W00418

NOAA Form 76-35A

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Survey

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	W00418

LOCALITY

State:	California
General Locality:	Channel Islands
Sub-locality:	Vicinity of Santa Cruz Basin

2017

CHIEF OF PARTY
Andrew A. Armstrong

LIBRARY & ARCHIVES

Date:

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET		**W00418**

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

State:	**California**
General Locality:	**Channel Islands**
Sub-Locality:	**Vicinity of Santa Cruz Basin**
Scale:	1: **10,000**
Dates of Survey:	**05/05/2017 to 05/12/2017**
Instructions Dated:	**N/A**
Project Number:	**OSD-PHB-17**
Field Unit:	**E/V *Nautilus***
Chief of Party:	**Andrew A. Armstrong**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to provide full coverage hydrographic data to inform marine management decision making. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Envitronmental Information (NCEI) and can be retrieved via http://www.ncei.noaa.gov/.

Descriptive Report Summary to Accompany **W00418**	
Project	OSD-PHB-17
Survey	W00418
State	California
Locality	Channel Islands
Sub Locality	Vicinity of Santa Cruz Basin
Scale of Survey	1:10,000
Sonars Used	EM302
Horizontal Datum	North American Datum of 1983 (NAD83)
Vertical Datum	Mean Lower Low Water (MLLW)
Vertical Datum Correction	Verified Observed Tides
Projection	UTM Zone 11N
Field Unit	E/V *Nautilus*
Survey Dates	05/05/2017 – 05/12/2017
Chief of Party / Data Originator	Ocean Exploration Trust http://www.oceanexplorationtrust.org

A. Area Surveyed

This hydrographic survey was acquired by the Ocean Exploration Trust (OET) on the E/V *Nautilus* south of the Channel Islands, off the coast of Santa Barbara, California. The area was surveyed with a Kongsberg EM302 between May 5th 2017 and May 12th 2017. The NOAA Hydrographic Specification and Deliveries Manual and the NOAA Field Procedures Manual were not requirements of this cruise.

Data was acquired within the following survey limits:

