

**NOAA *Okeanos Explorer* Program**

**MAPPING DATA ACQUISITION AND  
PROCESSING REPORT**

**CRUISE EX1104**

Exploration, Cayman Trench

August 2 – 18, 2011  
Balboa, Panama to Key West, Florida

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## 1. Introduction



### **The *Okeanos Explorer* Program**

Commissioned in August 2008, the NOAA Ship *Okeanos Explorer* is the nation's only federal vessel dedicated to ocean exploration. With 95% of the world's oceans left unexplored, the ship's unique combination of scientific and technological tools positions it to systematically explore new areas of our largely unknown ocean. These explorations will generate scientific questions leading to further scientific inquiries.

Using a high-definition multibeam sonar with water column capabilities, a deep water remotely operated vehicle, and telepresence technology, *Okeanos Explorer* provides NOAA the ability to foster scientific developments by identifying new targets in real time, diving on those targets shortly after initial detection, then sending this information back to shore for immediate near-real-time collaboration with scientists and experts at Exploration Command Centers around the world. The subsequent transparent and rapid dissemination of information-rich products to the scientific community ensures that discoveries are immediately available to experts in relevant disciplines for better understanding.

Through the *Okeanos Explorer* Program, NOAA's Office of Ocean Exploration and Research provides the nation with important capabilities to discover and investigate new ocean areas and phenomena, conduct the basic research required to document discoveries, and seamlessly disseminate data and information-rich products to a multitude of users. The program strives to develop technological solutions and innovative applications to critical problems in undersea exploration and to provide resources for developing, testing, and transitioning solutions to meet these needs.

### ***Okeanos Explorer* Management – a unique partnership within NOAA**

NOAA Ship *Okeanos Explorer* is operated, managed and maintained by NOAA's Office of Marine and Aviation Operations, which includes commissioned officers of the NOAA Corps and civilian wage mariners. NOAA's Office of Ocean Exploration and Research is responsible for operating the cutting-edge ocean exploration systems on the vessel. It is the only federal ship dedicated to systematic exploration of the planet's largely unknown ocean.

## Table of Contents

1. Introduction .....	2
2. Report Purpose .....	3
3. Cruise Objectives .....	4
4. Participating Personnel (Mapping).....	4
5. Summary of Major Findings .....	6
Cruise Overview Map.....	6
Mid Cayman Rise Focused Exploration Area Map .....	7
6. Mapping Statistics .....	8
7. Mapping Sonar Setup .....	8
8. Data Acquisition Summary .....	8
9. Multibeam Data Quality Assessment and Data Processing .....	9
Crossline Analysis .....	10
Built In System Tests (BIST).....	11
10. Data Archival Procedures.....	11
11. Cruise Calendar .....	12
12. Daily Cruise Log .....	12
13. References .....	15
14. Appendices .....	15
Appendix A: Field products generated during cruise .....	15
Appendix B: Tables of data files collected.....	18
Appendix C: List of acronyms.....	25
Appendix D: EM302 PU Parameters in use during cruise .....	26
Appendix E: EM 302 Built-In-System-Test (BIST) EX1104_03.txt; August 3, 2011.....	31
Appendix G: Permits and Cruise Correspondence .....	36
Appendix H: Additional Logs.....	42
Appendix I: Data Management Plan.....	46
Appendix J: EM 302 Kongsberg EM 302 Multibeam Sonar Description and Operational Specifications.....	48

### 2. Report Purpose

The purpose of this mapping report is to describe the mapping data collection and processing methods to enable maximum usability of the dataset. This report describes the data acquisition and processing for EX1104 data, without going into a finely detailed description of the multibeam and ancillary sensor setup. A detailed description of the setup of the various mapping equipment and sensors is provided in the ‘NOAA Ship *Okeanos Explorer* 2011 Readiness Report’ which can be obtained from the ship.

This report covers only the EM 302 multibeam mapping activities conducted during this cruise. Considerable other activities including Conductivity Temperature Depth (CTD) vertical casts and tow-yo's, Remotely Operated Vehicle (ROV) dives, as well as education and outreach activities were conducted which may be referred to in this report but details will not be provided here. A full cruise report describing these activities will be produced by the Expedition Manager.

The crew of the NOAA Ship *Okeanos Explorer* is greatly appreciated for their efforts in helping make the cruise a success.

### 3. Cruise Objectives

During the 2011 field season, *Okeanos Explorer* transited from San Francisco, California to Davisville, Rhode Island, incorporating exploration activities along the way. EX1104 began in Balboa, Panama, on the Pacific side of the Panama Canal. A standing objective of the *Okeanos Explorer* program is to continuously explore during transits between focused exploration sites. Thus, upon exiting the Panama Canal and entering the Caribbean Sea, the ship began collecting EM 302 mapping data. Mapping data is collected in all foreign Exclusive Economic Zones (EEZs) where marine research permits are in place. For EX1104, this included Panama, Nicaragua, Honduras, and the United Kingdom (Cayman Islands). Marine research permits were not obtained for the Colombian and Cuban EEZs.

The cruise objectives of the mapping team during transits included:

- a. Continuous EM 302 bathymetric and seabed backscatter data collection.
- b. Production of daily bathymetry and seabed backscatter mapping products, as defined in Section 9 of this report.
- c. Testing ship-to-shore collaboration tools, including the *Okeanos Explorer* Portal and FTP site.

The cruise objectives of the mapping team within the focused exploration area over the Cayman Trench included:

- a. Conduct evening and morning mapping operations to collect high resolution bathymetric and seabed backscatter data, and also EM 302 water column data as necessary.
- b. Conduct mapping operations of defined areas chosen with daily input from shore-based scientists via telepresence.

### 4. Participating Personnel (Mapping)

NAME	ROLE	AFFILIATION
CDR Robert Kamphaus	Commanding Officer	NOAA Corps
LT Megan Nadeau	Field Operations Officer	NOAA Corps
Kelley Elliott	Cruise Coordinator	NOAA OER (20/20 Inc.)
Elizabeth "Meme" Lobecker	Mapping Team Lead	NOAA OER (ERT Inc.)
Elaine Stuart	Senior Survey Technician	NOAA OMAO
Colleen Peters	Senior Survey Technician	NOAA OMAO
Vincent Howard	Mapping Watchstander	NOAA OER / UCAR Intern
Karl McLetchie	Mapping Watchstander	NOAA OER / UCAR Intern

Tom Kok	Mapping Watchstander	NOAA OER / UCAR Intern
Jonathan Mefford	Mapping Watchstander	NOAA OER / UCAR Intern
Christopher Ritter	Mapping Watchstander	NOAA OER / UCAR Intern

## 5. Summary of Major Findings

### *Cruise Overview Map*

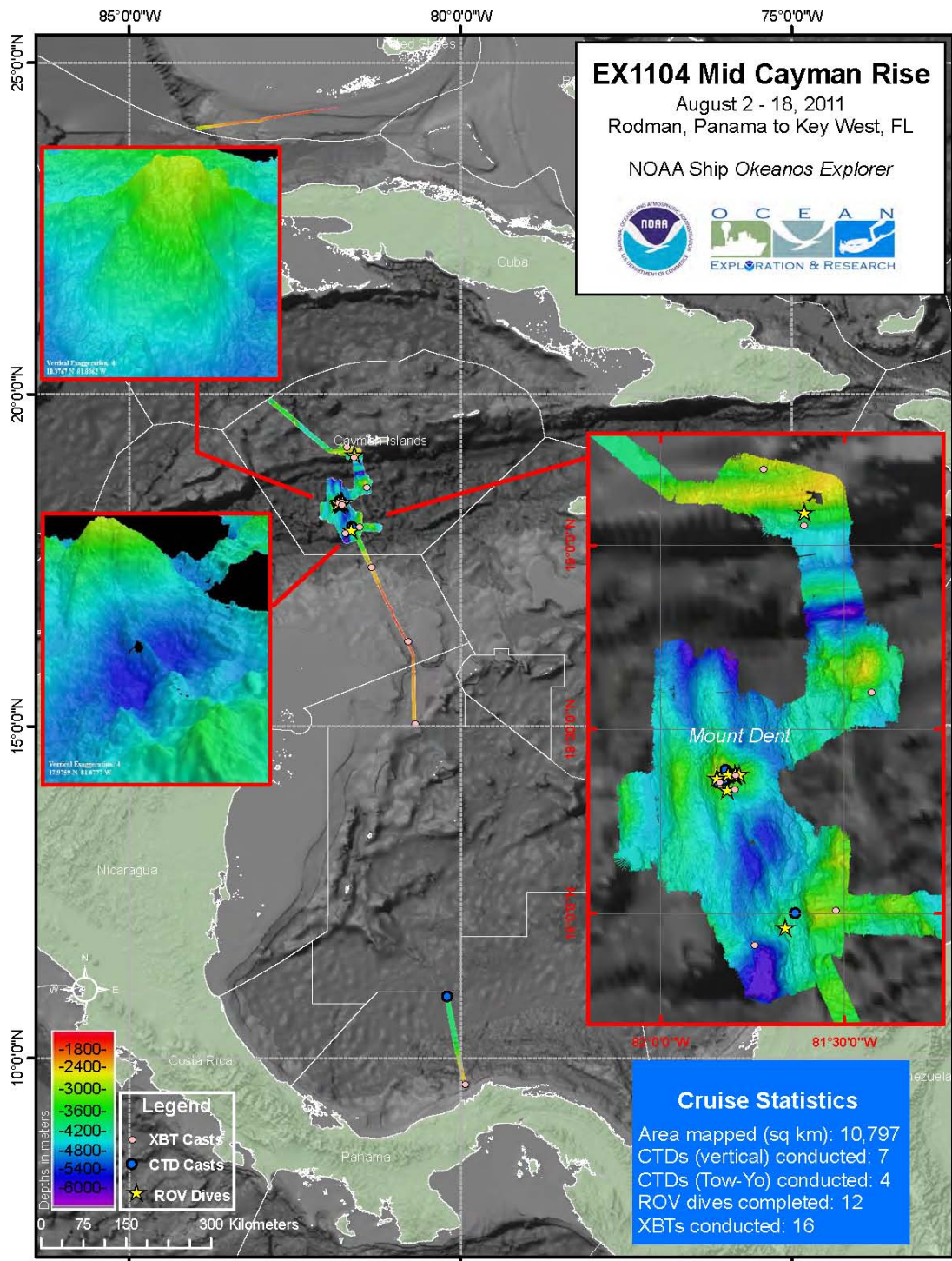


Figure 1. Map created in ArcMap showing overall cruise results.

# Mid Cayman Rise Focused Exploration Area Map

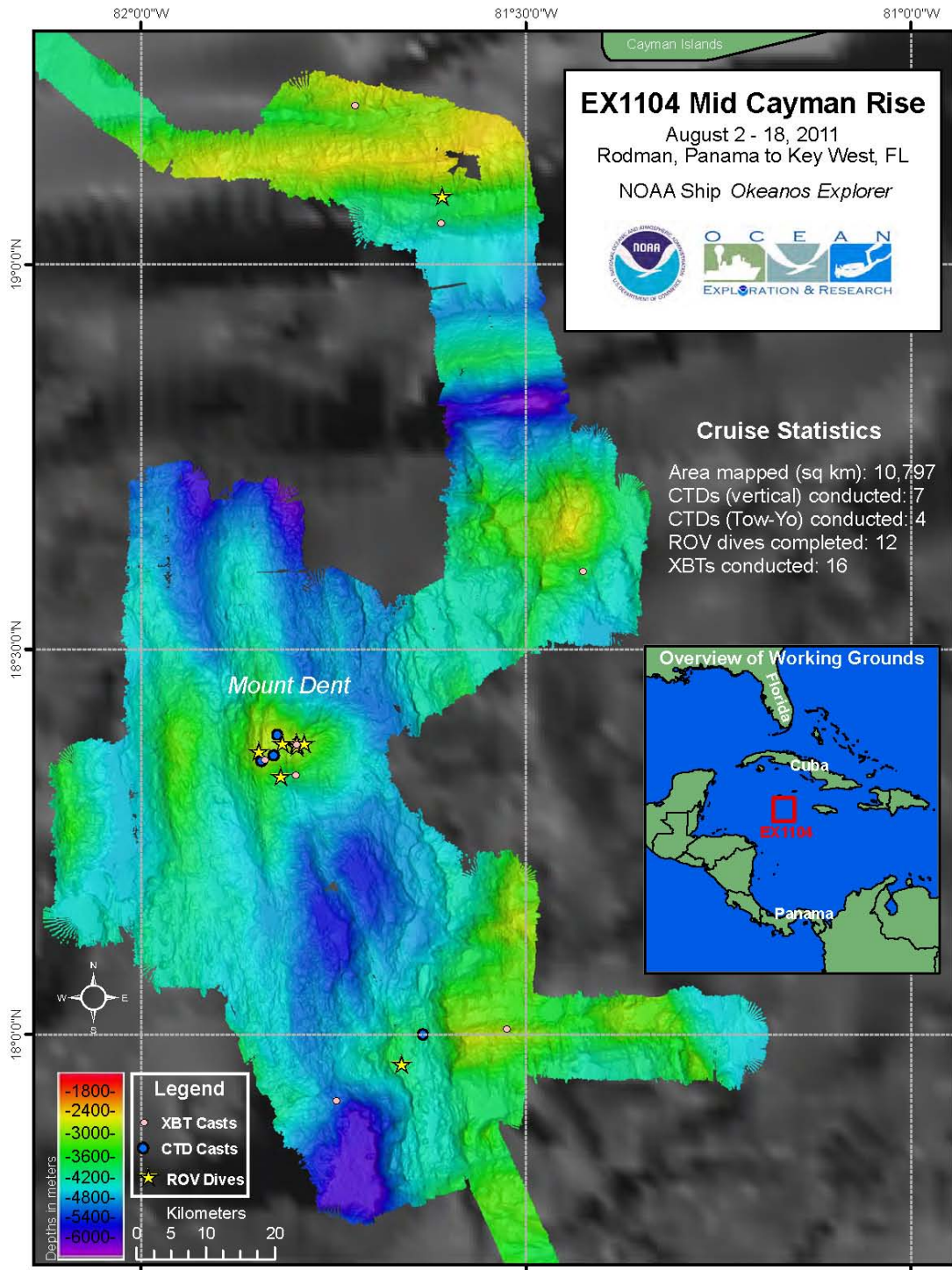


Figure 2. Map created in ArcMap showing focused exploration operations over Cayman Trench.

## 6. Mapping Statistics

Dates	August 2 - 18, 2011
Weather delays	0 days
Total non-mapping days	2 days
Total survey mapping days	9 partial days
Total transit mapping days	5 partial days
Line kilometers of survey	2553.5 km
Square kilometers mapped	10,797
Number of bathymetric multibeam files	107
Data volume of raw multibeam data files	11.6 MB
Number of water column multibeam files	0
Data volume of water column multibeam files	0
Number of XBT casts	16
Number of CTD casts - tow-yo	4
Number of CTD casts - vertical	7
Beginning draft	4.57 m (bow) 4.51 m (stern)
Ending draft	4.24 m (bow) 4.57 m (stern)
Average ship speed for survey	9.5 kts

## 7. Mapping Sonar Setup

The NOAA Ship *Okeanos Explorer* is equipped with a 30 kHz Kongsberg EM 302 multibeam sonar capable of mapping the seafloor in 0 to 8000 meters of water. The system generates a 150° beam fan containing up to 432 soundings per ping in waters deeper than 3000 meters. In waters less than 3000 meters, the system is operated in multiping, or dual swath mode, and obtains up to 864 soundings per ping, by generating two swaths per ping cycle. Appendix J contains a detailed description of sonar system functionality and technical specifications, including crosstrack and alongtrack data resolutions.

The ship is also equipped with a Kongsberg EK 60 singlebeam fisheries sonar. The transducer operates at 18 kHz and transmits a 7° beam fan.

The ship is also equipped with a Knudsen 3260 subbottom profiler. The transducers produce a 3.5 kHz chirp signal.

## 8. Data Acquisition Summary

Transit exploration multibeam mapping using the EM 302 occurred in the EEZs of the following countries: Panama, Nicaragua, Honduras, the United Kingdom (Cayman Islands) and the U.S. Multibeam data files were changed when crossing EEZs to facilitate ease of data delivery to relevant coastal states. The ship transited through the EEZs of Colombia and Cuba but did not collect mapping data, as marine research permits were not in place. Focused exploration mapping occurred over the Cayman Trench. Details are provided in the cruise calendar of this



report. Tables listing all sonar files collected and products created during the cruise are provided in the appendices of this report. Tables listing all sound velocity files collected during the cruise are also provided.

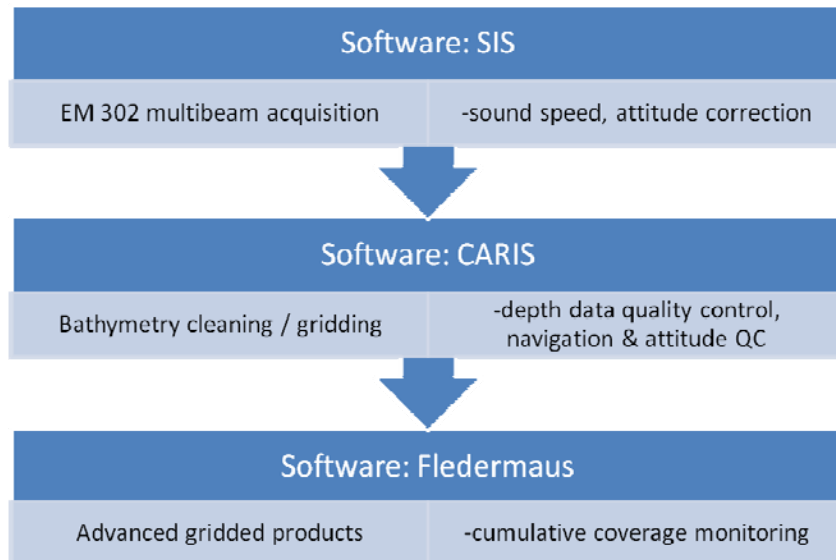
Expendable bathythermographs were collected every two to four hours to correct multibeam data for changes in sound speed in the water column, and were applied in real time using Seafloor Information Software (SIS). A thermosalinograph seawater intake mounted on the hull at the EM 302 transducers was used to determine sound speed at the sonar head and was applied in realtime using SIS.

Background data used for exploration mapping included Sandwell and Smith satellite altimetry bathymetric data.

### 9. Multibeam Data Quality Assessment and Data Processing

*Okeanos Explorer's* annual multibeam patch test was conducted during the 2011 shakedown cruise (EX1101). The full results of the patch test can be found in the EX1101 mapping data report and in the ship's readiness report.

Multibeam data quality was monitored in realtime by acquisition watchstanders. Expendable bathythermographs (XBTs) were conducted every two to four hours as necessary to maintain data quality. Ship speed was adjusted to maintain data quality as necessary. Line spacing was planned to ensure ¼ to ½ overlap between lines at all times. Cutoff angles in SIS were generally set to 70° on both the port and starboard sides.



**Figure 3. Shipboard multibeam data flow.**

Raw multibeam bathymetry data files were acquired by SIS, and were imported into CARIS. In CARIS, attitude and navigation data stored in each file were checked, and erroneous soundings

were removed using CARIS Swath Editor and Subset Editor. In general, data quality was very high, largely due to excellent environmental conditions for survey as the weather was mild throughout the cruise. A detailed weather log is provided in the appendix section of this report.

