CRUISE REPORT

USNS *Sumner*

U.S. Law of the Sea cruises to map sections of the Mariana Trench and the eastern and southern insular margins of Guam and the Northern Mariana Islands

CRUISE SU10-1

Leg 1: August 6 to September 5

Apra Harbor, Guam to Apra Harbor, Guam

James V. Gardner

Center for Coastal and Ocean Mapping/Joint Hydrographic Center
University of New Hampshire
Durham, NH 03824

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Introduction

This cruise is the third of four 30-day bathymetry cruises to the margins of Guam and the Commonwealth of the Northern Mariana Islands. Cruises in 2006 and 2007 focused on the West Mariana Ridge whereas the 2010 cruises concentrate on sections of the Mariana Trench (Fig. 1). An exhaustive study of the U.S. data holdings pertinent to the formulation of U.S. potential claims of an extended continental shelf under the United Nations Convention of the Law of the Sea (UNCLOS) identified these areas as regions where new bathymetric surveys are needed (Mayer, et al., 2002). That report recommended that multibeam echosounder (MBES) data are needed to rigorously define (1) the foot of the slope (FoS), a parameter of the two UNCLOS-stipulated formula lines, and (2) the 2500-m isobath, a parameter of one of the UNCLOS-stipulated cutoff lines. Both of these parameters, the first a precise geodetic isobath and second a geomorphic zone, are used to define an extended continental shelf claim. In addition, further consideration by the ECS Task Force suggested that seamounts accreted to the inner wall of the Mariana Trench (Fig. 2) might be used as criteria for a natural prolongation of an extended shelf. The Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) of the University of New Hampshire was directed by the U.S. Congress, through funding to the U.S. National Oceanic and Atmospheric Administration (NOAA) to conduct the new surveys and archive the resultant data.

NOAA entered into an agreement with the U.S. Naval Oceanographic Office (NAVOCEANO) to conduct the bathymetry cruises in 2010. NAVOCEANO made available the 329-ft, 5000-ton hydrographic ship USNS *Sumner* (T-AGS-61) (Fig. 3) with a hull-mounted Kongsberg Maritime EM122 MBES and a Kongsberg Maritime SBP120 chirp sub-bottom profiler. The schedule for the cruise called for a 30-day leg beginning and ending in Apra Harbor, Guam, Guam.

NAVOCEANO was responsible for system calibration, data collection and quality control and overall cruise management whereas the UNH/NOAA representative was responsible for cruise planning, both before and during the cruises, bathymetry, acoustic-backscatter and chirp subbottom profiler processing aboard ship.

The cruise began with a 36-hr, 230-km, data collection and transit from Apra Harbor, Guam to an area east of the Mariana Trench. A full patch test, including a calibration of an XBT cast with a CTD cast, was performed in this area and was followed by 28 days of progressively mapping the areas of interest in the Mariana Trench area from north to south. The cruise mapped a total of 187,503 km^2 in 29 mapping days and collected 17,399 line km of MBES with an average speed of 13.5 knts. A summary of the cruises is given in Table 1.

Table 1. Cruise Statistics

Leg 1

Julian dates..JD 218 to JD 248
Dates ....August 6 to Sept. 5, 2010
Weather delay .... 0 days
Total non-mapping days (transits) .... 1 days
Total mapping days.. 29 days
Total area mapped............................. 187,503 km^2 (72,395 mi^2)
Total line kilometers ....17,399 km (9395 nmi)
Beginning draft .... 6.7 m
Ending draft .... 6.1 m
Average ship speed for survey.......................................13.5 knts

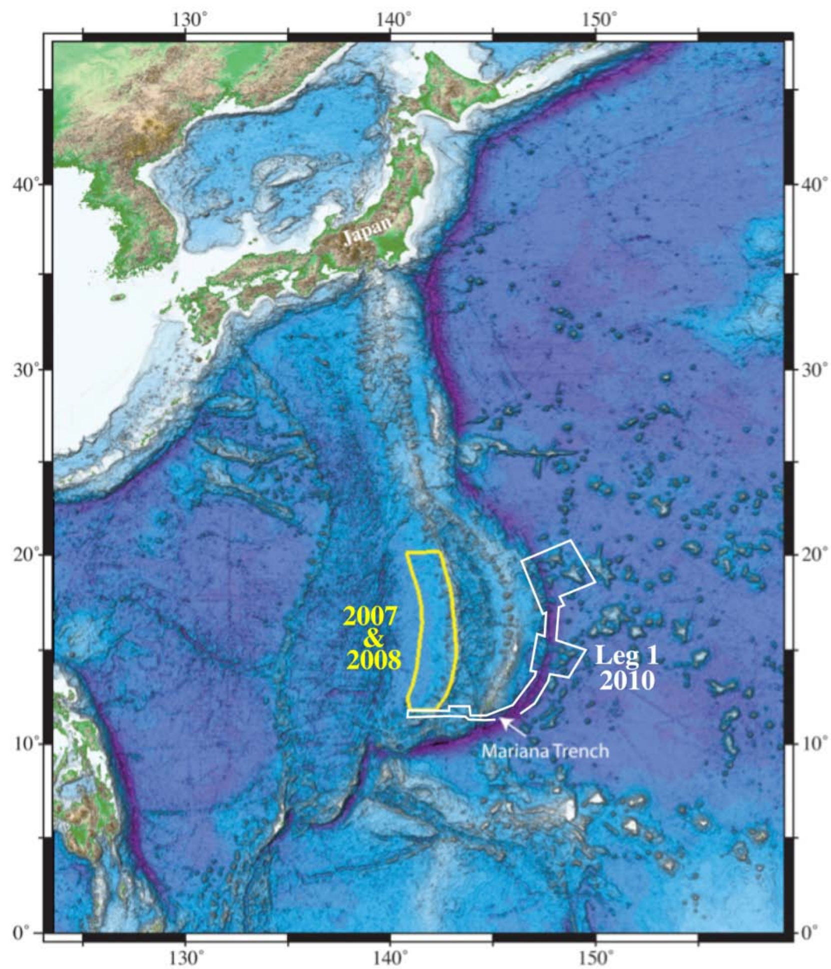

Figure 1. Overview map showing the areas mapped during Leg 1 2010 (white polygons). Yellow polygon outlines the combined area mapped in 2006 and 2007.

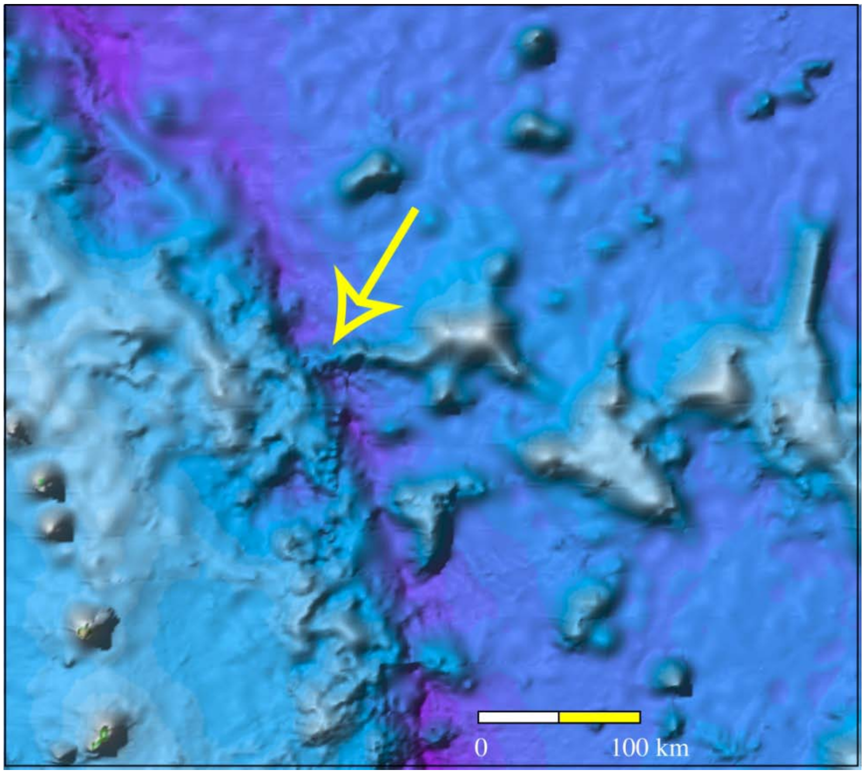

Figure 2. Example of accreted seamount (yellow arrow) within the Mariana Trench.

Figure 3. USNS *Sumner* used for the mapping.

The Multibeam Echosounder System and Associated Systems

The hull-mounted Kongsberg Maritime EM122 MBES system aboard USNS *Sumner* is a 12-kHz multibeam echosounder that transmits a 1° wide (fore -aft) acoustic pulse and then generates 432-1° receive apertures ("beams") over a swath as large as 150° perpendicular to the ship's heading. The system can automatically adjust the pointing angles of the receive beams to maximize the achievable coverage or a maximum aperture can be defined by the operator. The transmit cycle can be rapidly duplicated to provide two swaths per ping, each transmitted with a small along-track offset that compensates for water depths and ship speed that can generate a constant sounding spacing in the along-track direction. This mode can provide as many as 864 soundings per transmit cycle swath (432 soundings per swath) in the high-density dual-swath mode. With more than one sounding generated per beam in the high-density mode, the horizontal resolution is increased and is almost constant over the entire swath when run in the equidistant mode. In addition, the receive beams can be steered as much as 10° forward or aft to reduce the effects of specular reflection and/or sediment penetration of the acoustic pulse at nadir and near-nadir angles.

The EM122 uses both continuous wave (CW) and frequency modulation (FM) pulses with pulse compression on reception to increase the signal-to-noise ratio. The transmit pulse is split into several independently steered sectors to compensate for vessel yaw. The system is pitch, yaw and roll stabilized, beam steering up to ±10° from vertical, roll compensation up to ±10° to compensate for vehicle motion during transmission. Kongsberg Maritime states that, at a 10-ms pulse length used during most of these surveys (deep mode), the system is capable of depth accuracies of 0.3 to 0.5% of water depth. The Kongsberg Maritime EM122 Product Description should be consulted for the full details of the MBES system. The installed software versions used on the Seafloor Information System (SIS) and the transmit-receive unit (TRU) systems are given in Table 2.

Table 2. Kongsberg Maritime software version numbers.

System	Software Version
Seafloor Information System	3.6.4, build 174
TRU CPU	1.1.1
DDS DDS software version	3.4.9
BSV BSP software version	2.2.3
Transmit software version (RSV)	1.1.1
Transmit software vesion (TSV)	1.1.1
Datagram format version (DSV)	3.1.1

A hull-mounted Applied Microsystems Ltd Smart SV&T sound-speed sensor (serial no. 4276), last calibrated on May 13, 2010, was used to measure the sound speed at the MBES transducer array for accurate beam forming. Beam forming during this cruise used the high-density equidistant mode with FM enabled and Automatic mode in deep water. For receive beams at near-normal incidence, the depth values are determined by center-of-gravity amplitude detection, but for most of the beams, the depth is determined by split-beam phase detection. The spacing of individual sounding is approximately every 50 m, regardless of survey speed.

An Applanix POS/MV model 320 version 4 (serial no. 2571) inertial motion unit (IMU) (without TrueHeave) was interfaced to two Force 5 (version 0507) global positioning (GPS) receivers and a Starfire Navcom model SF-2050R (serial no. 5098) differential global positioning (DGPS) receiver to provided position fixes with an accuracy of ~±0.5 m. The IMU provides roll, pitch and yaw at accuracies of better than 0.1˚ at 1 Hz. The lack of the TrueHeave component with the installed POS/MV requires a 15-minute run-in for each line to eliminates residual heave at the start of each line. All horizontal positions were georeferenced to the WGS84 ellipsoid and vertical referencing was to instantaneous sea level.

The Kongsberg Maritime EM122 is capable of simultaneously collecting full time-series acoustic backscatter that is co-registered with each bathymetric sounding. The full time-series backscatter is a time series of acoustic-backscatter values across each beam footprint on the seafloor. If the received amplitudes are properly calibrated to the outgoing signal strength, receiver gains, spherical spreading and attenuation, then the corrected backscatter should provide clues as to the composition of the surficial seafloor. However, the interpreter must be cautious because the 12-kHz acoustic signal undoubtedly penetrates the seafloor to an unknown, but potentially significant (meters) depth, thereby generating a received signal that is a function of some unknown combination of acoustic impedance, seafloor roughness and volume reverberation.

Sippican Deep Blue expendable bathythermographs (XBTs) were used to calculate sound speed in the water column. Deep Blue XBTs have a 760-m maximum depth of measurement so the profiles were extrapolated to 12,000 m to provide a profile throughout the water column. Water-column sound-speed profiles were routinely collected every 6 hrs during the cruise as well as anytime the sound speed measured at the transducers differed by 0.5 m/s from the value at the transducer depth from the XBT-derived sound speed. Sound speeds were calculated from measurements of water temperature vs depth and the measured salinity from a CTD cast collected at the patch test site. A Sea Bird Electronics model SBE-911+ CTD was used to calibrate the XBTs during the patch test. The two temperature sensors (serial no. 2667 and 2558) were last calibrated on March 30, 2009, the two conductivity sensors (serial no. 2347 and 2560) were last calibrated on April 22, 2009 and the pressure sensor (serial no. 0581) ws last calibrated August 21, 2009. Derived sound-speed profiles calculated from the two systems (CTD vs XBT) from data collected during the patch test were compared between the systems to calibrate the XBT (Fig. 4).

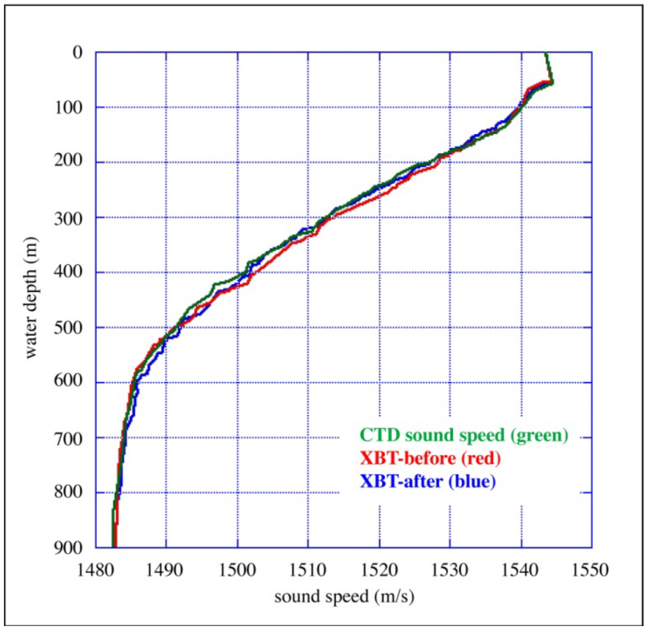

Figure 4. Comparison of sound speeds calculated from CTD (red) and XBT (blue).

A full patch test was conducted in the survey area on Monday August 9, 2010 to ensure sensor offsets were correct. Tables 3 and 4 show the sensor offsets used for the survey.

Table 3. Initial system sensor offsets

	Location Offsets			Angular Offsets		
Sensor	**Forward**	**Stbd**	**Down**	**Roll**	**Pitch**	**Heading**
POS 1	0.00	0.00	0.00	–	–	–
POS 2	0.00	0.00	0.00	–	–	–
POS 3	0.00	0.00	0.00	–	–	–
Tx tdr	18.34	-0.58	4.08	0.390	0.950	359.850
Rx tdr	13.51	0.02	4.16	0.150	0.987	359.880
Attitude 1	0.00	0.00	0.00	0.020	0.130	0.000
Attitude 2	0.00	0.00	0.00	0.000	0.000	0.000

Departure depth to transducers 6.7 m, Final depth to transducers 6.1 m

Table 4. Offset corrections determined by Patch Test

Offset	Value
roll	0
pitch	0
yaw	0
latency	0

Ancillary Systems

In addition to the MBES, the ship is equipped with a Kongsberg Maritime SBP120 high-resolution subbottom profiler to image the uppermost (i.e., ~50 m) sediment section. This system utilizes a 3° beam width generated from an extra set of fore-aft- oriented transducers that generate an FM chirp with a frequency span of 2.5 to 7 kHz. One broadband receiver transducer of the EM122 is used to record the SBP120 subbottom data. A frequency splitter divides the 12-kHz EM122 returns from the lower frequency subbottom chirp signal. The SBP120 data were continuously collected throughout the cruise. Data were recorded in SEG-Y format using the sound speed profile used by the EM122. Each subbottom profiler line coincides with a multibeam line. The SEG-Y data were processed aboard ship using SonarWeb (Chesapeake Technology, Inc.). However, because of the NAVO's lack of knowledge and experience of operating this system, as well as no manuals, these data were not collected on this cruise.

MBES Data Processing

NAVO assigned the cruise designator *610410* to the cruise whereas it was designated SU10-01 for UNH/NOAA purposes. All raw MBES files were initially labeled with a unique Kongsberg file designator but the files were renamed to MarianaTrench_line_X, where X is a consecutive line number starting with 1 (see Appendix 1). Transit lines and patch-test lines were given line numbers prefixed with "tranN" or "patchN", where N is the next consecutive line number in the X progression. The renaming was done so that the individual lines would be unequivocally identified with the survey area in the future.

The raw MBES bathymetry and acoustic backscatter data were processed aboard ship using the University of New Brunswick's OMG/SwathEd software suite, version 2010-07-30 rev. 97. Each EM122 .all files was collected by the onboard Kongsberg SIS data-acquisition system on a server and the file was copied to an external hard drive that was then disconnected from the server and connected to the UNH computer at the end of each line.

Each .all file is composed of individual data packets of bathymetry, acoustic backscatter, navigation, parameters, sound-speed profiles, orientation and sound speed at the transducer. The first step in the processing separates each of these data packets into the individual files. The second step in the processing plots the navigation file so that any bad fixes can be flagged. Once this step is completed, the good navigation is merged with the bathymetry and acoustic backscatter files.

The third step involves editing (flagging) individual soundings that appear to be fliers, bad points, multipaths, etc. The entire file of soundings is viewed and edited in a sequence of steps through the file. Once the bathymetry file has been edited, the valid soundings are ready to be gridded into area DTM maps and the co-registered valid acoustic backscatter full-beam time series is assembled into a file and gridded into area mosaics.

Each of the regions to be mapped was subdivided into North, Central and South regional maps and mosaics with 100 m/pixel spatial resolution (Fig. 5). Each regional map and mosaic was designed to maximize the spatial resolution allowed by the mapped water depths within the area. Each region also was subdivided into subareas (Figs. 5). Bathymetry and the full-beam time-series acoustic backscatter were gridded into the appropriate subarea maps and mosaics and the appropriate subarea maps and mosaics were gridded into the appropriate regional map.

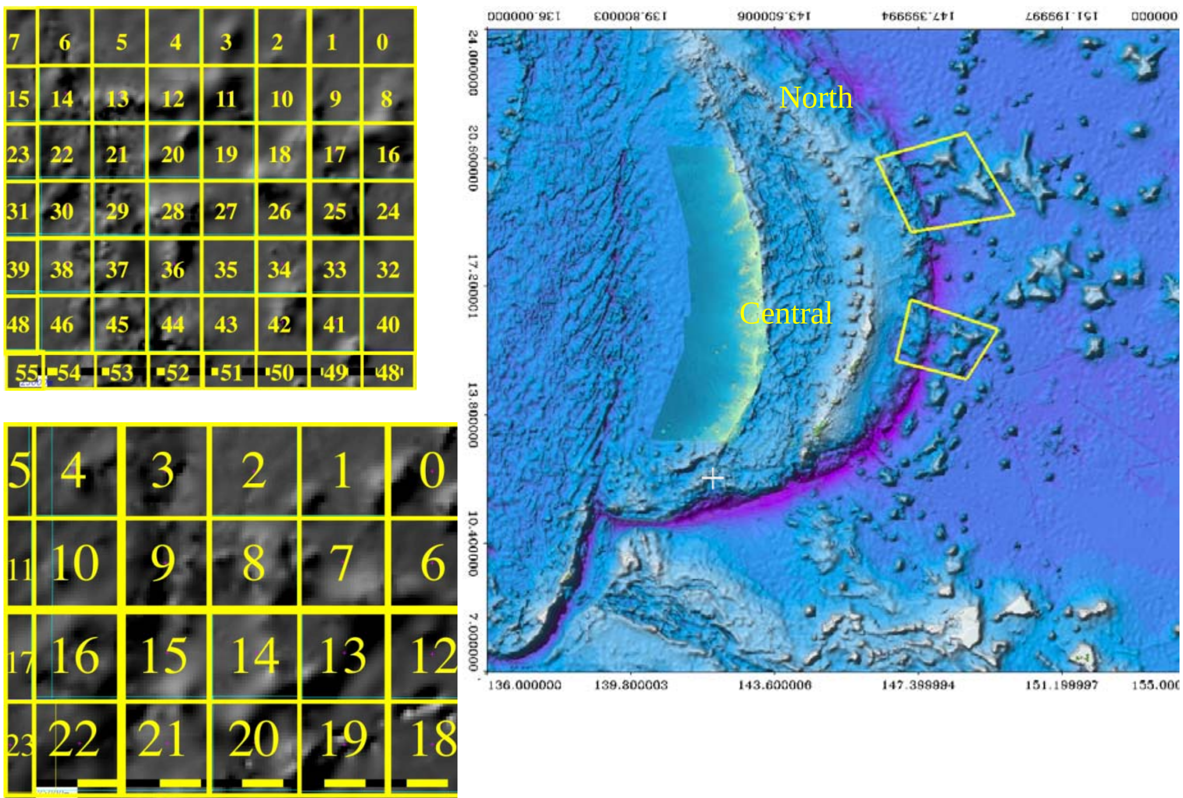

Figure 5. (upper left) map subarea numbers for North area and (ower left) subarea numbers for Central area. (right) Locations of North and Central map areas.