Northwest Limit	Southeast Limit
33.95 N	33.17 N
120.47 W	118.72 W

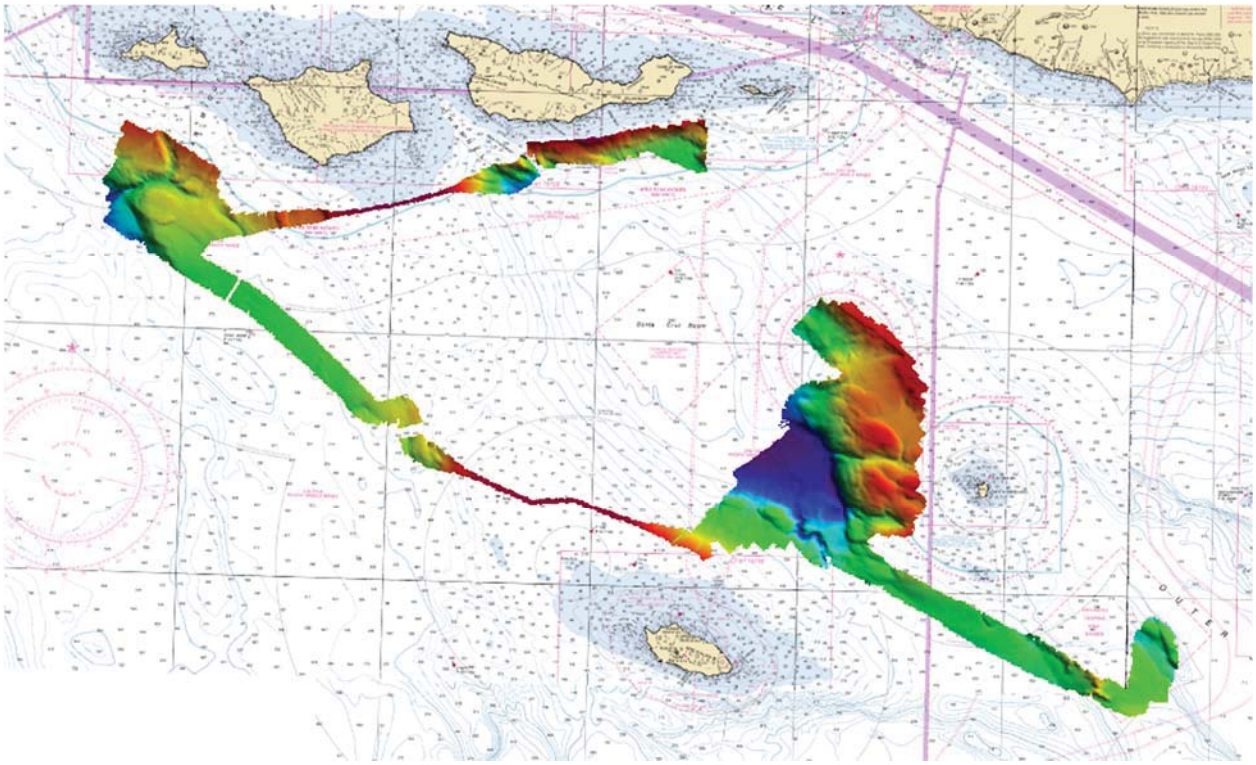


Figure 1 W00418 survey coverage. Depth Range 80 m – 1,766 m. Background chart 18720 1:232,188 and 18740 1:234,270.

B. Survey Purpose

In partnership with the NOAA Channel Islands National Marine Sanctuaries (CINMS), the Ocean Exploration Trust acquired exploratory mapping data of geological and geophysical aspects of the region, while covering areas not recently acquired with modern day survey techniques, in an effort to fill in gaps identified by the Southern California Seafloor Mapping Initiative. The CINMS and NOAA National Center for Coastal and Ocean Science (NCOSS) started the Southern California Seafloor Mapping Initiative (http://sanctuaries.noaa.gov/science/conservation/pdfs/seafloor-mapping-initiative.pdf) to identify areas that need to be mapped with modern hydrographic methods and organize resources to coordinate closing those gaps. Accurate, full coverage data is critical for informing marine management decision-making. The Office of Coast Survey is contributing to this initiative by post processing the Ocean Exploration Trust data for application to the chart and for use by NCCOSS and the CINMS.

C. Intended Use of Survey

Data is adequate to supersede prior data and is intended for chart compilation, pending results of comparison with NOAA Ship *Rainier* data, as discussed in Section G.

D. Data Acquisition and Processing

The Joint Hydrographic Center Integrated Ocean and Coastal Mapping Group received raw and processed data from the Ocean Exploration Trust and various reports including: instrument lists and calibration reports, equipment wiring diagrams, vessel survey report, and the most recent Multibeam Advisory Committee (MAC) System Review report from 2015. These reports have been included in the data submission.

The following equipment was used during the survey.

Task	**Equipment**
Sonar	Kongsberg EM302 (30 kHz)
Positioning Sensor	Kongsberg SeaPath 330+ GNSS Antennae
Motion Sensor	MRU 5+
Surface Sound Speed Sensor	AML Oceanographic Micro-X
Sound Speed Sensor	Sippican Expendable Bathythermograph (XBT)
Acquisition Software	Kongsberg Seafloor Information System (SIS)
Processing Software	Qimera

Processed GSF's, exported from Qimera, were received with the data package and opened in Caris Hips and Sips 10.2 for further processing for ingesting into the charting pipeline, including tide correction, cleaning, and variable resolution grid generation.

Sound speed data was collected and applied during acquisition. Sound speed data are stored in the raw ALL files. No major sound speed errors were found in the dataset, however some lines demonstrate minor refraction artifacts.

Crosslines were collected as part of the data set, and make up 3 % of total survey lines.

Transit lines were included to maximize data potential. The transit lines have heave artifacts and some sound speed errors, however considering the deep depths and that the coverage is more substantial than that provided in the chart, they have been retained. They also provide more opportunity for overlap with other surveys for depth validation.

The E/V *Nautilus* logged turn data between lines as separate files, which were included in the data submission. These files were omitted from the final grids, but are retained with the data.

Data was filtered to a 65 degree swath to remove poor quality outer beam data.

Survey speeds were between 7 and 10.6 knots, including transit lines.

E. Uncertainty

The EM302 is a deep water multibeam with a reported depth range of 10 to 7,000m. A portion of the data within the survey area falls within the lower range of the survey system. In these areas the data artifact, “Eric’s horns,” appear where noise presents itself in the transition between phase detections and amplitude detections. This noise was cleaned out where it was represented in the CUBE surface.

Another artifact presented itself in the data as raised along track bumps at nadir on downward slopes, as seen in Figure 2. These artifacts have been manually cleaned from the data, which in many areas resulted in holidays, particularly on transit lines with no other overlapping coverage. These holidays are not a concern considering the deep depths of the survey. This artifact was most likely caused by the sonar tracking a side lobe at nadir due to the penetration filter set too high.