The following products were archived to the shoreside FTP on a daily basis to facilitate shoreside scientist participation:

**Bathymetry:**

- ASCII text file (xyz) containing cleaned, gridded multibeam depth data
- Fledermaus v.7 SD object containing cleaned, gridded multibeam depth data
- Geotiff of cleaned, gridded multibeam depth data
- Arc Grid of cleaned, gridded multibeam depth data
- GoogleEarth KMZ file containing cleaned, gridded multibeam depth data

**Seabed backscatter:**

- ASCII text file (xyb) containing gridded bottom backscatter data
- Fledermaus v.7 SD object containing bottom backscatter draped over cleaned, gridded bathymetry
- Geotiff of bottom backscatter data
- GoogleEarth KMZ file containing bottom backscatter data

The naming convention for daily mapping products was:

EX1104\_MB\_DLY##\_50m\_WGS84\_YYMMDD

EX1104\_MB\_DLY##\_BBS\_30m\_WGS84\_YYMMDD

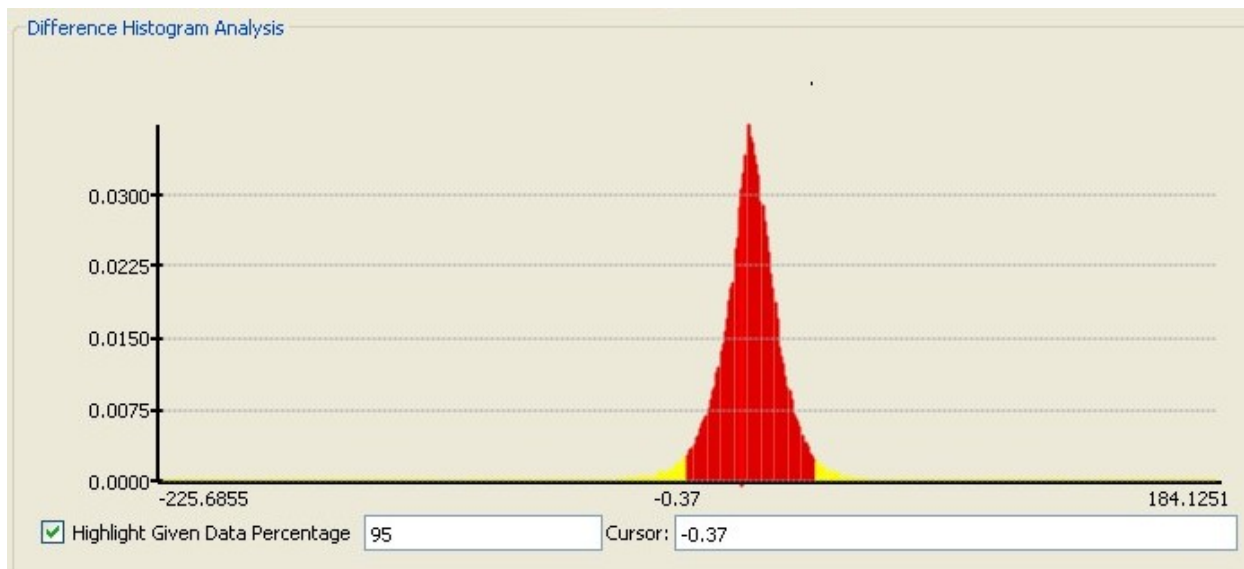
A “readme” file was provided to indicate which daily products used in tandem provided cumulative data for the cruise.

The Okeanos Explorer Digital Atlas, managed by the National Coastal Data Development Center, was updated daily with new multibeam bathymetry and bottom backscatter products.

***Crossline Analysis***

A multibeam crossline was collected on August 11 to verify multibeam data quality. Crossline 0057 was run perpendicular to mainscheme lines 0008 and 0026. The mainscheme lines were run at headings of 0° and 180°, and the crossline was run at a heading of 270°.

The cleaned, mainscheme data were gridded in CARIS and every accepted sounding was exported to text file. These text files were then gridded in Fledermaus DMagic, and the grid surface was compared to the raw .all crossline file using Fledermaus Crosscheck and the results are provided below.



**Figure 4. Screenshot of IVS Fledermaus Crosscheck crossline analysis results.**

Depths in meters:

-2711.961005 # Data Mean  
 -2715.317929 # Reference Mean  
 3.356900 # Mean  
 3.562600 # Median  
 12.506000 # Std. Deviation  
 -4117.72 -2049.21 # Data Z - Range  
 -4114.33 -2062.72 # Ref. Z - Range  
 -225.69 184.13 # Diff Z - Range  
 28.368958 # Mean + 2\*stddev  
 28.574610 # Median + 2\*stddev

### ***Built In System Tests (BIST)***

BISTs were run periodically throughout the cruise to verify the integrity and performance of the multibeam echosounder electronics. All BISTs passed. A sample BIST is provided in the appendices of this report.

## **10. Data Archival Procedures**

All data collected on the *Okeanos Explorer* is publically available in national archives. Raw and processed multibeam data for all *Okeanos Explorer* cruises are available via the National Geophysical Data Center archives accessible through [www.ngdc.gov](http://www.ngdc.gov). EX1104 data are available at

[http://www.ngdc.noaa.gov/nndc/struts/results?op\\_0=eq&v\\_0=NEW1556&t=101378&s=8&d=70](http://www.ngdc.noaa.gov/nndc/struts/results?op_0=eq&v_0=NEW1556&t=101378&s=8&d=70)

&d=75&d=76&d=91&d=93&d=74&d=73&d=72&d=81&d=82&d=85&d=86&d=79&no\_data=s  
uppress.

All data collected during the cruise was archived in partnership with the National Coastal Data Development Center in adherence to NAO 212-15 “Management of Environmental and Geospatial Data and Information”. Data collected within the EEZs of Panama, Nicaragua, and Honduras were provided to those states by the OER Expedition Coordinator. The full EX1104 Data Management Plan is included in the EX1104 Cruise Instructions, and can be obtained by contacting the ship.

## 11. Cruise Calendar

AUGUST 2011						
Sun	Mon	Tues	Wed	Thurs	Fri	Sat
July 31 New mission personnel arrives to ship, Balboa, Panama.	1 Ship in port: Balboa, Panama.	2 Depart dock at 1830 for Panama Canal, transit through Canal overnight.	3 Complete transit through Canal in the early morning, commence multibeam mapping in Panama EEZ. Data not collected in Colombian EEZ.	4 Continue transit multibeam mapping exploration en route to Mid-Caymen Rise exploration area. Data collected in Nicaragua and Honduras EEZs.	5 Continue multibeam transit exploration mapping. Arrive Mid-Cayman Rise exploration area. Conducted first ROV dive of cruise. Conduct hull dive. Evening CTD ops.	6 Morning multibeam mapping. Daylight ROV ops. Evening mapping.
7 Morning mapping. Daylight ROV ops. Evening CTD ops.	8 Morning mapping. Daylight ROV ops. Evening CTD ops.	9 Morning mapping. Daylight ROV ops. Evening CTD ops.	10 Morning mapping. Daylight CTD ops. Evening mapping.	11 Morning mapping. Daylight ROV ops. CTD termination failure. Evening mapping.	12 Morning mapping. Daylight ROV ops. CTD termination failure. Evening mapping.	13 Morning mapping. Daylight ROV ops.
14 Morning mapping. Daylight ROV ops.	15 Mapping in Cayman Islands EEZ. Discontinue mapping in Cuba EEZ.	16 No data collection while in Cuba EEZ.	17 Mapping in US EEZ.	18 Arrive Key West, FL.	19	20

## 12. Daily Cruise Log

August 1, 2011

The following personnel arrived to the ship at Rodman Barracks in Balboa, Panama: OER Mapping Team Lead Meme Lobecker, OER Expedition Manager Kelley Elliot, and visiting scientists Chris German (WHOI), Paul Tyler (National Oceanography Center, Southampton), and Cameron McIntyre (WHOI).

### **August 2, 2011**

The mapping department prepared for data collection, which will commence once the ship exits the Panama Canal. RTS communications unit training was conducted for personnel new to the ship. The mapping watchstander schedule was established.

Personnel from the Panama Canal boarded the ship at 1830. The ship departed the dock at 1900 to commence transit through the Canal.

### **August 3, 2011**

Mapping with the EM 302 multibeam sonar commenced at 0510 in the Panama EEZ after the ship exited the canal. At 1342, the EM 302 was secured just prior to entering the Colombia EEZ. Training for new mapping watchstanders from the ROV team commenced.

The marine research permit for Nicaragua was received.

A test CTD cast was conducted to ~1000 meters. The CTD data was processed by scientists onshore, and possible electrical problems were detected.

### **August 4, 2011**

Multibeam data collection began when the ship crossed into the Nicaragua EEZ at 1130. Permission to continue mapping in the Honduras EEZ was received, and data collection continued in that EEZ for the remainder of the day.

Emergency drills were conducted including: fire / emergency, and abandon ship.

The Fledermaus v7 license was upgraded to be equipped with FMGIS capabilities, a requirement for the ROV team to export bathymetric contours to shapefiles for use in Hypack during ROV dives.

The EK60 / EM302 sync was confirmed. There was no interference in the EM 302 data while the EK60 was operating. The trigger from the EM 302 to the Knudsen subbottom was moved to the EK60 in preparation for cruise EX1105, the Gulf of Mexico water column exploration cruise. The trigger is now connected to serial port 3 of the EK60.

### **August 5, 2011**

Mapping continued until 0700, when the ship arrived at the first ROV dive of the cruise, the vent site "Von Damm" on Mount Dent. In the afternoon, the ROV was recovered early to allow divers to remove a suspected net from a strainer on the hull. CTD tow-yo operations began in the evening and occurred between the sites "Von Damm" and "Europa" for the remainder of the day.

### **August 6, 2011**

Mapping occurred in the southern portion of mapping area “2a” from 0000 – 0700, until arrival at the second ROV dive site of the cruise. Mapping resumed at 2140 and continued into the morning of August 7<sup>th</sup>.

#### **August 7, 2011**

Mapping in the vicinity of Mount Dent and the ridge directly to the west continued through the morning until arriving at the ROV dive site at 0701. The western mapping area defined in the cruise plan was completed.

#### **August 8, 2011**

Mapping over Mount Dent and eastward commenced at 0023, just after the CTD was recovered, and continued until arriving at the ROV dive site at 0704.

#### **August 9, 2011**

Mapping commenced at 0008 after the CTD was on deck, and continued until arrival at the ROV dive site at 0657. Mapping occurred in the area south of previous EX coverage.

The permit from Florida Keys National Marine Sanctuary to deploy two XBTs within sanctuary bounds was received. The ship will transit through the sanctuary prior to pulling into Key West, Florida on August 18.

#### **August 10, 2011**

Mapping commenced at 0009 after the CTD was on deck, and continued until arrival at the ROV dive site at 0659. A holiday line over Mount Dent was filled, and a feature to the west of previous mapping coverage was developed. Swath coverage in the deepest section was less than expected, causing a small holiday between lines. A BIST was run, and all tests passed. Mapping operations resumed in the evening at 1915 and continued through the night into the following morning.

#### **August 11, 2011**

In the morning, mapping continued from the previous evening until arrival at the ROV dive site at 0712. Evening mapping operations commenced at 1842 after the ROV was on deck.

In the evening, mapping commenced at 1842 after the ROV came on deck and continued through the evening.

A workaround was found for when SIS will not launch SVP editor. In a command window, go to c:\Prog~1\Kongsberg Maritime\SIS\japp. Run svpeditor.bat.

#### **August 12, 2011**

Mapping continued through the morning until arrival at the ROV dive site at 0701. A crossline was run. In the evening, mapping commenced at 1830 and continued through the evening. A BIST was run, and all tests passed.

#### **August 13, 2011**

Mapping continued through the morning until arrival at the ROV dive site at 0657. In the evening, mapping operations commenced at 2330 after the CTD was on deck.

**August 14, 2011**

Mapping continued through the morning until arrival at the ROV dive site at 0653. In the evening, mapping operations commenced at 2135 and continued through the evening.

**August 15, 2011**

Survey continued through the morning until the final ROV dive was conducted over the Cayman Fracture Zone. When the ROV came on deck in the evening, mapping recommenced and a portion of the Cayman Fracture Zone was mapped before the ship began transit to Key West, Florida. Mapping continued during transit through the Cayman (UK) EEZ.

**August 16, 2011**

Mapping continued until crossing into the Cuban EEZ at 0934. All scientific sensors were secured at that time and for the remainder of the day. SCS navigation data was sent to shore for NOAA Ship Tracker purposes.

**August 17, 2011**

Mapping commenced when the ship crossed into the US EEZ near Florida and continued until 0604. The multibeam was secured in 200 meters of water. The ship was alongside at the Key West Trumbo Point Coast Guard Station at 0845.

**August 18, 2011**

In port, Key West.

**August 19, 2011**

Mission personnel departed the ship.

**13. References**

EX1104 Cruise Report (forthcoming)  
Kongsberg System Description  
NOAA Ship *Okeanos Explorer* Readiness Report 2012

**14. Appendices**

***Appendix A: Field products generated during cruise***

Following are field products are developed for professional development and training purpose.

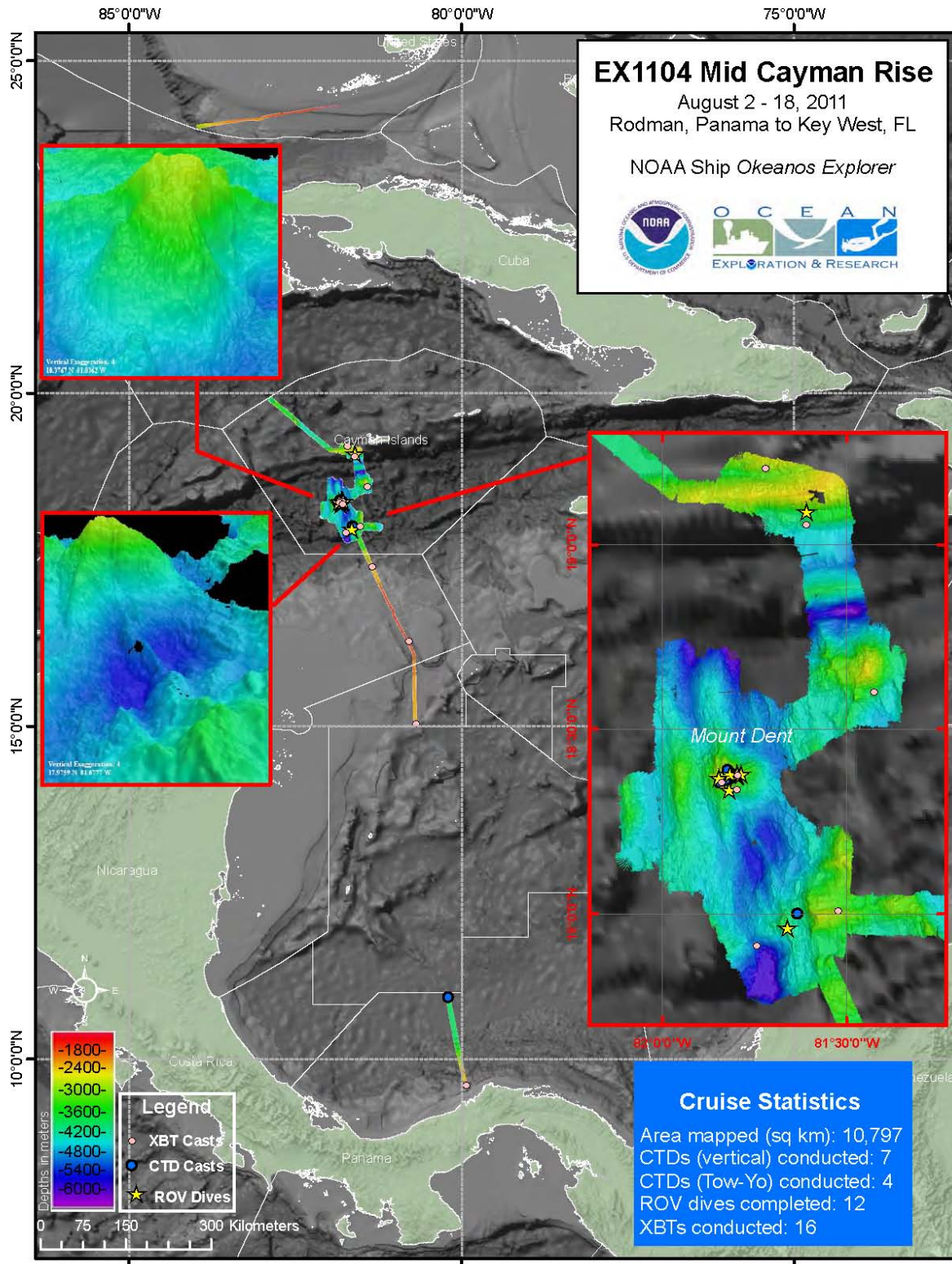


Figure 5. Overview map created by SST Colleen Peters in ArcMap showing all mapping data including transits and focused ops areas.



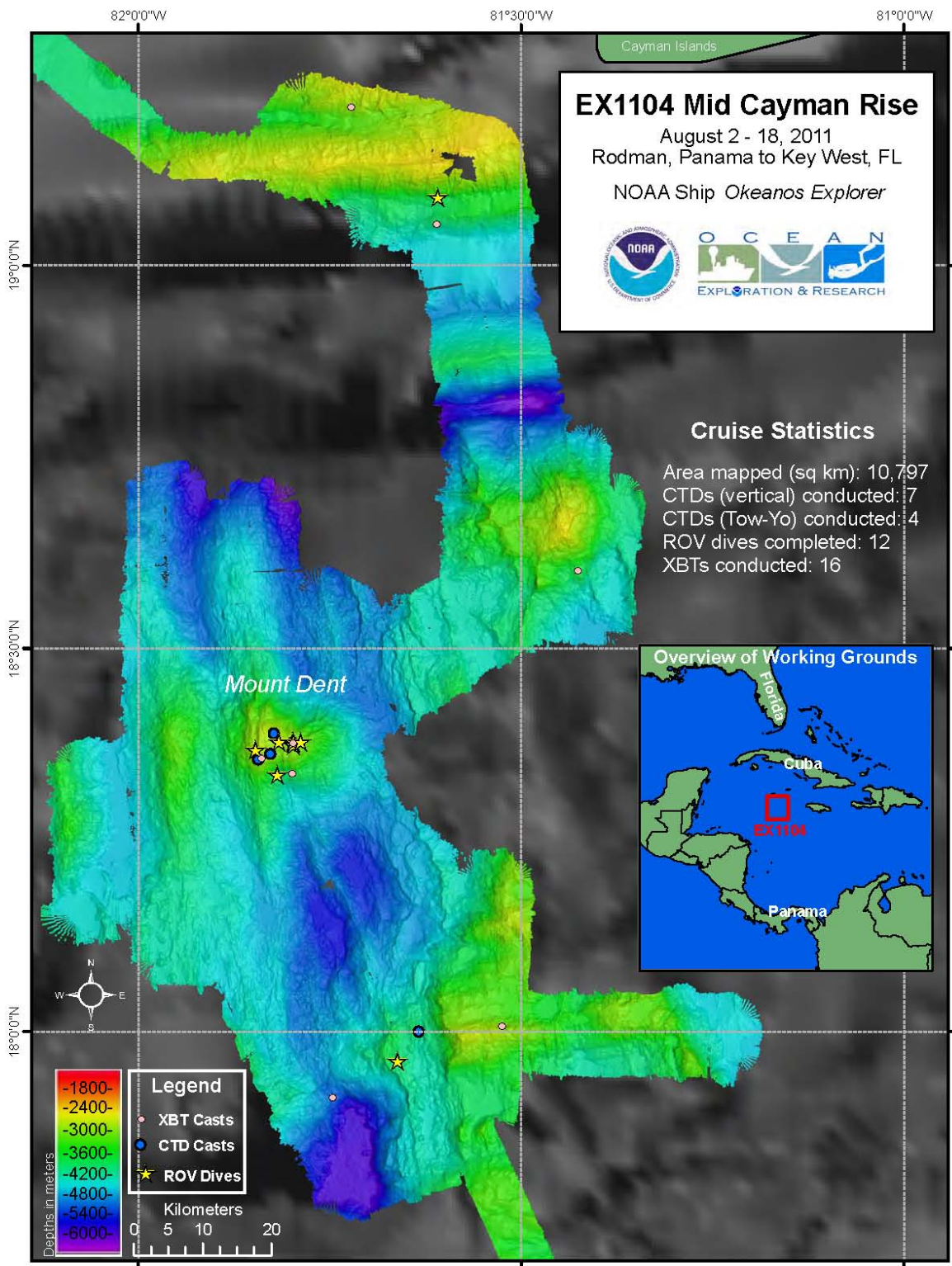


Figure 6. Map created by SST Colleen Peters in ArcMap showing focused operations area over the Mid Cayman Rise.

