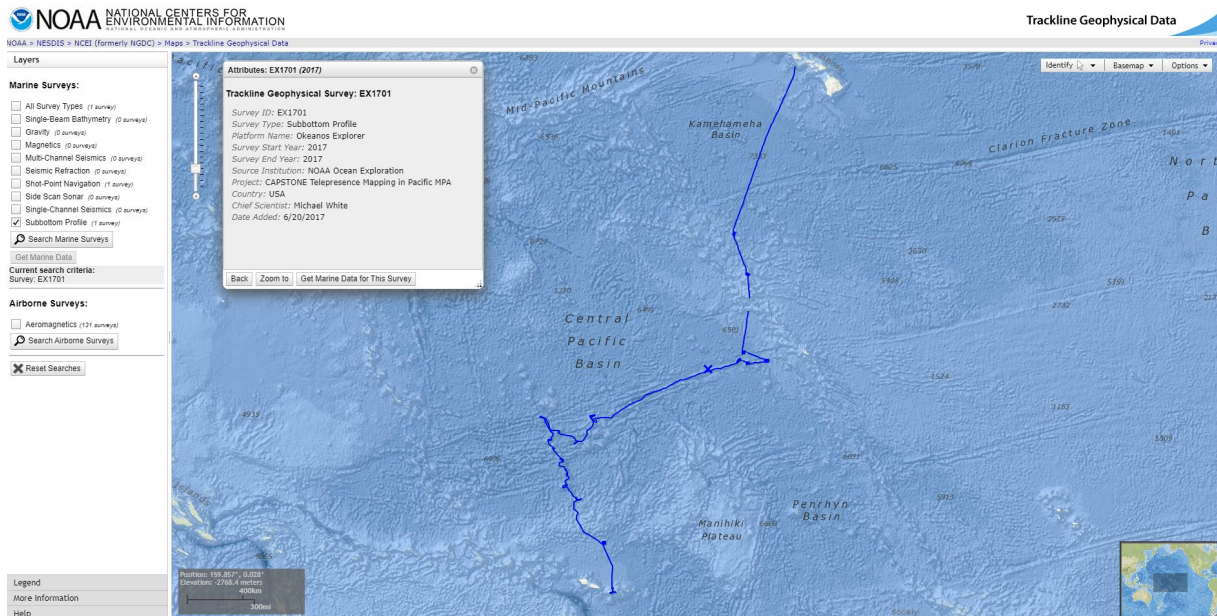


Figure 7. Screenshot of sub-bottom profiler data tracklines (in blue) collected during EX-17-01 from the National Centers for Environmental; Information Geophysical Trackline Viewer.

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

Figure 8 shows the multibeam data processing workflow for this cruise. EM 302 Built-in Self Tests (BISTs) were run throughout the cruise to monitor multibeam sonar system status and are available as ancillary files in the sonar data archives. Raw multibeam bathymetry data files were acquired in SIS, then imported into QPS Qimera for processing. In Qimera, the attitude and navigation data stored in each file were checked, and erroneous soundings were removed using 2D and 3D editors. Gridded digital terrain models were exported utilizing QPS Fledermaus software 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 (CCOM/UNH). With the vast majority of surveying completed in deep water, depth measurements were not adjusted for tides, as they are an essentially insignificant percent of the overall water depth. Data cleaning projects were in UTM zone projections for the operations area. Final data products were exported and archived as field geographic WGS84 coordinate reference frame (i.e., unprojected). EX-17-01 was the first non-shakedown expedition on the *Okeanos* to integrate the Qimera hydrographic processing software and workflows were adjusted and changed as necessary.

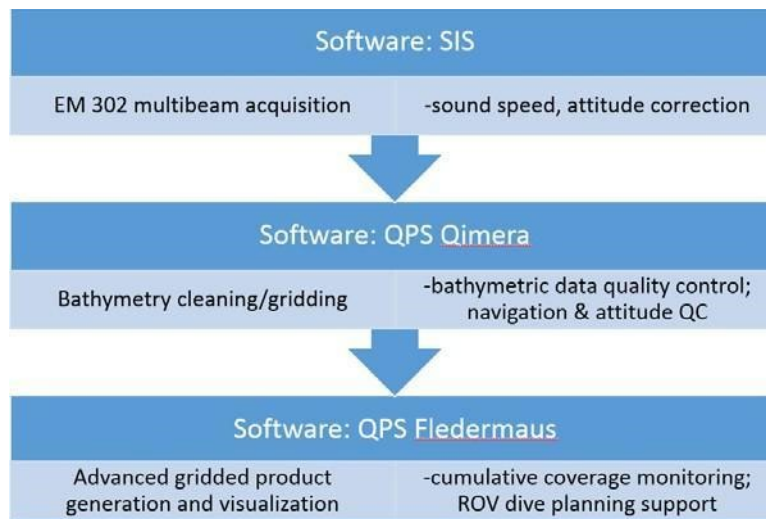


Figure 8. Shipboard multibeam data processing workflow.