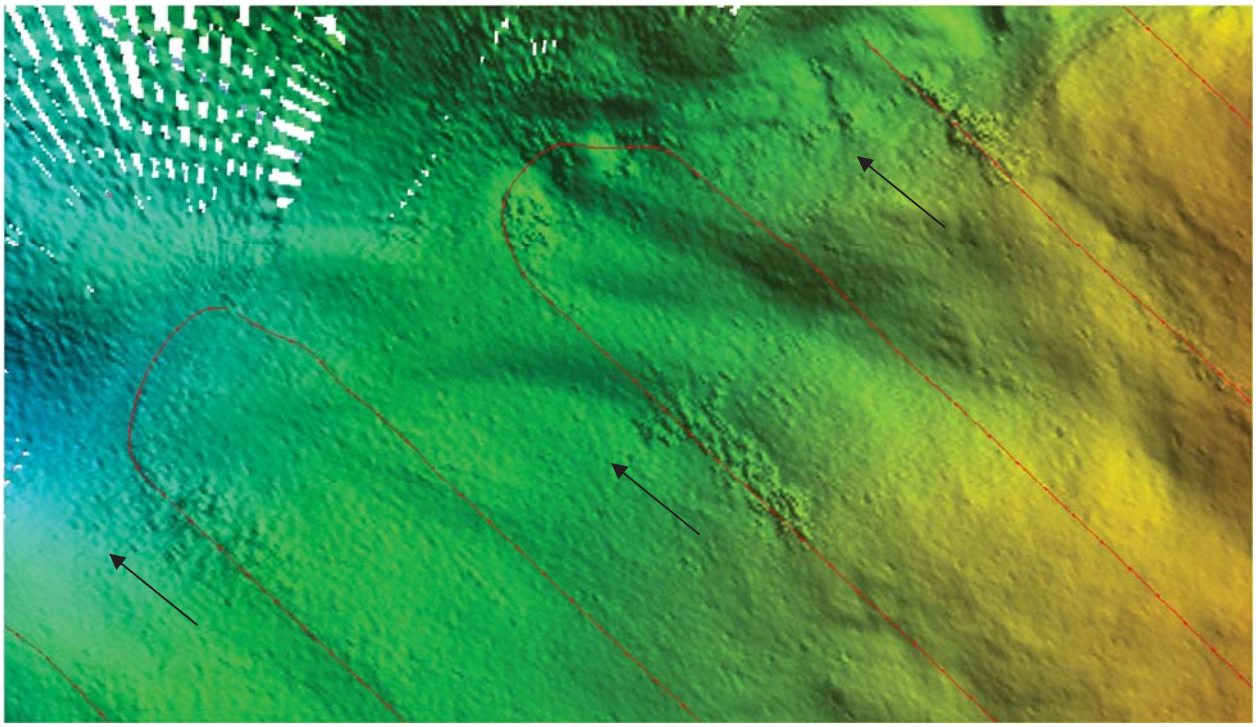


Figure 2 Data artifact as seen in surface before being cleaned from data. It appears at nadir on downward slopes.