## Appendix B: Tables of data files collected

**Table 1. EM 302 Multibeam bathymetry / bottom backscatter files.**

EX1104 MB ACQUISITION / FIELD PROCESSING LOG											
MB Line Filename	SVP File Applied	Julian Day	Date (GMT)	SO G (kts)	Heading	Northern Bounding Coordinate	Western Bounding Coordinate	Southern Bounding Coordinate	Eastern Bounding Coordinate	Level 01 Export (ASCII by Line, WGS84)	Level 02 Export (WGS84) (Gridded ASCII xyz, Fledermaus SD, geotiff, Google Earth KMZ)
0000_20110803_101031_EX1104_MB.all	EX1104_XBT02_20110803	215	08/03/11	10.5	350	10.727185N	080.199519W	09.664527N	079.918661W	EX1104_EXApril09_2011-215_0000_20110803_101031_EX1104_MB.txt	EX1104_1_50m_WGS84
0001_20110803_161037_EX1104_MB.all	EX1104_XBT02_20110803	215	08/03/11	10.5	350	10.947912N	080.233355W	10.716080N	080.126474W	EX1104_EXApril09_2011-215_0001_20110803_161037_EX1104_MB.txt	EX1104_1_50m_WGS84
0002_20110803_182723_EX1104_MB.all	EX1104_XBT02_20110803	215	08/03/11	10.5	350	10.979536N	080.240708W	10.919395N	080.167237W	EX1104_EXApril09_2011-215_0002_20110803_182723_EX1104_MB.txt	EX1104_1_50m_WGS84
0003_20110804_170346_EX1104_MB.all	EX1104_XBT05_20110804	216	8/04/11	11	000	15.929342N	080.727666W	15.093068N	080.669106W	EX1104_EXApril09_2011-216_0003_20110804_170346_EX1104_MB.txt	EX1104_2_50m_WGS84
0004_20110804_212857_EX1104_MB.all	EX1104_XBT05_20110804 EX1104_XBT06_20110804	216	8/04/11	11	360	16.419309N	080.891425W	15.928441N	080.685629W	EX1104_EXApril09_2011-216_0004_20110804_212857_EX1104_MB.txt	EX1104_2_50m_WGS84
0005_20110805_000004_EX1104_MB.all	EX1104_XBT06_20110804	217	8/05/11	12	340	17.496875N	081.414665W	16.408527N	080.868098W	EX1104_EXApril09_2011-217_0005_20110805_000004_EX1104_MB.txt	EX1104_2_50m_WGS84
0006_20110805_060005_EX1104_MB.all	EX1104_XBT06_20110804	217	8/05/11	12	335	17.593618N	081.464415W	17.483211N	081.366188W	EX1104_EXApril09_2011-217_0006_20110805_060005_EX1104_MB.txt	EX1104_2_50m_WGS84
0007_20110805_063823_EX1104_MB.all	EX1104_XBT06_20110804	217	8/05/11	11	335	18.383925N	081.827960W	17.575079N	081.405629W	EX1104_EXApril09_2011-217_0007_20110805_063823_EX1104_MB.txt	EX1104_3_50m_WGS84
0008_20110806_045649_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	8.9	180	18.404137N	081.861705W	18.252039N	081.777691W	EX1104_EXApril09_2011-218_0008_20110806_045649_EX1104_MB.txt	EX1104_3_50m_WGS84
0009_20110806_055712_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	8.8	270	18.290931N	081.903727W	18.206853N	081.786929W	EX1104_EXApril09_2011-218_0009_20110806_055712_EX1104_MB.txt	EX1104_3_50m_WGS84
0010_20110806_061844_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	9	0	18.514265N	081.920367W	18.249080N	081.832325W	EX1104_EXApril09_2011-218_0010_20110806_061844_EX1104_MB.txt	EX1104_3_50m_WGS84
0011_20110806_080211_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	9	270	18.554928N	081.954180W	18.476372N	081.844703W	EX1104_EXApril09_2011-218_0011_20110806_080211_EX1104_MB.txt	EX1104_3_50m_WGS84
0012_20110806_082935_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	9.5	180	18.292021N	081.970451W	18.212558N	081.896452W	EX1104_EXApril09_2011-218_0012_20110806_082935_EX1104_MB.txt	EX1104_3_50m_WGS84
0013_20110806_100256_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	9.8	270	18.499533N	081.962779W	18.255025N	081.882308W	EX1104_EXApril09_2011-218_0013_20110806_100256_EX1104_MB.txt	EX1104_3_50m_WGS84
0014_20110806_102034_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	9.8	0	18.352979N	082.013987W	18.213454N	081.939257W	EX1104_EXApril09_2011-218_0014_20110806_102034_EX1104_MB.txt	EX1104_3_50m_WGS84
0015_20110806_105731_EX1104_MB.all	EX1104_CTD02_110805	218	8/06/11	9.7	80	18.406817N	082.008878W	18.323332N	081.799628W	EX1104_EXApril09_2011-218_0015_20110806_105731_EX1104_MB.txt	EX1104_3_50m_WGS84

0016_20110807_024127_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.2	355	18.6935 59N	081.8633 93W	18.3430 17N	081.7630 45W	EX1104_EXApril09_2011- 219_0016_20110807_024127_EX1104_MB.txt	EX1104_3_50m _WGS84
0017_20110807_045548_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.9	266	18.7247 07N	081.9042 96W	18.6602 18N	081.7936 50W	EX1104_EXApril09_2011- 219_0017_20110807_045548_EX1104_MB.txt	EX1104_3_50m _WGS84
0018_20110807_051559_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.9	180	18.6899 59N	081.9224 23W	18.5016 91N	081.8397 52W	EX1104_EXApril09_2011- 219_0018_20110807_051559_EX1104_MB.txt	EX1104_3_50m _WGS84
0019_20110807_062305_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.2 1	355	18.5474 19N	081.9629 74W	18.4637 74N	081.8506 18W	EX1104_EXApril09_2011- 219_0019_20110807_062305_EX1104_MB.txt	EX1104_3_50m _WGS84
0020_20110807_064259_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.9	360	18.7208 11N	081.9669 82W	18.5048 60N	081.8904 75W	EX1104_EXApril09_2011- 219_0020_20110807_064259_EX1104_MB.txt	EX1104_3_50m _WGS84
0021_20110807_075714_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.9	257	18.7461 59N	082.0138 46W	18.6886 34N	081.9132 55W	EX1104_EXApril09_2011- 219_0021_20110807_075714_EX1104_MB.txt	EX1104_3_50m _WGS84
0022_20110807_081806_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.5	180	18.7104 31N	082.0244 33W	18.3394 21N	081.9504 70W	EX1104_EXApril09_2011- 219_0022_20110807_081806_EX1104_MB.txt	EX1104_3_50m _WGS84
0023_20110807_103702_E X1104_MB.all	EX1104_DIVE03_CPCTD_110806	219	8/07/11	9.5	78	18.4039 56N	082.0131 31W	18.3002 62N	081.7983 13W	EX1104_EXApril09_2011- 219_0023_20110807_103702_EX1104_MB.txt	EX1104_3_50m _WGS84
0024_20110808_052654_E X1104_MB.all	EX1104_CTD03_110807.a svp	220	8/08/11	8.5	192	18.3808 19N	081.8523 19W	18.1741 94N	081.7381 47W	EX1104_EXApril09_2011- 220_0024_20110808_052654_EX1104_MB.txt	EX1104_3_50m _WGS84
0025_20110808_064808_E X1104_MB.all	EX1104_CTD03_110807.a svp	220	8/08/11	8.8	43	18.2514 89N	081.8459 85W	18.1467 83N	081.7283 23W	EX1104_EXApril09_2011- 220_0025_20110808_064808_EX1104_MB.txt	EX1104_3_50m _WGS84
0026_20110808_072321_E X1104_MB.all	EX1104_CTD03_110807.a svp	220	8/08/11	9.8	0	18.5734 23N	081.8114 53W	18.2356 52N	081.7181 60W	EX1104_EXApril09_2011- 220_0026_20110808_072321_EX1104_MB.txt	EX1104_3_50m _WGS84
0027_20110808_092654_E X1104_MB.all	EX1104_CTD03_110807.a svp	220	8/08/11	10	112	18.6084 64N	081.7974 33W	18.5286 79N	081.6815 25W	EX1104_EXApril09_2011- 220_0027_20110808_092654_EX1104_MB.txt	EX1104_3_50m _WGS84
0028_20110808_095127_E X1104_MB.all	EX1104_CTD03_110807.a svp	220	8/08/11	10	180	18.5514 40N	081.7495 37W	18.3000 96N	081.6625 51W	EX1104_EXApril09_2011- 220_0028_20110808_095127_EX1104_MB.txt	EX1104_3_50m _WGS84
0029_20110808_112001_E X1104_MB.all	EX1104_CTD03_110807.a svp	220	8/08/11	10	288	18.3619 40N	081.8335 91W	18.2715 68N	081.6794 12W	EX1104_EXApril09_2011- 220_0029_20110808_112001_EX1104_MB.txt	EX1104_3_50m _WGS84
0030_20110809_050809_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.5	200	18.3557 63N	081.9084 39W	18.2423 54N	081.8003 79W	EX1104_EXApril09_2011- 221_0030_20110809_050809_EX1104_MB.txt	EX1104_3_50m _WGS84
0031_20110809_054756_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.5	180	18.2598 70N	081.9105 17W	18.1193 89N	081.8285 33W	EX1104_EXApril09_2011- 221_0031_20110809_054756_EX1104_MB.txt	EX1104_3_50m _WGS84
0032_20110809_063833_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.5	269	18.1458 53N	081.9541 66W	18.0792 15N	081.8436 28W	EX1104_EXApril09_2011- 221_0032_20110809_063833_EX1104_MB.txt	EX1104_3_50m _WGS84
0033_20110809_070113_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.5	360	18.2440 84N	081.9611 76W	18.1182 07N	081.8880 69W	EX1104_EXApril09_2011- 221_0033_20110809_070113_EX1104_MB.txt	EX1104_3_50m _WGS84
0034_20110809_074808_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.5	261	18.2858 30N	082.0067 80W	18.2087 06N	081.8941 09W	EX1104_EXApril09_2011- 221_0034_20110809_074808_EX1104_MB.txt	EX1104_3_50m _WGS84
0035_20110809_081055_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.8	180	18.2354 39N	082.0109 36W	18.0956 81N	081.9336 94W	EX1104_EXApril09_2011- 221_0035_20110809_081055_EX1104_MB.txt	EX1104_3_50m _WGS84
0036_20110809_090128_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.5	90	18.1270 44N	082.0077 85W	18.0487 05N	081.7861 04W	EX1104_EXApril09_2011- 221_0036_20110809_090128_EX1104_MB.txt	EX1104_3_50m _WGS84
0037_20110809_100039_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.3	0	18.3341 14N	081.8622 46W	18.0977 92N	081.7804 07W	EX1104_EXApril09_2011- 221_0037_20110809_100039_EX1104_MB.txt	EX1104_3_50m _WGS84
0038_20110809_113032_E X1104_MB.all	EX1104_CTD04_110808.a svp	221	8/09/11	9.0	30	18.3802 01N	081.8569 09W	18.3220 11N	081.7776 90W	EX1104_EXApril09_2011- 221_0038_20110809_113032_EX1104_MB.txt	EX1104_3_50m _WGS84
0039_20110810_050859_E X1104_MB.all	EX1104_CTD04_110808.a svp	222	8/10/11	9.0	306	18.4773 37N	081.8396 04W	18.3506 89N	081.7036 74W	EX1104_EXApril09_2011- 222_0039_20110810_050859_EX1104_MB.txt	EX1104_3_50m _WGS84
0040_20110810_055516_E	EX1104_CTD05_110809.a	222	8/10/11	9.8	244	18.4770	082.0710	18.3213	081.8016	EX1104_EXApril09_2011-	EX1104_3_50m

X1104_MB.all	svp		11			12N	59W	12N	99W	222_0040_20110810_055516_EX1104_MB.txt	_WGS84
0041_20110810_072038_E X1104_MB.all	EX1104_CTD05_110809.a svp	222	8/10/ 11	9.0	180	18.3465 38N	082.0836 39W	18.1546 38N	081.9856 31W	EX1104_EXApril09_2011- 222_0041_20110810_072038_EX1104_MB.txt	EX1104_3_50m _WGS84
0042_20110810_083729_E X1104_MB.all	EX1104_CTD05_110809.a svp	222	8/10/ 11	10	270	18.1905 88N	082.1254 14W	18.1138 08N	081.9926 04W	EX1104_EXApril09_2011- 222_0042_20110810_083729_EX1104_MB.txt	EX1104_3_50m _WGS84
0043_20110810_085808_E X1104_MB.all	EX1104_CTD05_110809.a svp	222	8/10/ 11	9.0	0	18.3442 87N	082.1186 94W	18.1466 39N	082.0368 13W	EX1104_EXApril09_2011- 222_0043_20110810_085808_EX1104_MB.txt	EX1104_3_50m _WGS84
0044_20110810_101150_E X1104_MB.all	EX1104_CTD05_110809.a svp	222	8/10/ 11	9.3	84	18.4086 68N	082.1178 90W	18.3069 61N	081.8054 86W	EX1104_EXApril09_2011- 222_0044_20110810_101150_EX1104_MB.txt	EX1104_3_50m _WGS84
0045_20110811_003034_E X1104_MB.all	EX1104_XBT08_20110810 .asvp	223	8/11/ 11	11. 7	55	18.5699 8N	081.7932 5W	18.3664 1N	081.4933 5W	EX1104_EXApril09_2011- 223_0045_20110811_003034_EX1104_MB.txt	EX1104_3_50m _WGS84
0046_20110811_015956_E X1104_MB.all	EX1104_XBT08_20110810 .asvp	223	8/11/ 11	10	008	18.7485 93N	081.5621 91W	18.5520 04N	081.4624 19W	EX1104_EXApril09_2011- 223_0046_20110811_015956_EX1104_MB.txt	EX1104_3_50m _WGS84
0047_20110811_030729_E X1104_MB.all	EX1104_XBT08_20110810 .asvp	223	8/11/ 11	9.6	068	18.7955 73N	081.5369 68W	18.7164 66N	081.4187 29W	EX1104_EXApril09_2011- 223_0047_20110811_030729_EX1104_MB.txt	EX1104_3_50m _WGS84
0048_20110811_033038_E X1104_MB.all	EX1104_XBT08_20110810 .asvp	223	8/11/ 11	9.9	185	18.7702 49N	081.5149 72W	18.5218 74N	081.4167 33W	EX1104_EXApril09_2011- 223_0048_20110811_033038_EX1104_MB.txt	EX1104_3_50m _WGS84
0049_20110811_044941_E X1104_MB.all	EX1104_XBT08_20110810 .asvp	223	8/11/ 11	9.9	102	18.5793 19N	081.4912 86W	18.5012 61N	081.4065 94W	EX1104_EXApril09_2011- 223_0049_20110811_044941_EX1104_MB.txt	EX1104_3_50m _WGS84
0050_20110811_050639_E X1104_MB.all	EX1104_XBT08_20110810 .asvp EX1104_XBT09_20110811 .asvp	223	8/11/ 11	10	006	18.7645 40N	081.4686 22W	18.5380 44N	081.3784 51W	EX1104_EXApril09_2011- 223_0050_20110811_050639_EX1104_MB.txt	EX1104_3_50m _WGS84
0051_20110811_062640_E X1104_MB.all	EX1104_XBT09_20110811 .asvp	223	8/11/ 11	9.8	212	18.7938 32N	081.4661 50W	18.7148 93N	081.3800 59W	EX1104_EXApril09_2011- 223_0051_20110811_062640_EX1104_MB.txt	EX1104_3_50m _WGS84
0052_20110811_064857_E X1104_MB.all	EX1104_XBT09_20110811 .asvp	223	8/11/ 11	10	188	18.7319 28N	081.4747 58W	18.6148 84N	081.4019 16W	EX1104_EXApril09_2011- 223_0052_20110811_064857_EX1104_MB.txt	EX1104_3_50m _WGS84
0053_20110811_072635_E X1104_MB.all	EX1104_XBT09_20110811 .asvp	223	8/11/ 11	10	040	18.7289 07N	081.4801 26W	18.5790 25N	081.3381 4W	EX1104_EXApril09_2011- 223_0053_20110811_072635_EX1104_MB.txt	EX1104_3_50m _WGS84
0054_20110811_081049_E X1104_MB.all	EX1104_XBT09_20110811 .asvp	223	8/11/ 11	10. 2	187	18.6976 96N	081.4310 38W	18.5282 84N	081.3355 04W	EX1104_EXApril09_2011- 223_0054_20110811_081049_EX1104_MB.txt	EX1104_3_50m _WGS84
0055_20110811_090839_E X1104_MB.all	EX1104_XBT09_20110811 .asvp	223	8/11/ 11	10	278	18.5782 01N	081.4748 67W	18.5024 75N	081.3520 89W	EX1104_EXApril09_2011- 223_0055_20110811_090839_EX1104_MB.txt	EX1104_3_50m _WGS84
0056_20110811_093837_E X1104_MB.all	EX1104_XBT09_20110811 .asvp	223	8/11/ 11	9.5	237	18.5805 31N	081.7559 99W	18.3547 55N	081.4677 93W	EX1104_EXApril09_2011- 223_0056_20110811_093837_EX1104_MB.txt	EX1104_3_50m _WGS84
0057_20110811_113127_E X1104_MB.all	EX1104_XBT10_20110811 .asvp	223	8/11/ 11	9.6	270	18.1715 65N	081.7849 12W	17.8739 11N	081.6076 04W	EX1104_EXApril09_2011- 223_0057_20110811_113127_EX1104_MB.txt	EX1104_3_50m _WGS84
0058_20110812_011243_E X1104_MB.all	EX1104_XBT10_20110811 .asvp	224	8/12/ 11	10	158	18.3566 26N	081.8559 97W	18.1514 87N	081.7102 28W	EX1104_EXApril09_2011- 224_0058_20110812_011243_EX1104_MB.txt	EX1104_3_50m _WGS84
0059_20110812_022759_E X1104_MB.all	EX1104_XBT10_20110811 .asvp	224	8/12/ 11	10	160	18.1715 65N	081.7849 12W	17.8750 67N	081.6079 75W	EX1104_EXApril09_2011- 224_0059_20110812_022759_EX1104_MB.txt	EX1104_3_50m _WGS84
0060_20110812_041001_E X1104_MB.all	EX1104_XBT10_20110811 .asvp	224	8/12/ 11	10	092	17.9266 92N	081.6510 06W	17.8545 03N	081.5397 32W	EX1104_EXApril09_2011- 224_0060_20110812_041001_EX1104_MB.txt	EX1104_3_50m _WGS84
0061_20110812_044347_E X1104_MB.all	EX1104_XBT10_20110811 .asvp EX1104_XBT11_20110812 .asvp	224	8/12/ 11	10	004	18.2340 67N	081.5660 15W	17.8577 23N	081.4799 03W	EX1104_EXApril09_2011- 224_0061_20110812_044347_EX1104_MB.txt	EX1104_3_50m _WGS84
0062_20110812_063957_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	10	260	18.2395 13N	081.5943 12W	18.1645 45N	081.5159 46W	EX1104_EXApril09_2011- 224_0062_20110812_063957_EX1104_MB.txt	EX1104_3_50m _WGS84