### Crosslines

Comparing depth values from orthogonal survey lines is a standard hydrographic quality control measure to evaluate the consistency of the multibeam sonar data collected during a cruise. A crossline was run on February 14, 2017 as shown in Figure 9. Crossline analysis was completed using the Crosscheck Tool in QPS Qimera software to evaluate if the survey meets the requirements for an International Hydrographic Order 1 survey. The results are shown below.

#### Crossline file:

0614\_20170210\_072551\_EX1701\_MB.all

#### Mainscheme line files:

0607\_20170210\_042444\_EX1701\_MB.all

0597\_20170209\_225222\_EX1701\_MB.all

<u>Statistic</u>	<u>Value (in meters)</u>
Number of points of comparison	84310
Grid Cell Size	80
Difference Mean	-6.531363
Difference Median	-6.531363

Difference Std. Dev	14.425903
Difference Range	[-84.15, 94.22]
Mean + 2*Stddev	35.383168
Median + 2*Stddev	35.383168
Data Mean	-2732.302529
Reference Mean	-2725.771166
Data Z-Range	[-3790.05, -1432.59]
Reference Z-Range	[-3791.21, -1442.78]
Order 1 Error Limit	35.438553
Order 1 # Rejected	4493
Order 1 P-Statistic	0.053291
<b>Order 1 Survey</b>	<b>REJECTED</b>

These results confirm that the data collected did not meet International Hydrographic Organization (IHO) Order 1 specifications for data quality. The main scheme and crosslines were run in an area of dynamic depth changes and were collected on days during which sea state and weather were elevated.