The Areas:

Leg 1: The Mariana Trench

The Mariana Trench marks the subduction zone where two oceanic plates converge; the older Pacific Plate underthrusts beneath the eastern edge of the younger Philippine Plate (Karig, 1971; Stern et al., 2003). The trench axis juxtaposes Pacific Plate crust of >170 Ma against Philippine Plate crust of ~55 Ma. The old Pacific Plate, having cooled for almost two hundred million years, is denser than the younger (warmer) Philippine Plate, thus it subducts beneath the younger plate. The Pacific Plate approaches the Philippine Plate on a N60W trend with angles with the trench that change from ~30° to almost orthogonal because of the curvature of the subduction zone (Fig. 6). As the Pacific Plate spreads westward at ~11 cm/yr, it passively carries with it an enormous number of seamounts, guyots, submarine ridges and other smaller features (Smoot, 1983; 1989) that rise above the basement depths and sediment cover (Fig. 7). In the vicinity of the Mariana Trench, the Magellan Seamounts are a prominent chain that has been dated as Early Cretaceous in age (Smith et al., 1989; Koppers et al., 1998; 2003). The seamount names in Figure 6 are from Smoot (1983), the basin and ridge names are from Stern et al. (2003) and informal names that do not appear in the SCUPN Gazeteer for undersea features (GEBCO, 2010) are in quotes. Once the seamounts and other features enter the subduction zone and are thrust against the leading edge of the Philippine Plate, they are either partially or totally subducted beneath the Philippine Plate or accreted to the Philippine Plate. Several seamounts appear to have been accreted to the Philippine Plate within the areas mapped on Leg 1 (see Fig. 2 for an example).

A series of suspected accreted seamounts in the Mariana Trench have been identified from existing bathymetry (Smoot, 1989; Smoot, 1997; Sandwell and Smith, 1997) and these are the targets for Leg 1.

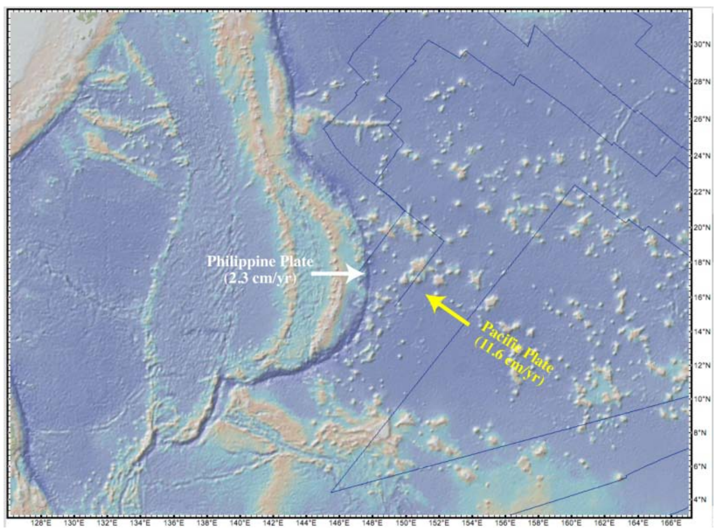

Figure 6. Spreading rates and angle of approach of Pacific and Philippine Plates

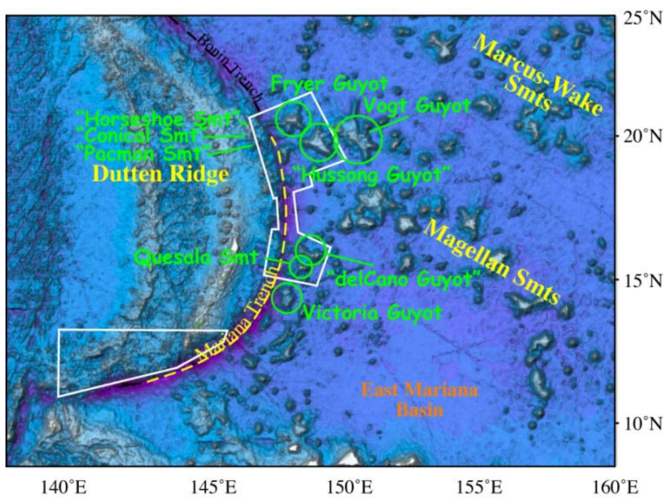

Figure 7. Formal and informal (in quotes) names of seamounts, guyots and ridges in the near vicinity of the Mariana Trench. White polygons are map areas.

Daily Log (local time UTC + 10)

JD 218 (Friday August. 6, 2010)

The ship was originally scheduled to depart at 1600 L on Friday, August 6. However, when I arrived at the ship at 0800 L, I was informed that the differential navigation receiver (Navcom) was dead and the replacement part was due to arrive by air at 1800 L. Consequently, I delayed sailing until 0900 L on Saturday so that the new receiver could clear customs and be set up and tested by the ETs prior to departure.

The differential receiver arrived at the ship at 2000 L and was up and running by 2200 L. It ran all night and appears stable with good static position statistics.

JD 219 (Saturday August. 7, 2010)

Departed Apra Harbor, Guam at 0900 L (2300 UTC JD218) and transited along the west coast and then set a straight course for the patch-test site. A BIST test (Appendix 3 BIST Test 1) was run while transiting at 7.5 knts along the west side of Guam in unknown water depths. The test shows the noise on all receivers is less than 50 dB.

The MBES and SBP120 were turned on and the ETs performed a series of tests on the systems that lasted several hours. No data were logged during the testing. After completion of the tests, logging began for both the MBES and the SBP120.

JD 220 (Sunday August. 8, 2010)

Continued the transit to the patch test site at 12 knts. I discovered early in the morning that the MBES logging configuration is set up for NAVO and it is not ideal for UNH/NOAA needs. The .all files logged by the ISS-60 had lots of errors when unraveling them. However, once I started logging .all files on the SIS system and compared the two .all files from the different logging systems, it was clear that the ISS-60 .all files are reformatted from the original Kongsberg .all datagram format. NAVO had their ISS-60 control everything and had the SIS only controlling the pinging but not logging. This created numerous ISS-60 files of various formats of interest to NAVO but of no interest to UNH/NOAA. I set up a new protocol that has the SIS controlling the line recording and incrementing, as well as logging .all datagrams, but without interrupting the NAVO scheme on the ISS-60. I changed the line length to 24800 seconds (8 hr) so that the SIS system would not automatically increment the line between the desired 6 hr intervals (0000, 0600, 1200 and 1800 UTC). To set this on the SIS, I used the main menu at the top left of the SIS window and go to Tools>Custom>Set Parameters. This opens a new window (see Fig. 8 below). Click on "Logging" (red rectangle in Fig. 6 below) and set the value to 28800 seconds (8 hr). Reboot the SIS and this will stop the automatic generation of new files.

I also decided to stop collecting the gsf files for each line because numerous gsf files are created for each .all file. It is all very confusing, even to NAVO personnel, so

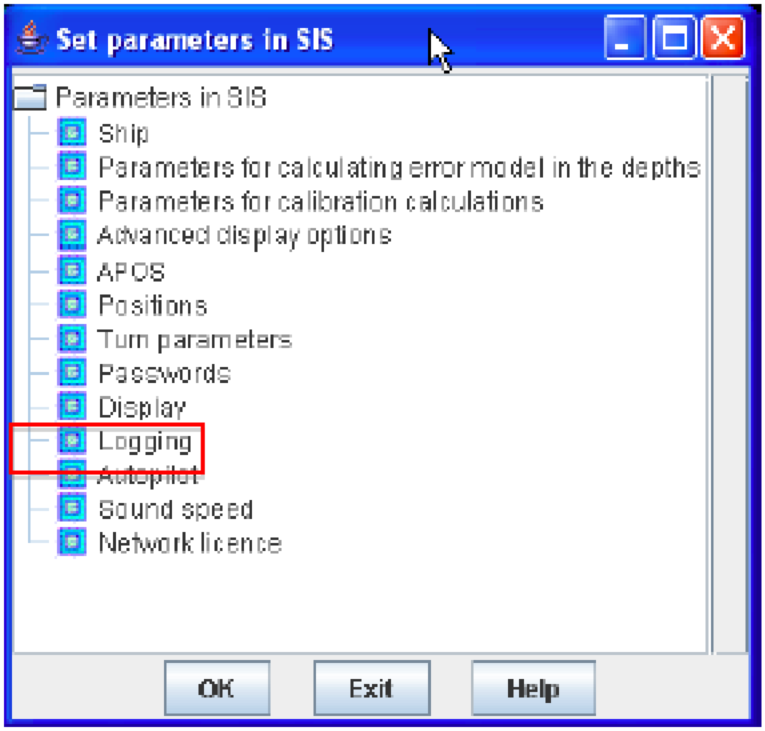

Figure 8. SIS ialog window (Tools>Custom>Set Parameters) to set the logging length to 24,800 seconds.

I'll just wait to get the full data set at the end of the cruise and try to figure out the gsf file convention then.

The SBP120 generates both raw and SEG-Y files for each line. The raw files are only good for reprocessing, so only the SEG-Y files were downloaded aboard ship. The raw files will be on the data tape, if they are ever needed. It is important to download the SEG-Y files from the SBP120 computer, not the ISS-60 server, because the ISS-60 chops the files into numerous small files.

I discovered late in the morning that the SIS was still generating lots of files, apparently not responding to the setting of 24800 seconds/file. Then I discovered that the NAVO person that was asked to reboot the SIS actually didn't reboot it but only stopped logging and then started logging. Obviously, this is not a reboot so an ET was asked to reboot the SIS.

At the change of Julian Day (1000 L), the SIS display showed a warning box saying "Unknown License Error no. 3" and the system crashed. The issue was solved by the lead ET when he found that the SIS dongle was broken. The SIS dongle is adjacent to the USB port used to download the .all files from the SIS. Evidently, when the watchstanders insert the USB cable into the USB port, they have been bumping up against the dongle and it finally failed. It failed at 0000 UTC because that was the last data transfer to the portable drive. The ET did a "field fix" and we continued on the transit to the patch test site.

Weather and sea state are ideal for mapping. We continued to have problems all afternoon with the EM122. The gridding engine kept locking up, thereby stopping production of the screen DTM on the SIS screen. The ISS-60 crashed several times. Sound speed at the transducer was allowed to differ by as much as 1.5 m/s from that of the SVP profile because of a difference in opinion between the guy in charge of the XBT and me. The SBP120 subbottom profiler defied all attempts to record a good SEG-Y record; only the lead ET could generate a good screen record by constant attention, but no one aboard ship knows where to fine the gain, match-filtered, InstAmp and AGC SEG-Y file. This is the file the NAVO seismic specialist at NAVO/Stennis recommended that I use for processing. All SEG-Y files that can be found are passed through ISS-60 and are chopped into millions of small files. Although I can read these SEG-Y files, they bear no resemblance to the image on the SBP120 screen and they are clearly not the processed files I need. So far, all this has happened on the transit line to the patch-test site. However, we are due to arrive at the patch-test site at ~2230 L and neither the EM122 nor the SBP120 appear ready for actual mapping.

We arrived at the patch-test site at 2230 L and launched the CTD. It made it to 240 m before shorting out. The CTD was brought back aboard and the ETs started repairing it. The CTD was back in the water by 1130 L.

JD 221 (Monday August. 9, 2010)

The CTD cast was completed by 0300 L, although it turned out that only the starboard XBT launcher could be used. The port launcher malfunctioned. An XBT was taken both before and after the CTD. The NAVO sound-speed software crashed each time the CTD salinity was input to calculate sound speed so an historical salinity of this area from the GDEM database was used and it was successful. The plot of the XBT vs CTD derived sound speed (Fig. 9) shows the XBT can provide a good reference for calculating sound speed.

Once the CTD-XBT comparisons were completed, the MBES was booted up but the data showed a large number of beam dropouts throughout the swath. There was an obvious noise source in the water column that was apparently interfering with the system. The SBP120 was shut down but the noise and dropouts persisted.

The problem with the EM122 appears to a communication issue between the SIS and the ISS-60. The problem seemed to go away and was left unresolved. The pitch and timing sections of the patch test (Lines patch13 and patch14) was begun at 0700 L and were completed at 1900 L. The results showed that both pitch and timing required no static offsets.

At 2050 L during the first of the roll-test lines, the SIS crashed and the line had to be rerun.

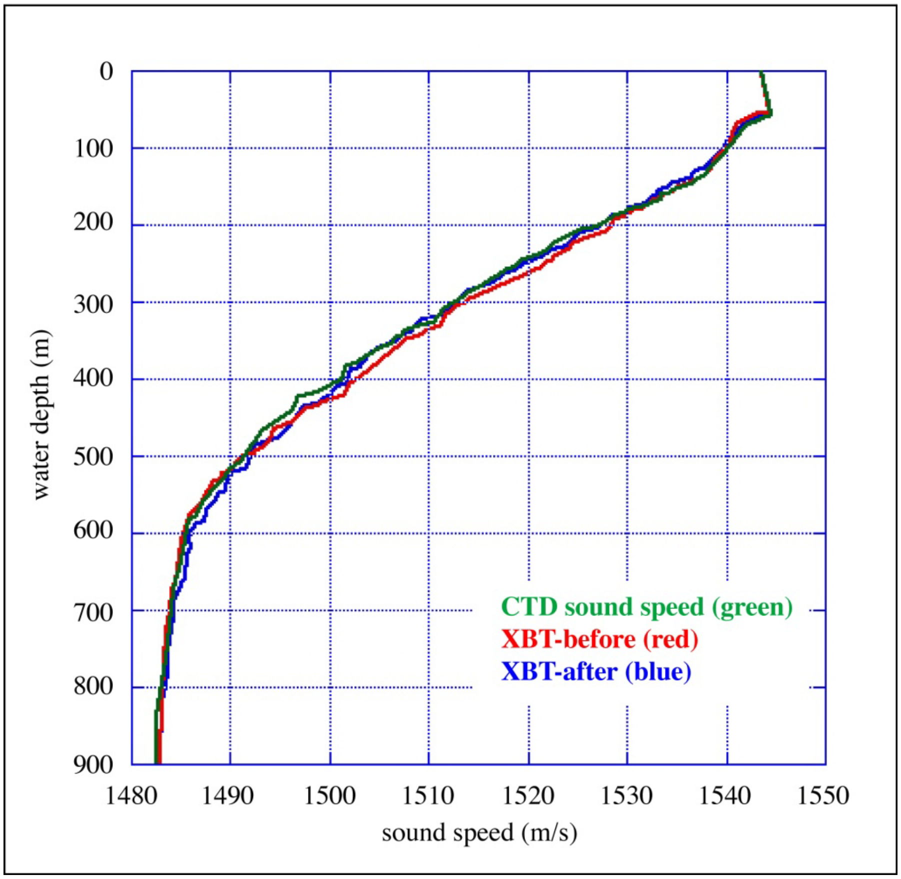

Figure 9. Comparison of calculated sound-speed profiles from XBT casts before and after the CTD cast.

JD 222 (Tuesday August. 10, 2010)

The day was fair with ~4 ft swells and light winds. The roll patch test (Lines patch15 and patch16) was completed during the night and no static offset was required. The heading patch test (Lines patch17 and patch19) were completed at 1245 L and no static offset was required. The dipline (Line 20) was begun at 1400 L.

At ~1530 L, all of the starboard sectors and the outer-most port sector of the EM122 started tracking depths of 11,500 m, whereas the depths were 5525 m (Fig. 10). The port sectors continued to track the 5525 m depths. The ET recovered the inner sectors by taking the system out of automatic mode and forcing the depth to 5500 m. A discussion with the Lead ET confirmed a suspicion of mine that the SBP120 is not synchronized to the EM122; it is transmitting independent of the EM122. The bad bottom tracking of the inner sectors of the EM122 appears to be a case where the inner sectors of the EM122 got bottom track on a multiple of the SBP120. I reduced the power on the SBP120 to -3 from -2.

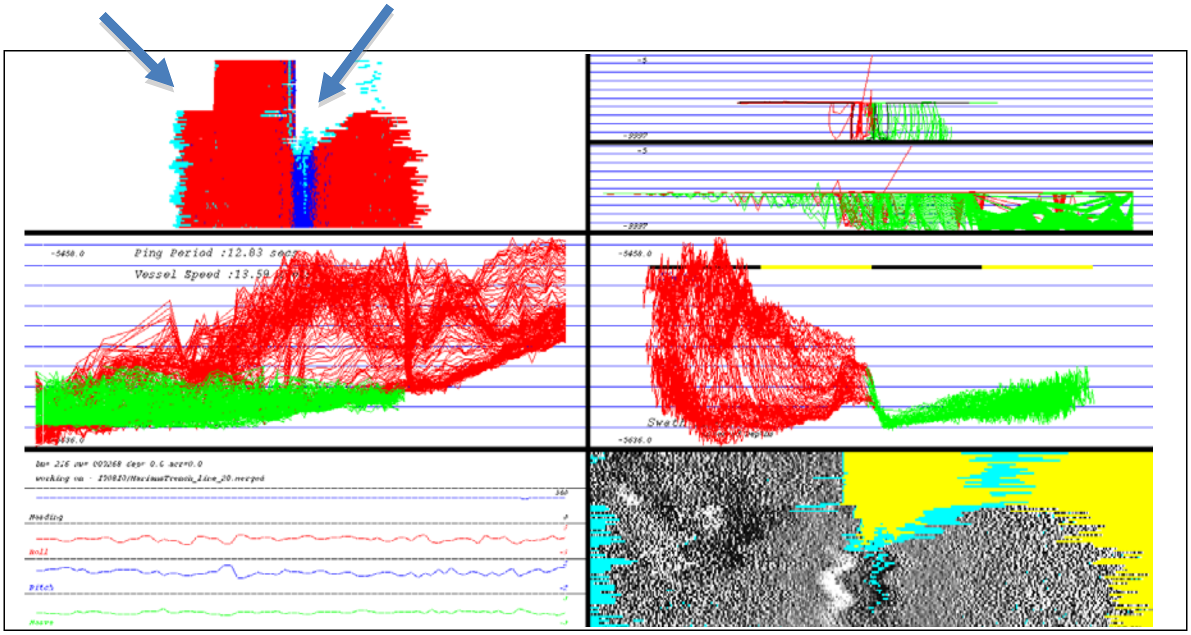

Figure 10. EM122 sectors lost bottom detection on Line 20 (blue arrows).

JD 223 (Wednesday August. 11, 2010)

The dipline (Lines 20-23) was completed at during the night and the transit to the start of the long E-W lines in the North area began on the western flank of the trench.

The weather was calm and the swell was <3 ft; perfect conditions for mapping.

No one aboard ship knew anything about how to set up the SBP120 or process the raw SBP120 SEG-Y data. Although the Lead ET set it up initially, the watchstanders knew nothing about how to monitor the system to keep recording good subbottom data. Therefore, NAVO will have to process the data post-cruise at Stennis. Consequently, I stopped copying the files to the UNH RAID and stopped logging the files in Table 5.

JD 224 (Thursday August. 12, 2010)

Routine day of mapping in North area. Light winds and swell >3 ft. Data quality is superb.

At 1500 L, I was called to the SNR's cabin to meet with the SNR and the Captain. It turns out that the ship's air conditioning units are both leaking Freon and cannot keep up with the tropical temperatures. The Captain has decided that we must return to Guam to pick up 1000 lbs of Freon and repair the air conditioning units. I was allowed to plot a transit that follows the axis of the Mariana Trench from the end of our next south-traveling line (Line 33) in the North Area to a point at the latitude of Guam. This allows me to collect useful data on our trip back to Guam.

JD 225 (Friday August. 13, 2010)

We arrived at the end of the south-running line at 0630 L and transited a short distance to start the trench-axis transit lines (line_trench37) to Guam to repair the air conditioners.