0063_20110812_065543_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	10	184	18.1979 42N	081.6132 75W	17.9383 32N	081.5287 30W	EX1104_EXApril09_2011- 224_0063_20110812_065543_EX1104_MB.txt	EX1104_3_50m _WGS84
0064_20110812_082723_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	10. 8	344	18.0669 54N	081.6621 37W	17.9054 98N	081.5477 52W	EX1104_EXApril09_2011- 224_0064_20110812_082723_EX1104_MB.txt	EX1104_3_50m _WGS84
0065_20110812_091411_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	8.1	004	18.2070 70N	081.6643 36W	18.0647 42N	081.5680 07W	EX1104_EXApril09_2011- 224_0065_20110812_091411_EX1104_MB.txt	EX1104_3_50m _WGS84
0066_20110812_101604_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	10. 1	318	18.2935 32N	081.6786 30W	18.2012 95N	081.5802 83W	EX1104_EXApril09_2011- 224_0066_20110812_101604_EX1104_MB.txt	EX1104_3_50m _WGS84
0067_20110812_104609_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	9.9	328	18.3376 64N	081.7168 88W	18.2434 34N	081.6443 47W	EX1104_EXApril09_2011- 224_0067_20110812_104609_EX1104_MB.txt	EX1104_3_50m _WGS84
0068_20110812_110729_E X1104_MB.all	EX1104_XBT11_20110812 .asvp	224	8/12/ 11	9.9	290	18.3868 87N	081.8483 68W	18.2923 52N	081.6867 31W	EX1104_EXApril09_2011- 224_0068_20110812_110729_EX1104_MB.txt	EX1104_3_50m _WGS84
0069_20110813_000627_E X1104_MB.all	EX1104_XBT12_20110812 .asvp	225	8/13/ 11	9.2	152	18.3218 45N	081.7435 10W	18.1294 20N	081.5990 23W	EX1104_EXApril09_2011- 225_0069_20110813_000627_EX1104_MB.txt	EX1104_3_50m _WGS84
0070_20110813_011611_E X1104_MB.all	EX1104_XBT12_20110812 .asvp	225	8/13/ 11	10. 4	274	18.2038 62N	081.8401 95W	18.1015 84N	081.5946 44W	EX1104_EXApril09_2011- 225_0070_20110813_011611_EX1104_MB.txt	EX1104_3_50m _WGS84
0071_20110813_021926_E X1104_MB.all	EX1104_XBT12_20110812 .asvp	225	8/13/ 11	9.4	159	18.1704 07N	081.8261 87W	17.8022 40N	081.6455 70W	EX1104_EXApril09_2011- 225_0071_20110813_021926_EX1104_MB.txt	EX1104_3_50m _WGS84
0072_20110813_043303_E X1104_MB.all	EX1104_XBT12_20110812 .asvp	225	8/13/ 11	9	261	17.8665 21N	081.7417 22W	17.7912 87N	081.6692 43W	EX1104_EXApril09_2011- 225_0072_20110813_043303_EX1104_MB.txt	EX1104_3_50m _WGS84
0073_20110813_045132_E X1104_MB.all	EX1104_XBT12_20110812 .asvp EX1104_XBT13_20110813 .asvp	225	8/13/ 11	8.5	342	18.0924 60N	081.8509 13W	17.8185 44N	081.6853 30W	EX1104_EXApril09_2011- 225_0073_20110813_045132_EX1104_MB.txt	EX1104_3_50m _WGS84
0074_20110813_064945_E X1104_MB.all	EX1104_XBT13_20110813 .asvp	225	8/13/ 11	8.3	255	18.1164 66N	081.8994 34W	18.0468 65N	081.7989 13W	EX1104_EXApril09_2011- 225_0074_20110813_064945_EX1104_MB.txt	EX1104_3_50m _WGS84
0075_20110813_071428_E X1104_MB.all	EX1104_XBT13_20110813 .asvp	225	8/13/ 11	8.1 8	156	18.0831 86N	081.8978 79W	17.7780 67N	081.7139 77W	EX1104_EXApril09_2011- 225_0075_20110813_071428_EX1104_MB.txt	EX1104_3_50m _WGS84
0076_20110813_092913_E X1104_MB.all	EX1104_XBT13_20110813 .asvp	225	8/13/ 11	7.6 5	73.0	17.8722 60N	081.7681 41W	17.7528 81N	081.5494 12W	EX1104_EXApril09_2011- 225_0076_20110813_092913_EX1104_MB.txt	EX1104_3_50m _WGS84
0077_20110813_104737_E X1104_MB.all	EX1104_XBT13_20110813 .asvp	225	8/13/ 11	8.3	306	17.9133 58N	081.6864 01W	17.8091 66N	081.5719 25W	EX1104_EXApril09_2011- 225_0077_20110813_104737_EX1104_MB.txt	EX1104_3_50m _WGS84
0078_20110813_112739_E X1104_MB.all	EX1104_XBT13_20110813 .asvp	225	8/13/ 11	8.4	0	17.9677 47N	081.7095 35W	17.8645 62N	081.6327 57W	EX1104_EXApril09_2011- 225_0078_20110813_112739_EX1104_MB.txt	EX1104_3_50m _WGS84
0079_20110814_042657_E X1104_MB.all	EX1104_CTD06_110813.a svp	226	8/14/ 11	9	090	18.0170 83N	081.6409 74W	17.9279 08N	081.2175 02W	EX1104_EXApril09_2011- 226_0079_20110814_042657_EX1104_MB.txt	EX1104_3_50m _WGS84
0080_20110814_070333_E X1104_MB.all	EX1104_CTD06_110813.a svp	226	8/14/ 11	8.5	358	18.0483 83N	081.2571 84W	17.9343 42N	081.1819 76W	EX1104_EXApril09_2011- 226_0080_20110814_070333_EX1104_MB.txt	EX1104_3_50m _WGS84
0081_20110814_072703_E X1104_MB.all	EX1104_CTD06_110813.a svp	226	8/14/ 11	8.9	270	18.0616 14N	081.5047 14W	17.9798 06N	081.2200 68W	EX1104_EXApril09_2011- 226_0081_20110814_072703_EX1104_MB.txt	EX1104_3_50m _WGS84
0082_20110814_091636_E X1104_MB.all	EX1104_CTD06_110813.a svp	226	8/14/ 11	10. 4	315	18.1888 18N	081.6919 71W	17.9913 58N	081.4911 87W	EX1104_EXApril09_2011- 226_0082_20110814_091636_EX1104_MB.txt	EX1104_3_50m _WGS84
0083_20110814_103043_E X1104_MB.all	EX1104_CTD06_110813.a svp	226	8/14/ 11	9.5	331	18.3755 45N	081.8086 66W	18.1582 70N	081.6404 86W	EX1104_EXApril09_2011- 226_0083_20110814_103043_EX1104_MB.txt	EX1104_3_50m _WGS84
0084_20110815_023245_E X1104_MB.all	EX1104_CTD07_110814.a svp	227	8/15/ 11	9.7	039	18.5298 96N	081.8532 04W	18.3454 45N	081.6664 03W	EX1104_EXApril09_2011- 227_0084_20110815_023245_EX1104_MB.txt	EX1104_3_50m _WGS84
0085_20110815_035227_E X1104_MB.all	EX1104_CTD07_110814.a svp	227	8/15/ 11	9.2	057	18.6043 02N	081.7058 79W	18.4855 35N	081.5566 29W	EX1104_EXApril09_2011- 227_0085_20110815_035227_EX1104_MB.txt	EX1104_3_50m _WGS84
0086_20110815_044239_E	EX1104_CTD07_110814.a	227	8/15/ 11	9.0	004	18.7473	081.6096	18.5492	081.5153	EX1104_EXApril09_2011-	EX1104_3_50m

X1104_MB.all	svp		11			13N	70W	46N	94W	227_0086_20110815_044239_EX1104_MB.txt	_WGS84
0087_20110815_055119_E X1104_MB.all	EX1104_CTD07_110814.a svp	227	8/15/ 11	8.9	352	19.0913 06N	081.6549 72W	18.7463 22N	081.5175 14W	EX1104_EXApril09_2011- 227_0087_20110815_055119_EX1104_MB.txt	EX1104_3_50m _WGS84
0088_20110815_081416_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	6.2	345	19.1630 71N	081.6573 03W	19.0827 31N	081.5778 93W	EX1104_EXApril09_2011- 227_0088_20110815_081416_EX1104_MB.txt	EX1104_3_50m _WGS84
0089_20110815_084442_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	9.2	279	19.2015 28N	081.8015 88W	19.1084 61N	081.6223 13W	EX1104_EXApril09_2011- 227_0089_20110815_084442_EX1104_MB.txt	EX1104_3_50m _WGS84
0090_20110815_094819_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	8.9	189	19.2008 31N	081.8422 33W	19.0969 15N	081.7700 97W	EX1104_EXApril09_2011- 227_0090_20110815_094819_EX1104_MB.txt	EX1104_3_50m _WGS84
0091_20110815_100530_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	9.9	99	19.1509 57N	081.8128 56W	19.0694 32N	081.6356 64W	EX1104_EXApril09_2011- 227_0091_20110815_100530_EX1104_MB.txt	EX1104_3_50m _WGS84
0092_20110815_110233_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	9.2	278	19.0937 82N	081.6918 72W	19.0194 59N	081.6444 31W	EX1104_EXApril09_2011- 227_0092_20110815_110233_EX1104_MB.txt	EX1104_3_50m _WGS84
0093_20110815_112152_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	9.6	188	19.1283 20N	081.6789 93W	19.0176 72N	081.5991 41W	EX1104_EXApril09_2011- 227_0093_20110815_112152_EX1104_MB.txt	EX1104_3_50m _WGS84
0094_20110815_113708_E X1104_MB.all	EX1104_XBT14_20110815 .asvp	227	8/15/ 11	2.7	19	19.0965 47N	081.7303 09W	19.0241 89N	081.6581 46W	EX1104_EXApril09_2011- 227_0094_20110815_113708_EX1104_MB.txt	EX1104_3_50m _WGS84
0095_20110815_233505_E X1104_MB.all	EX1104_DIVE12_CPCTD_ 110815.asvp	227	8/15/ 11	9.1	119	19.1274 32N	081.6067 85W	19.0561 91N	081.5336 43W	EX1104_EXApril09_2011- 227_0095_20110815_233505_EX1104_MB.txt	EX1104_3_50m _WGS84
0096_20110815_234916_E X1104_MB.all	EX1104_DIVE12_CPCTD_ 110815.asvp	227	8/15/ 11	10. 2	171	19.0864 55N	081.6037 45W	18.7634 82N	081.4862 69W	EX1104_EXApril09_2011- 227_0096_20110815_234916_EX1104_MB.txt	EX1104_3_50m _WGS84
0097_20110816_014021_E X1104_MB.all	EX1104_DIVE12_CPCTD_ 110815.asvp	228	8/16/ 11	10. 1	78	18.8035 42N	081.5393 69W	18.7392 62N	081.4377 56W	EX1104_EXApril09_2011- 228_0097_20110816_014021_EX1104_MB.txt	EX1104_3_50m _WGS84
0098_20110816_015915_E X1104_MB.all	EX1104_DIVE12_CPCTD_ 110815.asvp	228	8/16/ 11	10	350	19.1954 00N	081.5637 55W	18.7764 66N	081.4318 20W	EX1104_EXApril09_2011- 228_0098_20110816_015915_EX1104_MB.txt	EX1104_3_50m _WGS84
0099_20110816_042203_E X1104_MB.all	EX1104_DIVE12_CPCTD_ 110815.asvp EX1104_XBT15_20110816 .asvp	228	8/16/ 11	10	382	19.2531 06N	081.7888 05W	19.1420 01N	081.5358 76W	EX1104_EXApril09_2011- 228_0099_20110816_042203_EX1104_MB.txt	EX1104_3_50m _WGS84
0100_20110816_054521_E X1104_MB.all	EX1104_XBT15_20110816 .asvp	228	8/16/ 11	10	217	19.2527 55N	081.8529 80W	19.1121 64N	081.7573 65W	EX1104_EXApril09_2011- 228_0100_20110816_054521_EX1104_MB.txt	EX1104_3_50m _WGS84
0101_20110816_062233_E X1104_MB.all	EX1104_XBT15_20110816 .asvp	228	8/16/ 11	10. 1	272	19.1779 49N	081.9595 31W	19.1108 41N	081.8409 78W	EX1104_EXApril09_2011- 228_0101_20110816_062233_EX1104_MB.txt	EX1104_3_50m _WGS84
0102_20110816_070132_E X1104_MB.all	EX1104_XBT15_20110816 .asvp	228	8/16/ 11	10. 7	311	19.9524 31N	082.9146 98W	19.8439 91N	082.7959 76W	EX1104_EXApril09_2011- 228_0102_20110816_070132_EX1104_MB.txt	EX1104_3_50m _WGS84
0103_20110816_130129_E X1104_MB.all	EX1104_XBT15_20110816 .asvp	228	8/16/ 11	10. 8	311	19.8840 62N	082.8377 53W	19.1212 13N	081.9401 19W	EX1104_EXApril09_2011- 228_0103_20110816_130129_EX1104_MB.txt	EX1104_3_50m _WGS84
0104_20110817_210934_E X1104_MB.all	EX1104_XBT15_20110816 .asvp EX1104_XBT17_20110817 _2.asvp EX1104_XBT18_20110818 .asvp	229	8/17/ 11	9.5	82.0	24.1656 52N	083.9901 18W	23.9699 86N	082.9532 50W	EX1104_EXApril09_2011- 229_0104_20110817_210934_EX1104_MB.txt	EX1104_3_50m _WGS84
0105_20110818_030932_E X1104_MB.all	EX1104_XBT18_20110818 .asvp	230	8/18/ 11	9	80	24.0.315 33N	82.96516 67W	24.1355 N	81.9855W	EX1104_EXApril09_2011- 229_0105_20110818_030932_EX1104_MB.txt	EX1104_3_50m _WGS84
0106_20110818_090931_E X1104_MB.all	EX1104_XBT18_20110818 .asvp	230	8/18/ 11	9.1	81	24.3366 66N	81.986W	24.3043 33N	81.84416 667W	EX1104_EXApril09_2011- 229_0106_20110818_090931_EX1104_MB.txt	EX1104_3_50m _WGS84

**Table 2. Sound Velocity Profile files**

EX1104 SVP LOG				
DATE (GMT)	TIME (GMT)	XBT/CTD FILE NAME	LAT/LONG (WGS84)	NOTES
8/3/2011	09:57:32	EX1104_XBT01_20110803	09 36.272N 079 55.850W	very spikey, not used, a lot of lighting
8/3/2011	10:02:25	EX1104_XBT02_20110803	09 36.272N 079 55.850W	looked okay. A little spikey
8/4/2011	16:44:33	EX1104_XBT03_20110804		bad, tangled in fishing line
8/4/2011	16:49:22	EX1104_XBT04_20110804		bad, tangled in fishing line
8/4/2011	16:54:57	EX1104_XBT05_20110804	15 2.332N 080 41.626W	
8/4/2011	23:15:21	EX1104_XBT06_20110804	16 16.30762N 080 48.2266W	
8/5/2011	05:23:34	EX1104_XBT07_20110805	17 23.8811N 081 20.94727W	
8/6/2011	00:40:15	EX1104_CTD02_110805	18 22.59N 081 47.89W	
8/6/2011	17:40:46	EX1104_DIVE03_CPCTD_110806	18.372355N 081.793170W	
8/8/2011	00:00:03	EX1104_CTD03_110807	18 21.70N 081 49.63W	
8/8/2011	23:57:12	EX1104_CTD04_110808	18 21.26N 081 50.57W	
8/10/2011	00:10:00	EX1104_CTD05_110809.asvp	18 23.31N 081 49.34W	
8/11/2011	00:23:06	EX1104_XBT08_20110810	18 22.56299N 081 47.88672W	
8/11/2011	05:28:32	EX1104_XBT09_20110811	18 36.06653N 081 25.61182W	
8/12/2011	01:06:39	EX1104_XBT10_20110811.EDF	18 21.39734N 081 50.39404W	
8/12/2011	05:27:50	EX1104_XBT11_20110812	18 0.39893N 081 31.52588W	
8/12/2011	23:27:09	EX1104_XBT12_20110812	18 20.22351N 081 47.95166W	
8/13/2011	05:31:36	EX1104_XBT13_20110813	17 54.83704N 081 44.78271W	
8/14/2011	01:23:32	EX1104_CTD06_110813	17 59.99N 081 37.99W	
8/14/2011	23:50:53	EX1104_CTD07_110814	18 22.58N 081 47.89W	
8/15/2011	07:54:44	EX1104_XBT14_20110815	19 3.21509N 081 36.62012W	

8/15/2011	13:35:22	EX1104_DIVE12_CPCTD_110815	19 5.373N 081 36.575W	
8/16/2011	05:24:59	EX1104_XBT15_20110816	19 12.37988N 081 43.34473W	
8/17/2011	21:03:04	EX1104_XBT16_20110817	23 59.3689N 083 59.36816W	
8/17/2011	21:33:58	EX1104_XBT17_20110817_2	24 0.86182N 083 54.44727W	
8/18/2011	03:16:44	EX1104_XBT18_20110818	24 9.43286N 082 56.41992W	



### ***Appendix C: List of acronyms***

- ASCII – American Standard Code for Information Interchange
- AUV – autonomous underwater vehicle
- BIST – built in system test
- BRD – Blake Ridge Diapir
- CDR – Commander
- CFD – Cape Fear Diapir
- CO – Commanding Officer
- CTD – conductivity, temperature, depth
- CW – continuous wave
- DNP – do not process
- ECS – Extended Continental Shelf
- ERT – Earth Resources Technology Inc.
- ET – Electronics Technician
- EX – NOAA Ship *Okeanos Explorer*
- FM – frequency modulated / modulation
- FTP – file transfer protocol
- GMT – Generic Mapping Tools
- HTC – Hatteras Transverse Canyon
- kHz – kilohertz
- km – kilometer
- kts – knots
- LT – Lieutenant
- MB – multibeam sonar
- MB – megabytes
- NCDDC – National Coastal Data Development Center
- NGDC – National Geophysical Data Center
- NMEA – National Marine Electronics Association
- NOAA – National Oceanic and Atmospheric Administration
- NODC – National Oceanographic Data Center
- NOPP – National Ocean Partnership Program
- OER – NOAA Office of Ocean Exploration and Research
- OMAO – NOAA Office of Marine and Aviation Operations
- OPS – Operations Officer
- ROV – remotely operated vehicle
- SBP – subbottom profiler
- SCS – scientific computer system
- SIS – Seafloor Information System
- SVP – sound velocity profile
- TRU – transceiver unit
- TSG - thermosalinograph
- UCAR – University Corporation for Atmospheric Research
- UPS – uninterruptable power supply
- USBL – ultrashort baseline
- USGS – United States Geological Survey
- XBT – expendable bathythermograph
- XO – Executive Officer
- WD – water depth
- WHOI – Woods Hole Oceanographic Institution

## Appendix D: EM302 PU Parameters in use during cruise

## Database Parameters

## Seafloor Information System  
## Kongsberg Maritime AS  
## Saved: 2011.08.05 18:53:02

## Build info:

## SIS: [Version: 3.6.4, Build: 174 ,  
DBVersion 16.0 CD generated: Mon Mar 30  
2009 14:00:00]  
[Fox ver = 1.6.29]  
[db ver = 16, proc = 16.0]  
[OTL = 4.0.-95]  
[ACE ver = 5.5]  
[Coin ver = 2.4.4]  
[Simage ver = 1.6.2a]  
[Dime ver = DIME v0.9]  
[STLPort ver = 513]  
[FreeType ver = 2.1.9]  
[TIFF ver = 3.8.2]  
[GeoTIFF ver = 1230]  
[GridEngine ver = 2.3.0]