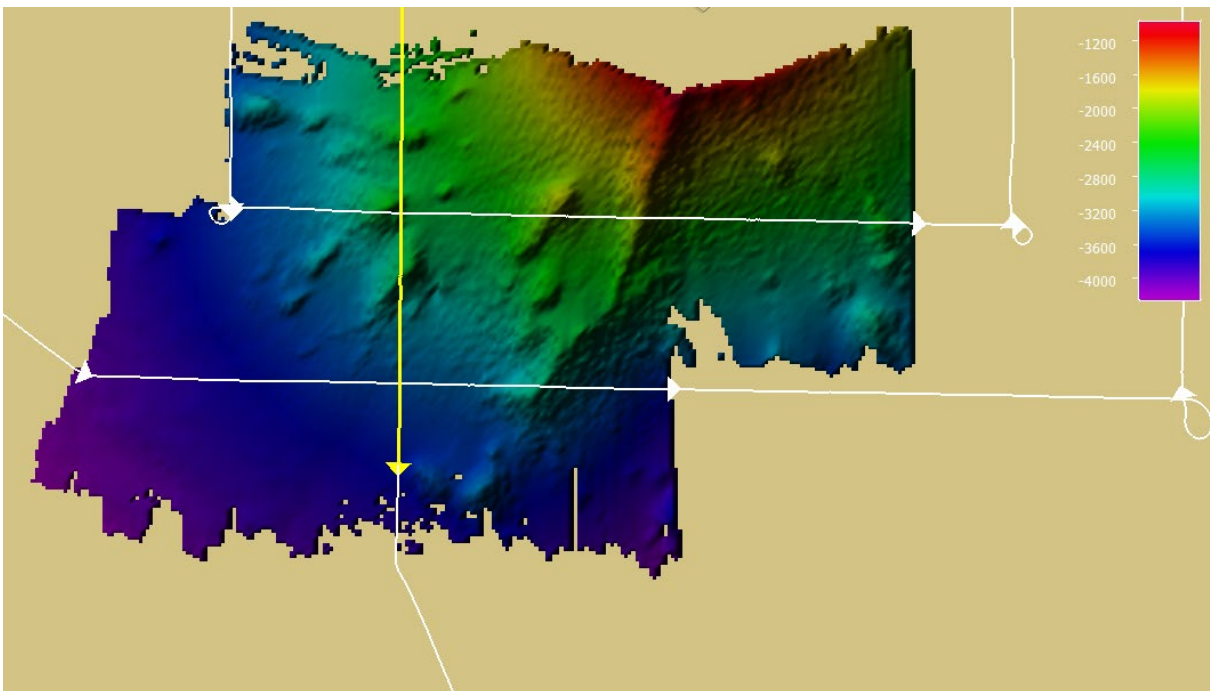


Figure 9. EX-17-01 crossline (shown in yellow) used for comparison against the bathymetric grid generated via orthogonal multibeam survey lines.

## 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-17-01 project instructions, available in the NOAA Central Library here:

<https://repository.library.noaa.gov/view/noaa/14217> (last accessed April 2020).

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)

*Simrad EK60 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)
- Multibeam water column data review log if data were reviewed for presence of seeps in Fledermaus MidWater or QPS Qimera

All sonar data is permanently discoverable at <https://www.ngdc.noaa.gov/> (last accessed April 2020).

At the time of writing this report, EM 302 and EK60 water column data, supporting data, and informational logs were available in the NCEI Water Column Sonar Archives:

[https://www.ngdc.noaa.gov/maps/waer\\_column\\_sonar/index.html](https://www.ngdc.noaa.gov/maps/waer_column_sonar/index.html) (last accessed April 2020). The Digital Object Identifier (DOI) for EX-17-01 EM 302 water column data is: <http://doi.org/10.7289/V5SJ1HSN> (last accessed April 2020).

Sub-bottom data, supporting data, and informational logs will be available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/> (last accessed April 2020). For any challenges accessing SBP data, send an inquiry to [ncei.info@noaa.gov](mailto:ncei.info@noaa.gov) requesting access to EX-17-01 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 April 2020)



## 10. Cruise Calendar

*All times listed are local ship time, -10 hours from UTC*

### January – February 2017

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				19 Mobilization	20 Depart, Honolulu, Hawaii	21 Mapping operations, Argo deployment
22 Mapping operations	23 Mapping operations	24 Mapping operations	25 Mapping operations	26 Mapping operations	27 Argo deployment, mapping operations	28 Argo deployment. Mapping operations
29 Mapping operations	30 Argo deployment, mapping operations	31 Mapping operations	February 01 Arrive, Canton Island, PIPA. Mapping operations	02 Small boat transfer and customs in Canton/PIPA. Mapping operations	03 Mapping operations	04 Mapping operations
05 Mapping operations	06 Mapping operations	07 Mapping operations	08 Mapping operations	09 Mapping operations	10 Mapping operations	11 Arrival, Pago Pago, American Samoa



## 11. Daily Cruise Log Entries

***Generated from the daily expedition situation reports. All times listed are in local ship time (-10 hours from UTC)***

### ***January 19***

Mobilization in Honolulu, Hawaii. Survey department worked on various hardware and software tasks to continue to prepare for the first half of the field season. The Keyboard Video Mouse (KVM) switches continued to be tested as various stations and software were opened and tested. The KVM continues to perform well.

The new Fast Response Boat (FRB) was put in the water and was driven to the EX. The davits and fittings have been squared away and the new FRB is onboard and operational.

Caris licenses have been installed and updated. While Caris will no longer be the primary software for hydrographic processing, there is consideration of using it for generating detailed line queries. Otherwise this information will have to be manually entered in the log.

A Pelican case was purchased to transport the replaced EM 302 receive (RX) board back from American Samoa. The case will be hand carried back to CCOM/UNH.

Explorers-in-Training (EiTs) have begun orientation and training.

### ***January 20***

Depart Honolulu, Hawaii.

The EM302 swath width continues to be much less than the predicted swath width for the range of depth the ship is transiting in, by around 35-40%. The reason for this is unknown.

The live mosaic display using the SMD University of HI software (XQuartz) is now working and updating with the real-time mosaic display. The standard operating procedure (SOP) will be updated to reflect datagram changes and settings.

The “old” XBT gun is being used to collect sound velocity profile (SVP) data. One of the objectives of this cruise will be to develop a workflow from the XBT auto launcher to Pydro Velocity or Sound Speed Manager (SSM) in order to automate this process.