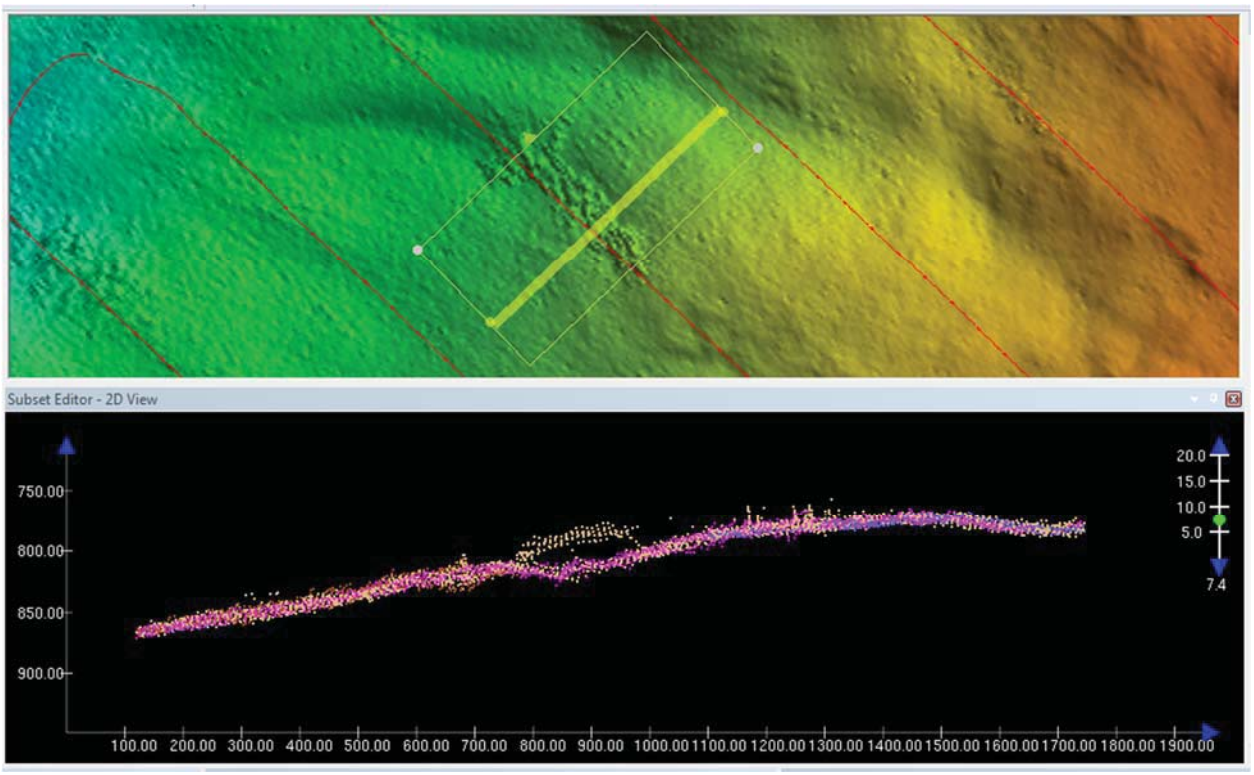


Figure 3 Nadir data artifact as seen in the swath profile cross section in Caris, appearing in one line and not the others, as raised data points disconnected from the bottom.

A variable resolution grid was generated from the data in Caris Hips and Sips 10.2, as described in section F. Chart Comparison. The data density of those grids meets Office of Coast Survey's data density requirements of 95% of nodes having five soundings for more.

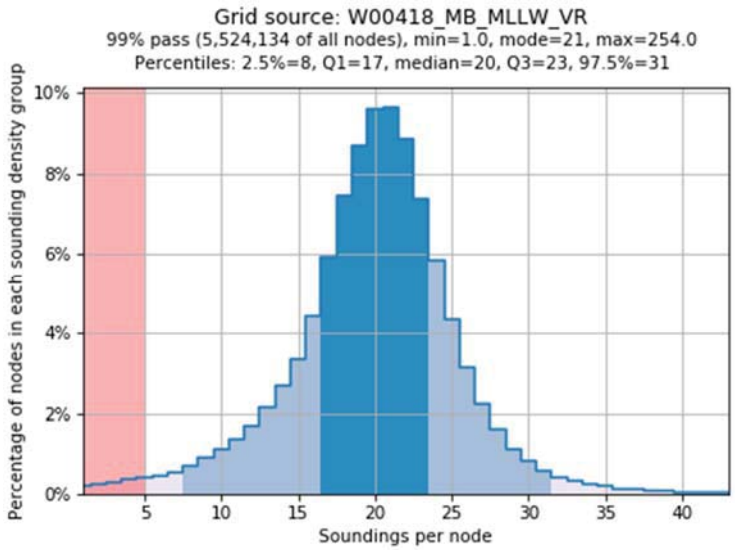


Figure 4 Histogram generated by QC Tools show that 99% of nodes with the variable resolution grid have five soundings or more.

The data meets IHO Order 1b accuracy standards.

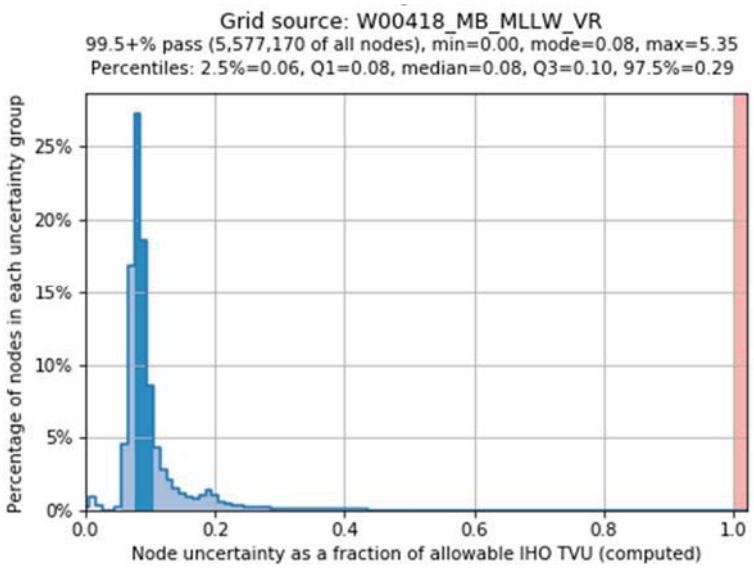


Figure 5 Histogram generated from QC Tools show that 99.5% of nodes meet IHO Order 1b uncertainty standards.

Concur with clarification. The tool used above measures the IHO TVU for both Order 1b and Order 2 depending on depth.