## Language [3] ## Current language,  
1-Norwegian, 2-German,3-English, 4-  
Spanish

## Type [302]  
## Serial no. [101]  
## Number of heads [2]  
## System descriptor [50331648] ##  
03000000

##  
\*\*\*\*\*  
\*\*\*\*\*  
## Installation parameters

## Input Setup ## All Input setup parameters

## COM1 ## Link settings.

## Com. settings ## Serial line parameter  
settings.

## Baud rate: [9600]  
## Data bits [8]  
## Stop bits: [1]  
## Parity: [NONE]  
## Com. settings

## Position ## Position input settings.  
## None [1] [0]

## GGK [1] [0]  
## GGA [1] [1]  
## GGA\_RTK [1] [0]  
## SIMRAD90 [1] [0]  
## Position

## Input Formats ## Format input  
settings.

## Attitude [0] [0]  
## MK39 Mod2 Attitude, [0] [0]  
## ZDA Clock [1] [1]  
## HDT Heading [0] [0]  
## SKR82 Heading [0] [0]  
## DBS Depth [1] [0]  
## DBT Depth [1] [0]  
## EA500 Depth [0] [0]  
## ROV. depth [1] [0]  
## Height, special purp [1] [0]  
## Ethernet AttVel [0] [0]  
## Input Formats

## COM1

## COM2 ## Link settings.

## Com. settings ## Serial line parameter  
settings.

## Baud rate: [19200]  
## Data bits [8]  
## Stop bits: [1]  
## Parity: [NONE]  
## Com. settings

## Position ## Position input settings.

## None [0] [1]  
## GGK [0] [0]  
## GGA [0] [0]  
## GGA\_RTK [0] [0]  
## SIMRAD90 [0] [0]  
## Position

## Input Formats ## Format input  
settings.

## Attitude [1] [1]  
## MK39 Mod2 Attitude, [0] [0]  
## ZDA Clock [0] [0]  
## HDT Heading [0] [0]  
## SKR82 Heading [0] [0]  
## DBS Depth [0] [0]  
## DBT Depth [0] [0]  
## EA500 Depth [0] [0]  
## ROV. depth [0] [0]  
## Height, special purp [0] [0]  
## Ethernet AttVel [0] [0]  
## Input Formats

## COM2

## COM3 ## Link settings.

## Com. settings ## Serial line parameter  
settings.

## Baud rate: [4800]  
## Data bits [8]  
## Stop bits: [1]  
## Parity: [NONE]  
## Com. settings

## Position ## Position input settings.  
## None [1] [1]

## GGK [1] [0]  
## GGA [1] [0]  
## GGA\_RTK [1] [0]  
## SIMRAD90 [1] [0]  
## Position

## Input Formats ## Format input  
settings.

## Attitude [0] [0]  
## MK39 Mod2 Attitude, [0] [0]  
## ZDA Clock [0] [0]  
## HDT Heading [1] [1]  
## SKR82 Heading [0] [0]  
## DBS Depth [1] [0]  
## DBT Depth [1] [0]  
## EA500 Depth [0] [0]  
## ROV. depth [1] [0]  
## Height, special purp [1] [0]  
## Ethernet AttVel [0] [0]  
## Input Formats

## COM3

## COM4 ## Link settings.

## Com. settings ## Serial line parameter  
settings.

## Baud rate: [9600]  
## Data bits [8]  
## Stop bits: [1]  
## Parity: [NONE]  
## Com. settings

## Position ## Position input settings.

## None [1] [1]  
## GGK [1] [0]  
## GGA [1] [0]  
## GGA\_RTK [1] [0]  
## SIMRAD90 [1] [0]  
## Position

## Input Formats ## Format input  
settings.

## Attitude [0] [0]  
## MK39 Mod2 Attitude, [0] [0]  
## ZDA Clock [0] [0]  
## HDT Heading [0] [0]  
## SKR82 Heading [0] [0]  
## DBS Depth [1] [0]  
## DBT Depth [1] [0]  
## EA500 Depth [0] [0]  
## ROV. depth [1] [0]  
## Height, special purp [1] [0]  
## Ethernet AttVel [0] [0]  
## Input Formats

## COM4

## UDP2 ## Link settings.

## Com. settings ## Serial line parameter  
settings.

## N/A  
## Com. settings

## Position ## Position input settings.

## None [1] [1]  
## GGK [1] [0]  
## GGA [1] [0]  
## GGA\_RTK [1] [0]

```

    #* SIMRAD90      [1] [0]
  #} Position

#{ Input Formats /// Format input
settings.
  #* Attitude      [0] [0]
  #* MK39 Mod2 Attitude, [0] [0]
  #* ZDA Clock     [0] [0]
  #* HDT Heading   [0] [0]
  #* SKR82 Heading [0] [0]
  #* DBS Depth     [0] [0]
  #* DBT Depth     [0] [0]
  #* EA500 Depth  [1] [0]
  #* ROV. depth    [0] [0]
  #* Height, special purp [0] [0]
  #* Ethernet AttVel [0] [0]
#} Input Formats

#} UDP2

#{ UDP3 /// Link settings.

  #{ Com. settings /// Serial line parameter
settings.
  #// N/A
#} Com. settings

#{ Position /// Position input settings.
  #* None          [0] [1]
  #* G GK          [0] [0]
  #* G GA          [0] [0]
  #* G GA_RTK      [0] [0]
  #* SIMRAD90     [0] [0]
#} Position

#{ Input Formats /// Format input
settings.
  #* Attitude      [0] [0]
  #* MK39 Mod2 Attitude, [0] [0]
  #* ZDA Clock     [0] [0]
  #* HDT Heading   [1] [0]
  #* SKR82 Heading [0] [0]
  #* DBS Depth     [1] [0]
  #* DBT Depth     [1] [0]
  #* EA500 Depth  [0] [0]
  #* ROV. depth    [1] [0]
  #* Height, special purp [1] [0]
  #* Ethernet AttVel [0] [0]
#} Input Formats

#} UDP3

#{ UDP4 /// Link settings.

  #{ Com. settings /// Serial line parameter
settings.
  #// N/A
#} Com. settings

#{ Position /// Position input settings.
  #* None          [0] [1]
  #* G GK          [0] [0]
  #* G GA          [0] [0]
  #* G GA_RTK      [0] [0]
  #* SIMRAD90     [0] [0]
#} Position

#{ Input Formats /// Format input
settings.
  #* Attitude      [1] [0]

```

```

  #* MK39 Mod2 Attitude, [0] [0]
  #* ZDA Clock          [0] [0]
  #* HDT Heading       [1] [0]
  #* SKR82 Heading     [0] [0]
  #* DBS Depth         [1] [0]
  #* DBT Depth         [1] [0]
  #* EA500 Depth       [0] [0]
  #* ROV. depth        [1] [0]
  #* Height, special purp [1] [0]
  #* Ethernet AttVel   [0] [0]
#} Input Formats

#} UDP4

#{ UDP5 /// Link settings.

  #{ Com. settings /// Serial line parameter
settings.
  #// N/A
#} Com. settings

#{ Position /// Position input settings.
  #* None          [0] [0]
  #* G GK          [0] [0]
  #* G GA          [0] [0]
  #* G GA_RTK      [0] [0]
  #* SIMRAD90     [0] [0]
#} Position

#{ Input Formats /// Format input
settings.
  #* Attitude      [0] [0]
  #* MK39 Mod2 Attitude, [0] [0]
  #* ZDA Clock     [0] [0]
  #* HDT Heading   [0] [0]
  #* SKR82 Heading [0] [0]
  #* DBS Depth     [0] [0]
  #* DBT Depth     [0] [0]
  #* EA500 Depth  [0] [0]
  #* ROV. depth    [0] [0]
  #* Height, special purp [0] [0]
  #* Ethernet AttVel [1] [1]
#} Input Formats

  #{ Attitude Velocity settings /// Only
relevant for UDP5 on EM122, EM302 and
EM710, currently
  #* Attitude 1      [1] [1]
  #* Attitude 2      [1] [0]
  #* Use Ethernet 2  [1] [1]
  #* Port:          [5602]
  #* IP addr.:      [192.168.2.20]
  #* Net mask:      [255.255.255.0]
#} Attitude Velocity settings

#} UDP5

#{ Misc. /// Misc. input settings.
  #* External Trigger [1] [0]
#} Misc.

#} Input Setup

#{ Output Setup /// All Output setup
parameters
  #* PU broadcast enable [1] [1]
  #* Log watercolumn to s [1] [1]

```

```

#{ Host UDP1 /// Host UDP1 Port: 16100

#{ Datagram subscription ///
  #* Depth          [0] [0]
  #* Raw range and beam a [0] [0]
  #* Seabed Image   [0] [0]
  #* Central Beams  [0] [0]
  #* Position       [0] [0]
  #* Attitude       [0] [0]
  #* Heading        [0] [0]
  #* Height         [0] [0]
  #* Clock          [0] [0]
  #* Single beam echosoun [0] [0]
  #* Sound Speed Profile [0] [1]
  #* Runtime Parameters [0] [1]
  #* Installation Paramet [0] [1]
  #* BIST Reply     [0] [1]
  #* Status parameters [0] [1]
  #* PU Broadcast   [0] [0]
  #* Stave Display  [0] [0]
  #* Water Column   [0] [0]
  #* Internal, Range Data [0] [0]
  #* Internal, Scope Data [0] [0]
#} Datagram subscription

#} Host UDP1

#{ Host UDP2 /// Host UDP2 Port: 16101

#{ Datagram subscription ///
  #* Depth          [1] [1]
  #* Raw range and beam a [1] [1]
  #* Seabed Image   [1] [1]
  #* Central Beams  [1] [0]
  #* Position       [1] [1]
  #* Attitude       [1] [1]
  #* Heading        [1] [1]
  #* Height         [1] [1]
  #* Clock          [1] [1]
  #* Single beam echosoun [1] [1]
  #* Sound Speed Profile [0] [1]
  #* Runtime Parameters [0] [1]
  #* Installation Paramet [0] [1]
  #* BIST Reply     [1] [1]
  #* Status parameters [0] [1]
  #* PU Broadcast   [1] [0]
  #* Stave Display  [0] [1]
  #* Water Column   [0] [1]
  #* Internal, Range Data [1] [0]
  #* Internal, Scope Data [1] [0]
#} Datagram subscription

#} Host UDP2

#{ Host UDP3 /// Host UDP3 Port: 16102

#{ Datagram subscription ///
  #* Depth          [0] [1]
  #* Raw range and beam a [0] [0]
  #* Seabed Image   [0] [0]
  #* Central Beams  [0] [0]
  #* Position       [0] [0]
  #* Attitude       [0] [1]
  #* Heading        [0] [0]
  #* Height         [0] [1]
  #* Clock          [0] [0]
  #* Single beam echosoun [0] [1]
  #* Sound Speed Profile [0] [1]

```

```

#* Runtime Parameters [0] [0]
#* Installation Paramet [0] [1]
#* BIST Reply [0] [0]
#* Status parameters [0] [0]
#* PU Broadcast [0] [0]
#* Stave Display [0] [0]
#* Water Column [0] [0]
#* Internal, Range Data [0] [0]
#* Internal, Scope Data [0] [1]
#) Datagram subscription

#) Host UDP3

#{ Host UDP4 /// Host UDP4 Port 16103

#{ Datagram subscription ///
#* Depth [1] [1]
#* Raw range and beam a [1] [0]
#* Seabed Image [1] [0]
#* Central Beams [1] [0]
#* Position [1] [0]
#* Attitude [1] [0]
#* Heading [1] [0]
#* Height [1] [0]
#* Clock [1] [0]
#* Single beam echosoun [1] [0]
#* Sound Speed Profile [1] [0]
#* Runtime Parameters [1] [0]
#* Installation Paramet [1] [0]
#* BIST Reply [1] [0]
#* Status parameters [1] [0]
#* PU Broadcast [1] [0]
#* Stave Display [1] [0]
#* Water Column [1] [0]
#* Internal, Range Data [1] [0]
#* Internal, Scope Data [1] [0]
#) Datagram subscription

#) Host UDP4

#{ Watercolumn /// Host UDP4 Port 16103

#{ Datagram subscription ///
#* Depth [1] [1]
#* Raw range and beam a [1] [1]
#* Seabed Image [1] [1]
#* Central Beams [1] [0]
#* Position [1] [1]
#* Attitude [1] [1]
#* Heading [1] [1]
#* Height [1] [1]
#* Clock [1] [1]
#* Single beam echosoun [1] [1]
#* Sound Speed Profile [1] [1]
#* Runtime Parameters [1] [1]
#* Installation Paramet [1] [1]
#* BIST Reply [1] [1]
#* Status parameters [1] [1]
#* PU Broadcast [1] [0]
#* Stave Display [1] [0]
#* Water Column [1] [1]
#* Internal, Range Data [1] [0]
#* Internal, Scope Data [1] [0]
#) Datagram subscription

#) Watercolumn

#) Output Setup

#{ Clock Setup /// All Clock setup
parameters
#{ Clock /// All clock settings.
#* Source: [1] /// External ZDA
Clock
#* 1PPS Clock Synch. [1] [1]
#* Offset (sec.): [0]
#) Clock

#) Clock Setup

#{ Settings /// Sensor setup parameters

#{ Positioning System Settings /// Position
related settings.
#{ COM1 /// Positioning System Ports:
#* P1T [0] /// System
#* P1M [0] /// Enable
position motion correction
#* P1D [0.000] /// Position
delay (sec.):
#* P1G [WGS84] /// Datum:
#* P1Q [1] /// Enable
#* Pos. qual. indicator [] ///
#) COM1

#) Positioning System Settings

#{ Motion Sensor Settings /// Motion
related settings.
#{ COM2 /// Motion Sensor Ports:
#* MRP [RP] /// Rotation
(POSMV/MRU)
#* MSD [0] /// Motion Delay
(msec.):
#* MAS [1.00] /// Motion
Sensor Roll Scaling:
#) COM2

#) Motion Sensor Settings

#{ Active Sensors ///
#* APS [0] [COM1] ///
Position:
#* ARO [2] [COM2] /// Motion:
#* AHE [2] [COM2] /// Motion:
#* AHS [3] [COM3] ///
Heading:
#) Active Sensors

#) Settings

#{ Locations /// All location parameters

#{ Location offset (m) ///
#{ Pos, COM1: ///
#* P1X [0.00] /// Forward (X)
#* P1Y [0.00] /// Starboard
(Y)
#* P1Z [0.00] /// Downward
(Z)
#) Pos, COM1:
#{ Pos, COM3: ///
#* P2X [0.00] /// Forward (X)
#* P2Y [0.00] /// Starboard
(Y)
#* P2Z [0.00] /// Downward
(Z)
#) Pos, COM3:
#{ Pos, COM4/UDP2: ///
#* P3X [0.00] /// Forward (X)
#* P3Y [0.00] /// Starboard
(Y)
#* P3Z [0.00] /// Downward
(Z)
#) Pos, COM4/UDP2:
#{ TX Transducer: ///
#* S1X [6.147] /// Forward
(X)
#* S1Y [1.822] /// Starboard
(Y)
#* S1Z [6.796] /// Downward
(Z)
#) TX Transducer:
#{ RX Transducer: ///
#* S2X [2.497] /// Forward
(X)
#* S2Y [2.481] /// Starboard
(Y)
#* S2Z [6.790] /// Downward
(Z)
#) RX Transducer:
#{ Attitude 1, COM2: ///
#* MSX [0.00] /// Forward
(X)
#* MSY [0.00] /// Starboard
(Y)
#* MSZ [0.00] /// Downward
(Z)
#) Attitude 1, COM2:
#{ Attitude 2, COM3: ///
#* NSX [0.00] /// Forward
(X)
#* NSY [0.00] /// Starboard
(Y)
#* NSZ [0.00] /// Downward
(Z)
#) Attitude 2, COM3:
#{ Waterline: ///
#* WLZ [1.838] ///
Downward (Z)
#) Waterline:
#) Location offset (m)

#) Locations

#{ Angular Offsets /// All angular offset
parameters
#{ Offset angles (deg.) ///
#{ TX Transducer: ///
#* S1R [0.00] /// Roll
#* S1P [0.00] /// Pitch
#* S1H [359.98] /// Heading
#) TX Transducer:

```

```

#{ RX Transducer: #//
  #* S2R      [0.00] #// Roll
  #* S2P      [0.00] #// Pitch
  #* S2H      [0.03] #// Heading
#} RX Transducer:

#{ Attitude 1, COM2: #//
  #* MSR      [0.00] #// Roll
  #* MSP      [-0.725] #// Pitch
  #* MSG      [0.00] #// Heading
#} Attitude 1, COM2:

#{ Attitude 2, COM3: #//
  #* NSR      [0.00] #// Roll
  #* NSP      [0.00] #// Pitch
  #* NSG      [0.00] #// Heading
#} Attitude 2, COM3:

#{ Stand-alone Heading: #//
  #* GCG      [0.00] #// Heading
#} Stand-alone Heading:

#} Offset angles (deg.)

#} Angular Offsets

#{ ROV. Specific #// All ROV specific
parameters

  #{ Depth/Pressure Sensor #//
    #* DSF      [1.00] #// Scaling:
    #* DSO      [0.00] #// Offset:
    #* DSD      [0.00] #// Delay:
    #* DSH      [NI] #// Disable Heave
  Sensor
  #} Depth/Pressure Sensor

#} ROV. Specific

#{ System Parameters #// All system
parameters

  #{ System Gain Offset #//
    #* GO1      [0.0] #// BS Offset (dB)
  #} System Gain Offset

  #{ Opening angles #//
    #* S1S      [0] #// TX Opening
  angle:
    #* S2S      [1] #// RX Opening
  angle:
  #} Opening angles

#} System Parameters

#//
*****
#// Runtime parameters

#{ Sounder Main #//

  #{ Sector Coverage #//

    #{ Max. angle (deg.): #//
      #* MPA      [75] #// Port
      #* MSA      [75] #// Starboard
    #} Max. angle (deg.):

    #{ Max. Coverage (m): #//
      #* MPC      [5000] #// Port
      #* MSC      [5000] #// Starboard
    #} Max. Coverage (m):

    #* ACM      [1] #// Angular
  Coverage mode: AUTO
    #* BSP      [2] #// Beam Spacing:
  HIDENS EQDIST

  #} Sector Coverage

  #{ Depth Settings #//
    #* FDE      [1250] #// Force Depth
  (m)
    #* MID      [500] #// Min. Depth
  (m):
    #* MAD      [5000] #// Max. Depth
  (m):
    #* DSM      [2] #// Dual swath
  mode: DYNAMIC
    #* PMO      [0] #// Ping Mode:
  AUTO
    #* FME      [1] #// FM enable
  #} Depth Settings

  #{ Stabilization #//
    #* YPS      [1] #// Pitch
  stabilization
    #* TXA      [0] #// Along Direction
  (deg.):

    #{ Yaw Stabilization #//
      #* YSM      [2] #// Mode: REL.
  MEAN HEADING
    #* YMA      [300] #// Heading:
    #* HFI      [1] #// Heading filter:
  MEDIUM
  #} Yaw Stabilization

  #} Stabilization
#} Sounder Main

#{ Sound Speed #//

  #{ Sound Speed at Transducer #//
    #* SHS      [0] #// Source
  SENSOR
    #* SST      [15000] #// Sound
  Speed (dm/sec.):
    #* Sensor Offset (m/sec [0] #//
    #* Filter (sec.): [5] #//
  #} Sound Speed at Transducer

#} Sound Speed

#{ Filter and Gains #//

  #{ Filtering #//
    #* SFS      [1] #// Spike Filter
  Strength: WEAK
    #* PEF      [0] #// Penetration
  Filter Strength: OFF
    #* RGS      [0] #// Range Gate:
  SMALL
    #* SLF      [1] #// Slope
    #* AEF      [0] #// Aeration
    #* STF      [1] #// Sector Tracking
    #* IFF      [1] #// Interference
  #} Filtering

  #{ Absorption Coefficient #//
    #* ABC      [6.521] #// 31.5 kHz
  #} Absorption Coefficient

  #{ Normal incidence sector #//
    #* TCA      [7] #// Angle from nadir
  (deg.):
  #} Normal incidence sector

  #{ Mammal protection #//
    #* TXP      [0] #// TX power level
  (dB): Max.
    #* SSR      [4] #// Soft startup
  ramp time (min.):
  #} Mammal protection
#} Filter and Gains

#{ Data Cleaning #//
  #* Active rule: [STANDARD] #//
  #{ STANDARD #//
    #* PingProc.maxPingCountRadius
  [10]
    #* PingProc.radiusFactor
  [0.050000]
    #* PingProc.medianFactor
  [1.500000]
    #* PingProc.beamNumberRadius
  [3]
    #* PingProc.sufficientPointCount
  [40]
    #* PingProc.neighborhoodType
  [Elliptical]
    #* PingProc.timeRule.use
  [false]
    #* PingProc.overhangRule.use
  [false]
    #* PingProc.medianRule.use
  [false]
    #* PingProc.medianRule.depthFactor
  [0.050000]
    #* PingProc.medianRule.minPointCount
  [6]
    #* PingProc.quantileRule.use
  [false]
    #* PingProc.quantileRule.quantile
  [0.100000]
    #* PingProc.quantileRule.scaleFactor
  [6.000000]
    #* PingProc.quantileRule.minPointCount
  [40]
    #* GridProc.minPoints
  [8]
    #* GridProc.depthFactor
  [0.200000]
    #* GridProc.removeTooFewPoints
  [false]
    #* GridProc.surfaceFitting.surfaceDegree
  [1]
    #* GridProc.surfaceFitting.tukeyConstant
  [6.000000]
    #* GridProc.surfaceFitting.maxIteration
  [10]
    #* GridProc.surfaceFitting.convCriterion
  [0.010000]
    #*
  GridProc.surfaceDistanceDepthRule.use
  [false]