The day was calm with <5 ft swells. Data quality was superb. During the trench-axis transect back to Guam, we mapped over an unnamed seamount at 17˚59.3266’N 147˚49.7313’E, one of the western-most seamounts in the Magellan seamount chain. The 7500 and 8000 m isobaths clearly show a bridge between the west trench wall and “Hussong” seamount to the east of the trench axis (Fig. 11).

The trench-axis line was terminated at 2200 L and we changed course to a transit that puts us just north of Guam.

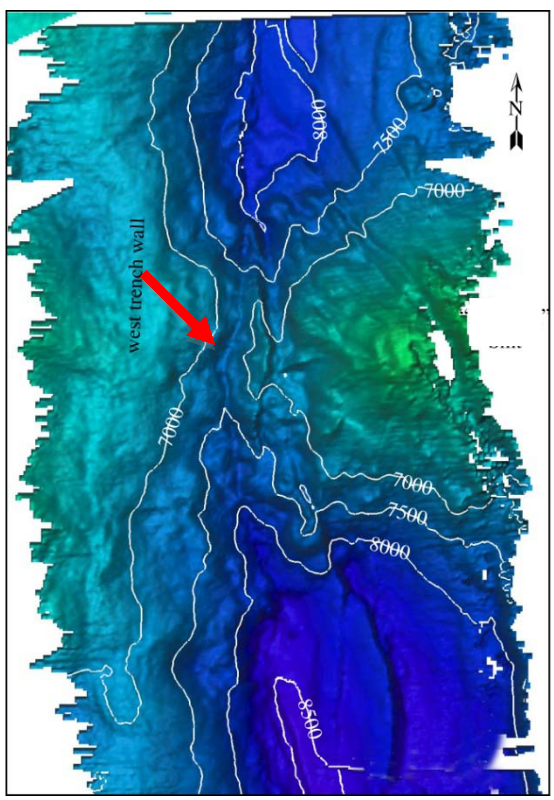

Figure 11. DTM of seamount showing bridge from west trench wall to the seamount (red arrow).

JD 226 (Saturday August. 14, 2010)

We continued on our transit to Guam to get parts for the air conditioners. The transit took us between Guam and Rota and then down the west side of Guam. We arrived at a point off Apra Harbor at 1145 L and hove-to to await the delivery of Freon and repair spares for the air conditioners. The transfer of parts was completed by 1215 L and we got underway on transit Line tran43 to intersect the trench-axis transect south of the Central area and then map northward to the North area to resume mapping there (Fig. 12).

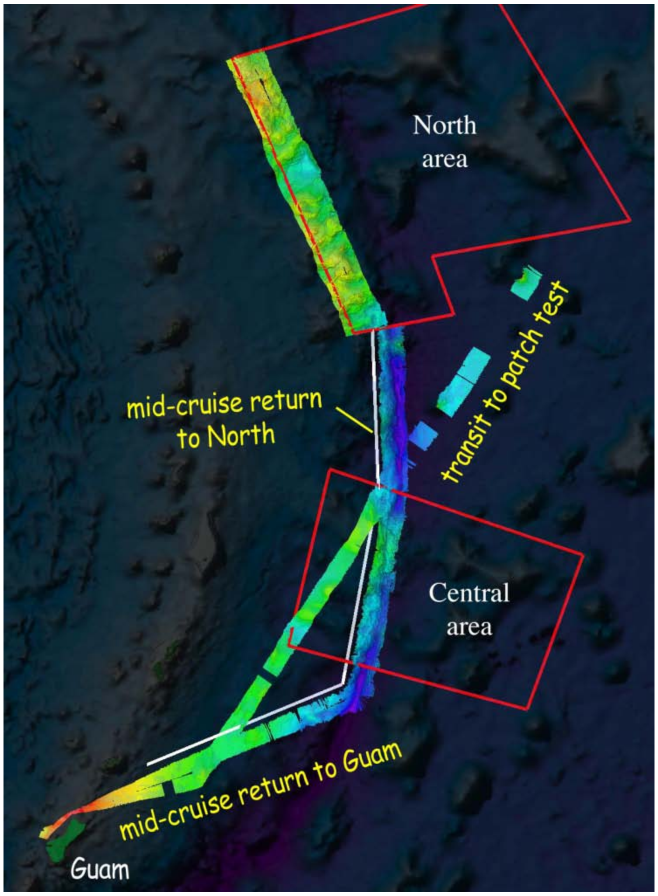

Figure 12. Map of transit lines to patch test and mid-cruise return to Guam.

As soon as we turned around and started transiting to the NE, the differential GPS crashed. A reboot of the POS/MV corrected the problem. A BIST test was run in 1500 m depths at 13 knts (Appendix 3 BIST Test 2).

The SIS locked up at 1828 L (on Line tran45) and had to be rebooted.

JD 227 (Sunday August. 15, 2010)

Continued on the transit back to North area. The day began with heavy rain and sustained winds of 40 knts generating a 5-ft sea during the night. But even with the high sea and swell, the data quality continued to be superb. The winds calmed to <15 knts during the morning and the sea subsided to <3 ft.

Lines trench48 and trench49 were run offset to the west of the trench-axis lines collected during the transit back to Guam. The SIS lost track of the center beams and created a brief period of no bottom early in the morning. The SIS was taken out of Auto mode and put into Deep mode and the bottom tracking corrected itself.

We got back to the North area at 1815 L and resumed mapping there with Line 52.

JD 228 (Monday August. 16, 2010)

Routine day of mapping in North area. The day was bright with <15 knt winds and <3 ft swell. Data quality was superb. We continued to map in the North area immediately east of the trench axis.

JD 229 (Tuesday August. 17, 2010)

Routine day of mapping in North area. The day was bright with winds <15 knts and swells <3 ft. Data quality was superb. Two XBTs taken 6 hours apart (ave. ship speed 13.5 knts) shows large (~1.5 ˚C) temperature differences for about the first 100 m below the mixed layer (Fig. 13). These differences suggest a variation in water-mass properties that may affect the raytracing of sounding locations. However, a sensitivity test suggests that the error is still within the 32 m footprint at 70˚ of a 1˚ receive aperture with 432 beams at these depths.

JD 230 (Wednesday August. 18, 2010)

Routine day of mapping in North area. The day was cloudy with winds <15 knts and swells <2 ft. Data quality was superb.

JD 231 (Thursday August. 19, 2010)

Routine day of mapping in North area. The day was sunny with winds <15 knts and swells <3 ft. Data quality was superb.

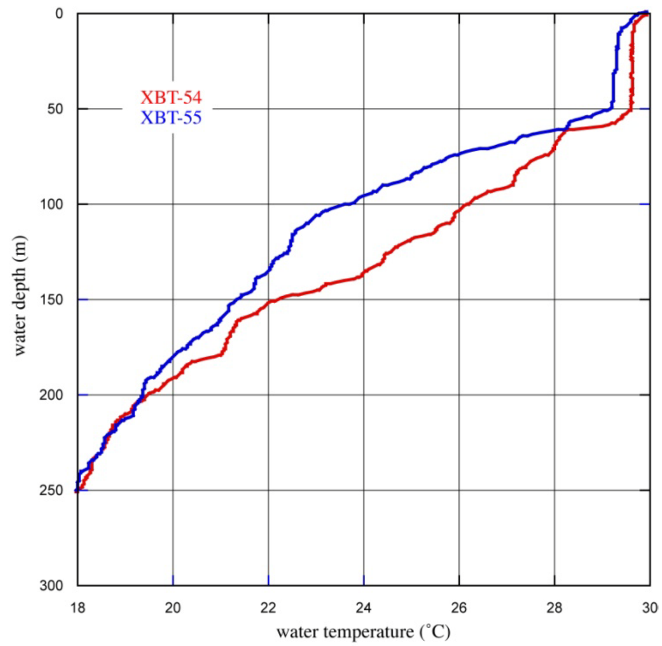

Figure 13. Two XBT profiles taken 6 hr apart on JD 228 showing a ~1.5˚C difference in temperature at depths of 75 to 140 m.

By the late afternoon we had mapped the full extent of “Hussong” seamount (informally named by Smoot (1997) but not recognized as the formal name in the SCUPN 2010 gazeteer) had been mapped (Fig. 14). “Hussong” seamount is actually a guyot, not a seamount, and is in the process of being subducted beneath the Philippine Plate. The Pacific Plate upon which the guyot sits is cracked my numerous faults (Fig. 14b).

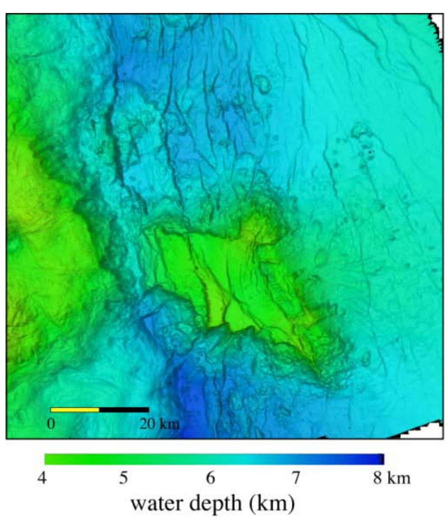

Figure 14a. “Hussong” guyot.

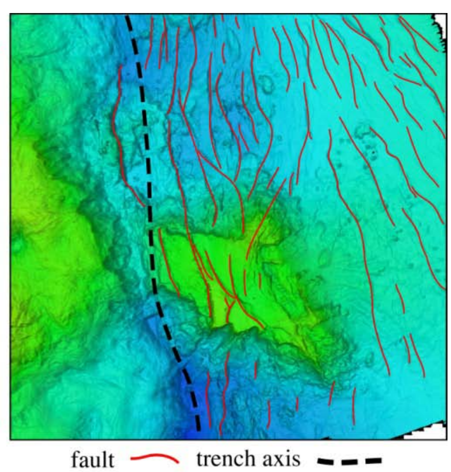

Figure 14b. Map showing trench axis and faults on the upper surface of the Pacific Plate

At 1800 L, the ship veered off course and Line 72 had to be prematurely terminated. The ship circled back to a point about 5 km up the line and resumed mapping with Line 73.

JD 232 (Friday August 20, 2010)

Routine day of mapping in North area. The day was sunny with winds <15 knts and swells <3 ft. Data quality was superb.

JD 233 (Saturday August 21, 2010)

Routine day of mapping in North area. The day was sunny with winds <15 knts and swells <3 ft. Data quality was superb.

JD 234 (Sunday August 22, 2010)

Routine day of mapping in North area. The day was squally in the morning and sunny in the afternoon with winds <15 knts and swells <2 ft. Data quality was superb. The late afternoon, evening and night was spent filling in holidays on Fryer Guyot to get a complete picture of the summit. The Smith and Sandwell 1-arcmin DTM gives a shoal depth on the summit of 367 m but we found the shoal depth of 1205 m.

JD 235 (Monday August 23, 2010)

The holiday fill-ins on Fryer Guyot (Fig. 15) were completed at 0630 L and we mapped south to Vogt Guyot.

At 1008 L the POS/MV crashed. A reboot of the POS/MV brought it back up so we circled around and reran the last 0.5 hr of the line.

The day was sunny with winds <15 knts and swells <3 ft. Data quality was superb.

JD 236 (Tuesday August 24, 2010)

The day was overcast and showery interspersed with partly sunny with winds <15 knts and swells <3 ft. Data quality was superb. Routine day of mapping in North area.

JD 237 (Wednesday August 25, 2010)

Routine day of mapping in North area. The day was sunny with winds <15 knts and swells <3 ft. Data quality was stunning. The last major line in the North Area was broken (Line 103) in the mid afternoon and the rest of the day was spent filling in 3 large holidays over Vogt Guyot.

JD 238 (Thursday August 26, 2010)

After completing the holiday fill-ins, the last line was resumed (Lines 108 and 109) to the southern end of the North Area. The day was cloudy with squalls and 15 knt wind with 5 ft swells.

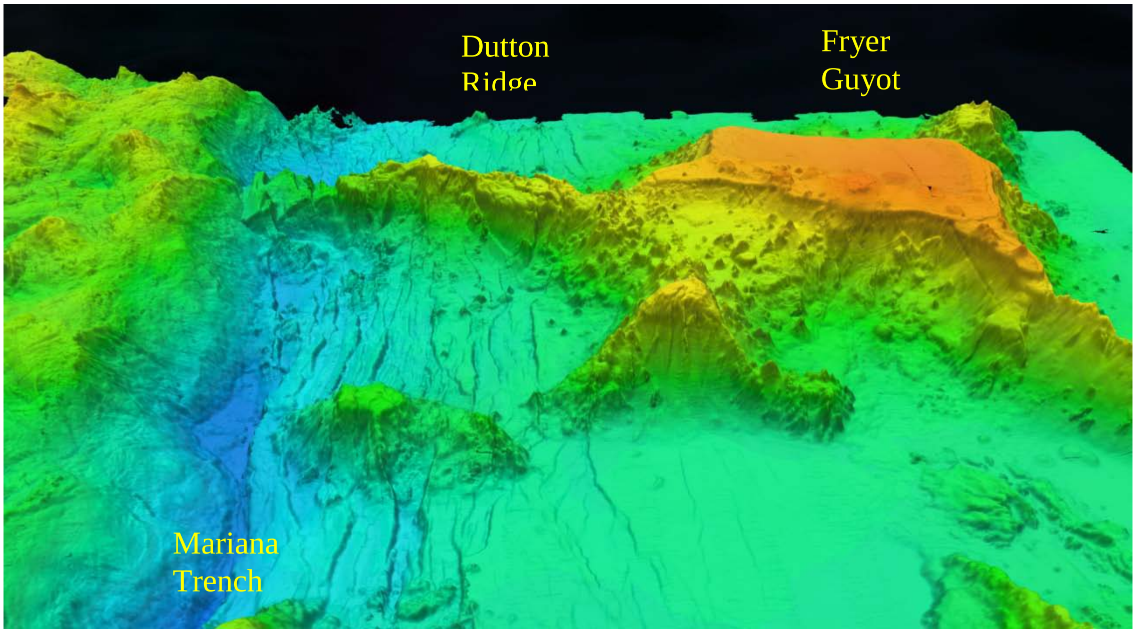

Figure 15. Perspective view of western-most Dutton Ridge and Fryer Guyot. VE = 5x, looking NE.

At 1045 L, NAVO personnel powered down all the computers and restarted them, including the Kongsberg SIS and the NAVO SIS-60 (never a good thing to do when everything is running smoothly). They did not get all systems up and running until 1205 L.

At 1425 L the SIS crashed with a message that the license had expired. The dongle was suspected of being jiggled loose, so it was reseated and SIS started back up. We looped back to rerun the section of the line that was lost to this problem. However, within about 30 minutes of SIS starting up, it failed again. The TRU was rebooted and then SIS started up. We were back mapping by 1515 L.

A traverse along the southern boundary of the North Area (Line 110) was then run that brought us to the eastern side of the trench transects that were collected earlier in the cruise. A line was run south on the east side of the three lines already collected along the trench that connect the North and Central Areas (Line trench111).

JD 239 (Friday August 27, 2010)

The day was overcast and squally with 20 knt winds and 5 ft swells. The trench line was continued south to the Central Area. Mapping began in the Central Area at 0930 L. Routine day of mapping. Data quality remained stunning.

JD 240 (Saturday August 28, 2010)

The SIS crashed in the middle of the night at 0430 L on Line 118. It locked up both the SIS and the ISS-60. Both systems were rebooted but it took until 0620 L to get all systems back up working. The SIS did not record a short section of line, but the ISS-60 did, so I had to use a section of a gsf file, brought into Fledermaus to create an sd file, then brought in the sd file into DMagic to create a short xyz fill

(ASCIIxyz/100827/littleFill.xyz) to fill the gap in the coverage. There is no xyb file for littleFill.

Routine day of mapping. Data quality remained stunning.

JD 241 (Sunday August 29, 2010)

Routine day of mapping. Data quality remained stunning. The day was partly cloudy and with ~20 knt winds and 5 ft swells.

JD 242 (Monday August 30, 2010)

Routine day of mapping in Central area. The day was clear with <15 knt winds and <5 ft swells. Kongsberg files 0180 and 0181.all were combined (into Line 130) because the watchstander inadvertantly hit the "advance line number" button. However, after unraveling the combined .all file, it was seen that the 0180 file was collected during the turn, so the data were deleted from the beginning of the combined file (Line 130).

Line 131 shows moderate refraction (smile), especially noticable over a flat that was not corrected with a new SVP from an XBT cast . The two casts that bracket the time the refraction showed up show the differences in temperature and calculated sound speed profiles (Fig. 16).

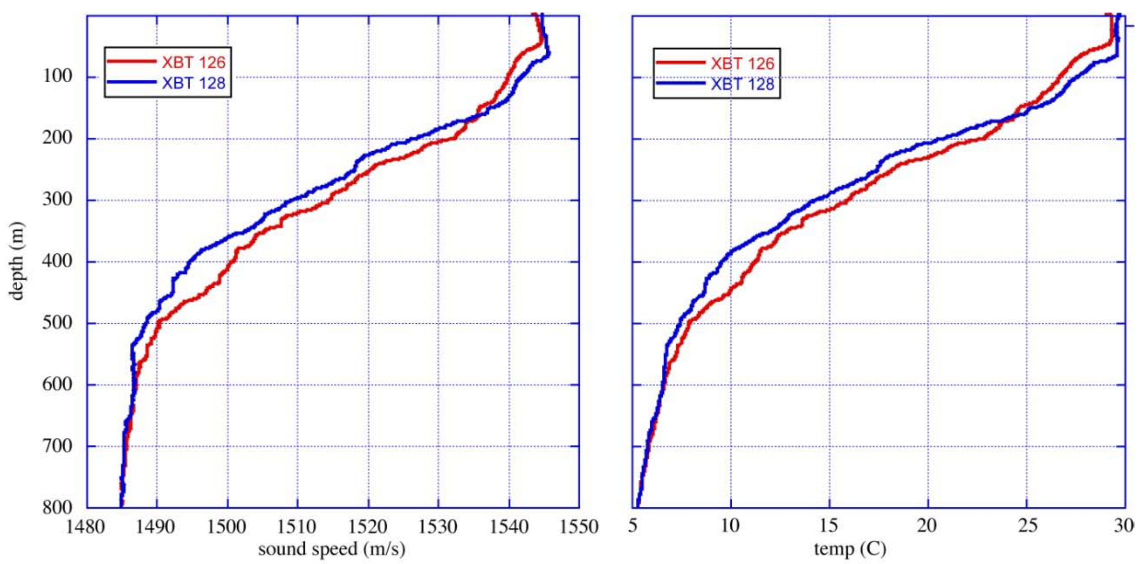

Figure 16. Comparison of XBT 127 and 128 for (left) sound speed vs depth and (right) water temperature vs depth.

Line 134 began a series of three holiday fill-ins on the northeastern side of the Central area.

JD 243 (Tuesday August 31, 2010)

Routine day of mapping in Central area. The day was cloudy with <15 knt winds and <5 ft swells and large squalls throughout the morning and early afternoon. We completed the eastern side of the Central Area and transited to the NW to fill in some large holidays on our way to the NW to complete the Central area.

The Pacific Plate in the Central area shows extensional faulting, a result of the downward flexing of the plate as it descends into the trench (Fig. 17). The faults have broken up the seamounts and appear to have reactivated into compressional thrust faults in the immediate vicinity of the trench axis.

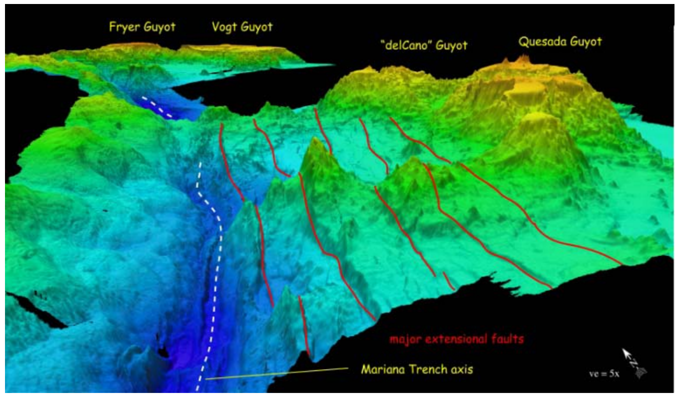

Figure 17. Perspective view of the Central Area area showing the major extensional faults. The western-most fault appears to be a compressional thrust fault.

Line L-143 completed the holiday fill-ins and the rest of the evening was spent transiting to the NW to complete the Central area.

JD 244 (Wednesday September 1, 2010)

The last day of mapping in Central area. The day was cloudy, cool, with 20 to 25 knt winds and 5 to 8 ft swells and intense squalls. The sea was very lumpy throughout the day.