F. Chart Comparison

The following are the largest scale Electronic Navigational Charts (ENC) and Raster Navigational Charts (RNC), which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date
US3CA69M	1:232,188	21.4	2/1/2017	6/21/2017
US5CA64M	1:40,000	9	10/6/2017	10/6/2016
US5CA66M	1:40,000	3.1	10/6/2017	10/6/2016
US5CA67M	1:40,000	3.1	9/22/2016	9/22/2016
US3CA70M	1:234,270	34.4	4/27/2017	9/1/2017

RNC	Scale	Edition	Edition Date	LNM Date	NM Date
18720	1:232,188	34	7/1/2013	8/15/2017	7/22/2017
18727	1:40,000	12	7/1/2004	8/15/2017	7/22/2017
18728	1:40,000	9	11/1/2004	8/15/2017	7/22/2017
18729	1:40,000	13	10/1/2005	8/15/2017	7/22/2017
18740	1:234,270	45	1/1/2017	8/15/2017	8/19/2017

The boundary between UTM zones 10N and 11N runs between the middle of the survey area, along the 120°W meridian, on the east side of Santa Rosa Island. UTM zone 10N was used to grid the data as the majority falls within this zone.

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter
W00418_MB_MLLW_VR	CSAR	4 to 32 m	80 – 1,766 m	CUBE

The original surfaces were Variable Resolution Surface using CARIS Density and CUBE parameters. Because the data had minor cleaning occur during office review, the reviewer created new variable resolution surfaces utilizing the guidance outlined in HTD 2017-2 CARIS VR Grids. The reviewer utilized the Calder-Rice method which had very similar results to the CARIS Density style grids. The surface was also finalized to ensure the "greater of the two" were selected for the uncertainty value. The resolution of these surfaces range from 2.19m-32m and the depth range is comparable to what is reported above.

The survey covers an area of predominantly sparse chart soundings (Figure 6), collected before 1937 with partial bottom coverage. High variability is observed between charted soundings and survey soundings, with some soundings agreeing well and some areas different by 50 -100m (Figure 7), due to the highly irregular and deep nature of the seabed in the area. The data presently supporting the ENC in areas of overlap was collected with hand lead, machine soundings, wire frame and fathometer, as documented in the H05773, H06260, H06259 and H06258 Descriptive Reports. Large discrepancies throughout the survey exist between charted and W00418 survey depths.

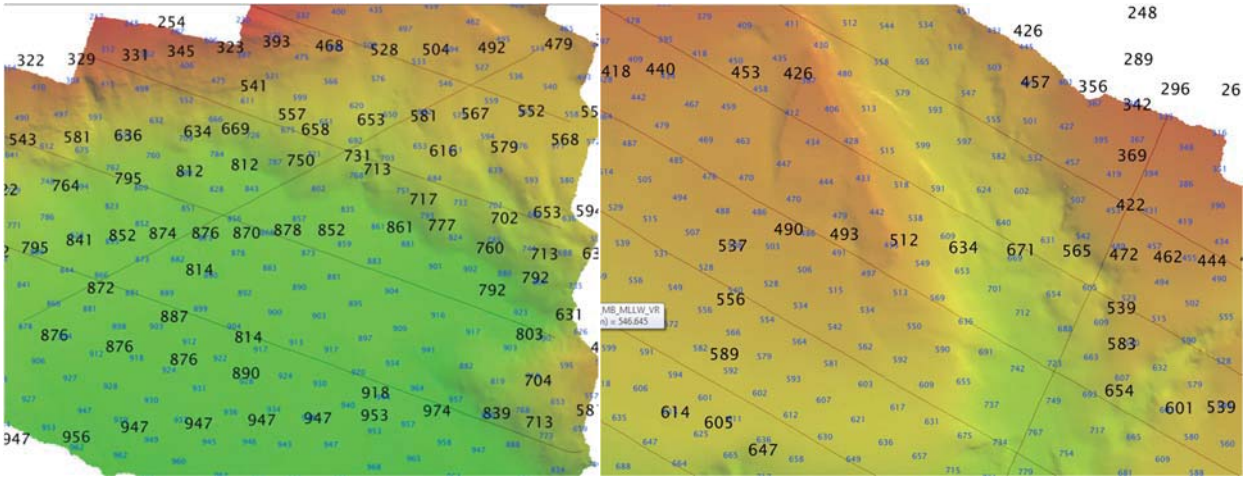


Figure 6 Survey W00418 provides more complete coverage in deep waters, compared to largest scale chart soundings (black) from ENC US5CA67M, 1:40,000 (left) and US5CA64M, 1:40,000 (right). The blue soundings were generated from the survey grid. Sounding depth in meters.