```

```
    #*
GridProc.surfaceDistanceDepthRule.depthFactor [0.050000]
    #*
GridProc.surfaceDistancePointRule.use [false]
    #*
GridProc.surfaceDistancePointRule.scaleFactor [1.000000]
    #* GridProc.surfaceDistanceUnitRule.use [false]
    #*
GridProc.surfaceDistanceUnitRule.scaleFactor [1.000000]
```

```
    #*
GridProc.surfaceDistanceStDevRule.use [false]
    #*
GridProc.surfaceDistanceStDevRule.scaleFactor [2.000000]
    #* GridProc.surfaceAngleRule.use [false]
    #* GridProc.surfaceAngleRule.minAngle [20.000000]
    #* SonarProc.use [false]
    #* SonarProc.gridSizeFactor [4]
    #* SonarProc.mergerType [Average]
```

```
    #* SonarProc.interpolatorType [TopHat]
    #* SonarProc.interpolatorRadius [1]
    #* SonarProc.fillInOnly [true]
    #} STANDARD

    #{ Seabed Image Processing #//
    #* Seabed Image Process [1] [0]
    #} Seabed Image Processing
    #} Data Cleaning

    #{ Advanced param. #//
    #} Advanced param.
```

## Appendix E: EM 302 Built-In-System-Test (BIST) EX1104\_03.txt; August 3, 2011

Saved: 2011.08.03 18:50:34

Sounder Type: 302, Serial no.: 101

Date Time Ser. No. BIST  
Result

-----  
-----  
2011.08.03 18:43:09.282 101 0  
OK

Number of BSP67B boards: 2

BSP 1 Master 2.3 090702 4.3 070913 4.3  
070913

BSP 1 Slave 2.3 090702 6.0 080902

BSP 1 RXI FPGA 3.6 080821

BSP 1 DSP FPGA A 4.0 070531

BSP 1 DSP FPGA B 4.0 070531

BSP 1 DSP FPGA C 4.0 070531

BSP 1 DSP FPGA D 4.0 070531

BSP 1 PCI TO SLAVE A1 FIFO: ok

BSP 1 PCI TO SLAVE A2 FIFO: ok

BSP 1 PCI TO SLAVE A3 FIFO: ok

BSP 1 PCI TO SLAVE B1 FIFO: ok

BSP 1 PCI TO SLAVE B2 FIFO: ok

BSP 1 PCI TO SLAVE B3 FIFO: ok

BSP 1 PCI TO SLAVE C1 FIFO: ok

BSP 1 PCI TO SLAVE C2 FIFO: ok

BSP 1 PCI TO SLAVE C3 FIFO: ok

BSP 1 PCI TO SLAVE D1 FIFO: ok

BSP 1 PCI TO SLAVE D2 FIFO: ok

BSP 1 PCI TO SLAVE D3 FIFO: ok

BSP 1 PCI TO MASTER A HPI: ok

BSP 1 PCI TO MASTER B HPI: ok

BSP 1 PCI TO MASTER C HPI: ok

BSP 1 PCI TO MASTER D HPI: ok

BSP 1 PCI TO SLAVE A0 HPI: ok

BSP 1 PCI TO SLAVE A1 HPI: ok

BSP 1 PCI TO SLAVE A2 HPI: ok

BSP 1 PCI TO SLAVE B0 HPI: ok

BSP 1 PCI TO SLAVE B1 HPI: ok

BSP 1 PCI TO SLAVE B2 HPI: ok

BSP 1 PCI TO SLAVE C0 HPI: ok

BSP 1 PCI TO SLAVE C1 HPI: ok

BSP 1 PCI TO SLAVE C2 HPI: ok

BSP 1 PCI TO SLAVE D0 HPI: ok

BSP 1 PCI TO SLAVE D1 HPI: ok

BSP 1 PCI TO SLAVE D2 HPI: ok

BSP 2 Master 2.3 090702 4.3 070913 4.3  
070913

BSP 2 Slave 2.3 090702 6.0 080902

BSP 2 RXI FPGA 3.6 080821

BSP 2 DSP FPGA A 4.0 070531

BSP 2 DSP FPGA B 4.0 070531

BSP 2 DSP FPGA C 4.0 070531

BSP 2 DSP FPGA D 4.0 070531

BSP 2 PCI TO SLAVE A1 FIFO: ok

BSP 2 PCI TO SLAVE A2 FIFO: ok

BSP 2 PCI TO SLAVE A3 FIFO: ok

BSP 2 PCI TO SLAVE B1 FIFO: ok

BSP 2 PCI TO SLAVE B2 FIFO: ok

BSP 2 PCI TO SLAVE B3 FIFO: ok

BSP 2 PCI TO SLAVE C1 FIFO: ok

BSP 2 PCI TO SLAVE C2 FIFO: ok

BSP 2 PCI TO SLAVE C3 FIFO: ok

BSP 2 PCI TO SLAVE D1 FIFO: ok

BSP 2 PCI TO SLAVE D2 FIFO: ok

BSP 2 PCI TO SLAVE D3 FIFO: ok

BSP 2 PCI TO MASTER A HPI: ok

BSP 2 PCI TO MASTER B HPI: ok

BSP 2 PCI TO MASTER C HPI: ok

BSP 2 PCI TO MASTER D HPI: ok

BSP 2 PCI TO SLAVE A0 HPI: ok

BSP 2 PCI TO SLAVE A1 HPI: ok

BSP 2 PCI TO SLAVE A2 HPI: ok

BSP 2 PCI TO SLAVE B0 HPI: ok

BSP 2 PCI TO SLAVE B1 HPI: ok

BSP 2 PCI TO SLAVE B2 HPI: ok

BSP 2 PCI TO SLAVE C0 HPI: ok

BSP 2 PCI TO SLAVE C1 HPI: ok

BSP 2 PCI TO SLAVE C2 HPI: ok

BSP 2 PCI TO SLAVE D0 HPI: ok

BSP 2 PCI TO SLAVE D1 HPI: ok

BSP 2 PCI TO SLAVE D2 HPI: ok

-----  
-----  
2011.08.03 18:43:10.799 101 1  
OK

High Voltage Br. 1

-----  
TX36 Spec: 90.0 - 145.0

0-1 119.7

0-2 119.7

0-3 119.3

0-4 119.3

0-5 119.3

0-6 118.4

0-7 119.3

0-8 118.0

0-9 119.3

0-10 119.3

0-11 119.7

0-12 118.0

0-13 120.1

0-14 119.3

0-15 120.1

0-16 119.7

0-17 118.4

0-18 119.3

0-19 118.8

0-20 118.8

0-21 118.8

0-22 119.7

0-23 118.4

0-24 119.3

High Voltage Br. 2

-----  
TX36 Spec: 90.0 - 145.0

0-1 119.3

0-2 118.9

0-3 118.9

0-4 118.4

0-5 118.9

0-6 118.9

0-7 118.4

0-8 118.4

0-9 119.3

0-10 119.3

0-11 118.9

0-12 119.3

0-13 118.0

0-14 119.3

0-15 119.7

0-16 119.3

0-17 118.9

0-18 119.3

0-19 118.4

0-20 118.9

0-21 119.3

0-22 119.7

0-23 118.9

0-24 118.9

-----  
Input voltage 12V

-----  
TX36 Spec: 11.0 - 13.0

0-1 11.9

0-2 11.9

0-3 11.9

0-4 11.9

0-5 11.9

0-6 11.9

0-7 11.9

0-8 11.9

0-9 11.9

0-10 11.9

0-11 11.9

0-12 11.9

0-13 11.9

0-14 11.9

0-15 11.9

0-16 12.0

0-17 11.9

0-18 11.9

0-19 11.8

0-20 11.9

0-21 11.9

0-22 11.9

0-23 11.8

0-24 11.9

-----  
Digital 3.3V

-----  
TX36 Spec: 2.8 - 3.5

0-1 3.3

0-2 3.3

0-3 3.3

0-4 3.3  
0-5 3.3  
0-6 3.3  
0-7 3.3  
0-8 3.3  
0-9 3.3  
0-10 3.3  
0-11 3.3  
0-12 3.3  
0-13 3.3  
0-14 3.3  
0-15 3.3  
0-16 3.3  
0-17 3.3  
0-18 3.3  
0-19 3.3  
0-20 3.3  
0-21 3.3  
0-22 3.3  
0-23 3.3  
0-24 3.3

Digital 2.5V

-----  
TX36 Spec: 2.4 - 2.6

0-1 2.5  
0-2 2.5  
0-3 2.5  
0-4 2.5  
0-5 2.5  
0-6 2.5  
0-7 2.5  
0-8 2.5  
0-9 2.5  
0-10 2.5  
0-11 2.5  
0-12 2.5  
0-13 2.5  
0-14 2.5  
0-15 2.5  
0-16 2.5  
0-17 2.5  
0-18 2.5  
0-19 2.5  
0-20 2.5  
0-21 2.5  
0-22 2.5  
0-23 2.5  
0-24 2.5

Digital 1.5V

-----  
TX36 Spec: 1.4 - 1.6

0-1 1.5  
0-2 1.5  
0-3 1.5  
0-4 1.5  
0-5 1.5  
0-6 1.5  
0-7 1.5  
0-8 1.5  
0-9 1.5  
0-10 1.5  
0-11 1.5  
0-12 1.5  
0-13 1.5  
0-14 1.5  
0-15 1.5

0-16 1.5  
0-17 1.5  
0-18 1.5  
0-19 1.5  
0-20 1.5  
0-21 1.5  
0-22 1.5  
0-23 1.5  
0-24 1.5

Temperature

-----  
TX36 Spec: 15.0 - 75.0

0-1 43.2  
0-2 43.2  
0-3 43.2  
0-4 42.8  
0-5 43.2  
0-6 43.6  
0-7 44.0  
0-8 44.0  
0-9 44.0  
0-10 41.2  
0-11 40.8  
0-12 41.2  
0-13 42.4  
0-14 44.4  
0-15 42.8  
0-16 43.2  
0-17 43.2  
0-18 44.0  
0-19 43.2  
0-20 43.6  
0-21 43.2  
0-22 42.4  
0-23 42.8  
0-24 42.8

Input Current 12V

-----  
TX36 Spec: 0.3 - 1.5

0-1 0.6  
0-2 0.6  
0-3 0.6  
0-4 0.5  
0-5 0.5  
0-6 0.5  
0-7 0.6  
0-8 0.5  
0-9 0.6  
0-10 0.5  
0-11 0.6  
0-12 0.6  
0-13 0.6  
0-14 0.6  
0-15 0.6  
0-16 0.5  
0-17 0.8  
0-18 0.7  
0-19 0.6  
0-20 0.6  
0-21 0.7  
0-22 0.5  
0-23 0.6  
0-24 0.6

TX36 power test passed

IO TX MB Embedded PPC Embedded  
PPC Download  
2.11 One CPU1.13 Reduced Performance: 1  
voice/Mar 5 2007/1.07 Jun 17 2008/1.11

TX36 unique firmware test OK

-----  
-----  
2011.08.03 18:43:10.982 101 2  
OK

Input voltage 12V

-----  
RX32 Spec: 11.0 - 13.0  
7-1 11.6  
7-2 11.7  
7-3 11.7  
7-4 11.7

Input voltage 6V

-----  
RX32 Spec: 5.0 - 7.0  
7-1 5.7  
7-2 5.7  
7-3 5.7  
7-4 5.7

Digital 3.3V

-----  
RX32 Spec: 2.8 - 3.5  
7-1 3.3  
7-2 3.3  
7-3 3.3  
7-4 3.3

Digital 2.5V

-----  
RX32 Spec: 2.4 - 2.6  
7-1 2.5  
7-2 2.5  
7-3 2.5  
7-4 2.4

Digital 1.5V

-----  
RX32 Spec: 1.4 - 1.6  
7-1 1.5  
7-2 1.5  
7-3 1.5  
7-4 1.5

Temperature

-----  
RX32 Spec: 15.0 - 75.0  
7-1 48.0  
7-2 49.0  
7-3 49.0



7-4 46.0

Input Current 12V

RX32 Spec: 0.4 - 1.5

7-1 0.7  
7-2 0.7  
7-3 0.7  
7-4 0.7

Input Current 6V

RX32 Spec: 2.4 - 3.3

7-1 2.7  
7-2 2.8  
7-3 2.8  
7-4 2.8

RX32 power test passed

IO RX MB Embedded PPC Embedded  
PPC Download  
1.12 Generic1.14 GenericMay 5 2006/1.06  
May 5 2006/1.07 Apr 25 2008/1.11

RX32 unique firmware test OK

-----  
-----  
2011.08.03 18:43:11.115 101 3  
OK

High Voltage Br. 1

TX36 Spec: 90.0 - 145.0

0-1 119.7  
0-2 119.7  
0-3 119.3  
0-4 119.3  
0-5 119.3  
0-6 118.4  
0-7 119.3  
0-8 118.0  
0-9 119.3  
0-10 119.3  
0-11 119.7  
0-12 118.0  
0-13 120.1  
0-14 118.8  
0-15 120.1  
0-16 119.7  
0-17 118.8  
0-18 119.3  
0-19 118.8  
0-20 118.8  
0-21 118.8  
0-22 119.7  
0-23 118.4  
0-24 119.3

High Voltage Br. 2

TX36 Spec: 90.0 - 145.0

0-1 119.3  
0-2 119.3  
0-3 118.9  
0-4 118.4  
0-5 118.9  
0-6 118.9  
0-7 118.4  
0-8 118.4  
0-9 119.3  
0-10 119.3  
0-11 118.9  
0-12 119.3  
0-13 118.0  
0-14 119.3  
0-15 119.7  
0-16 119.3  
0-17 119.3  
0-18 118.9  
0-19 118.4  
0-20 118.9  
0-21 119.3  
0-22 119.7  
0-23 118.9  
0-24 119.3

Input voltage 12V

TX36 Spec: 11.0 - 13.0

0-1 11.9  
0-2 11.9  
0-3 11.9  
0-4 11.9  
0-5 11.9  
0-6 11.9  
0-7 11.9  
0-8 11.9  
0-9 11.9  
0-10 11.9  
0-11 11.9  
0-12 11.9  
0-13 11.9  
0-14 11.9  
0-15 11.9  
0-16 12.0  
0-17 11.9  
0-18 11.9  
0-19 11.8  
0-20 11.9  
0-21 11.9  
0-22 11.9  
0-23 11.8  
0-24 11.9

RX32 Spec: 11.0 - 13.0

7-1 11.6  
7-2 11.7  
7-3 11.7  
7-4 11.7

Input voltage 6V

RX32 Spec: 5.0 - 7.0

7-1 5.7  
7-2 5.7

7-3 5.7

7-4 5.7

TRU power test passed

-----  
-----  
2011.08.03 18:43:11.299 101 4  
OK

EM 302 High Voltage Ramp Test

Test Voltage:20.00 Measured Voltage:  
19.00 PASSED  
Test Voltage:40.00 Measured Voltage:  
39.00 PASSED  
Test Voltage:60.00 Measured Voltage:  
59.00 PASSED  
Test Voltage:80.00 Measured Voltage:  
79.00 PASSED  
Test Voltage:100.00 Measured Voltage:  
100.00 PASSED  
Test Voltage:120.00 Measured Voltage:  
121.00 PASSED  
Test Voltage:120.00 Measured Voltage:  
121.00 PASSED  
Test Voltage:120.00 Measured Voltage:  
106.00 PASSED  
Test Voltage:80.00 Measured Voltage:  
85.00 PASSED  
Test Voltage:60.00 Measured Voltage:  
65.00 PASSED  
Test Voltage:40.00 Measured Voltage:  
45.00 PASSED

11 of 11 tests OK

-----  
-----  
2011.08.03 18:45:45.157 101 5  
OK

BSP 1 RXI TO RAW FIFO: ok  
BSP 2 RXI TO RAW FIFO: ok

-----  
-----  
2011.08.03 18:45:49.474 101 6  
OK

Receiver impedance limits [600.0 1000.0]

ohm  
Board 1 2 3 4

1: 855.7 847.4 820.0 850.6  
 2: 827.8 856.7 821.0 849.7  
 3: 814.4 846.3 847.4 819.3  
 4: 838.6 830.3 835.8 850.3  
 5: 844.1 842.4 799.7 847.8  
 6: 850.2 850.1 829.3 840.9  
 7: 829.6 846.4 832.9 847.5  
 8: 839.4 839.2 849.0 761.4  
 9: 835.1 840.9 826.8 864.6  
 10: 816.7 852.3 782.6 835.8  
 11: 836.7 832.1 832.5 850.2  
 12: 846.4 823.6 845.5 853.3  
 13: 840.3 833.1 816.4 831.9  
 14: 825.5 834.9 852.8 840.8  
 15: 820.8 839.1 840.5 820.8  
 16: 845.9 826.1 850.6 872.2  
 17: 823.2 875.2 852.5 858.0  
 18: 842.7 843.2 854.0 827.6  
 19: 812.6 835.1 838.5 839.7  
 20: 827.1 863.0 844.1 851.2  
 21: 856.0 839.8 877.8 876.3  
 22: 874.0 844.6 831.5 840.2  
 23: 865.5 860.9 851.2 860.1  
 24: 877.4 877.2 867.6 853.9  
 25: 837.8 836.5 837.2 865.9  
 26: 841.1 827.4 845.7 851.0  
 27: 824.3 834.2 838.6 847.8  
 28: 813.1 834.3 815.5 839.5  
 29: 812.3 847.8 835.2 837.3  
 30: 850.7 827.9 838.4 0.0\*  
 31: 826.3 830.1 849.8 837.4  
 32: 848.6 871.3 848.9 868.6