The Central DTM clearly shows that delCano and Quesada Guyots are part of one large "complex" of seamounts and guyots with a shallow "lagoon" perched ~1400 m above the adjacent abyssal seafloor. A western arm of delCano Guyot has migrated across the trench axis and is accreted to the inner trench wall (Fig. 18).

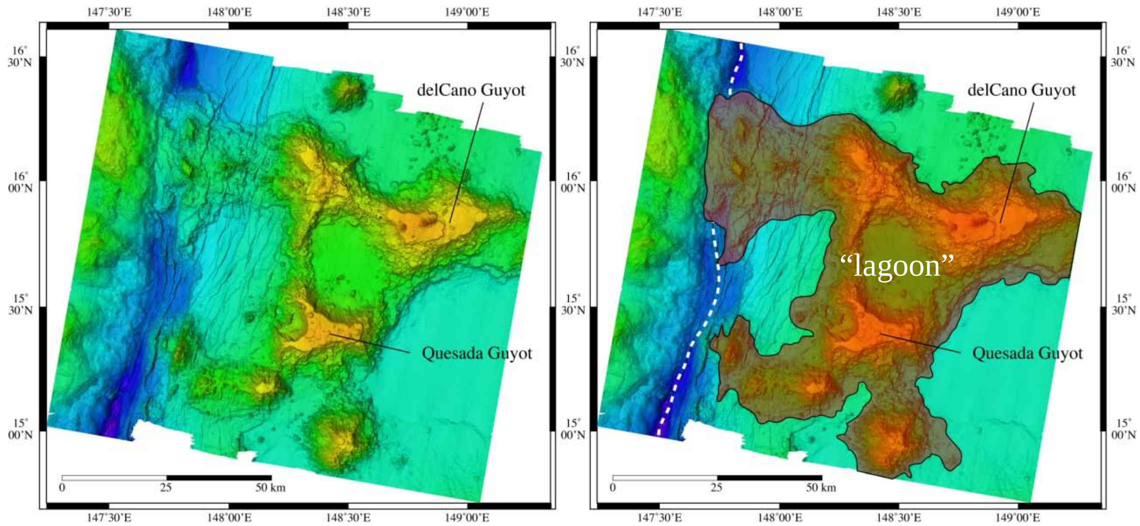

Figure 18. Plan view (left) and interpretation (right) of the bathymetry of delCano and Quesada Guyots in the vicinity of the axis of the Mariana Trench. Shaded area on right image is the delCano-Quesada Guyot complex. Note the west arm of delCano Guyot has accreted to the inner trench wall. White dashed line is the axis of the trench.

JD 245 (Thursday September 2, 2010)

The Central area was completed at 0515 L. We transited to the trench axis and commenced to run a single line down the axis. Routine day of mapping south of the Central area along the trench axis. The morning was partly cloudy with <15 knt winds and <5 ft swells. Torrential rain in the afternoon. The data quality continued to be excellent. We started the E-W line that will run along the northern border of the South area (Line trench153) at 1843 L. After processing Line trench152 it became obvious that there is a potential accreted seamount in the southern section of the trench (Figs. 19 and 20), located at 13˚14.2288’N 146˚26.6454’E . The junction of the NW flank of the seamount and the inner trench wall has formed a “bridge “ that rises more than 1500 m above the trench axis. There was not enough time left in the cruise before our required arrival in Guam, so the area was documented so it must be left to Leg 2 to map it.

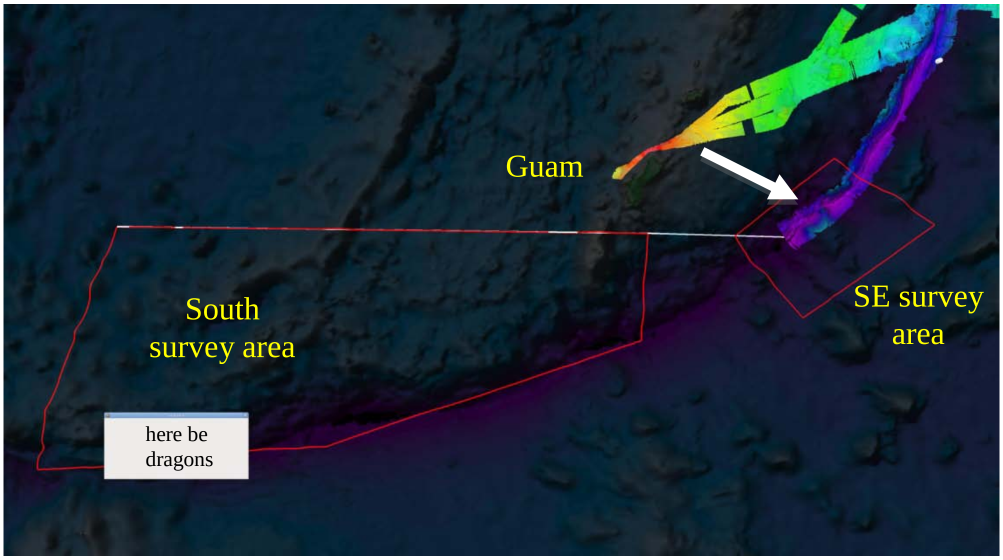

Figure 19. Overview of SE Survey Area area that should be mapping on Leg 2.

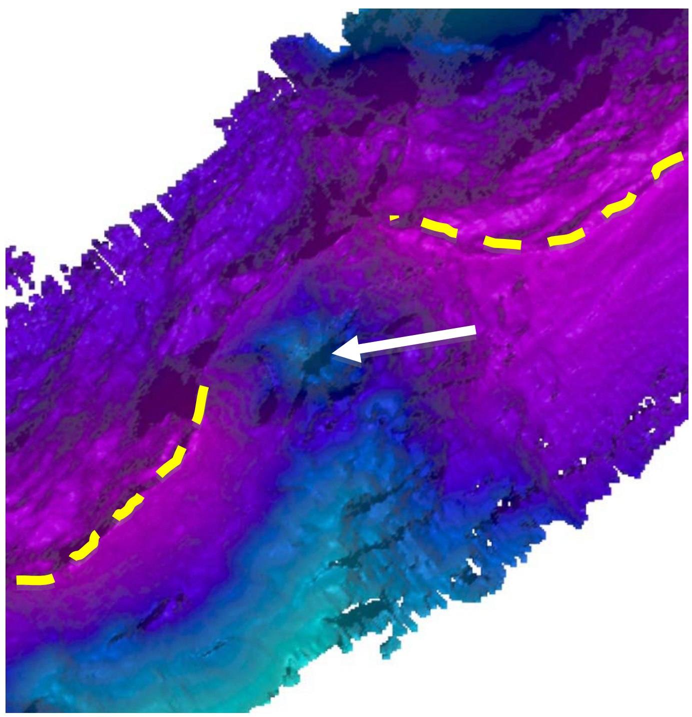

Figure 20. Close-up plan view of accreted seamount (arrow) in southeastern section of the Mariana Trench. Yellow dashed line is trench axis.

JD 246 (Friday September 3, 2010)

During the night the ship passed over a shoal area (35-m depth) and the EM122 could not track bottom. The EM710 was booted up and the ship looped back around logging no data and then collected data over the shoal (Line EM710-155). The shoal appears to be part of the Mariana volcanic arc that extends SSW of Guam (Fig. 21). It was decided that we would not map over the feature on the return line, but turn at the 1000-m isobath to a new westward line, for fear of dangerously shallow depths.

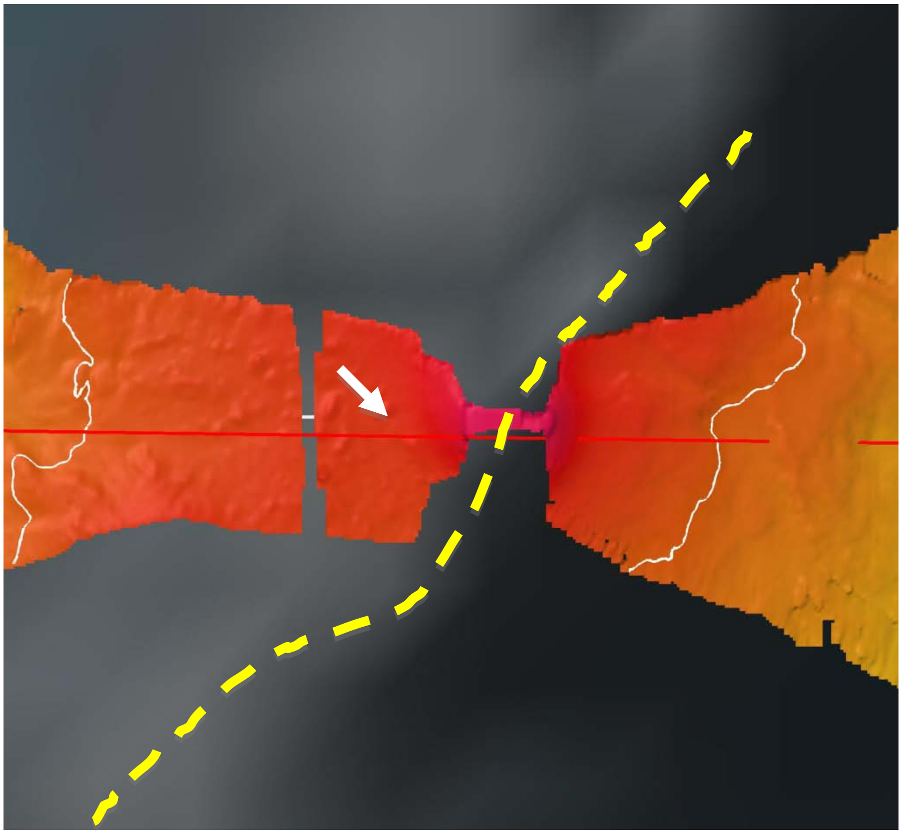

Figure 21. Shoal (35 m) on Line 155. White contours are 1000-m isobaths. Yellow dashed line is alignment of summits of Mariana Arc SW of Guam. White arrow is plume location.

The EM710 recorded a 500-m tall suspicious "plume" in the water column at 13˚02857'N 144˚41490'E in a water depth of 720 m (Figs. 21 and 22), although it was unrecognized by the midnight watchstanders (*see discussion on JD 247 Saturday Sept. 4 below*). Because they didn't recognize the "plume", it was not recorded in a water-column datagram. However, the EM710 was stopped as the ship was still passing over the "plume" so the EM710 SIS water-column display still had the image of the "plume" on it, as well as the navigation information. The "plume" rises from a submarine

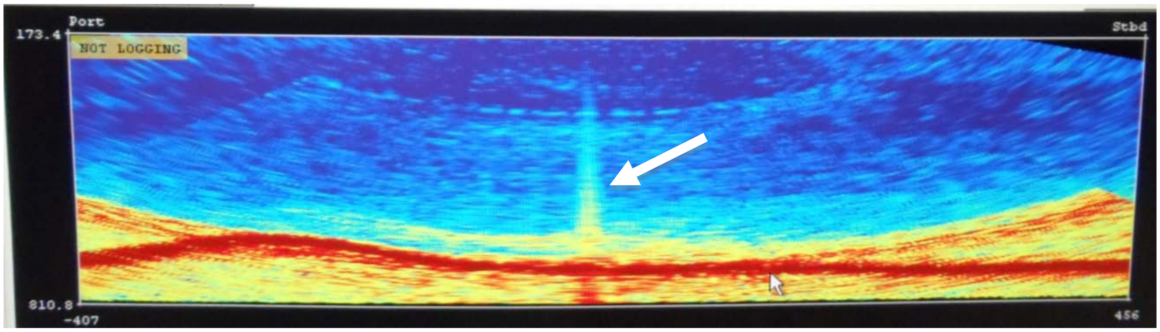

Figure 22. SIS water-column display from EM710 of plume (arrow) over the southern Mariana Arc.

ridge that is on trend as part of the Mariana Arc system. However, the “plume” does not rise from the summit of the ridge (mapped as 35 m deep). The ”plume” rises ~4 km west of the summit on the flank of the ridge

JD 247 (Saturday September 4, 2010)

The day is partly cloudy and breezy with 15 to 20 knt winds and 5 ft lumpy sea. Data quality excellent. Continued mapping in the South area.

At about 1500 L, we turned north to run a line across the “plume”. Both the EM710 and the EM122 recorded the water column on the line. The “plume” did not show up on the EM122 but did show up on the EM710. However, the “plume” did not look like a plume on the crossing. Pinging was stopped on the EM122 but the “plume” continued to show on the EM710. The Automatic mode of the EM710 put the transmit in Deep mode. When the EM710 was forced into Deep mode, the “plume” was greatly reduced in strength, but still present on the screen. The two ADCPs (38 and 300 kHz) were turned off but did not affect the presence of the “plume”. The tentative conclusion is that the “plume” shown in Figures 21 and 22 is an artifact of some kind.

The bridge determined that last two lines had to be cut short by ~30 nm on their west ends so that we could make the ETA (0800 L) at Guam tomorrow morning. This created a hole in the DTM between the 2007 West Mariana Ridge data and the present cruise data.

JD 248 (Sunday September 5, 2010)

We continued to collect EM122 bathymetry up to 0715 L, the point where we hove-to to pick up the Guam pilot. We were at the dock at 0900 L.

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Table 5. Conversion table of Kongsberg .all file names to UNH .all file names by Julian Day

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	100807	0034 thru 0041_	MarianaTrench_line_tran3a thru tran3p
220	**100808**	**0044_20100808_003225**	**MarianaTrench_line_tran4**
	100808	0045_20100808_022416	MarianaTrench_line_tran5
	100808	0046_20100808_034522	MarianaTrench_line_tran6
	100808	0047_20100808_040428	MarianaTrench_line_tran7
	100808	61mbo10122_raw_001_p_100.do5	MarianaTrench_line_tran8
		No files between 0047 & 0053	
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	100808	0054_20100808_091834	MarianaTrench_line_tran10
	100808	0055_20100808_091834	MarianaTrench_line_tran11
		No 0056	
	100808	0057_20100808_091834	MarianaTrench_line_patch12
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	100809	0060_20100809_120912	MarianaTrench_line_patch15 (roll)
	100809	0061_20100809_144153	MarianaTrench_line_patch16 (roll)
	100809	0062_20100809_190337	MarianaTrench_line_patch17 (head)
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	100810	0067_20100810_120044	MarianaTrench_line_22 (dip)
	100810	0068_20100810_142957	MarianaTrench_line_23 (dip)
	100810	0069_20100810_180227	MarianaTrench_line_24
223	**100811**	**0070_20100811_000052**	**MarianaTrench_line_25**
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	100811	0072_20100811_065606	MarianaTrench_line_27
	100811	0073_20100811_120015	MarianaTrench_line_28
	100811	0074_20100811_185333	MarianaTrench_line_29
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224	**100812**	**0076_20100812_000014**	**MarianaTrench_line_31**
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	100812	0078_20100812_082800	MarianaTrench_line_33
	100812	0079_20100812_120057	MarianaTrench_line_34
	100812	0080_20100812_180014	MarianaTrench_line_35
	100812	0081_20100812_203407	MarianaTrench_line_36
	100812	0082_20100812_205635	MarianaTrench_line_trench37
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	100814	0090_20100814_073112	MarianaTrench_line_tran45
	100814	0091_20100814_083509	MarianaTrench_line_tran46
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	100818	0116_20100818_180019	MarianaTrench_line_70
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	100822	0133_2010822_112453	MarianaTrench_line_87
	100822	0134_2010822_135349	MarianaTrench_line_88
	100822	0135_2010822_165819	MarianaTrench_line_89
	100822	0136_2010822_194138	MarianaTrench_line_90
	100822	0137_2010822_214916	MarianaTrench_line_91
235	**100823**	**0138_20100823_011253**	**MarianaTrench_line_92**
	100823	0139_20100823_033157	MarianaTrench_line_93
	100823	0140_20100823_052227	MarianaTrench_line_94
	100823	0141_20100823_071420	MarianaTrench_line_95
	100823	0142_20100823_122003	MarianaTrench_line_96
	100823	0143_20100823_180027	MarianaTrench_line_97
236	**100824**	**0144_20100824_001958**	**MarianaTrench_line_98**
	100824	0145_20100824_060004	MarianaTrench_line_99
	100824	0146_20100824_121826	MarianaTrench_line_100
	100824	0147_20100824_180125	MarianaTrench_line_101
237	**100825**	**0148_20100825_000521**	**MarianaTrench_line_102**
	100825	0149_20100825_060008	MarianaTrench_line_103
	100825	0150_20100825_093326	MarianaTrench_line_104
	100825	0151_20100825_131309	MarianaTrench_line_105
	100825	0152_20100825_180100	MarianaTrench_line_106
	100825	0153_20100825_232115	MarianaTrench_line_107
238	**100826**	**0154_20100826_020429**	**MarianaTrench_line_108**
	100826	0155_20100826_051547	MarianaTrench_line_109
	100826	0156_20100826_080955	MarianaTrench_line_110
	100826	0157_20100826_161620	MarianaTrench_line_trench111
	100826	0158_20100826_180632	MarianaTrench_line_trench112
	100826	0159_20100826_231352	MarianaTrench_line_113
239	**100827**	**0160_20100827_060028**	**MarianaTrench_line_114**
	100827	0161_20100827_083206	MarianaTrench_line_115
	100827	0162_20100827_120040	MarianaTrench_line_116
	100827	0163_20100827_162832	MarianaTrench_line_117
	100827	*no 0164-0166*	———————
	100827	0167_20100827_180716	MarianaTrench_line_117a
	100827	0168_20100827_201952	MarianaTrench_line_118
240	**100828**	**0169_20100828_000010**	**MarianaTrench_line_119**
	100828	0170_20100828_034837	MarianaTrench_line_120
	100828	0171_20100828_060010	MarianaTrench_line_121
	100828	0172_20100828_113437	MarianaTrench_line_122
	100828	0173_20100828_180019	MarianaTrench_line_123
	100828	0174_20100828_195417	MarianaTrench_line_124
JD	**Data Folder**	**Kongsberg .all file name Line_yyyymmdd_time_Ship.all**	**UNH file name .all**

241	**100829**	**0175_20100829_000005**	**MarianaTrench_line_125**
	100829	0176_20100829_034925	MarianaTrench_line_126
	100829	0177_20100829_060008	MarianaTrench_line_127
	100829	0178_20100829_115055	MarianaTrench_line_128
	100829	0179_20100829_180005	MarianaTrench_line_129
		combined 0180 & 0181 to 0181	
	100829	0181_2010829_185217	MarianaTrench_line_130
242	**100830**	**0182_20100830_000007**	**MarianaTrench_line_131**
	100830	0183_20100830_033342	MarianaTrench_line_132
	100830	0184_20100830_060005	MarianaTrench_line_133
	100830	0185_20100830_104503	MarianaTrench_line_134
	100830	0186_20100830_121946	MarianaTrench_line_135
	100830	0187_20100830_141141	MarianaTrench_line_136
	100830	0188_201000830_155803	MarianaTrench_line_137
	100830	0189_20100830_181200	MarianaTrench_line_138
243	**100831**	**0190_20100831_000022**	**MarianaTrench_line_139**
	100831	0191_20100831_040638	MarianaTrench_line_140
	100831	0192_20100831_061234	MarianaTrench_line_141
	100831	0193_20100831_085035	MarianaTrench_line_142
	100831	0194_20100831_112252	MarianaTrench_line_143
	100831	0195_20100831_172312	MarianaTrench_line_144
244	**100901**	**0196_20100901_000009**	**MarianaTrench_line_145**
	100901	0197_20100901_020553	MarianaTrench_line_146
	100901	0198_20100901_060005	MarianaTrench_line_147
	100901	0199_20100901_102150	MarianaTrench_line_148
	100901	0200_20100901_211326	MarianaTrench_line_trench149
	100901	0201_20100901_2214211	MarianaTrench_line_trench150
245	**100902**	**0202_20100902_000007**	**MarianaTrench_line_trench151**
	100902	0203_20100902_051931	MarianaTrench_line_trench152
	100902	0204_20100902_080840	MarianaTrench_line_153
	100902	0205_20100902_120700	MarianaTrench_line_154
	100902	0206_20100902_131658	MarianaTrench_line_155
	100902	0206_20100902_154645	MarianaTrench_line_EM710-155
	100902	0207_20100902_161118	MarianaTrench_line_156
	100902	0208_20100902_180002	MarianaTrench_line_157
246	**100903**	**0209_20100903_000012**	**MarianaTrench_line_158**
	100903	0210_20100903_060008	MarianaTrench_line_159
	100903	0211_20100903_105806	MarianaTrench_line_160
	100903	0212_20100903_180103	MarianaTrench_line_161
247	**100904**	**0213_20100904_000016**	**MarianaTrench_line_162**
	100904	0214_20100904_044518	MarianaTrench_line_163
	100904	0215_20100904_060957	MarianaTrench_line_164
	100904	0217_20100904_133307	MarianaTrench_line_165
	100904	0218_20100904_180002	MarianaTrench_line_166
	100904	0219_20100904_194640	MarianaTrench_line_167