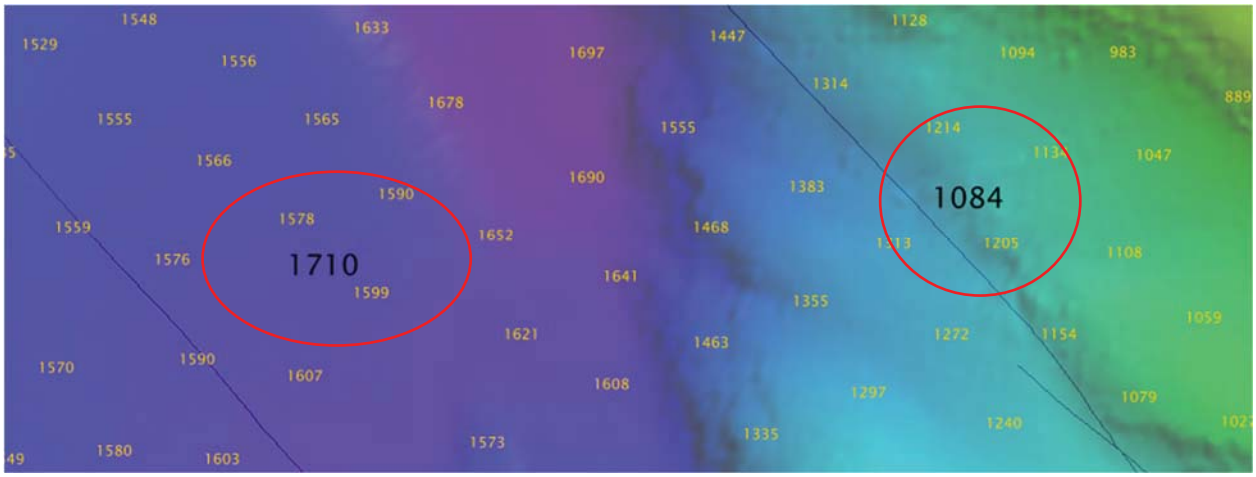


Figure 7 The ENC soundings (black) in deep water were found to be significantly different than survey soundings (orange), by up to 100m. Sounding depth in meters.

G. Comparison with Adjacent Surveys

Several modern multibeam surveys collected by other NOAA organizations, including the Office of Ocean Exploration and Research and the NCCOS Biogeography Branch, overlap W00418. These surveys are not NOAA charting hydrographic surveys, but have potential to be used for the chart based on the age and coverage of current chart data. Depth comparison was performed between W00418 and these surveys to assess vertical accuracy. The comparisons resulted in a variety of vertical offsets, with average differences ranging from -1 m to 5 m, discussed below. It was requested that the NOAA Ship *Rainier* collect chart quality data over these surveys as a Field Investigation to validate depths and clarify data quality issues. *Rainier* is scheduled to survey in the Channel Islands in the fall of 2017 under project number OPR-L397-RA-17. Any crosslines run will be under Field Investigation D00228.