Transducer impedance limits [250.0 2000.0] ohm

Board 1 2 3 4  
 1: 329.1 345.6 346.7 346.8  
 2: 345.7 345.2 350.1 342.2  
 3: 331.4 326.6 361.9 350.1  
 4: 334.4 347.6 369.7 342.3  
 5: 328.4 350.5 361.7 338.6  
 6: 320.3 336.1 342.9 351.1  
 7: 332.7 342.1 374.5 356.1  
 8: 323.9 332.4 348.3 389.6  
 9: 355.9 350.7 366.7 347.5  
 10: 347.5 340.5 367.9 339.6  
 11: 320.0 351.3 352.1 354.7  
 12: 330.7 355.7 345.6 341.3  
 13: 330.3 340.3 371.4 354.0  
 14: 354.5 340.3 362.6 341.5  
 15: 323.5 334.7 359.2 336.2  
 16: 321.8 348.9 363.1 353.4  
 17: 323.0 350.4 345.6 352.7  
 18: 338.3 341.1 353.3 362.3  
 19: 345.8 347.9 349.8 360.5  
 20: 339.2 336.1 348.6 340.4  
 21: 336.5 340.7 340.2 351.1  
 22: 347.7 350.8 362.5 351.2  
 23: 356.9 336.3 349.0 355.5  
 24: 354.6 352.8 343.6 336.5  
 25: 334.9 355.3 352.0 343.7  
 26: 341.8 359.6 357.8 348.2  
 27: 334.2 349.2 353.0 340.8  
 28: 349.1 355.3 359.8 335.5  
 29: 345.6 350.7 370.3 362.5  
 30: 321.7 336.1 339.2 0.0\*  
 31: 336.7 354.1 348.1 352.4  
 32: 331.2 346.2 349.0 350.3

Receiver Phase limits [-50.0 20.0] deg

Board 1 2 3 4  
 1: -2.2 2.3 4.6 -1.2  
 2: 1.6 -4.5 3.6 -2.8  
 3: 3.6 -2.5 -0.9 3.7  
 4: -0.5 2.2 1.6 -3.6  
 5: -1.0 0.6 4.9 0.7  
 6: -3.0 -2.4 0.5 0.9  
 7: 2.5 0.1 2.9 -1.0  
 8: -1.6 0.5 -3.4 13.0  
 9: -0.8 2.5 2.9 -2.1  
 10: 3.2 -2.6 7.7 -0.9  
 11: -2.6 2.2 -1.0 0.4  
 12: -1.6 2.0 -3.4 -1.8  
 13: 0.5 1.3 4.3 3.9  
 14: 2.0 0.0 -0.5 0.4  
 15: 1.2 -2.9 -0.4 3.7  
 16: -2.0 2.9 -2.4 -5.1  
 17: 0.6 -3.2 -3.4 -0.2  
 18: -3.0 1.5 -3.1 3.3  
 19: 2.3 2.4 -3.3 2.1  
 20: 2.0 -2.3 -0.8 1.0  
 21: -0.5 2.7 -5.5 -2.9  
 22: -2.3 -1.1 1.5 0.0  
 23: 0.2 -3.4 -0.5 -1.1  
 24: -2.7 -2.8 -3.8 -2.0  
 25: -0.4 2.0 1.5 -3.8  
 26: -1.1 4.7 -3.2 -1.9  
 27: 1.9 -0.9 0.2 -3.0  
 28: 5.6 -1.0 2.0 0.8  
 29: 2.9 1.6 0.8 2.9  
 30: -2.8 1.1 -0.4 200.9\*  
 31: 1.2 1.3 -1.8 1.7  
 32: -3.3 -4.1 -1.4 -5.0

Transducer Phase limits [-100.0 0.0] deg

Board 1 2 3 4  
 1: -34.5 -36.6 -35.4 -39.2  
 2: -36.0 -39.6 -32.6 -43.5  
 3: -31.0 -40.7 -35.8 -39.7  
 4: -38.2 -35.9 -38.5 -37.7  
 5: -37.8 -40.0 -38.6 -37.0  
 6: -36.3 -35.9 -36.5 -37.6  
 7: -33.4 -38.4 -37.4 -40.1  
 8: -36.2 -38.9 -42.4 -32.6  
 9: -38.9 -36.0 -36.6 -41.5  
 10: -41.6 -38.5 -29.6 -33.2  
 11: -37.8 -38.7 -43.2 -39.0  
 12: -35.2 -37.9 -44.9 -40.2  
 13: -34.8 -42.0 -33.9 -43.3  
 14: -36.7 -43.5 -36.2 -38.1  
 15: -29.8 -44.9 -38.0 -30.1  
 16: -37.1 -38.8 -37.2 -36.8  
 17: -28.0 -37.5 -40.3 -36.3  
 18: -33.3 -35.4 -39.4 -37.5  
 19: -35.2 -36.0 -36.9 -39.3  
 20: -33.2 -40.6 -40.9 -38.4  
 21: -32.3 -37.8 -35.8 -38.8  
 22: -36.3 -40.8 -32.7 -35.3  
 23: -35.5 -42.4 -35.5 -35.7  
 24: -37.2 -40.7 -40.2 -32.4  
 25: -29.6 -35.7 -35.8 -39.0  
 26: -40.2 -37.1 -36.1 -40.9  
 27: -32.3 -38.6 -34.6 -41.3  
 28: -36.7 -39.3 -34.3 -37.4  
 29: -37.7 -40.4 -39.1 -35.3  
 30: -33.9 -39.5 -38.3 -126.7\*  
 31: -39.5 -41.3 -35.5 -31.8  
 32: -39.9 -40.5 -35.9 -40.8

Rx Channels test passed

-----  
 -----  
 2011.08.03 18:46:16.476 101 7  
 OK

Tx Channels test passed

-----  
 -----  
 2011.08.03 18:49:10.869 101 8  
 OK

RX NOISE LEVEL

Board No:	1	2	3	4
0:	46.3	42.6	43.6	45.7 dB
1:	45.0	42.0	42.8	45.0 dB
2:	44.4	42.3	43.6	45.6 dB
3:	43.6	41.3	42.1	44.0 dB
4:	43.4	43.6	44.5	46.5 dB
5:	42.8	42.5	44.8	45.6 dB
6:	43.4	42.9	44.1	44.5 dB
7:	42.7	42.2	43.9	46.6 dB
8:	42.2	44.6	45.8	51.9 dB
9:	42.5	42.0	45.0	47.2 dB
10:	42.7	42.9	44.7	47.6 dB
11:	42.1	43.9	43.7	46.7 dB
12:	42.7	44.3	45.0	46.5 dB
13:	42.4	43.3	44.9	46.6 dB
14:	41.4	43.6	44.5	46.2 dB
15:	42.1	43.3	45.5	45.4 dB
16:	40.1	41.7	42.3	44.1 dB
17:	41.5	41.5	42.5	43.4 dB
18:	40.9	42.1	43.7	44.0 dB
19:	41.3	41.1	44.2	42.9 dB
20:	41.4	42.5	49.2	43.9 dB
21:	42.4	42.3	54.3	45.3 dB
22:	43.4	41.6	51.1	45.4 dB
23:	43.1	44.1	53.6	45.9 dB
24:	42.4	41.7	48.4	46.2 dB
25:	43.0	43.6	47.0	45.4 dB
26:	42.8	43.3	45.1	46.4 dB
27:	43.2	42.5	44.0	46.8 dB
28:	43.0	43.4	44.7	47.9 dB
29:	41.8	43.4	44.0	61.7 dB
30:	41.1	43.8	43.9	49.6 dB
31:	41.8	44.9	45.2	50.9 dB

Maximum noise at Board 4 Channel 29  
 Level: 61.7 dB

Broadband noise test

-----  
 Average noise at Board 1 42.8 dB OK  
 Average noise at Board 2 43.0 dB OK  
 Average noise at Board 3 46.8 dB OK  
 Average noise at Board 4 49.6 dB OK

-----  
-----  
2011.08.03 18:49:16.569 101 9  
OK

RX NOISE SPECTRUM

Board No:	1	2	3	4
26.1 kHz:	49.2	50.5	53.6	63.1
dB				
26.3 kHz:	45.8	47.4	50.6	51.1
dB				
26.5 kHz:	43.8	44.1	50.7	47.8
dB				
26.7 kHz:	44.5	44.4	51.1	49.1
dB				
26.9 kHz:	43.2	43.1	51.4	48.3
dB				
27.1 kHz:	44.1	45.1	52.5	50.5
dB				
27.3 kHz:	43.2	42.8	50.5	47.1
dB				
27.5 kHz:	42.9	43.3	50.2	47.5
dB				
27.7 kHz:	42.1	42.5	48.6	46.3
dB				
27.9 kHz:	42.5	42.2	48.2	45.9
dB				
28.1 kHz:	43.0	42.3	48.8	45.8
dB				
28.3 kHz:	42.6	43.0	49.0	45.3
dB				
28.5 kHz:	42.1	42.7	48.0	45.3
dB				
28.7 kHz:	42.3	42.7	49.1	45.9
dB				
28.9 kHz:	42.7	42.1	47.7	45.9
dB				
29.1 kHz:	42.7	43.0	47.7	47.3
dB				
29.3 kHz:	41.6	43.0	47.6	48.2
dB				
29.5 kHz:	41.7	42.7	48.1	48.2
dB				
29.7 kHz:	41.9	42.1	46.6	47.8
dB				
29.9 kHz:	41.2	42.4	47.6	48.0
dB				
30.1 kHz:	42.3	43.0	48.3	47.4
dB				
30.3 kHz:	43.2	43.7	46.9	47.6
dB				
30.5 kHz:	43.4	43.1	46.9	46.0
dB				
30.7 kHz:	46.3	44.4	48.6	47.1
dB				
30.9 kHz:	41.9	42.2	47.0	45.8
dB				
31.1 kHz:	41.3	41.9	47.1	46.5
dB				
31.4 kHz:	41.4	42.5	46.4	47.1
dB				
31.6 kHz:	40.9	42.0	46.6	44.7
dB				

31.8 kHz:	40.6	41.5	45.2	45.0
dB				
32.0 kHz:	40.8	41.8	44.8	45.2
dB				
32.2 kHz:	41.0	41.1	45.8	44.7
dB				
32.4 kHz:	40.7	41.2	45.3	44.4
dB				
32.6 kHz:	40.4	41.2	45.0	44.1
dB				
32.8 kHz:	40.7	40.6	44.1	43.9
dB				
33.0 kHz:	40.0	40.9	43.4	43.7
dB				
33.2 kHz:	39.8	40.3	43.0	43.3
dB				
33.4 kHz:	39.2	40.4	43.2	43.0
dB				
33.6 kHz:	38.7	40.2	42.7	44.7
dB				
33.8 kHz:	39.0	39.5	43.2	42.8
dB				
34.0 kHz:	38.2	39.0	44.2	43.0
dB				

Maximum noise at Board 4 Frequency 26.1 kHz Level: 63.1 dB

Spectral noise test

-----  
Average noise at Board 1 42.7 dB OK  
Average noise at Board 2 43.2 dB OK  
Average noise at Board 3 48.2 dB OK  
Average noise at Board 4 49.8 dB OK

-----  
-----  
2011.08.03 18:49:22.270 101 10  
OK

CPU: KOM CP6011  
Clock 1795 MHz  
Die 42 oC (peak: 55 oC @ 2011-08-03 - 10:57:59)  
Board 45 oC (peak: 50 oC @ 2011-08-03 - 11:05:35)  
Core 1.34 V  
3V3 3.30 V  
12V 12.05 V  
-12V -12.04 V  
BATT 3.50 V  
Primary network: 157.237.14.60:0xffff0000  
Secondary network: 192.168.2.20:0xfffff00

-----  
-----  
2011.08.03 18:49:22.403 101 15  
OK

EM 302

BSP67B Master: 2.2.3 090702  
BSP67B Slave: 2.2.3 090702  
CPU: 1.4.8 091110  
DDS: 3.4.9 070328  
RX32 version : Apr 25 2008 Rev 1.11  
TX36 LC version : Jun 17 2008 Rev 1.11  
VxWorks 5.5.1 Build 1.2/2-IX0100 May 16 2007, 11:31:17

## Appendix G: Permits and Cruise Correspondence

### Permit to conduct XBT operations in Florida Keys National Marine Sanctuary

#### FLORIDA KEYS NATIONAL MARINE SANCTUARY RESEARCH & EDUCATION PERMITS

#### GUIDELINES FOR SUBMITTING PERMIT REPORTS Interim Report & Final Report

Please submit all the requested information electronically (MS Word, rich text format, or PDF) to Scott Donahue ([Scott.Donahue@noaa.gov](mailto:Scott.Donahue@noaa.gov)) and Joanne Delaney ([Joanne.Delaney@noaa.gov](mailto:Joanne.Delaney@noaa.gov)).

Permit number:

Date:

Permittee name and contact information (affiliation, address, phone, fax, e-mail):

Type of report: (contents are the same)

Interim report

Final report

Please provide a 1-2 page (max.) project summary, which includes topics listed below. Please indicate if any of the information contained in your project summary **should not be made available to the public** in Sanctuary research summaries or other literature.

- Goal(s) of project
- Significance of project and connection to Sanctuary management issues
- Hypotheses (if applicable) & methods (brief description)
- Results/findings to date
- Table, graph, photos as appropriate
- List of publications resulting from permitted activities

Additionally, if permitted activities included collection of organisms, provide the following information (list, table or chart is acceptable):

For stony coral and/or sea fan collections:

- Dates of collection
- Species
- Quantity
- Size(s)
- Method of collection
- Location of collection (GPS coordinates)
- Fate of all specimens collected
- Mitigation completed, if any

For non-coral species collections (fish, regulated invertebrates, algae, etc.):

- Dates of collection
- Location of collections (GPS coordinates)
- Names of organisms and approximate quantity collected

Please briefly describe any other permitted activities conducted (date and description of activity performed) that were not mentioned above (list, table or chart).

Please briefly describe any deviations from permitted activities.



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL OCEAN SERVICE

Florida Keys National Marine Sanctuary  
33 East Quay Road  
Key West, FL 33040

August 9, 2011

Ms. Elizabeth Lobecker  
NOAA Office of Ocean Exploration and Research  
24 Colovos Rd.  
UNH-IOCM  
Durham, NH 03824

Dear Ms. Lobecker:

The National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries (ONMS) has approved the issuance of permit number FKNMS-2011-097 to conduct activities within Florida Keys National Marine Sanctuary (sanctuary) for research purposes. Activities are to be conducted in accordance with the permit application and all supporting materials submitted to the sanctuary, and the terms and conditions of permit number FKNMS-2011-097 (enclosed).

This permit is not valid until signed and returned to the ONMS. Retain one signed copy and carry it with you while conducting the permitted activities. Additional copies must be signed and returned, by either mail or email, to the following individuals within 30 days of issuance and before commencing any activity authorized by this permit:

Scott Donahue  
Associate Science Coordinator  
Florida Keys National Marine Sanctuary  
33 East Quay Road  
Key West, FL 33040  
[Scott.Donahue@noaa.gov](mailto:Scott.Donahue@noaa.gov)

National Permit Coordinator  
NOAA Office of National Marine Sanctuaries  
1305 East-West Highway (N/ORM6)  
SSMC4, 11<sup>th</sup> Floor  
Silver Spring, MD 20910  
[nmspermits@noaa.gov](mailto:nmspermits@noaa.gov)

Your permit contains specific terms, conditions and reporting requirements. Review them closely and fully comply with them while undertaking permitted activities.

If you have any questions, please contact Joanne Delaney at [Joanne.Delaney@noaa.gov](mailto:Joanne.Delaney@noaa.gov). Thank you for your continued cooperation with the ONMS.

Sincerely,

Sean Morton  
Superintendent

Enclosure





UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL OCEAN SERVICE

Florida Keys National Marine Sanctuary  
33 East Quay Road  
Key West, FL 33040

## FLORIDA KEYS NATIONAL MARINE SANCTUARY RESEARCH PERMIT

**Permittee:**

Ms. Elizabeth Lobecker  
NOAA Office of Ocean Exploration and Research  
24 Colovos Rd.  
UNH-IOCM  
Durham, NH 03824

**Permit Number:** FKNMS-2011-097

**Effective Date:** August 9, 2011

**Expiration Date:** August 31, 2011

**Project Title:** NOAA Ship Okeanos Explorer cruise EX1104, Exploration - Cayman Trench

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This permit is issued for activities in accordance with the National Marine Sanctuaries Act (NMSA), 16 USC §1431 *et seq.*, and regulations thereunder (15 CFR Part 922). All activities must be conducted in accordance with those regulations and law. No activity prohibited in 15 CFR Part 922 is allowed except as specified in the activity description below.

Subject to the terms and conditions of this permit, the National Oceanic and Atmospheric Administration (NOAA), Office of National Marine Sanctuaries (ONMS) hereby authorizes the permittee listed above to conduct research activities within Florida Keys National Marine Sanctuary (FKNMS or sanctuary). All activities are to be conducted in accordance with this permit and the permit application received July 25, 2011. The permit application is incorporated into this permit and made a part hereof; provided, however, that if there are any conflicts between the permit application and the terms and conditions of this permit, the terms and conditions of this permit shall be controlling.

**Permitted Activity Description:**

The following activities are authorized by this permit:

1. Discharge of up to two (2) expendable Bathy Thermographs (XBTs) within waters of FKNMS.

No further violation of sanctuary regulations is allowed.

**Permitted Activity Location:**

The permitted activity is allowed in FKNMS waters of west of Key West, FL (west of 81.80° W longitude).



**Special Terms and Conditions:**

1. No other materials are authorized for discharge or deposit into the Sanctuary.
2. NOAA Ship Okeanos Explorer may not enter the Area To Be Avoided (ATBA).
3. The permittee must submit a final report of activities thirty (30) days after the permit expires or (30) days prior if a renewal is desired. The report shall consist of a 1-2 page summary of activities conducted under this permit that follows the attached permit report guidelines. The report shall be submitted to: Scott Donahue ([Scott.Donahue@noaa.gov](mailto:Scott.Donahue@noaa.gov)), FKNMS Associate Science Coordinator, and Joanne Delaney ([Joanne.Delaney@noaa.gov](mailto:Joanne.Delaney@noaa.gov)), FKNMS Permit Coordinator.
4. Any scientific publications and/or reports resulting from activities conducted under the authority of this permit must include the notation that the activity was conducted under permit number FKNMS-2011-097. Additionally, the permittee and her respective institution(s) are required to acknowledge during any media coverage (press releases, video/photo, or other means) that research activities occurred within the FKNMS and under permit. Boilerplate language on the sanctuary is available by request; contact Karrie Carnes at [Karrie.Carnes@noaa.gov](mailto:Karrie.Carnes@noaa.gov).

**General Terms and Conditions:**

1. Within 30 (thirty) days of the date of issuance, the permittee must sign and date this permit for it to be considered valid. Once signed, the permittee must send copies, via mail or email, to the following individuals:

Scott Donahue  
Associate Science Coordinator  
Florida Keys National Marine Sanctuary  
33 East Quay Road  
Key West, FL 33040  
[Scott.Donahue@noaa.gov](mailto:Scott.Donahue@noaa.gov)

National Permit Coordinator  
NOAA Office of National Marine Sanctuaries  
1305 East-West Highway (N/ORM6)  
SSMC4, 11<sup>th</sup> Floor  
Silver Spring, MD 20910  
[nmspermits@noaa.gov](mailto:nmspermits@noaa.gov)

2. It is a violation of this permit to conduct any activity authorized by this permit prior to the ONMS having received a copy signed by the permittee.
3. This permit may only be amended by the ONMS. The permittee may not change or amend any part of this permit at any time. The terms of the permit must be accepted in full, without revision; otherwise, the permittee must return the permit to the sanctuary office unsigned with a written explanation for its rejection. Amendments to this permit must be requested in the same manner the original request was made.