Table 6. UNH line numbers and SBP120 file names by Julian Day

JD	Date	UNH Line no. .all	SBP120 File no.sgy
219	**100807**	**MarianaTrench_line_tran1**	**61sya10219_segy_001_p_100_d01**
		MarianaTrench_line_tran1a	61sya10219_segy_001_p_100_d02
		MarianaTrench_line_tran1b	61sya10219_segy_001_p_100_d03
		MarianaTrench_line_tran1c	61sya10219_segy_001_p_100_d04
		MarianaTrench_line_tran2	61sya10219_segy_002_p_100_d01
		MarianaTrench_line_tran2a	61sya10219_segy_002_p_100_d02
		MarianaTrench_line_tran3	61sya10219_segy_003_p_100_d01
		MarianaTrench_line_tran3a	61sya10219_segy_003_p_100_d02
		MarianaTrench_line_tran4	61sya10219_segy_004_p_100_d01
		MarianaTrench_line_tran4a	61sya10219_segy_004_p_100_d02
		MarianaTrench_line_tran5	61sya10219_segy_005_p_100_d01
		MarianaTrench_line_tran5a	61sya10219_segy_005_p_100_d02
		MarianaTrench_line_tran6	61sya10219_segy_006_p_100_d01
		MarianaTrench_line_tran6a	61sya10219_segy_006_p_100_d02
		MarianaTrench_line_tran7	61sya10219_segy_007_p_100_d01
219	**100807**	**MarianaTrench_line_tran7a**	**61sya10219_segy_007_p_100_d02**
		MarianaTrench_line_tran8	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran8a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran9	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran9a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran10	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran10a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran11	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran11a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran12	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran12a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran13	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran13a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran14	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran14a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran15	61sya10219_segy_007_p_100_d01
		MarianaTrench_line_tran15a	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran16	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran17	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran18	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran19	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran20	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran21	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran22	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran23	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran24	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran25	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran26	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran27	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran28	61sya10219_segy_007_p_100_d02
		MarianaTrench_line_tran29	61sya10219_segy_007_p_100_d02
220	**100808**	**MarianaTrench_line_tran30**	**61sya10220_segy_001_p_100_d01**
		MarianaTrench_line_tran30a	61sya10220_segy_001_p_100_d02

		MarianaTrench_line_tran30b	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran31	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran32	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran33	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran34	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran35	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran36	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran37	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran38	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran39	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran40	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran41	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran42	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran43	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran44	61sya10220_segy_001_p_100_d03
		MarianaTrench_line_tran45	61sya10220_segy_001_p_100_d03
		STOPPED LOGGING	STOPPED LOGGING

Table 7. Location of XBT casts

XBT number	Latitude N	Longitude E
1	13.57528	144.67622
2	13.78044	145.12912
3	13.91781	145.65811
4	14.83410	146.54430
5	15.95161	147.28112
7	16.96819	147.91533
8	17.40863	148.25107
9	18.03258	148.66489
11	19.08387	149.36138
12	19.09275	149.36261
13	19.08824	149.38548
14	19.11959	148.89533
15	19.09807	149.23239
16	19.17185	149.41458
17	19.21945	149.51575
18	19.26637	148.85042
19	19.16577	148.79372
20	19.06290	149.21893
21	19.01854	148.97578
22	18.75113	147.51032
23	18.07796	147.41805
24	19.34550	146.86154
25	19.87625	146.62718
26	20.54325	146.33161
27	19.50194	146.82978
28	18.21774	147.39424
29	19.00393	147.10838
30	20.31231	146.5460
31	19.85684	146.86937
32	18.59146	147.42769
33	17.45240	147.77095
34	16.77555	147.79600
35	16.11909	147.70282
36	14.76971	147.41004
37	14.25548	146.16178
38	13.72481	144.87762
39	13.91566	145.24824
40	14.57087	146.54984
41	15.032223	147.39354
42	16.58072	147.62577

Table 7 continued

XBT number	Latitude N	Longitude E
43	17.39676	147.61237
44	17.90610	147.59320
45	18.95716	147.41413
46	20.21203	146.86020
47	20.24224	146.96885
48	19.35943	147.35739
49	18.97284	147.52690
50	18.43994	147.90511
52	19.74470	147.33405
53	20.85085	146.94460
54	20.37742	147.20039
55	19.63191	147.52747
56	18.31741	148.10055
57	19.18186	147.83685
58	20.42941	147.29002
59	20.75530	147.14643
60	20.22240	147.49523
61	18.91207	148.06676
62	18.68305	148.28888
63	19.93451	147.74466
64	20.60689	147.45047
66	20.81195	147.48416
67	20.48492	147.62606
68	19.78108	147.93031
69	18.72259	148.51805
70	19.82285	148.04593
71	20.68394	147.67411
73	21.03979	147.59758
74	19.77650	148.17803
75	18.76675	148.74425
76	19.99115	148.21979
77	21.12323	147.86849
78	20.78350	148.02262
79	19.77871	148.45451
80	18.90068	148.97253
81	20.00122	148.50298
82	20.21857	148.40985
83	21.15374	148.02109
84	20.96111	148.23509
85	20.60532	148.38789

Table 7 continued

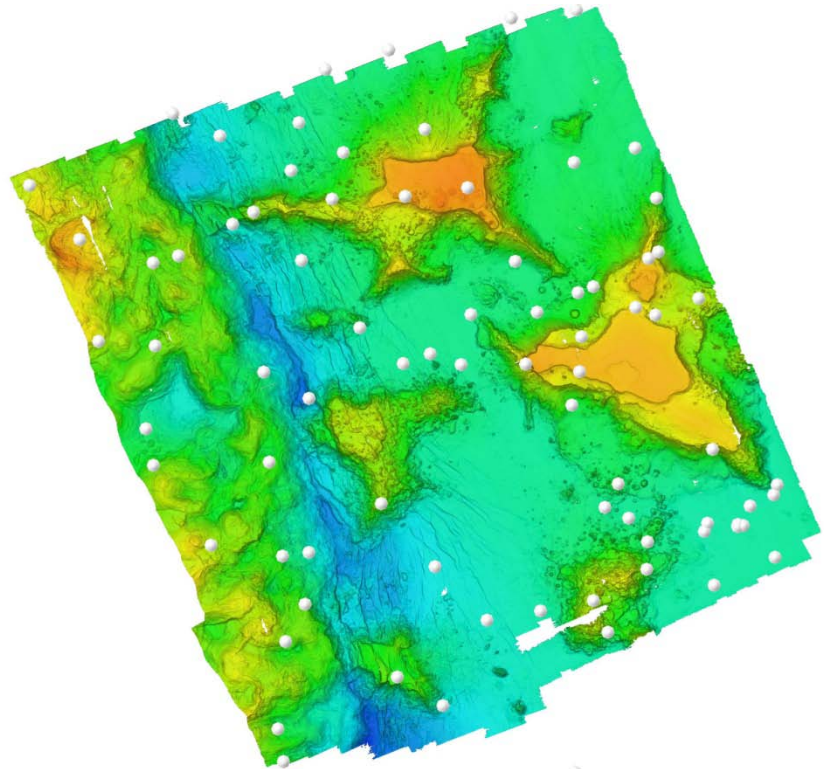
XBT number	Latitude N	Longitude E
86	20.49670	147.93900
87	20.53361	148.20570
88	19.89585	148.69334
89	19.60326	148.65192
90	19.74643	148.68512
91	18.83269	149.26074
92	20.10995	148.74390
93	21.25952	148.39227
94	20.64131	148.66118
95	20. 02161	148.92529
96	18.95230	149.52145
97	20.23069	148.98023
98	21.29423	148.67147
99	20.70350	148.92253
100	20.48909	149.01364
101	20.06006	149.19489
102	20.08425	148.67814
103	19.41419	149.25394
104	19.98872	149.00949
105	20.25918	149.02240
107	19.26225	149.53099
108	18.63157	148.80643
110	17.75030	147.93017
111	17.29489	147.94619
112	16.49698	147.94274
113	15.26941	147.71522
114	15.80420	147.96611
115	16.38297	148.23589
116	15.51180	148.07196
117	14.87569	147.95776
119	15.49840	148.21118
120	16.36566	148.50853
121	15.04078	148.25610
122	15.73767	148.52135
123	16.03171	148.71084
124	15.82796	148.67163
125	14.79656	148.60650
126	16.12506	148.86206
127	15.28176	148.83167
128	14.80983	148.74067
129	15.22674	148.95400

Table 7 continued

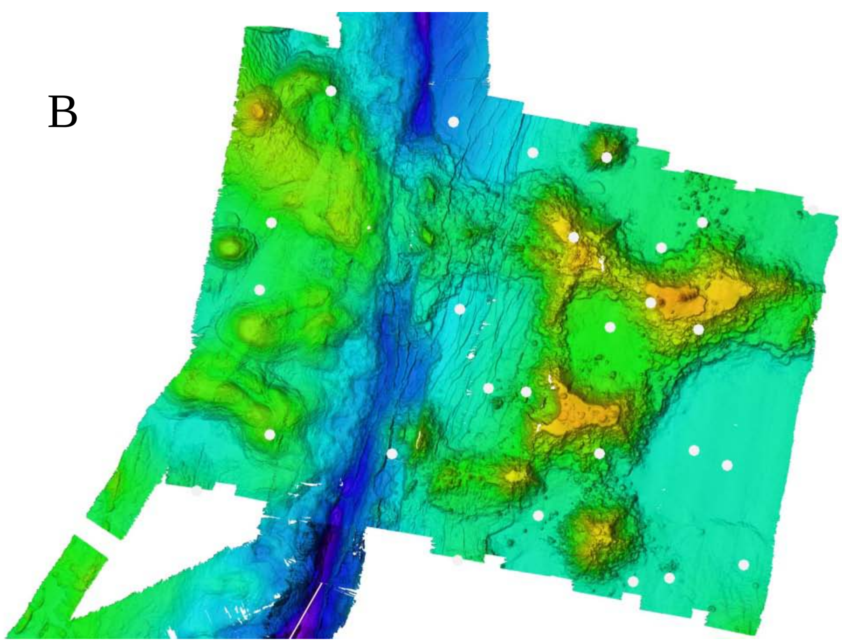
XBT number	Latitude N	Longitude E
130	15.72895	148.84832
131	16.17184	149.27139
132	14.85818	149.01530
133	15.27037	148.48205
134	16.07043	148.38693
135	16.61145	147.48976
136	15.34016	147.26374
137	15.87564	147.22583
139	16.12423	147.26950
140	16.46752	147.19671
141	15.13236	146.99383
142	14.45477	147.26265
143	13.30783	146.54437
144	13.00787	146.00492
145	13.01871	145.15823
146	13.03484	143.95267
147	13.05361	142.56974
149	13.07277	141.15915
150	12.92618	143.27412
151	12.94499	141.89004
152	12.92618	143.27412
153	13.13543	144.42023
154	13.17376	142.95365
155	13.28103	143.92160

Maps of 2010 locations of XBT casts (white dots) in North (A) and Central (B) areas. Backdrop is the newly acquired MBES bathymetry. See Table 7 for XBT locations.

A



B



Appendix 1. Cruise calendar

August 2010

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	JD218 6 delayed depart for D-GPS part	JD219 7 Leg 1 depart Guam 0900 L
JD220 8 transit to patch test site	JD221 9 patch test	JD222 10 patch test & dipline	JD223 11 mapping in North	JD224 12 mapping in North	JD225 13 mapping in North & start trench axis to Guam	JD226 14 transit and H/T Guam
JD227 15 transit back to North trench axis	JD228 16 mapping in North	JD229 17 mapping in North	JD230 18 mapping in North	JD231 19 mapping in North	JD232 20 mapping in North	JD233 21 mapping in North
JD234 22 mapping in North	JD235 23 mapping in North	JD236 24 mapping in North	JD237 25 mapping in North	JD238 26 North completed	JD239 27 trench transit to Central & started mapping	JD240 28 mapping in Central
JD241 29 mapping in Central	JD241 30 mapping in Central	JD243 31 mapping in Central				

September 2010

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			JD244 1 Central completed	JD245 2 map south along trench	JD246 3 mapping in South	JD247 4 mapping in South
JD248 5 Leg 1 arrive Guam 0800 L	JD249 6	JD250 7	JD251 8	JD252 9	JD253 10	JD254 11
JD255 12	JD256 13	JD257 14	JD258 15	JD259 16	JD260 17	JD261 18
JD262 19	JD263 20	JD264 21	JD265 22	JD266 23	JD267 24	JD268 25
JD269 26	JD270 27	JD271 28	JD272 29	JD273 30		

Appendix 2. Cruise Personnel

Capt. Kristin Mangold	Ship's Master
Dr. James V. Gardner	UNH/NOAA representative/Chief Scientist
Ms. Molly Haynes	Senior NAVO Representative
Mr. Chauncey Philan	NAVY Lead Electronics Technician
Mr. Julius Jackson	NAVY Electronics Technician
Mr. Terry Dean	NAVO Data Manager
Mr. Rafal Filipczyk	NAVO Oceanographer (N3)
Mr. Neil Duffin	NAVO Lead Survey Tech
Ms. Lisa Baehr	NAVO Survey Tech
Mr. Donovan Taylor	NAVO Survey Tech
Mr. Frank Sablan	NGA observor

Appendix 3. Built-in Self Tests (BIST)

BIST Test 1 while underway at 7.5 knts in unknown water depth just outside Apra Harbor, Guam

```
Sounder Type:  122, Serial no.:  111
Date       Time          Ser. No.    BIST      Result
2010.08.07 00:10:24.152   111         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
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Appendix 3 (cont.)

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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

-------------------------------------------------------------------

2010.08.07 00:10:25.669  111         1         OK

High Voltage Br. 1
------------------
TX36   Spec: 108.0  - 132.0
0-1   121.3
0-2   121.3
0-3   120.9
0-4   121.7
0-5   121.3
0-6   121.3
0-7   121.7
0-8   121.3
0-9   122.6
0-10   121.3
0-11  122.1
0-12  120.1
0-13  120.9
0-14  122.6
0-15  122.1
0-16  121.3
0-17  121.7
0-18  121.3
```

Appendix 3 (cont.)

```
0-19  121.7
0-20  121.7
0-21  121.7
0-22  120.5
0-23  122.1
0-24  121.3

High Voltage Br. 2
------------------
```

```
TX36   Spec: 108.0  - 132.0
0-1   121.3
0-2   121.7
0-3   120.9
0-4   121.7
0-5   122.2
0-6   121.7
0-7   121.7
0-8   121.7
0-9   121.7
0-10   121.7
0-11  121.7
0-12  120.5
0-13  120.9
0-14  121.7
0-15  121.7
0-16  121.3
0-17  122.2
0-18  121.3
0-19  121.7
0-20  121.7
0-21  120.9
0-22  120.9
0-23  122.2
0-24  121.7

Input voltage 12V
-----------------
TX36   Spec: 11.0  - 13.0
0-1    11.9
0-2    11.9
0-3    11.8
0-4    11.9
0-5    11.8
0-6    11.8
0-7    11.8
0-8    11.9
0-9    11.9
0-10    11.9
0-11   11.9
0-12   11.8
0-13   11.8
0-14   11.9
0-15   11.9
```

Appendix 3 (cont.)

```
0-16   11.8
0-17   11.9
0-18   11.8
0-19   11.9
0-20   11.8
0-21   11.8
0-22   11.8
0-23   11.9
0-24   11.8

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
```

Appendix 3 (cont.)

```
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     39.2
0-2     38.4
0-3     38.0
0-4     37.2
0-5     38.0
0-6     39.2
0-7     39.2
0-8     40.0
0-9     38.4
```

Appendix 3 (cont.)

```
0-10     39.2
0-11    38.8
0-12    38.0
0-13    38.8
0-14    38.4
0-15    38.4
0-16    39.2
0-17    39.2
0-18    40.4
0-19    39.6
0-20    38.8
0-21    38.4
0-22    38.0
0-23    39.2
0-24    39.6

Input Current 12V
-----------------
TX36    Spec:  0.3  -  1.5
0-1      0.6
0-2      0.5
0-3      0.5
0-4      0.5
0-5      0.5
0-6      0.6
0-7      0.5
0-8      0.5
```

```
0-9     0.5
0-10     0.5
0-11    0.5
0-12    0.5
0-13    0.5
0-14    0.5
0-15    0.5
0-16    0.5
0-17    0.5
0-18    0.5
0-19    0.5
0-20    0.5
0-21    0.6
0-22    0.5
0-23    0.5
0-24    0.5

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

-------------------------------------------------------------------
```

Appendix 3 (cont.)

```
2010.08.07 00:10:40.403  111         2         OK

Input voltage 12V
-----------------
RX32   Spec: 11.0  - 13.0
7-1    11.7
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     3.4
7-4     3.3

Digital 2.5V
------------
RX32   Spec:  2.4  -  2.6
7-1     2.4
7-2     2.5
7-3     2.5
```

```
7-4      2.5

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    43.0
7-2    47.0
7-3    42.0
7-4    40.0

Input Current 12V
-----------------
```

Appendix 3 (cont.)

```
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      2.8
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

--------------------------------------------------------------------

2010.08.07 00:10:40.503  111         3         OK

High Voltage Br. 1
------------------
TX36   Spec: 108.0  - 132.0
0-1   121.3
0-2   121.3
0-3   120.9
0-4   121.7
0-5   121.3
0-6   121.3
0-7   121.7
0-8   121.3
0-9   122.1
0-10   121.3
```

```
0-11  122.1
0-12  120.1
0-13  121.3
0-14  122.6
0-15  122.1
0-16  120.9
0-17  121.7
0-18  121.3
0-19  121.7
0-20  121.3
0-21  121.3
0-22  120.5
0-23  122.1
0-24  121.3
```

Appendix 3 (cont.)

```
High Voltage Br. 2
------------------
TX36   Spec: 108.0  - 132.0
0-1   121.3
0-2   121.7
0-3   120.9
0-4   121.7
0-5   122.2
0-6   121.7
0-7   121.3
0-8   121.7
0-9   121.7
0-10   121.7
0-11  121.3
0-12  120.5
0-13  120.9
0-14  121.7
0-15  121.3
0-16  121.3
0-17  122.2
0-18  121.3
0-19  121.7
0-20  121.7
0-21  120.9
0-22  120.9
0-23  122.2
0-24  121.7

Input voltage 12V
-----------------
TX36   Spec: 11.0  - 13.0
0-1    11.9
0-2    11.9
0-3    11.8
0-4    11.9
0-5    11.8
0-6    11.8
0-7    11.8
0-8    11.9
0-9    11.9
0-10    11.9
0-11   11.9
0-12   11.8
0-13   11.8
0-14   11.9
```

```
0-15   11.9
0-16   11.8
0-17   11.9
0-18   11.8
0-19   11.9
0-20   11.8
0-21   11.8
0-22   11.8
```

Appendix 3 (cont.)

```
0-23   11.9
0-24   11.8

RX32   Spec: 11.0  - 13.0
7-1    11.7
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

-------------------------------------------------------------------

2010.08.07 00:10:40.686  111         4         OK

EM 122 High Voltage Ramp Test
Test Voltage:20.00  Measured Voltage: 17.00 PASSED
Test Voltage:60.00  Measured Voltage: 60.00 PASSED
Test Voltage:100.00  Measured Voltage: 101.00 PASSED
Test Voltage:120.00  Measured Voltage: 121.00 PASSED
Test Voltage:80.00  Measured Voltage: 85.00 PASSED
Test Voltage:40.00  Measured Voltage: 45.00 PASSED

6 of 6 tests OK

-------------------------------------------------------------------

2010.08.07 00:13:04.743  111         5         OK

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

-------------------------------------------------------------------

2010.08.07 00:13:09.710  111         6         OK

Receiver impedance limits [350.0 700.0] ohm
Board  1      2      3      4
 1: 543.8  550.8  582.5  587.5
 2: 573.2  561.4  558.5  590.9
 3: 581.1  555.4  574.4  520.9
 4: 560.3  528.3  586.7  534.0
 5: 562.5  559.6  569.9  586.5
```

```
 6: 578.5  550.1  545.4  582.1
 7: 542.9  544.2  546.0  558.7
```