After some failed built-in self-tests (BISTs) in the last several days, the first BIST was passed upon starting the EM 302. The survey team will continue to monitor connections with the Transmit-Receive Unit (TRU).

The Scientific Computer System (SCS) was not finding the full set of environmental parameters it needs and was only seeing the parameters designated for the sonar. This may have been the result from changing the physical wiring of the cables between the EM 302 and SCS data input boxes.

The ADCPs were turned on at the dock and new settings were applied. The ADCPs recorded the transit out of Honolulu until the ship reached a depth of 1000 m and were secured. The data collected from this exercise will be used to evaluate alignment angles. The power cable to the ADCP unit in the rack room was found unplugged and it was later discovered one of the POS MV wire feeds was loose. The wire connections should be examined before ADCP use.

### ***January 21***

After a complete 24 hour mapping and testing period the KVM system continues to perform well.

The SCS issues have been addressed and remedied. The causes were carry overs from a recent update that was pushed to the system without clearly being communicated to the Survey Technician (ST) and Electronic Technician (ET).

The EK60, now being run using the EK80 software, is also now communicating with the SCS. After some modifications in the software it is now sending the correct data string.

The EM 302 swath width concern has been addressed. It may have been a combination of factors including but not limited to speed, bottom type, bottom relief and/or certain runtime parameters. These issues will be watched closely during focused mapping operations.

The data team onshore is having difficulty communicating to the data warehouse. This may be associated with the wireless drop outs on the ship. The VSAT is on and working but the public ports on the router do not seem to be sending data.

The Explorers-in-Training (EiTs) continue to be trained in using and processing XBT SVPs and have begun processing multibeam data in Qimera.

Tomorrow the mapping team is planning to deploy the first of 4 Argo floats on EX-17-01.

### **January 22**

The EX continues on its transit to the first Red Dot seamount mapping target.

The first Argo has been deployed.

Using the “Export to .csv Format” plugin that QPS put into the EX Qimera software during EX-16-09, the processed multibeam line metadata can be exported to the log sheet. This process is analogous to the “Detailed Line Query” found in Caris and streamlines acquisition/processing log recording.

Training continues for EITs with data acquisition and processing with Qimera.

### **January 23**

The team is currently working on integrating the automatic XBT launcher from NOAA’s Atlantic Oceanographic and Meteorological Laboratory (AOML) into our workflow. Part of the challenge is that the XBT auto launcher is designed to work on large container ships, remotely, with little to no adjustments once set up. The vision for the *Okeanos Explorer* (EX) would be a more manual interaction with the software, triggering launches at will with a streamlined interface. An additional challenge is the exported file format which is currently not supported by the EX’s sound speed profile processing software (.bin files and Velocity). And finally, the CTD computer is simply running out of communication ports, which means switching ports for what is now four systems (XBT, Auto XBT, Underway CTD, and CTD+Rosette).

The mapping team continues training on Qimera. A running list of issues/questions will be communicated to QPS individuals. The team is also working on a “wish list” of functionalities.

Science equipment in the wet lab has been secured for sea.

EITs have begun planning and working on their capstone projects.

Seas are diminishing as we head further south. Late tonight the EX will start its transit to Northern Kingman/Palmyra seamount.

### **January 24**

The EX is transiting south/southeast to Northern Kingman Seamount. This will be the area for the second focused survey. Seas are diminishing as the EX transits further south.

The Permits for PIPA/ Kiribati have been received.

The XBT autolauncher continues to be addressed.

### ***January 25***

The EX is currently transiting through Kiribati territorial waters. All sonars and science equipment have been secured since the EX does not have permits to acquire data. The EX completed its survey on the North Kingman seamount and is transiting towards the Jarvis Seamounts.

Planning and preparation continue for the Canton port call. There are some biosecurity issues that need to be addressed as well as small boat logistics.

ST, ET and the data management team are in communication about SCS data that is not getting pushed to the warehouse. This might be an unresolved issue from the recent update that had caused some issues earlier in the cruise or a hardware change. Since the EX is not acquiring data, now is a good time to address this issue.

ADCPs are running in passive mode.

Letters of Departure have been delivered to the science team.

EX-17-01 track line adjustments continue with the potential of making port in Pago Pago on the 11<sup>th</sup> of February.

The running list of Qimera issues/wishes have been communicated to QPS developers. Further communication to follow.