4. All persons participating in the permitted activity must be under the supervision of the permittee, and the permittee is responsible for any violation of this permit, the NMSA, and sanctuary regulations for activities conducted under, or in junction with, this permit. The permittee must assure that all persons performing activities under this permit are fully aware of the conditions herein.
5. This permit is non-transferable and must be carried by the permittee at all times while engaging in any activity authorized by this permit.
6. This permit may be suspended, revoked, or modified for violation of the terms and conditions of this permit, the regulations at 15 CFR Part 922, the NMSA, or for other good cause. Such action will be communicated in writing to the applicant or permittee, and will set forth the reason(s) for the action taken.
7. This permit may be suspended, revoked or modified if requirements from previous ONMS permits or authorizations issued to the permittee are not fulfilled by their due date.
8. Permit applications for any future activities in the sanctuary or any other sanctuary in the system by the permittee might not be considered until all requirements from this permit are fulfilled.
9. This permit does not authorize the conduct of any activity prohibited by 15 CFR § 922, other than those specifically described in the “Permitted Activity Description” section of this permit. If the permittee or any person acting under the permittee’s supervision conducts, or causes to be conducted, any activity in the sanctuary not in accordance with the terms and conditions set forth in this permit, or who otherwise violates such terms and conditions, the permittee may be subject to civil penalties, forfeiture, costs, and all other remedies under the NMSA and its implementing regulations at 15 CFR Part 922.
10. Any publications and/or reports resulting from activities conducted under the authority of this permit must include the notation that the activity was conducted under National Marine Sanctuary Permit FKNMS-2011-097 and be sent to the ONMS officials listed in general condition number 1.
11. This permit does not relieve the permittee of responsibility to comply with all other federal, state and local laws and regulations, and this permit is not valid until all other necessary permits, authorizations, and approvals are obtained. Particularly, this permit does not allow disturbance of marine mammals or seabirds protected under provisions of the Endangered Species Act, Marine Mammal Protection Act, or Migratory Bird Treaty Act. Authorization for incidental or direct harassment of species protected by these acts must be secured from the U.S. Fish and Wildlife Service and/or NOAA Fisheries, depending upon the species affected.






12. The permittee shall indemnify and hold harmless the Office of National Marine Sanctuaries, NOAA, the Department of Commerce and the United States for and against any claims arising from the conduct of any permitted activities.
13. Any question of interpretation of any term or condition of this permit will be resolved by NOAA.

Your signature below, as permittee, indicates that you accept and agree to comply with all terms and conditions of this permit. This permit becomes valid when you, the permittee, countersign and date below. Please note that the expiration date on this permit is already set and will not be extended by a delay in your signing.

  
\_\_\_\_\_  
Ms. Elizabeth Lobecker  
NOAA Office of Ocean Exploration and Research

*Aug. 9, 2011*  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Sean Morton  
Superintendent  
Florida Keys National Marine Sanctuary

August 9, 2011  
\_\_\_\_\_  
Date

1 document attached.



## Appendix H: Additional Logs

**Table 3. Built In System Tests**

EX1104 BIST LOG												
BIST FILE NAME	DATE (UTC)	TIME (GMT)	BIST TYPE	SHIP HDG	LAT N / LONG W (WGS84)	SPEED (kts)	Max RX Noise (dB) / Board / Channel	Avg RX Noise Board 1 (dB)	Avg RX Noise Board 2 (dB)	Avg RX Noise Board 3 (dB)	Avg RX Noise Board 4 (dB)	NOTES
EX1104_01	8/2/11	2257	All	231	8.953/79.575	00.0	71.3/4/31	67.6	67.6	67.9	68.7	At the pier in Panama
EX1104_02	8/3/11	0924	All	342	9.672/79.945	10.0	64.2/4/1	59.3	59.5	59.8	60.3	Just left Panama Canal
EX1104_03	8/3/11	1843	All	350	10.974/80.209	10.0	61.7/4/29	42.8	43.0	46.8	49.6	At the Columbia EEZ
EX1104_04	8/4/11	1629	All	001	15.092/80.694	11.0	53.6/4/31	41.0	42.3	44.8	46.7	Columbia/Nicaragua EEZ
EX1104_05	8/5/11	1208	All	359	18.376/81.790	05.2	61.7/4/29	40.1	39.2	39.9	48.3	Cayman EEZ
EX1104_06	8/10/11	1214	All	075	18.378/81.806	11.0	58.4/1/17	55.0	52.3	50.0	51.8	Cayman EEZ
EX1104_07	8/12/11	2351	All	151	18.303/81.720	11.0	54.1/1/0	47.5	45.1	43.8	43.3	Cayman EEZ
EX1104_08	8/16/11	1420	All	309	19.929/82.894	11.0	61.7/4/29	44.8	43.6	44.4	50.5	Cayman/Cuba EEZ
EX1104_09	8/18	1007	All	224	24.338/81.831	7	61.7/4/29	45.0	44.5	44.5	49.6	Final BIST - outside Key West

**Table 4. Weather Log**

EX1104 Weather Log								
Local Date	Local Time	UTC Time	Wind Direction (deg)	Wind Speed (kts)	Swell Height (ft)	Swell Direction (deg)	Wave Height (ft)	Wave Direction (deg)
8/3/2011	0615	1115	047	11.0	2-4	020	0-1	020
8/3/2011	0900	1400	050	12.0	2-4	050	1-2	050
8/3/2011	1200	1700	070	10.0	3-5	040	2-4	070
8/3/2011	1500	2200	060	4.0	3-5	030	2-4	060
8/4/2011	1207	1707	000	9.0	2-3	050	0-1	000
8/4/2011	1500	2000	330	9.0	2-3	060	1-2	330
8/4/2011	1800	2300	025	7.0	2-3	040	1-2	025
8/4/2011	2100	0200	350	7.0	2-3	030	1	350
8/5/2011	0000	0500	020	7.0	-	-	-	-
8/5/2011	0300	0800	var	3.0	-	-	-	-
8/5/2011	0600	1100	060	7.0	2-3	040	1-2	060
8/5/2011	1800	2300	090	5.0	1-2	060	1	090
8/5/2011	2100	0200	100	8.0	1-2	060	1	100
8/6/2011	0000	0500	110	13.0	-	-	-	-

8/6/2011	0300	0800	150	12.0	-	-	-	-
8/6/2011	0416	0916	118.5	14.1	2	-	1-2	-
8/6/2011	0600	1100	120	14.0	3-4	110	2-3	120
8/6/2011	2200	0300	090	12.0	3-4	110	2-3	090
8/7/2011	0100	0600	090	18.0	-	-	-	-
8/7/2011	0400	0900	100	16.0	-	-	-	-
8/7/2011	0700	1200	100	13.0	5-6	120	3-4	100
8/7/2011	1900	0000	080	15.0	4-6	110	2-4	080
8/7/2011	2200	0300	070	17.0	4-6	110	2-4	070
8/8/2011	0100	0600	060	13.0	-	-	-	-
8/8/2011	0400	0900	090	14.0	-	-	-	-
8/8/2011	0700	1200	090	16.0	4-6	130	1-2	090
8/9/2011	0000	0500	090	10.0	-	-	-	-
8/9/2011	0347	0847	083	16.0	-	110	4-6	-
8/9/2011	0600	1100	080	14.0	4-5	110	2-3	080
8/9/2011	1900	0000	080	4.0	3-5	130/160	1-2	080
8/9/2011	2200	0300	030	15.0	3-5	140	1	030
8/9/2011	2335	0435	080	7.0	3-4	130	1-3	080
8/10/2011	0100	0600	100	10.0	-	-	1-2	100
8/10/2011	0400	0900	100	10.0	-	-	2-3	100
8/10/2011	0700	1200	100	10.0	3-4	130	2-3	100
8/10/2011	2000	0300	060	11.0	2-4	120	1-2	060
8/10/2011	2252	0352	290	15.0	3-4	120	1-2	-
8/11/2011	0200	0700	080	10.0	-	-	1-2	080
8/11/2011	0500	1000	090	8.0	-	-	1-2	090
8/11/2011	2017	0117	061	10.0- 11.0	2-3	130	1-2	060
8/11/2011	2300	0400	070	9.0	2-3	130	1-2	070
8/12/2011	0300	0800	070	10.0	-	-	1-2	070
8/12/2011	0700	1200	090	6.0	3-4	130	1-2	090
8/12/2011	1900	0000	090	11.0	3-4	134	1-2	090
8/12/2011	2200	0300	100	16.0	3-5	140	1-2	100
8/13/2011	0100	0600	120	15.0	-	-	2-3	120
8/13/2011	0400	0900	120	16.0	4-5	130	2-3	120
8/13/2011	0700	1200	100	16.0	3-5	105	2-3	100
8/13/2011	2000	0100	080	17.0	4-6	115	3-5	080
8/13/2011	2300	0400	060	18.0	4-6	090	3-5	060
8/14/2011	0200	0700	060	14.0	4-6	110	3-5	060
8/14/2011	0500	1000	070	14.0	4-6	120	2-4	070
8/14/2011	2200	0300	070	15.0	3-5	120	1-2	070
8/15/2011	0100	0600	090	11.0	-	-	1-2	090
8/15/2011	0400	0900	050	7.0	2-3	120	1-3	050

8/15/2011	0700	1200	050	13.0	3-4	090	1-2	050
8/15/2011	1900	0000	080	12.0	2-3	130	1-2	080
8/15/2011	2200	0300	080	14.0	2-4	080	1-2	080
8/16/2011	0100	0600	080	12.0	-	-	1-2	080
8/16/2011	0500	0900	100	9.0	-	-	1-2	100
8/16/2011	0800	1200	080	9.0	1-3	090	1-2	080
8/17/2011	1700	2100	L/V	L/V	Calm	-	<1	-
8/17/2011	2000	0000	030	8.0	Calm	-	<1	030
8/17/2011	2300	0300	100	12.0	-	-	-	100
8/18/2011	0200	0600	140	15.0	-	-	1-2	140

**Table 5. Software versions in use during the cruise.**

Software	Version	Computer	Hot fix
Caris HIPS	6.1	MBPROC1, MBPROC2	None--1-8 downloaded but not applied
C-NAV	3.0.45	N/A	N/A
DP Line Conversion Utility (Matlab)	1	N/A	N/A
ESRI ArcMap	9.3	MBPROC2	N/A
Fledermaus (IVS 3D)	7	MBPROC2	N/A
Fledermaus (IVS 3D)	6.7.0	MBPROC3	N/A
Global Mapper	11.01	EXSCSCL2	N/A
Hydro_MI	8.3	MBPROC1 & 2	N/A
Hypack	9.0.0.22 (hypack admin) - 9.0.5.3 (survey)	Hypack	N/A
KAP Converter	5.7.2	N/A	N/A
Knudsen SBP, Sounder Suite Echo Control Server and Client	Software: V 2.07 Firmware: V.2.04	Knudsen SBP	N/A
MapInfo	10	MBPROC1 & 2	Release Build 35
NOAA Chart Reprojector	2.0.6	N/A	N/A

POS Controller	320 MV V4 SN# 2572 Firmware: 4.0.2.0	Hypack	N/A
Pydro	9.4	MBPROC2	N/A
SCS	4.3.4	SCS-A	N/A
Seasave	7.18	CTD	seabird.com
SIS EM 302	3.6.4	Multibeam	N/A
Snagit	9.1.2	MBPROC1 & SURVEY2	N/A
SonarWiz	4004.0034	MBPROC2	N/A
TRU EM 302	BSV 2.2.3 090702, PSV 1.4.8 091110	N/A	N/A
Velociwin	8.92 Plus	MBPROC1	N/A

## **Appendix I: Data Management Plan**

# Okeanos Explorer

EX-11-04: Mid-Cayman Rise Exploration  
Data Management Plan

### **Document Purpose**

*This document is an addendum to the overarching Okeanos Explorer FY11 Data Management Plan (Appendix VII) and is specific to the EX-11-04 mission entitled “Mid-Cayman Rise Exploration” For more detailed information on the data management effort for the Okeanos Explorer in FY11, please refer to that document.*

### **Data Management Overview**

The fourth *Okeanos Explorer (EX)* mission of the FY11 field season will take the ship from Balboa, Panama to Key West, Florida and along the way, will explore the Mid-Cayman Rise in British waters around the Cayman Islands. During transits to and from the primary operating area, underway meteorological and oceanographic data and multibeam mapping survey data will be collected. During the approximately ten days at the Mid-Cayman Rise, multibeam mapping, CTD/rosette casts and ROV dive operations will be performed. High-definition imagery, water samples, gas chromatography, CTD and multibeam data will be generated and managed from this mission. The ship will segment bathymetric survey tracks when crossing over EEZ areas so that each coastal state through whose waters the EX cruises will receive a data package of all data collected in their waters after the mission is complete. The expedition coordinator will mark the dates/times of the EEZ crossings so that the data management team can segment the underway data for the coastal states data delivery. No data, underway or operational, will be collected in Columbian or Cuban waters during this mission.

### **Assumptions**

All data from the entire mission will be publicly releasable. No protected sites have been identified.

### **Data Management Objectives**

The DMT’s objectives for this mission are:

- Develop ISO metadata for collection-level and dataset-level records (multibeam, CTD, SCS, gas chromatograph, water sample analysis, imagery, and video) for NOAA and for delivery with foreign data sets.
- Ensure the near real-time update of the *Okeanos Atlas* with
  - Add new data layers as contextual data to the display, including primary operating area, planned survey boundaries, and any other appropriate data layers found.
  - Ship track and hourly observations received via email.

- CTD launch sites and profiles received via URI SRS. DMT will post-process and thin the profiles for quicker display on the site.
  - Daily logs pulled from URI through RSS feeds and links to related images on oceanexplorer.noaa.gov website.
  - Daily cumulative bathymetric image overlays received via URI SRS.
  - Test new ship track KML received via URI SRS, if applicable.
- Cross train backup personnel in SOPs.
  - Post-Mission:
    - Execute multibeam data, METOC data, and video/image data pipelines.
    - Deliver ISO metadata and corresponding data collected within the EEZ of foreign coastal states to those states.

### **Expedition Principals for Data Management**

Kelley Elliott, OER Expedition Coordinator

Lt. Megan Nadeau, OMAO, Okeanos Explorer Operations Officer

Webb Pinner, OER Telepresence, EX Data and Information Lead

Sharon Mesick, NCDDC, Federal Program Manager, IPT Chair

Susan Gottfried, NCDDC, OER Data Management Coordinator

Andrew Navard, NCDDC, Okeanos Atlas Developer

David Fischman, NGDC, Geophysical Data Officer

Thomas Ryan, NODC, Oceanographic Data Officer

Anna Fiolek, NCL, Multimedia Librarian

## **Appendix J: EM 302 Kongsberg EM 302 Multibeam Sonar Description and Operational Specifications**

Several features of the *Okeanos Explorer's* 30 kHz multibeam make it an excellent tool for ocean exploration. The following is a brief description of these features.

### **Depth Range**

The system is designed to map the seafloor in water depths of 10 to 7000 meters. This leaves only the deepest parts of the deeper ocean trenches out of the EM 302's reach. In fact, when the ship transited over the Mariana Trench going to and from Indonesia in 2010, the system was able to detect the bottom at depths of up to 8000 meters.

### **High Density Data**

In multibeam data, the denser the data, the finer resolution maps can be produced. In water depths 3000 meters and shallower, the system can operate in dual swath, or multiping mode, which results in increased along track data density. This is achieved by detecting two swaths per ping cycle, resulting in up to 864 beams per ping.

The *Okeanos Explorer* mapping team typically operates the multibeam in high density equidistant ping mode, which results in up to 864 evenly spaced soundings on the seafloor per ping.

### **Multiple Data Types Collected**

The system collects seafloor backscatter data, which provides information about the character of the seafloor in terms of bottom type.

The system also collects water column backscatter data, which has the ability to detect gaseous plumes in the water column. The full value of this feature is still being realized.

FM chirp mode is utilized in water depths greater than 1000 meters, and allows for the detection of the bottom further out from nadir than with previous 30 kHz systems. This results in wider swath widths, giving a higher likelihood of new discoveries as well as efficiency of survey operations.

### **Multibeam Primer**

The area of the seafloor covered, or ensonified, by a single beam within a pulse of sound, or ping, is called the beam footprint. This beam footprint is defined in terms of the across track and along track values. Both of these values are dependent on water depth and the beam width at which the sound pulse is transmitted and received. The across track beam width value is also dependent on the receive angle, or "listening" angle, of the system, and the angle from nadir which it is received. The transmit angle for the transmit transducer is  $0.5^\circ$ , which is the smallest possible angle currently available for the EM302 system. The further out from nadir a sounding occurs, the larger the footprint will be. The receive angle for the receive transducer is  $1^\circ$ . As an example, as seen in Table 1 below, in 2000 meters of water, a beam footprint will have a radius of 18 meters at nadir but 25 meters by the time it hits the seafloor at an angle 140 degrees out from nadir.

Calculated acrosstrack acoustic beam footprint in meters for EM 302 (high density ping mode, 432 soundings/profile)
--



Water depth (m)	Angle from nadir			
	1 deg RX center	90 deg	120 deg	140 deg
50				
100	1	0.5	1	1
200	2	1	2	3
400	4	2	3	5
1000	7	4	6	10
2000	18	9	16	25
4000	35	19	32	-
6000	70	37	-	-
7000	105	56	-	-

**Table 6.**  
across track  
footprint.  
Kongsberg

**Calculated  
EM 302 beam  
Reference:  
Product**

description, Kongsberg document 302675 Rev B, Date 14/06/06, p. 17.

Calculated across track sounding density for EM 302 (high density ping mode, 432 soundings/profile)			
Water depth (m)	Swath Width		
	90 deg	120 deg	140 deg
50			
100	0.2	0.4	0.9
200	0.5	0.8	1.7
400	0.9	1.6	3.5
1000	1.9	3.2	6.9
2000	4.6	8.1	17.4
4000	9.3	16.2	-

**Table 7.** Calculated across track EM 302 sounding density. Reference: Kongsberg Product description, Kongsberg document 302675 Rev B, Date 14/06/06, p. 17.

Acrosstrack sounding density describes the spacing between individual soundings on the seafloor in the across track direction. The maximum swath of the EM 302 is 150 degrees. At this swath, the sounding density will be the least dense, since the beams will be spread out over a larger horizontal distance over the seafloor. As the swath angle (width) is decreased, the sounding density will increase, as the same number of beams are now spread out over a smaller horizontal distance over the seafloor.

Calculated ping rate and alongtrack resolution for EM 302					
140 deg swath, one profile per ping					
Water depth (m)	Swath Width (m)	Ping Rate (pings/second)	Alongtrack distance between profiles (m)		
			@4 kts	@8 kts	@12 kts
50	275	3.2	0.7	1.2	1.9
100	550	1.8	1.1	2.2	3.3
200	1100	1	2.1	4.2	6.3
400	2200	0.5	4.1	8.2	12.2
1000	5500	0.2	10	20	30
2000	8000	0.1	15.2	30.5	45.7
4000	8000	0.06	19.2	38.5	57.7

6000	8000	0.04	24.5	49	73.4
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**Table 8. Calculated ping rate and along track EM 302 sounding density, one profile per ping. Reference: Kongsberg Product description, Kongsberg document 302675 Rev B, Date 14/06/06, p. 15.**

Calculated ping rate and alongtrack resolution for EM 302					
140 deg swath, two profiles per ping					
Water depth (m)	Swath Width (m)	Ping Rate	Alongtrack distance between profiles (m)		
			@4 kts	@8 kts	@12 kts
50	275	3.2	0.3	0.6	0.9
100	550	1.8	0.6	1.1	1.7
200	1100	1	1.1	2.1	3.2
400	2200	0.5	2	4.1	6.1
1000	5500	0.2	5	10	15
2000	8000	0.1	7.6	15.2	22.8

**Table 9. Calculated ping rate and along track EM 302 sounding density, two profiles per ping. Reference: Kongsberg Product description, Kongsberg document 302675 Rev B, Date 14/06/06, p. 15.**

Reference: Kongsberg Product Description: EM 302 multibeam echosounder