Appendix 3 (cont.)

```
8: 570.5  579.5  570.6  537.8
 9: 551.6  576.3  565.9  580.5
10: 556.5  566.0  576.6  591.4
11: 557.4  564.1  583.4  599.1
12: 543.9  583.6  550.8  547.0
13: 566.5  540.5  577.8  562.9
14: 574.5  572.8  586.4  598.0
15: 559.9  546.6  581.3  589.9
16: 566.2  534.3  558.4  586.9
17: 585.5  572.7  546.4  499.4
18: 557.0  553.4  581.4  556.4
19: 545.5  568.5  506.9  578.4
20: 559.4  567.0  572.8  605.9
21: 562.0  521.2  536.0  579.3
22: 546.4  536.3  558.1  516.7
23: 552.2  572.3  564.7  603.3
24: 579.0  553.0  571.0  589.0
25: 564.0  568.8  565.7  582.5
26: 573.5  568.3  566.5  520.6
27: 536.9  582.7  578.3  540.1
28: 575.8  555.3  538.1  520.7
29: 571.5  573.1  572.3  606.6
30: 571.1  572.7  577.6  538.2
31: 576.3  551.8  574.5  581.7
32: 539.3  586.1  585.5  580.2

Receiver Phase limits [-20.0 20.0] deg
Board  1      2      3      4
 1:   1.6    0.7   -1.1   -1.5
 2:  -1.2    0.2    0.3   -2.7
 3:  -1.6   -0.2   -1.4    4.1
 4:   0.1    2.4   -1.6    2.6
 5:   0.0   -0.4   -1.2   -1.8
 6:  -1.4    0.4    1.1   -1.3
 7:   1.4    0.7    1.1    0.5
 8:   0.3   -2.1   -2.2    2.8
 9:   1.1   -0.8    0.2   -0.2
10:   1.1    0.4   -0.2   -1.8
11:   1.0    0.4   -0.4   -2.4
12:   1.7   -0.3    2.4    1.8
13:  -0.5    0.9   -0.6    1.4
14:  -0.2   -0.9   -0.6   -2.4
15:  -0.1    0.7   -0.1   -1.8
16:   0.4    1.8    1.4   -1.2
17:  -1.8   -0.3    1.6    6.1
18:   0.5    0.5   -1.6    0.9
19:   1.1   -1.1    4.6   -1.2
20:   0.3   -0.3   -0.8   -3.4
21:  -0.5    3.4    2.4   -1.6
22:   0.8    1.6    0.6    4.1
23:   0.9   -1.0   -0.1   -3.6
24:  -1.7    0.2   -0.2   -2.3
25:  -0.3   -1.3   -0.2   -1.4
```

Appendix 3 (cont.)

```
26:  -1.4   -0.5   -0.2    4.2
27:   1.9   -2.0   -1.0    2.0
```

28:	-1.8	-0.2	2.2	3.7
29:	-0.6	-1.1	-1.2	-3.5
30:	-1.0	-0.9	-1.1	2.6
31:	-1.6	0.6	-0.6	-1.6
32:	1.7	-1.5	-1.5	-1.2

Rx Channels test passed

2010.08.07 00:13:42.295 111 7 OK

Tx Channels test passed

2010.08.07 00:16:35.504 111 8 OK

RX NOISE LEVEL

Board No:	1	2	3	4	
0:	43.6	43.1	43.4	43.8	dB
1:	42.1	41.6	42.0	42.9	dB
2:	43.0	42.3	43.6	44.1	dB
3:	41.6	41.5	42.1	43.2	dB
4:	41.7	43.1	42.6	44.3	dB
5:	41.8	41.7	42.1	43.1	dB
6:	42.9	42.0	44.5	44.1	dB
7:	41.5	42.3	41.7	43.2	dB
8:	42.9	43.1	43.1	44.8	dB
9:	41.0	41.7	42.3	43.3	dB
10:	42.3	43.0	42.8	44.4	dB
11:	42.2	42.1	42.5	43.8	dB
12:	42.8	42.8	42.6	44.9	dB
13:	41.6	42.0	42.6	43.2	dB
14:	42.5	42.5	44.3	45.0	dB
15:	41.9	41.9	42.8	44.3	dB
16:	43.4	42.4	43.5	44.5	dB
17:	42.1	41.5	41.2	44.0	dB
18:	42.4	42.0	43.0	45.3	dB
19:	41.7	41.0	42.2	44.5	dB
20:	42.5	42.2	42.5	45.5	dB
21:	41.7	41.6	43.1	44.7	dB
22:	42.6	42.8	43.2	44.0	dB
23:	42.1	40.8	42.1	42.5	dB
24:	43.4	42.0	43.4	45.0	dB
25:	41.6	41.5	42.4	43.4	dB
26:	43.7	42.0	43.3	44.8	dB
27:	42.0	41.4	43.2	44.9	dB
28:	42.8	42.2	42.7	46.4	dB
29:	42.3	42.4	43.0	46.9	dB

Appendix 3 (cont.)

30:	42.6	43.1	43.9	48.1	dB
31:	41.8	41.7	43.0	48.6	dB

Maximum noise at Board 4 Channel 31 Level: 48.6 dB

Broadband noise test

Average noise at Board 1 42.4 dB OK

```
Average noise at Board 2   42.1 dB    OK
Average noise at Board 3   42.9 dB    OK
Average noise at Board 4   44.8 dB    OK

-------------------------------------------------------------------

2010.08.07 00:16:41.971  111         9         OK

RX NOISE SPECTRUM

Board No:     1           2          3         4

10.0 kHz:     41.1       40.4       41.9       45.2   dB
10.2 kHz:     41.8       41.5       41.9       44.9   dB
10.3 kHz:     43.3       43.0       44.5       46.2   dB
10.4 kHz:     44.0       43.7       43.9       46.7   dB
10.6 kHz:     44.2       43.6       43.3       46.8   dB
10.7 kHz:     45.9       46.5       45.2       47.4   dB
10.9 kHz:     45.7       45.5       45.6       47.3   dB
11.0 kHz:     46.2       45.4       45.8       47.2   dB
11.2 kHz:     45.3       44.8       44.9       48.0   dB
11.3 kHz:     44.7       44.8       45.7       47.0   dB
11.4 kHz:     45.2       44.2       44.9       46.6   dB
11.6 kHz:     45.3       44.0       44.2       45.5   dB
11.7 kHz:     44.7       44.4       44.7       45.9   dB
11.9 kHz:     43.6       43.7       44.2       44.7   dB
12.0 kHz:     44.4       44.2       44.0       44.6   dB
12.1 kHz:     44.3       43.9       43.8       44.6   dB
12.3 kHz:     43.3       41.6       41.8       43.7   dB
12.4 kHz:     41.4       41.4       42.9       44.1   dB
12.6 kHz:     41.4       40.6       42.1       43.2   dB
12.7 kHz:     41.1       41.3       41.1       42.6   dB
12.9 kHz:     40.1       38.9       39.8       41.7   dB
13.0 kHz:     39.6       38.7       40.2       41.8   dB

Maximum noise at Board 4 Frequency 11.2 kHz Level:  48.0 dB

Spectral noise test
------------------
Average noise at Board 1   43.9 dB    OK
Average noise at Board 2   43.5 dB    OK
Average noise at Board 3   43.8 dB    OK
Average noise at Board 4   45.6 dB    OK

2010.08.07 00:16:48.438  111         10        OK
```

Appendix 3 (cont.)

```
CPU: KOM CP6011
Clock 1795 MHz
Die   37 oC (peak: 39 oC @ 2010-08-04 - 04:54:14)
Board 39 oC (peak: 41 oC @ 2010-08-04 - 04:54:33)
Core  1.34 V
3V3   3.33 V
12V   12.05 V
-12V  -11.96 V
BATT  3.22 V
Primary network: 157.237.14.60:0xffff0000
Secondary network: 192.168.3.11:0xffffff00

-------------------------------------------------------------------
```

```
2010.08.07 00:16:48.505  111         15         OK

EM 122

BSP67B Master: 2.2.3 090702
BSP67B Slave: 2.2.3 090702
CPU: 1.1.5 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 3 (cont.)

BIST Test 2 while underway at 13 knts in 1500 m water depths on west margin of Guam

```
Sounder Type:  122, Serial no.:  111

Date       Time           Ser. No.    BIST      Result

--------------------------------------------------------------------
----------------

2010.08.14 01:57:05.848  111         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
```

Appendix 3 (cont.)

```
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


---------------------------------------------------------------------
------------

2010.08.14 01:57:07.365  111         1         OK



High Voltage Br. 1
------------------
TX36   Spec: 108.0  - 132.0
0-1   122.6
0-2   122.6
0-3   122.1
0-4   122.6
0-5   122.6
0-6   122.6
```

Appendix 3 (cont.)

```
0-7   122.6
0-8   122.6
0-9   123.4
0-10   122.6
0-11  123.4
0-12  120.9
0-13  122.1
0-14  123.4
0-15  123.0
```

```
0-16  122.1
0-17  122.6
0-18  122.1
0-19  123.0
0-20  122.6
0-21  122.6
0-22  121.3
0-23  123.4
0-24  122.1

High Voltage Br. 2
------------------
TX36   Spec: 108.0  - 132.0
0-1   122.6
0-2   123.0
0-3   122.2
0-4   123.0
0-5   123.0
0-6   122.6
0-7   122.6
0-8   122.6
0-9   122.6
0-10   122.6
0-11  122.6
0-12  121.3
0-13  121.7
0-14  123.0
0-15  122.6
0-16  122.6
0-17  123.4
0-18  122.6
0-19  123.0
0-20  123.0
0-21  122.2
0-22  122.2
0-23  123.0
0-24  122.6

Input voltage 12V
-----------------
TX36   Spec: 11.0  - 13.0
0-1    11.8
0-2    11.8
0-3    11.8
```

Appendix 3 (cont.)

```
0-4    11.9
0-5    11.8
0-6    11.8
0-7    11.8
0-8    11.9
0-9    11.9
0-10    11.9
0-11   11.8
0-12   11.8
0-13   11.8
0-14   11.8
0-15   11.9
0-16   11.8
0-17   11.9
0-18   11.8
```

```
0-19   11.9
0-20   11.8
0-21   11.8
0-22   11.8
0-23   11.8
0-24   11.8

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
```

Appendix 3 (cont.)

```
-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
```

Appendix 3 (cont.)

```
Temperature
-----------
TX36   Spec: 15.0  - 75.0
0-1    44.0

0-2    42.8
0-3    42.0
0-4    41.2
0-5    42.0
0-6    43.2
0-7    43.6
0-8    44.4
0-9    42.8
0-10    43.2
0-11   43.2
0-12   42.0
0-13   43.2
0-14   42.8
0-15   42.8
0-16   43.6
0-17   44.0
0-18   44.8

0-19   44.4
0-20   43.2
0-21   42.8
0-22   41.6
```

```
0-23   43.6
0-24   44.0
nput Current 12V
-----------------
TX36   Spec:  0.3  -  1.5
0-1     0.6

I 0-2     0.5
0-3     0.6
0-4     0.5
0-5     0.5
0-6     0.6
0-7     0.5
0-8     0.5
0-9     0.5
0-10     0.5
0-11    0.5
0-12    0.5
0-13    0.5
0-14    0.5
0-15    0.5
0-16    0.5
0-17    0.5
0-18    0.5
0-19    0.6
0-20    0.5
```

Appendix 3 (cont.)

```
0-21    0.6
0-22    0.5
0-23    0.6
0-24    0.5

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


--------------------------------------------------------------------
------------

2010.08.14 01:57:07.515  111         2         OK



Input voltage 12V
-----------------
RX32   Spec: 11.0  - 13.0
7-1    11.7
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     3.4
7-4     3.3


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

Appendix 3 (cont.)

```
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    53.0
7-3    48.0
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     2.8
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
```

```
-----------------------------------------------------------------------
------------

2010.08.14 01:57:07.648  111         3          OK



High Voltage Br. 1
------------------
TX36   Spec: 108.0  - 132.0
0-1   122.6
0-2   122.6
```

Appendix 3 (cont.)

```
0-3   122.1
0-4   122.6
0-5   122.6
0-6   122.6
0-7   122.6
0-8   122.6
0-9   123.4
0-10   122.6
0-11  123.4
0-12  121.3
0-13  122.1
0-14  123.4
0-15  123.0
0-16  122.1
0-17  122.6
0-18  122.1
0-19  123.0
0-20  122.6
0-21  122.6
0-22  121.7
0-23  123.0
0-24  122.1

High Voltage Br. 2
------------------
TX36   Spec: 108.0  - 132.0
0-1   122.6
0-2   123.0
0-3   122.2
0-4   123.0
0-5   123.0
0-6   122.6
0-7   122.6
0-8   122.6
0-9   122.6
0-10   123.0
0-11  122.6
0-12  121.3
0-13  121.7
0-14  123.0
0-15  122.6
0-16  122.2
0-17  123.4
0-18  122.6
0-19  122.6
```

```
0-20  123.0
0-21  122.2
0-22  121.7
0-23  123.0
0-24  122.6

Input voltage 12V
-----------------
```

Appendix 3 (cont.)

```
TX36   Spec: 11.0  - 13.0
0-1    11.8
0-2    11.8
0-3    11.8
0-4    11.9
0-5    11.8
0-6    11.8
0-7    11.8
0-8    11.9
0-9    11.9
0-10    11.9
0-11   11.8
0-12   11.8
0-13   11.8
0-14   11.8
0-15   11.8
0-16   11.8
0-17   11.9
0-18   11.8
0-19   11.9
0-20   11.8
0-21   11.8
0-22   11.8
0-23   11.9
0-24   11.8

RX32   Spec: 11.0  - 13.0
7-1    11.7
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


--------------------------------------------------------------------
------------

2010.08.14 01:57:07.798  111        4         OK



EM 122 High Voltage Ramp Test
```

```
Test Voltage:20.00  Measured Voltage: 18.00 PASSED
Test Voltage:60.00  Measured Voltage: 60.00 PASSED
```

Appendix 3 (cont.)

```
Test Voltage:100.00  Measured Voltage: 101.00 PASSED
Test Voltage:120.00  Measured Voltage: 121.00 PASSED
Test Voltage:80.00  Measured Voltage: 85.00 PASSED
Test Voltage:40.00  Measured Voltage: 45.00 PASSED

6 of 6 tests OK


--------------------------------------------------------------------
------------

2010.08.14 01:59:31.889  111         5         OK


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


--------------------------------------------------------------------
------------

2010.08.14 01:59:36.856  111         6         OK



Receiver impedance limits [350.0 700.0] ohm
Board  1      2      3     4
 1: 547.0  551.3  584.0  588.6
 2: 575.7  563.2  560.3  591.9
 3: 583.1  557.4  577.1  526.0
 4: 563.0  530.9  589.5  535.2
 5: 564.4  561.9  573.0  589.4
 6: 580.6  552.5  548.2  583.2
 7: 545.6  546.4  547.2  560.3
 8: 570.5  580.5  572.1  538.5
 9: 556.1  579.6  568.0  583.1
10: 560.1  568.6  579.6  593.6
11: 561.6  568.3  586.0  601.8
12: 547.8  587.4  553.6  550.7
13: 570.5  547.0  581.8  567.9
14: 577.7  576.5  589.0  599.3
15: 563.4  550.3  582.6  590.3
16: 569.3  537.6  561.7  588.6
17: 586.0  573.1  547.4  501.6
18: 558.6  554.1  582.2  558.0
19: 547.3  569.0  510.9  580.9
20: 560.8  567.5  574.9  606.4
21: 563.5  523.1  538.1  580.7
22: 547.2  538.6  559.5  518.0
23: 553.7  574.5  565.3  602.8
24: 578.8  553.7  571.1  587.9
25: 566.6  571.6  567.4  584.2
26: 576.3  570.9  569.8  521.4
```

Appendix 3 (cont.)

```
27: 539.5  585.8  580.7  542.0
28: 578.3  557.2  541.0  523.1
```

```
29: 574.4  574.8  572.8  607.3
30: 574.2  574.5  577.9  539.6
31: 580.1  552.7  573.7  584.0
32: 540.9  585.4  584.3  579.1

Receiver Phase limits [-20.0 20.0] deg
Board  1      2      3     4
 1:   1.5    0.8   -1.0   -1.4
 2:  -1.3    0.2    0.4   -2.7
 3:  -1.5   -0.3   -1.5    3.9
 4:   0.1    2.3   -1.6    2.7
 5:   0.0   -0.5   -1.3   -2.0
 6:  -1.5    0.3    1.0   -1.3
 7:   1.4    0.7    1.2    0.5
 8:   0.6   -2.0   -2.1    2.9
 9:   1.0   -1.0    0.1   -0.3
10:   1.0    0.3   -0.3   -1.9
11:   0.8    0.2   -0.5   -2.5
12:   1.6   -0.4    2.3    1.6
13:  -0.7    0.6   -0.8    1.1
14:  -0.3   -1.0   -0.7   -2.4
15:  -0.2    0.6   -0.1   -1.7
16:   0.3    1.7    1.3   -1.2
17:  -1.7   -0.2    1.7    6.1
18:   0.6    0.7   -1.6    0.9
19:   1.2   -1.0    4.5   -1.2
20:   0.4   -0.2   -0.8   -3.3
21:  -0.5    3.4    2.4   -1.6
22:   0.9    1.6    0.6    4.2
23:   1.0   -1.0    0.0   -3.4
24:  -1.5    0.4   -0.2   -2.1
25:  -0.3   -1.3   -0.1   -1.3
26:  -1.5   -0.5   -0.3    4.3
27:   1.9   -2.1   -1.1    2.0
28:  -1.9   -0.2    2.2    3.7
29:  -0.6   -1.0   -0.9   -3.4
30:  -1.0   -0.8   -0.9    2.7
31:  -1.7    0.7   -0.4   -1.7
32:   1.8   -1.2   -1.3   -1.1
Rx Channels test passed


--------------------------------------------------------------------
------------

2010.08.14 02:00:09.441  111         7         OK



Tx Channels test passed
```

Appendix 3 (cont.)

```
--------------------------------------------------------------------
------------

2010.08.14 02:03:04.649  111         8         OK



RX NOISE LEVEL
```

Board No:	1	2	3	4	
0:	43.2	40.8	40.4	39.7	dB
1:	44.3	41.3	40.5	40.5	dB
2:	43.2	41.3	41.0	41.3	dB
3:	42.0	40.5	40.2	40.0	dB
4:	42.3	41.9	40.3	41.1	dB
5:	42.0	40.4	39.5	39.3	dB
6:	41.2	40.9	41.1	40.8	dB
7:	41.5	40.2	39.6	40.1	dB
8:	42.1	41.5	40.0	40.2	dB
9:	41.1	40.6	39.3	40.0	dB
10:	41.9	41.9	39.9	40.3	dB
11:	41.5	41.0	39.9	39.8	dB
12:	42.2	41.2	40.0	40.1	dB
13:	41.5	40.6	39.8	39.4	dB
14:	42.0	40.9	41.2	39.8	dB
15:	40.5	40.2	40.1	39.2	dB
16:	41.5	40.5	40.7	41.2	dB
17:	41.3	39.2	39.4	39.7	dB
18:	41.5	40.1	40.5	40.0	dB
19:	40.9	40.1	39.8	39.3	dB
20:	41.4	40.1	39.7	40.2	dB
21:	41.0	40.5	39.8	39.9	dB
22:	41.3	40.2	39.9	39.3	dB
23:	40.6	39.7	39.5	38.6	dB
24:	41.4	41.3	40.0	42.4	dB
25:	40.7	40.1	39.6	39.0	dB
26:	42.0	40.6	40.6	39.9	dB
27:	40.8	39.8	39.7	39.7	dB
28:	41.6	40.4	40.4	39.2	dB
29:	41.0	39.8	40.1	40.1	dB
30:	41.2	40.6	40.2	40.6	dB
31:	40.4	40.0	40.0	41.6	dB

Maximum noise at Board 1 Channel 1 Level: 44.3 dB

Broadband noise test

Average noise at Board 1   41.7 dB   OK
Average noise at Board 2   40.6 dB   OK
Average noise at Board 3   40.1 dB   OK

Appendix 3 (cont.)