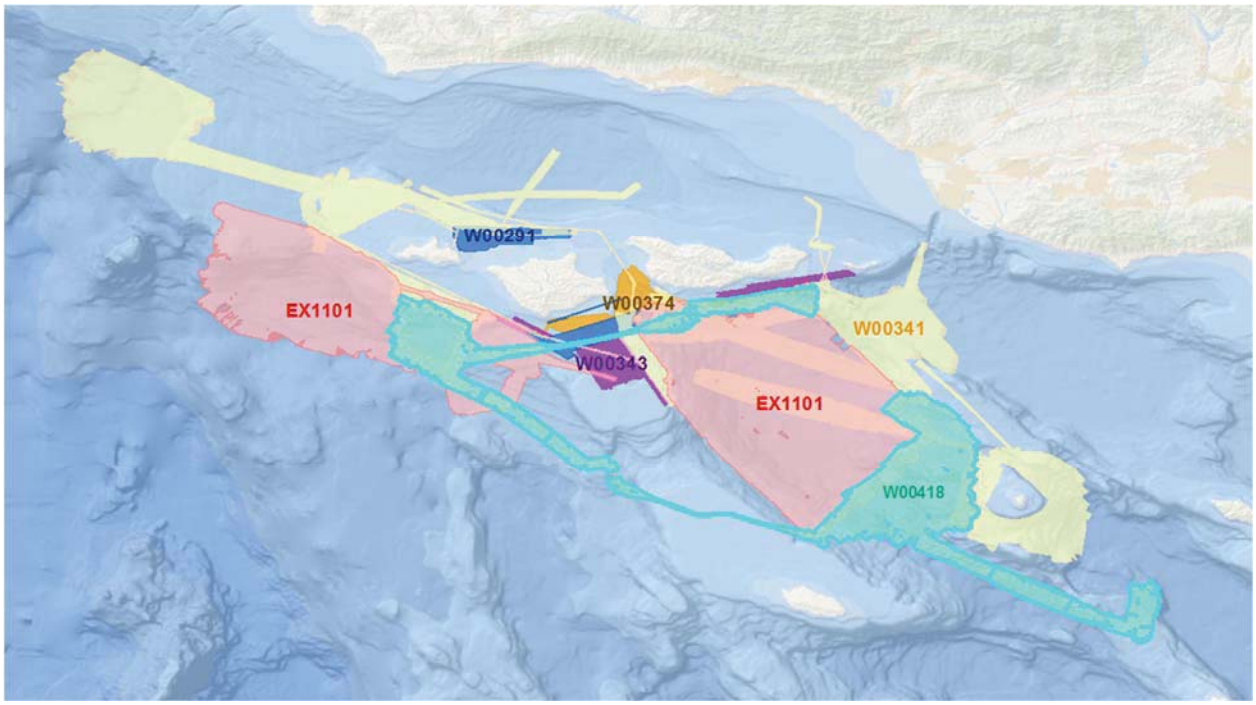


Figure 8 Recent multibeam surveys with regions of overlap with W00418 (turquoise polygon) used for difference comparison.

The following was found when comparing W00418 with multibeam surveys in Figure 8. Unless otherwise noted, the resolutions of comparison grids were the same.

W00341:

W00341 was collected by the E/V Nautilus the previous year (2016) in the Channel Islands.

Nautilus Grid	Resolution	Average Difference	Standard Deviation	Deeper
W00341 East	16 m	**-0.4 m**	3.2 m	W00341
W00341 West	16 m	**-0.2 m**	1.4 m	W00341

EX1101:

The 30 m EX1101 *Okeanos Explorer* grid (not corrected for tides) was compared with a 16 m W00418 *Nautilus* grid. Depth discrepancies were observed in areas of steep slopes, the outer beams due to refraction errors in the EX survey, and a surface artifact from the EX survey consistent with EX line direction.

Okeanos Grid	Resolution	Average Difference	Standard Deviation	Deeper
EX1101	30 m	**0.0 m**	4 m	Undetermined

W00343 (RL-16-06):

The NOAA NCCOS Biogeography Branch performed a survey with the Kongsberg ME70 aboard the NOAA Ship *Reuben Laskar*, which had been submitted to the Office of Coast Survey as outside source data W00343. Prior to this cruise a representative from Coast Survey's Hydrographic Systems and Technology Branch was aboard the *Laskar* to assist with Hypack system integration. The trip report from this visit has been included in the data submission. The following W00343 grids were compared with W00418.

Laskar Grid	Resolution	Average Difference	Standard Deviation	Deeper
1b	16 m	**5.2 m**	0.8 m	Nautilus
3	16 m	**4.5 m**	2.8 m	Nautilus

W00291 (SH-15-03):

The NOAA NCCOS Biogeography Branch performed a survey with the Kongsberg ME70 aboard the NOAA Ship *Shimada*, which had been submitted to the Office of Coast Survey as outside source data W00291. This data has since been assessed for charting by the Atlantic Hydrographic Branch. A heave and roll artifact in the *Shimada* data was noticed during comparison.

Shimada Grid	Resolution	Average Difference	Standard Deviation	Deeper
W00291	8 m	**-1.0 m**	1.2 m	Shimada

W00374 (SH-17-05):

The NOAA NCCOS Biogeography Branch performed a survey with the Kongsberg ME70 aboard the NOAA Ship *Shimada*, which had been submitted to the Office of Coast Survey as outside source data W00374. Prior to this cruise a representative from Coast Survey's Hydrographic Systems and Technology Branch was aboard the *Shimada* to assist with Hypack system integration. The trip report from this visit has been included in the data submission. Areas of steep slopes were omitted from comparison. The Shimada grids were not final grids.

Shimada Grid	Resolution	Average Difference	Standard Deviation	Deeper
P1	16 m	**1 m**	4.3 m	Nautilus

The variability in offsets suggests that a waterline value may be applied incorrectly in W00343 and possible other ME70 cruises. Based on the reports received from the Ocean Exploration Trust and the information found in the .ALL files, it appears the E/V *Nautilus* reference frame information and waterline was entered correctly. The values from these documents equate the distance from the sonar to the waterline as 4.501 m for the Nautilus. To be prudent it is recommended to compare W00341 with the *Rainier* data once it becomes available, prior to applying the data to the chart.

H. Vertical and Horizontal Control

The vertical datum for this project is Mean Lower Low Water. Discrete Tide Zoning from NOAA COOPS was applied in post processing by the IOCM Center. The following National Water Level Observation Network (NWLON) stations served as datum control for this survey:

Station Name	Station ID
Santa Barbara, CA	9411340

This project was collected in horizontal datum WGS84 and reprojected in Caris Hips and Sips to NAD83 UTM 10N. Differential GPS (DGPS) was the sole method of positioning.