Progress is being made on the XBT auto launcher. Currently the EX team is looking to see if the device can be accessed through a hyperlink terminal.

The SOPs for XQuartz (real-time mosaic software) and GNSS Azimuth Measurement System (GAMS) calibration are currently being updated.

### ***January 26***

The mapping team has started about 2.75 days of focused mapping on the Jarvis Seamount.

The EITs were trained on the Sun Photometer today. Hopefully sea state and weather the rest of the trip will be conducive for continued measurements.

SCS communications with shore were repaired.

EX-17-01 track line adjustments continue with the potential of making port in Pago Pago on the 10<sup>th</sup> of February.



### ***January 27***

After extended communications with AOML, the XBT auto launcher is now performing casts as intended. The next challenge is getting the profile exported to a format that can either be read directly into SIS or into Velocipy (Pydro). A SOP is being put together. The team is very pleased to have reached this point. GPS data can be updated manually.

In addition to using the XBT auto launcher for EX data acquisition, the raw profiles can also be automatically sent to AOML and it archives. This will provide AOML with additional water column data from the remote geographic areas the EX travels to - another potential project where the EX can act as a ship of opportunity.

The EITs continue their training on the EX's sonar acquisition systems.

### ***January 28***

The EX has completed its surveys on the Jarvis area seamounts and is now transiting along the Nova-Canton Fracture Zone. The suggested transit speed was set 0.5 knots slower than usual as to improve the quality of data acquisition over interesting features.

### ***January 29***

Mapping operations, no updates.

### ***January 30***

The EX is transiting along the Nova-Canton Fracture Zone and will arrive in the vicinity of Canton Island (PIPA) in about 2.5 days. EX personnel have been in communication with the PIPA contacts.

The file format issue for the XBT autolauncher is being followed both with the Amverseas software developers and Velocipy developers.

Argo 3 has been deployed.

### ***January 31***

The file format issue for the XBT autolauncher is being followed up with both with the Amverseas software developers and Velocipy developers. Both groups are now in touch to enable functionality of the exported files from Amverseas into Velocipy/SSP Manager.

For Canton customs tomorrow the EX will be using small boats to pick up the customs official(s) from Canton and transport them out to the EX where they will perform their inspection of the EX, including permits and biosecurity protocols. The supplies brought



by the EX will then be transported with the officials back to Canton. Once the small boat is secured, the EX will head straight down to the “Hadal Hole” survey area.

A fire alarm sounded from the winch room, prompting a general alarm. Fire was reported from a valve on an oxyacetylene bottle. The valve was secured and the fire was put out. Ventilation was secured and muster was completed. Ventilation of the affected space was begun and after a second muster was completed, the EX was secured from the fire alarm.

### ***February 01***

The EX arrived in Canton and pulled in close to the western side near the recommended channel area. Conditions were poor and the small boat transfer was postponed. The EX then pulled away from Canton and began surveying around Canton, completing two encircling surveys following the 1 nm and the 3 nm boundaries. Tonight the EX will follow a planned survey over the seamount just north of Canton. Additional specifics, including tides, currents, recommendations from pilots who have been in and out of Canton, and communications have been evolving throughout the day. Alternative line plans are being considered with the increased time spent near Canton.

The Trigger Jigger sonar synchronization device power cord became disconnected from the device – the connection itself structurally failed. The Trigger Jigger allows the ship’s sonars to communicate so they will not interfere with each other. While the Trigger Jigger was being repaired, the EK60 and Knudsen sonars were secured. After a series of trial repairs and swapping devices, the current device is now working.

The POS MV computer in the Wetlab lost connection and the POS MV had to be restarted. POS MV was still operational and feeding into its clients. The restart was done as the ship was standing by for the small boat transfer. The Ethernet cord connected to the POS MV computer was held in by insufficient means. The situation has been remedied.

The Seafloor Information System (SIS) software froze and crashed unexpectedly today. Telnet and SIS were restarted and we have been unable to find any reason for the crash. A BIST was run and passed.

The data team onshore is having trouble communicating with the warehouse computer. This may be due to network issues as a result from the change to onshore control.