Average noise at Board 4   40.1 dB   OK

2010.08.14 02:03:11.116 111   9   OK

RX NOISE SPECTRUM

Board No: 1   2   3   4

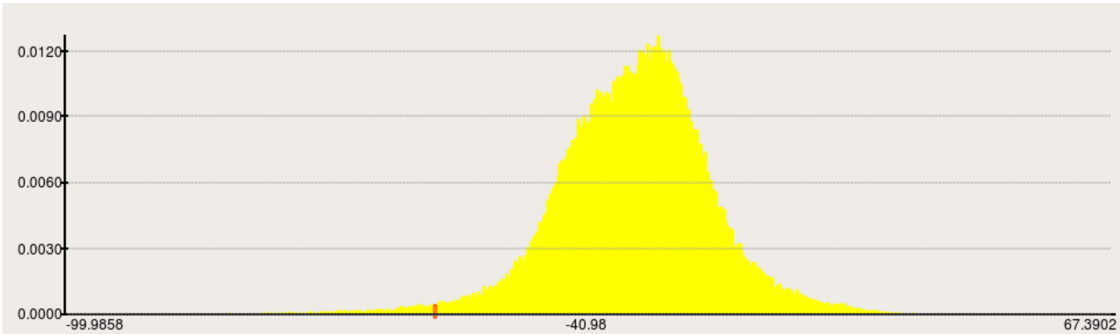
```
10.0 kHz:     38.8       37.8       37.8       37.3   dB
10.2 kHz:     39.6       38.7       38.7       39.0   dB
10.3 kHz:     41.0       40.0       39.9       39.4   dB
10.4 kHz:     41.3       40.7       40.4       40.6   dB
10.6 kHz:     41.7       41.0       40.9       40.3   dB
10.7 kHz:     42.4       41.5       40.9       40.5   dB
10.9 kHz:     42.7       41.8       41.1       41.1   dB
11.0 kHz:     42.3       41.7       41.4       41.3   dB
11.2 kHz:     43.3       41.5       41.9       41.3   dB
11.3 kHz:     42.7       41.7       41.6       41.4   dB
11.4 kHz:     42.4       41.2       41.3       41.2   dB
11.6 kHz:     42.9       41.8       41.1       41.0   dB
11.7 kHz:     42.7       40.8       40.8       41.3   dB
11.9 kHz:     42.1       40.9       40.7       41.0   dB
12.0 kHz:     42.2       41.2       40.7       40.9   dB
12.1 kHz:     41.2       40.7       40.4       39.7   dB
12.3 kHz:     41.5       39.8       40.5       40.1   dB
12.4 kHz:     41.9       40.2       39.4       39.4   dB
12.6 kHz:     41.0       39.6       39.1       39.3   dB
12.7 kHz:     40.1       39.3       39.2       38.4   dB
12.9 kHz:     39.2       38.4       38.0       38.1   dB
13.0 kHz:     39.0       37.9       37.8       37.5   dB

Maximum noise at Board 1 Frequency 11.2 kHz Level:  43.3 dB

Spectral noise test
------------------
Average noise at Board 1   41.6 dB    OK
Average noise at Board 2   40.5 dB    OK
Average noise at Board 3   40.3 dB    OK
Average noise at Board 4   40.2 dB    OK


--------------------------------------------------------------------
------------

2010.08.14 02:03:17.583  111         10         OK
```

Appendix 3 (cont.)

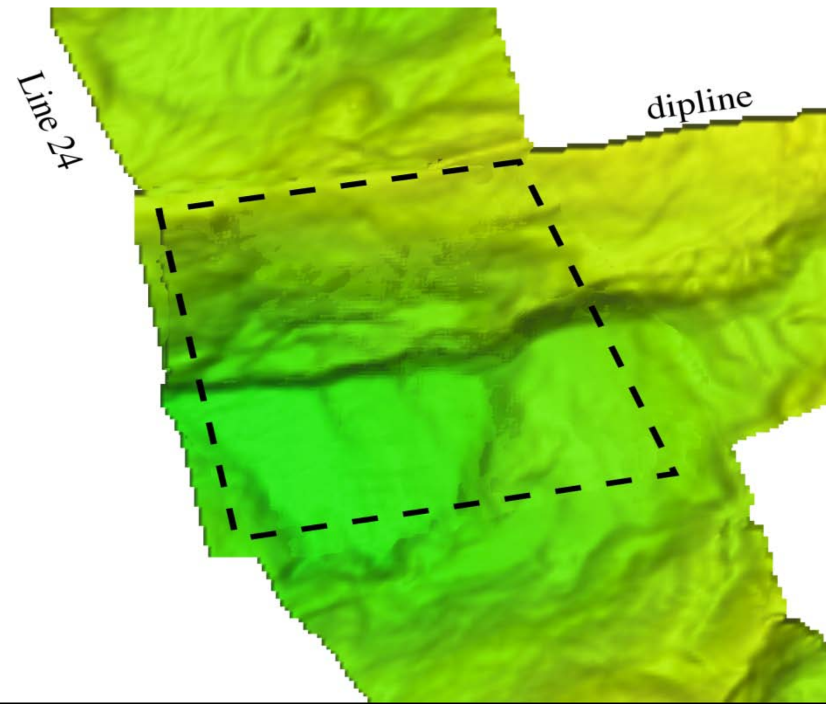
```
CPU: KOM CP6011
Clock 1795 MHz
Die   42 oC (peak: 51 oC @ 2010-08-12 - 05:11:23)
Board 44 oC (peak: 49 oC @ 2010-08-13 - 23:01:35)
Core  1.33 V
3V3   3.31 V
12V   12.05 V
-12V  -11.96 V
BATT  3.22 V
Primary network: 157.237.14.60:0xffff0000
Secondary network: 192.168.3.11:0xffffff00


--------------------------------------------------------------------
------------

2010.08.14 02:03:17.683  111         15         OK
```

```
EM 122

BSP67B Master: 2.2.3 090702
BSP67B Slave: 2.2.3 090702
CPU: 1.1.5 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

-------------------------------------------------------------------
                             end of BIST test
```

Appendix 4. Cross-check Analyses



-100 m sounding-depth difference (m) -100 m

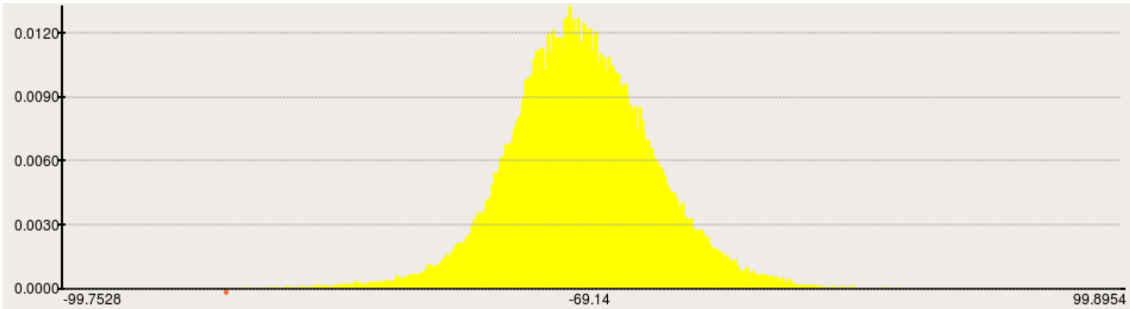


(upper) Histogram of sounding-depth differences from cross-line check of Line 24 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

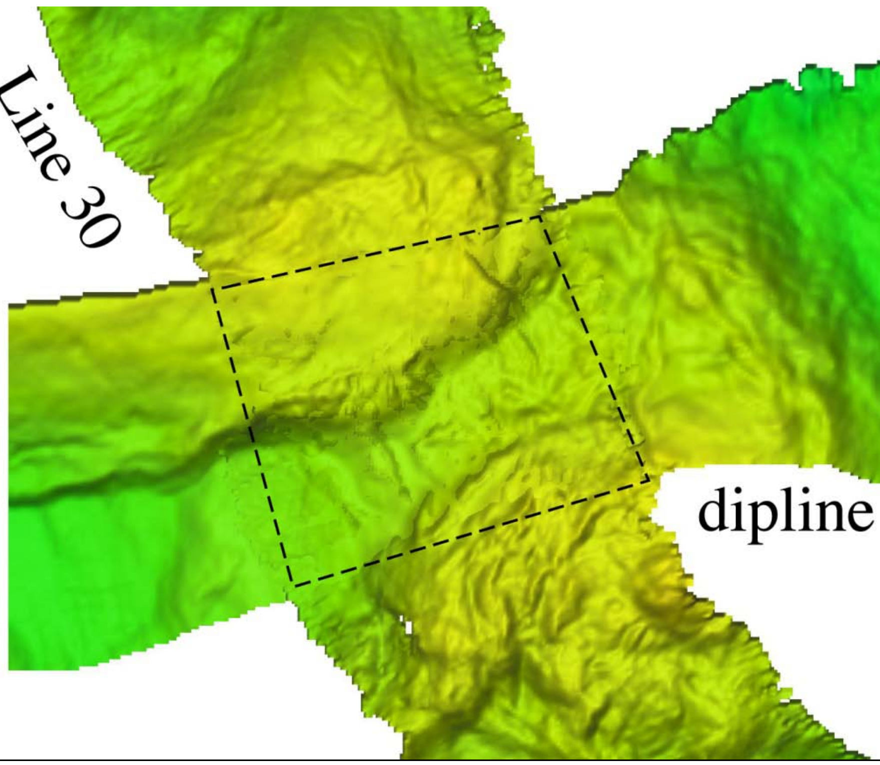
Cross check statistics

North Line 24 vs dipliine	Mean water depth	3552 m
	Mean Z difference	-9.09 m
	Standard deviation	12.5 m
	Number of samples	110979
	Percent of water depth	0.9% at 2σ

Appendix 4 (cont.)



-100 m sounding-depth difference (m) -100 m

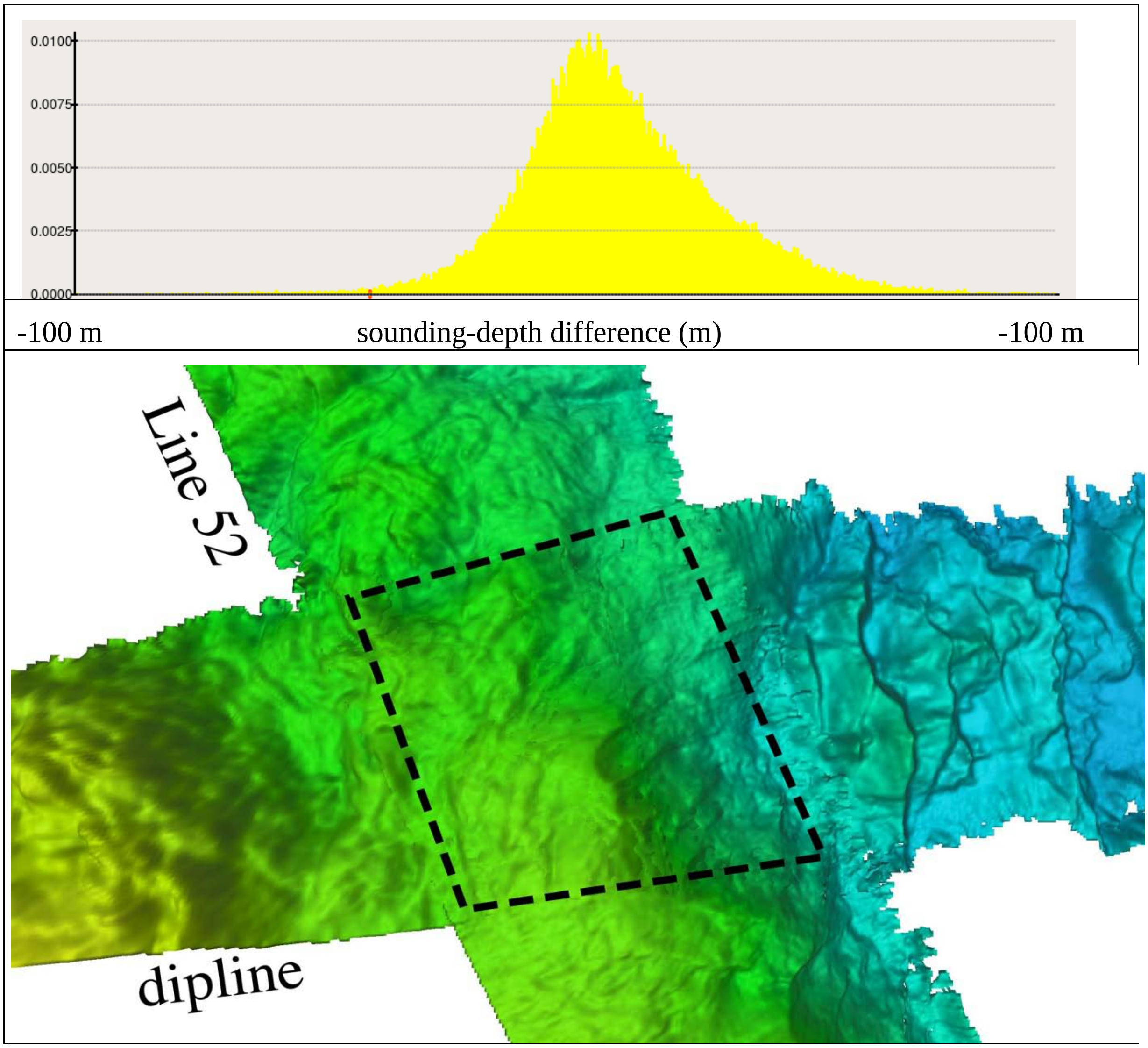


(upper) Histogram of sounding-depth differences from cross-line check of Line 30 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

Cross check statistics

North Line 30 vs dipliine	Mean water depth	2970 m
	Mean Z difference	-2.04 m
	Standard deviation	14.3 m
	Number of samples	87609
	Percent of water depth	1.0% at 2σ

Appendix 4 (cont.)

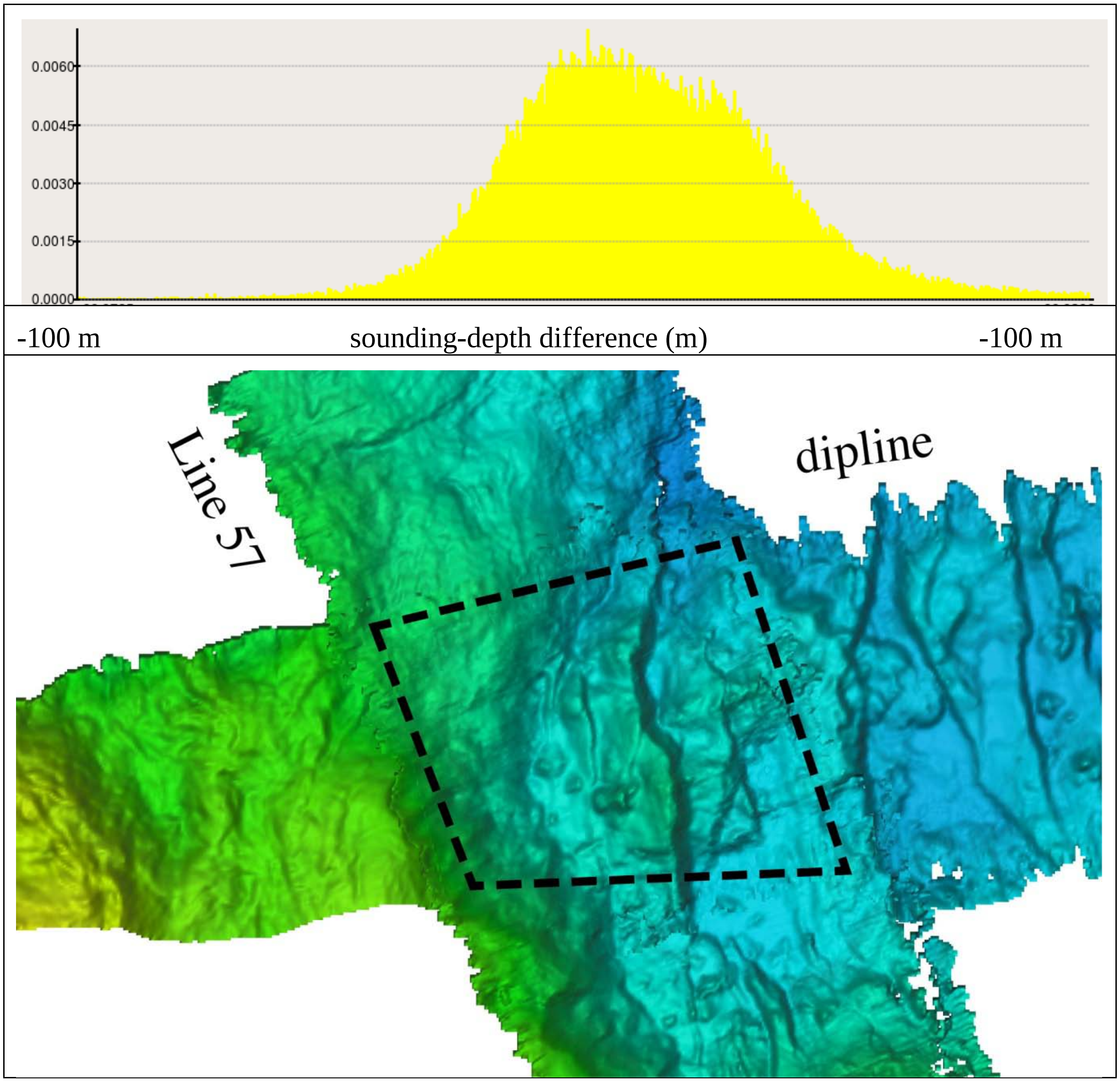


(upper) Histogram of sounding-depth differences from cross-line check of Line 52 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

Cross check statistics

North Line 52 vs dipliine	Mean water depth	4606 m
	Mean Z difference	10.8 m
	Standard deviation	20.8 m
	Number of samples	97502
	Percent of water depth	1.1% at 2σ

Appendix 4 (cont.)

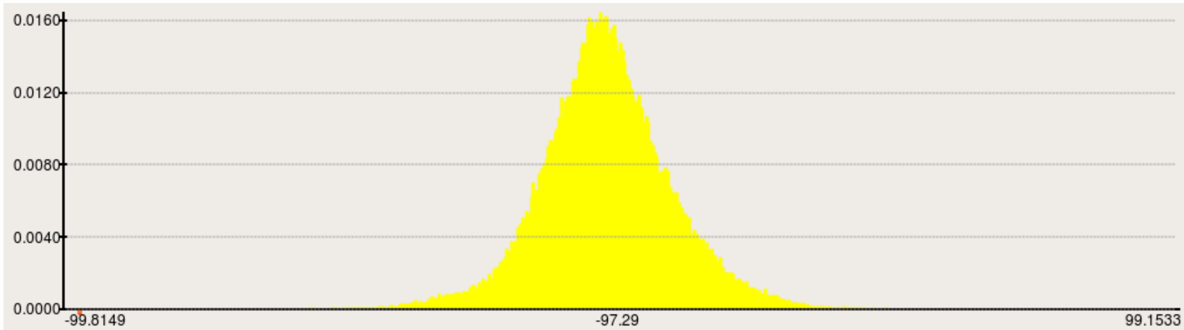


(upper) Histogram of sounding-depth differences from cross-line check of Line 57 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

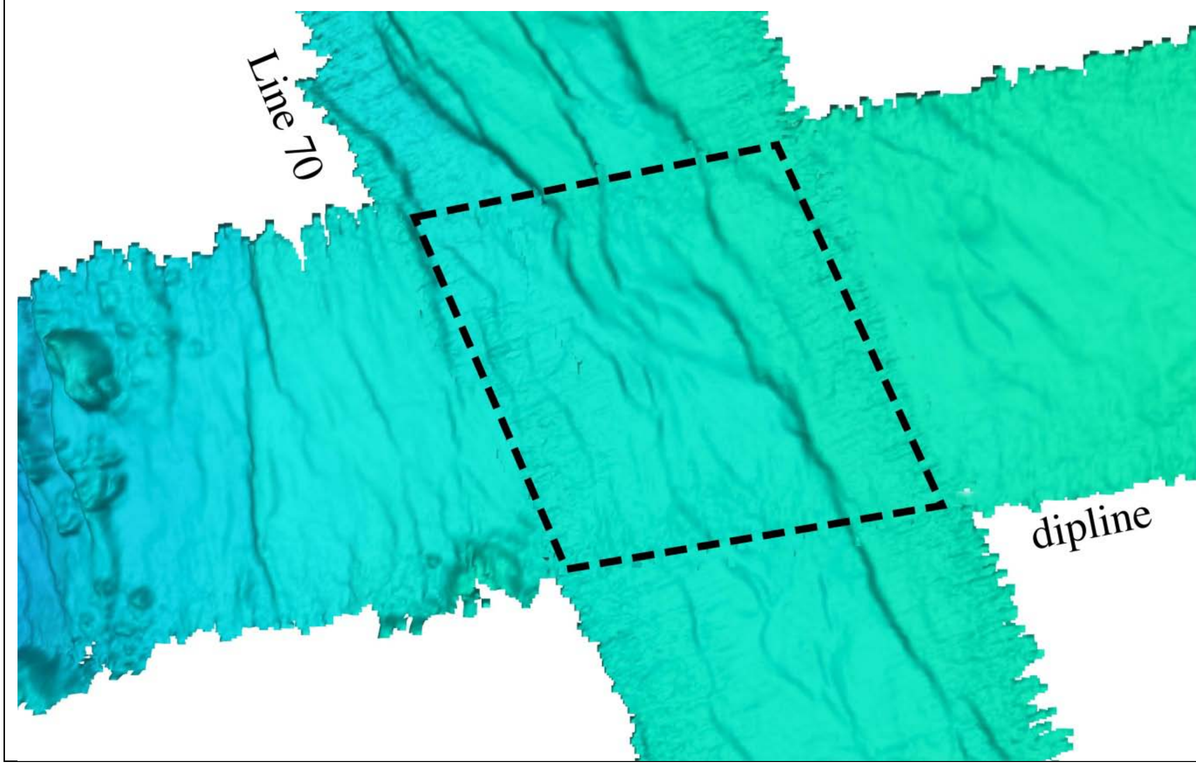
Cross check statistics

North Line 57 vs dipliine	Mean water depth	5614 m
	Mean Z difference	11.6 m
	Standard deviation	25.6 m
	Number of samples	101833
	Percent of water depth	1.1% at 2σ

Appendix 4 (cont.)