I. Additional Results

Backscatter was processed using QPS Fledermaus Geocoder Toolbox (FMGT) version 7.6.4. Processed GSFs from the Ocean Exploration Trust were used to generate a GeoTIFF mosaic because FMGT was unable to pair the raw data with Caris HDCS data. Some data artifacts are visible in the mosaics.

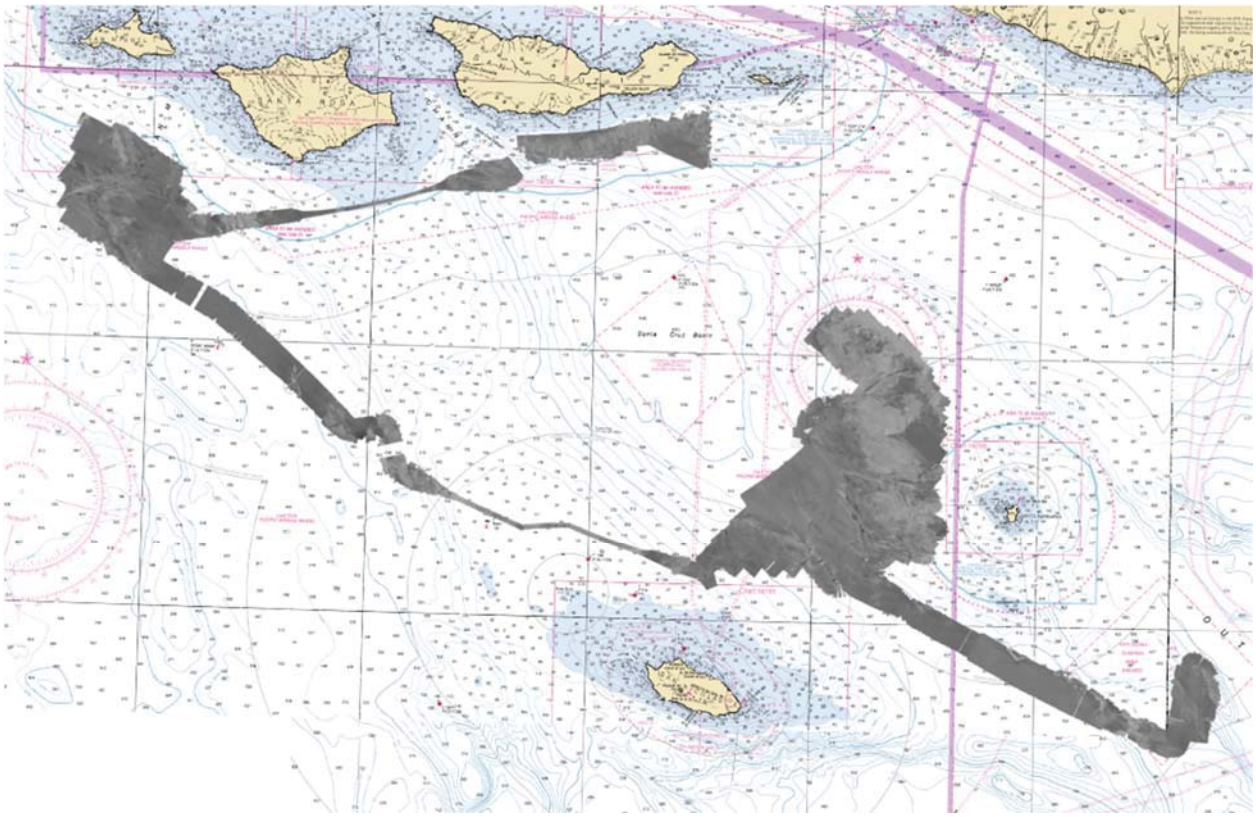


Figure 92 Backscatter mosaic generated for W00418. Greyscale color range 10 to -70 dB. Background chart 18720 1:232,188.

J. Approval

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys and Specifications Deliverables Manual, Field Procedures Manual, Standing and Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Survey Summary Report. All surfaces, this Survey Summary Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

Approver Name	Approver Title	Approval Date	Signature
Andrew A. Armstrong	Co-Director, JHC	22 September 2017	

APPROVAL PAGE

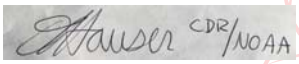
W00418

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- Descriptive Report
- Collection of Bathymetric Attributed Grids (BAGs)
- Collection of backscatter mosaics
- Processed survey data and records
- GeoPDF of survey products

The survey evaluation and verification has been conducted according current OCS Specifications, and the survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.



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Commander Olivia Hauser, NOAA
Chief, Pacific Hydrographic Branch