### ***February 02***

The EX arrived near Canton early on 02/02/17 around 0900 (-10 hours from UTC). As the EX passed the NW side of the island, pyrotechnics and the ship’s horn were used to



make our presence known. Shortly following this display the Bridge began to hear some radio transmissions from Canton. Over the last 24 hours there has been no contact from the island nor were there any signs the inhabitants were aware of our presence. Having markedly improved conditions, especially visibility, the EX stationed itself in Dynamic Positioning (DP) mode and dropped a small boat in the water. The small boat transited through the western channel with the crew and science passports and the purchased supplies (along with some books/crayons and copies of “How We Explore”). Unable to land due to the biosecurity protocols and unable to tie-up to a pier or dock due to lack thereof and conditions, the small boat crew identified the Canton customs official and held station as he swam out to the boat. All customs paperwork was completed alongside the small boat and the supplies were carried/floated onshore. The small boat returned safely to the EX around 1300 (-10 hours from UTC), was secured and the EX left Canton around 1500 (-10 hours from UTC) having successfully cleared customs.

The EX will arrive in Pago Pago early in the am at the sea buoy on the 11<sup>th</sup> of February.

The XBT auto launcher is now fully functioning. When the EX was holding position near Canton, CET connected the live GPS feed into the Amverseas program. ST is completing an SOP of the auto launcher and associated software. Casts are now being completed and the nuances of the hardware/software have been identified and documented.

Communication with AOML Amverseas developers and the developers behind Sound Speed Manager/Velocipy/Pydro Office) has successfully ended with a file reader that will take the exported ASCII text files from Amverseas and convert and load the files into Sound Speed Manager. The file reader is now available in the latest version of Sound Speed Manager (SSM). SSM will then apply salinity to the temperature profile and calculate a sound speed profile which can then in turn be exported to an .asvp and applied to the multibeam in SIS. The only caveat to this workflow is that SSM uses historical/modeled salinity measures to combine with the XBT temperature profile to calculate sound speed. The MK21 Sippican software has an input for salinity from field measurements, but it is only one input.

### ***February 03***

Mapping operations, no updates.

### ***February 04***

The EX is transiting over the western PIPA seamounts. For this transit the ship’s speed will be reduced to survey speed since these seamounts are all potential future dive sights.

### ***February 05***



The EX is complementing historical bathymetric datasets over the western PIP seamounts as well as transiting over interesting features for preliminary dive planning. Seas are elevated and are affecting the data with certain headings.

The EX is about 43 hours away from entering Tokelau waters. As per the permit conditions, approximate time and location of entry are being sent to Tokelau officials. Daily updates of time and position when transiting through Tokelau waters will also be sent off ship.

Sun Photometer data have been downloaded and sent. The serial cable has been plugged into the ST computer since plugging it in to the CTD computer would require a good deal of cable swapping.

### ***February 06***

The EX is finishing its surveys on the western PIPA seamounts and will transition into Tokelau waters later today.

A review presentation of the ship's scientific equipment was given to the crew with good attendance from the Bridge, Deck, and Engineering departments.

The XBT auto launcher can now be used to generate sound velocity profiles for sound speed corrections applied to the multibeam in SIS

### ***February 07***

The EX is mapping the northern Tokelau seamounts. Overall systems are functioning smoothly.

The first sound velocity profile generated from the automatic XBT launcher was applied to the multibeam data in SIS.

### ***February 08***

Mapping operations, no updates.

### ***February 09***

The EX has left Tokelau water and is running survey lines on the flanks of Swains Island. Once completed, the EX will begin the final transit of EX-17-01 to Pago Pago, AS. At the end of the transit the EX will gather sonar data near the Anu'u Unit of NMSAS.

### ***February 10***

The EX is transiting south to Pago Pago. Once there, the EX will run survey lines southeast in and around the Anu'u Unit.

## **February 11**

Arrive Pago Pago, American Samoa. Demobilization, systems secured.

## **12. References**

NOAA Office of Ocean Exploration and Research, 2017. The 2017 NOAA Ship *Okeanos Explorer* Survey Readiness Report NOAA is available at the NOAA Central Library

NOAA Office of Ocean Exploration and Research, 2017. EX-17-01 Project Instructions: <https://repository.library.noaa.gov/view/noaa/14217> (last accessed April 2020). The EX-17-01 Data Management Plan is an appendix of the project instructions.

NOAA Office of Ocean Exploration and Research, 2016. The 2017 EK60 Calibration Report can be obtained by contacting [oar.oer.exmappingteam@noaa.gov](mailto:oar.oer.exmappingteam@noaa.gov).

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<https://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml>, (last accessed April 2020)

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