-100 m sounding-depth difference (m) -100 m

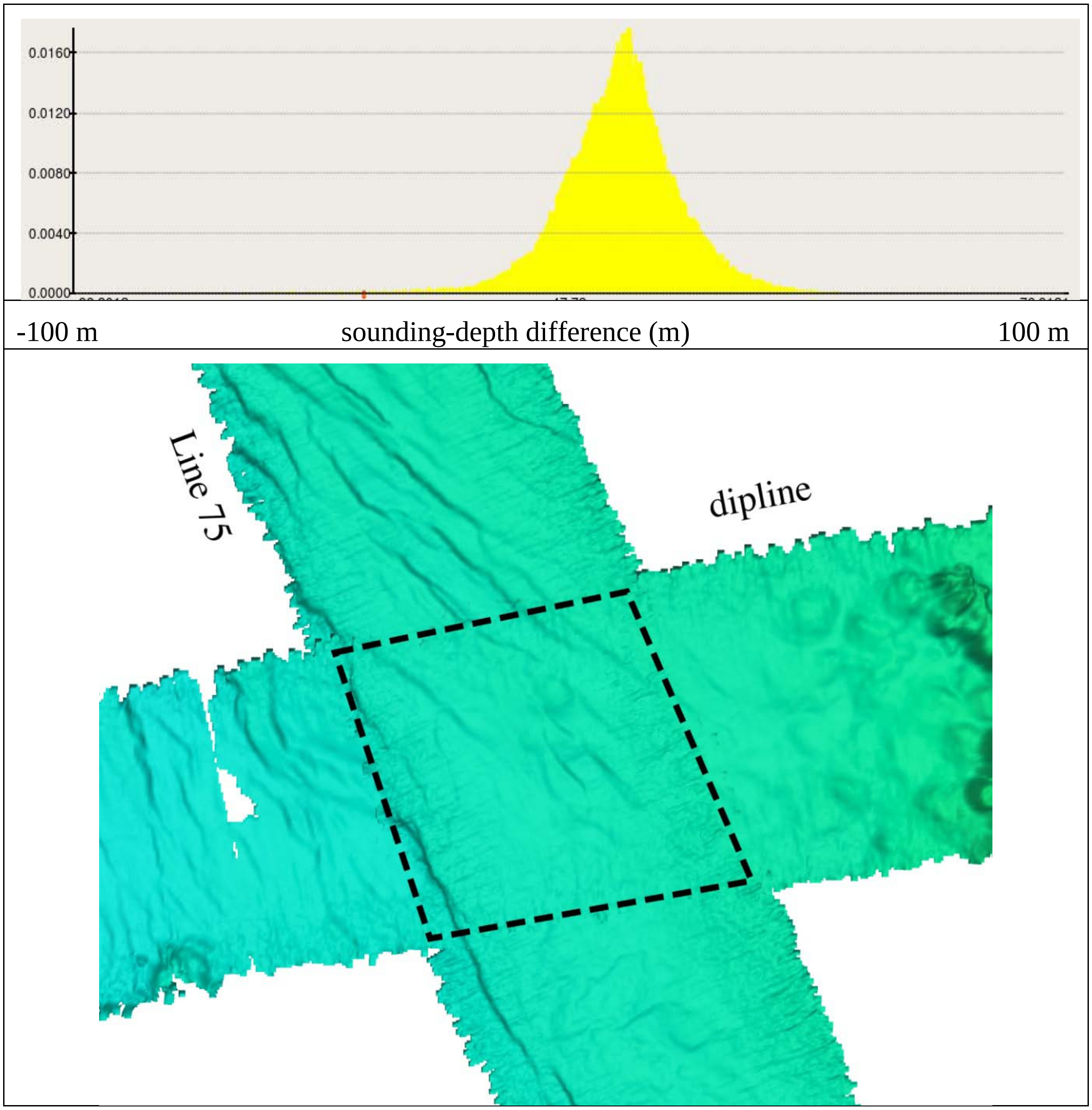


(upper) Histogram of sounding-depth differences from cross-line check of Line 70 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

Cross check statistics

North Line 70 vs dipliine	Mean water depth	6011 m
	Mean Z difference	2.9 m
	Standard deviation	12.2 m
	Number of samples	105858
	Percent of water depth	0.4% at 2σ

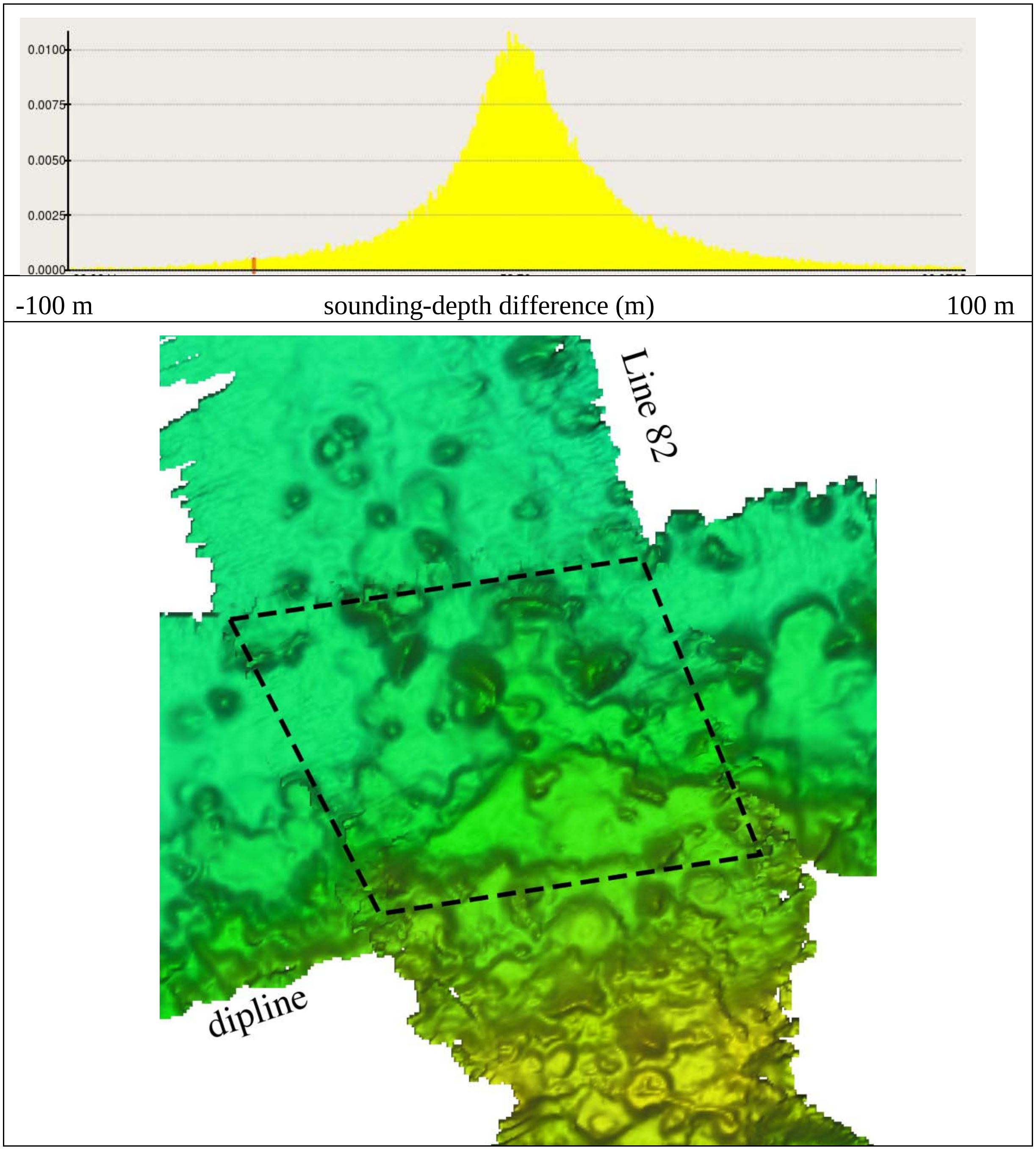
Appendix 4 (cont.)



(upper) Histogram of sounding-depth differences from cross-line check of Line 75 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

Cross check statistics

North Line 75 vs dipliine	Mean water depth	5800 m
	Mean Z difference	2.9 m
	Standard deviation	11.6 m
	Number of samples	115478
	Percent of water depth	0.4% at 2σ

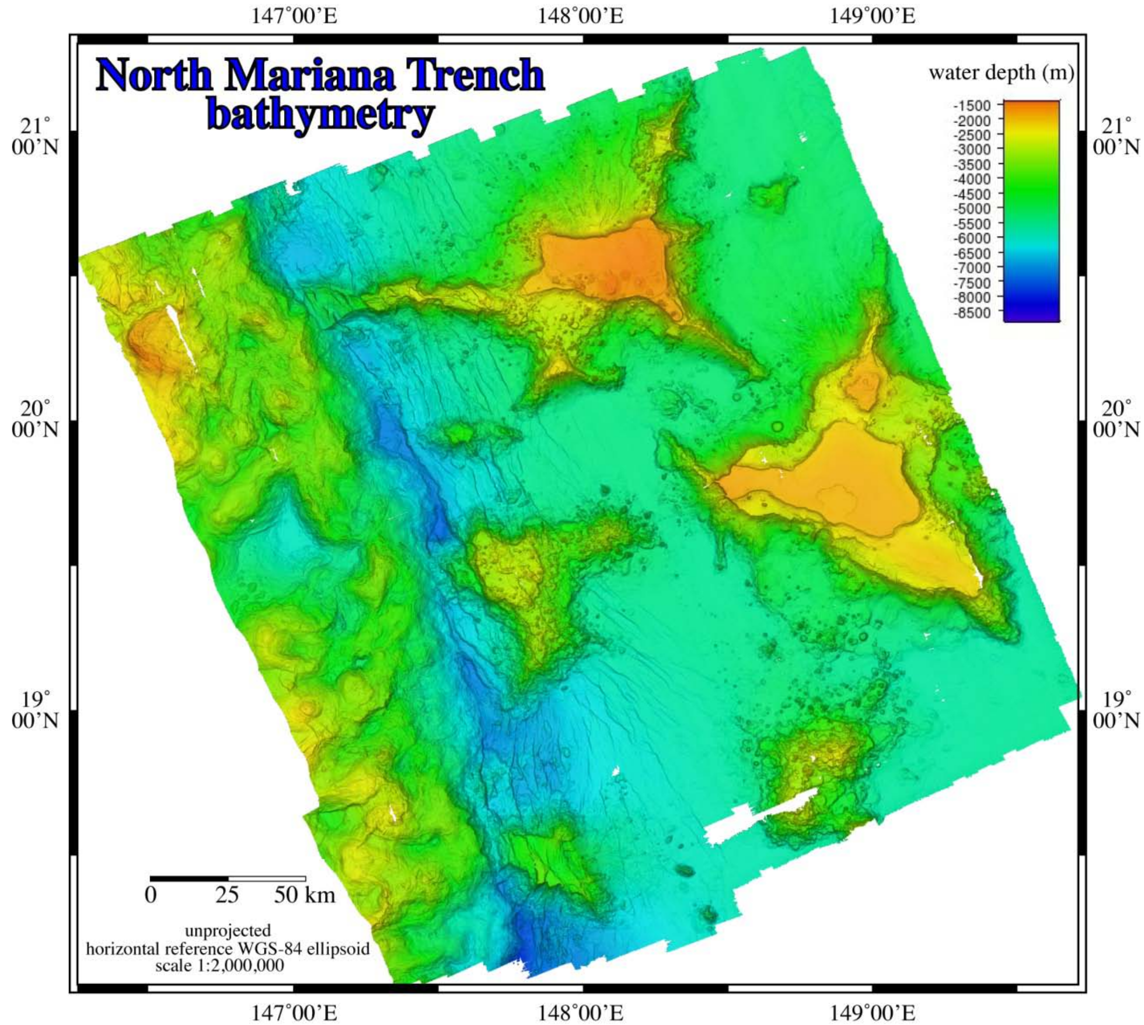


(upper) Histogram of sounding-depth differences from cross-line check of Line 82 and dipline. (lower) DTM showing area of cross-line check (dashed polygon).

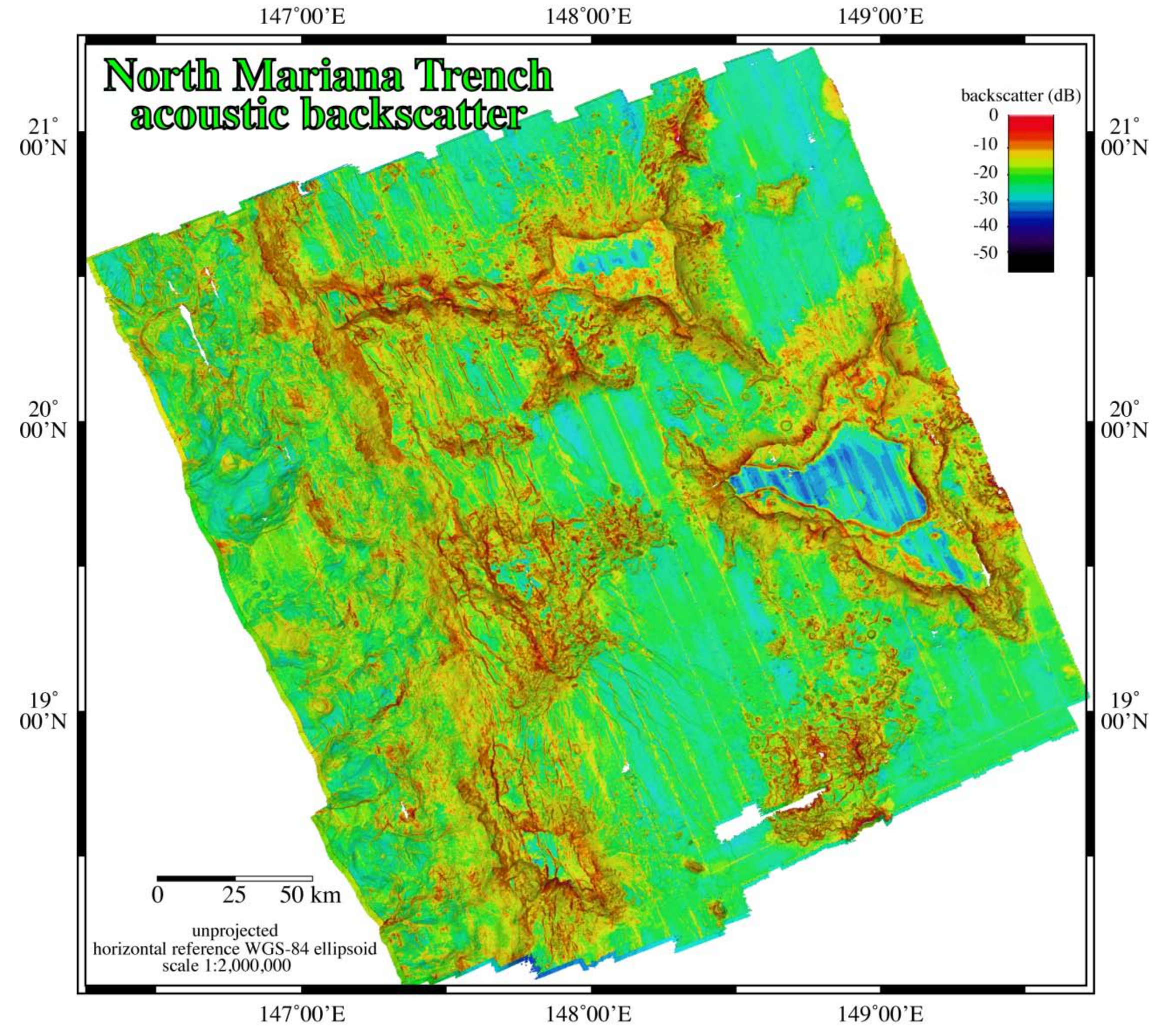
Cross check statistics

North Line 82 vs dipliine	Mean water depth	4536 m
	Mean Z difference	2.0 m
	Standard deviation	25.3 m
	Number of samples	95946
	Percent of water depth	0.6% at 2σ

Appendix 5. Color shaded-relief bathymetry and acoustic backscatter maps of the Mariana Trench west of Guam and the Northern Mariana Islands.

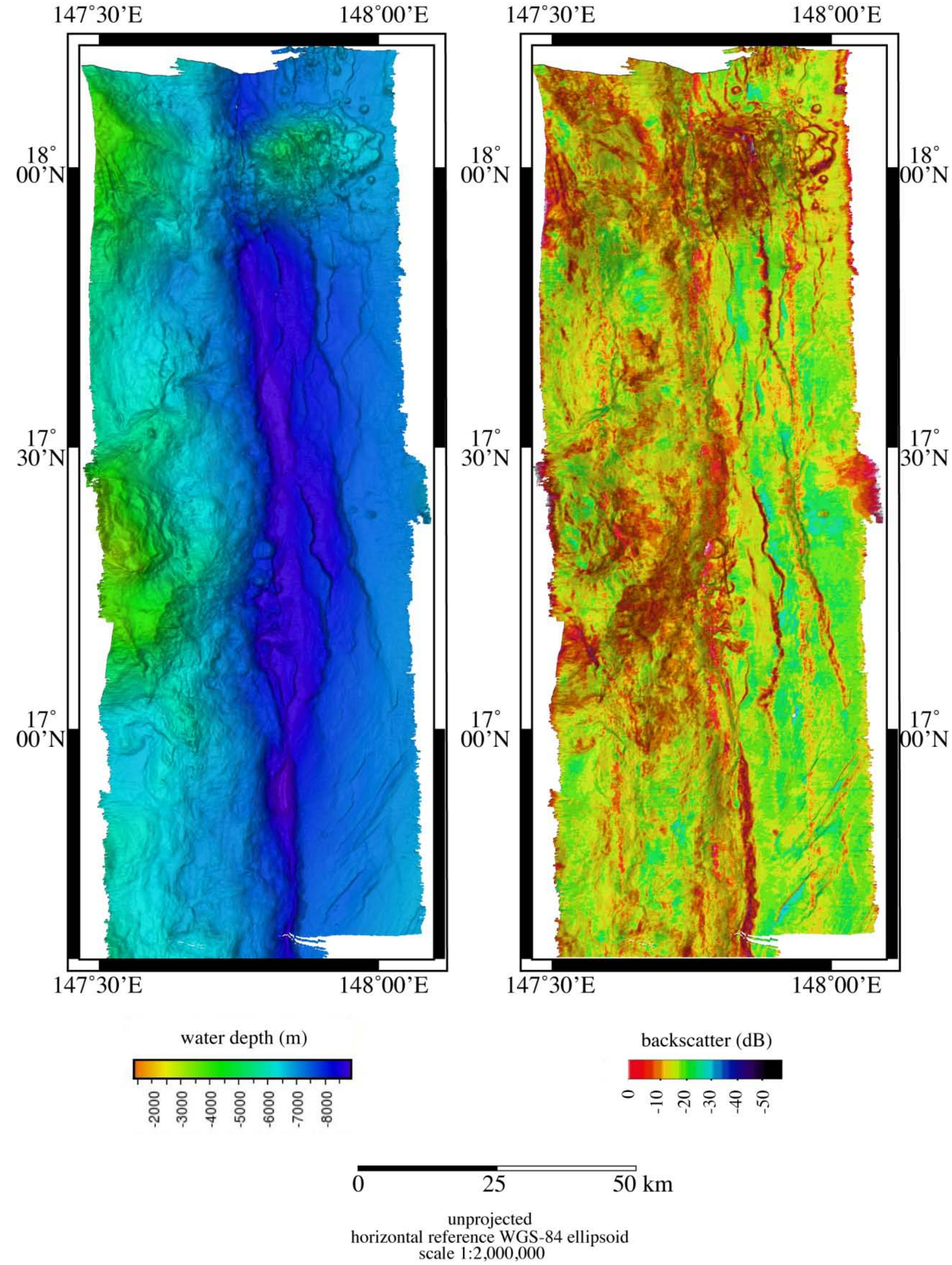


Appendix 5 continued



Appendix 5 continued

Trench transect between North and Central areas



Appendix 5 continued

Central area bathymetry and acoustic backscatter