CRUISE REPORT

RV *Kilo Moana*

U.S. Law of the Sea cruise to map the foot of the slope and 2500-m isobath of the Gulf of Alaska continental margin

CRUISES KM0514-1 and KM0514-2

June 24, to September 1, 2005

Honolulu, HI to Honolulu, HI

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Introduction

An exhaustive study of the US data holdings pertinent to the formulation of U.S. potential claims under the United Nations Convention of the Law of the Sea (UNCLOS) (Mayer, et al., 2002) identified several regions where new bathymetric surveys are needed. The report recommended multibeam echo sounder (MBES) data are needed to rigorously define (1) the foot of the slope (FoS), a parameter of a stipulated formula lines, and (2) the 2500-m isobath, a parameter of a stipulated cutoff line. Both of these features, the first a precise geodetic feature and second a somewhat vague geomorphic feature, must be used to define an extended claim. The National Oceanic and Atmospheric Administration (NOAA) was directed through funding by Congress to have the Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) of the University of New Hampshire manage the UNCLOS surveys and archive the resultant data. This is the report from the third U.S. Law of the Sea mapping cruise, a detailed MBES survey of the U.S. Gulf of Alaska continental margin (Figs.1 and 2).

NOAA contracted through NSF-UNOLS (National Science Foundation University National Oceanographic Laboratory System) with the University of Hawaii to conduct the Gulf of Alaska mapping using the 186-ft, 3060-ton RV *Kilo Moana* (Fig. 3), a SWATH (small water area twin hull) vessel with a hull-mounted Kongsberg Simrad EM120 MBES as well as a Knudsen 320 B/R 3.5-kHz chirp sub-bottom profiler and a Carson gravimeter.

The planned schedule for the cruise called for 2 legs of approximately 30 days of operations and one port call.

The University of Hawaii's Hawaii Mapping Research Group was responsible for systems calibrations, data collection and quality control and overall cruise management whereas the UNH group was responsible for bathymetry, acoustic-backscatter and 3.5-kHz processing. Gravity data were collected and processed by the University of Hawaii group.

The first leg of operations required a 7.5-day, 4200 km, transit from Honolulu, HI to an area ~70 km NW of Bowie Seamount (Fig. 1). A complete patch test was performed in this area and then the mapping commenced with a dip line run up the margin in the southern portion of the area. Twenty five days of continuous mapping the margin from south to north followed the patch test. Mapping during Leg 1 was halted on July 27, 2005 and the ship transited to Kodiak, AK for a scheduled re-supply and a crew change. Leg 1 collected 18,135 line km of MBES and 3.5-kHz profiler lines and mapped a total area of 163,215 km^2. Leg 2 of the survey departed Kodiak, AK on August 2, 2005 and collected 8745 line km of MBES and 3.5-kHz profiler lines and mapped a total area of 158,251 km^2. Leg 2 of the survey was completed on August 24, 2005 and the ship transited back to Honolulu, HI. The cruise mapped a total of 321,466 km^2 in 42 days, with an average speed of 10 kts. A summary of the cruises is given in Table 2.

This report is divided into several sections to document the cruise; there is a description of the MBES system used to collect the data, a brief geological description of the Gulf of Alaska area mapped, a section of the daily log of events, a table of the data file names and a section of bathymetric and acoustic-backscatter maps produced from the of the data.

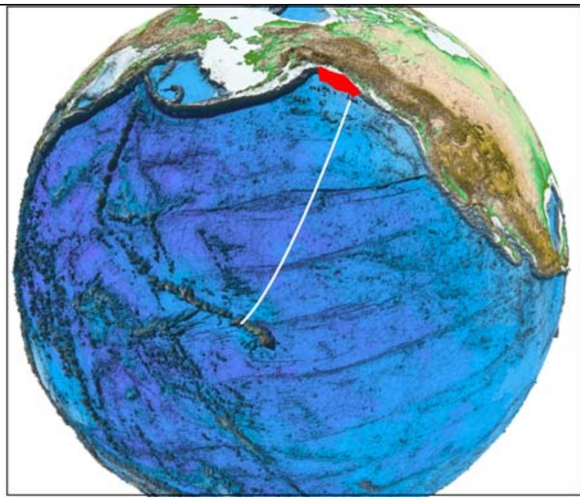

Figure 1. Transit track (white line) from Honolulu, HI to the Gulf of Alaska survey Area (See Fig. 2)

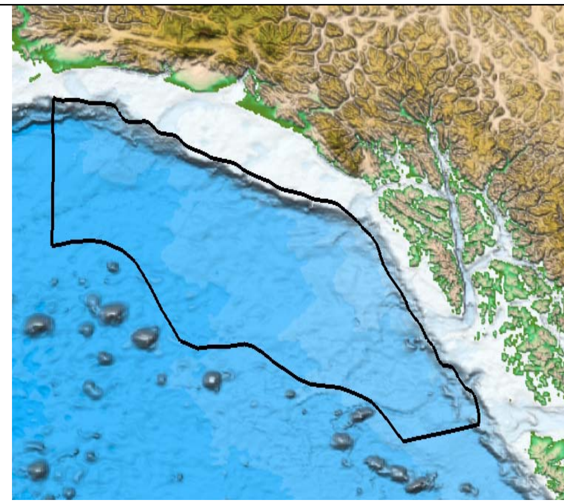

Figure 2. Survey area (black polygon) of the U.S. Gulf of Alaska margin

Figure 3. RV *Kila Moana* used to map the U.S. Gulf of Alaska margin.

The Multibeam Echo sounder System and Associated Systems

A hull-mounted Kongsberg Simrad EM120 MBES system was used throughout the survey. This EM120 is a 12-kHz, MBES system that transmits a 1˚ wide (fore-aft) acoustic pulse and then generates 191-2˚ receive apertures (beams) over a 150˚ swath. The system is both pitch and yaw stabilized to compensate for vehicle motion during transmission. The Konsberg Simrad EM120 Product Description should be consulted for the full details of the MBES system. Two hull-mounted Applied Microsystems Ltd Smart SV&T sound-velocity sensors are used to measure the sound speed at the MBES array for accurate beam forming. Beam forming used both the equiangular and in-between modes at various times during the cruises. 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 interferometric phase detection. The spacing of individual sounding is approximately every 50 m, regardless of survey speed.

The manufacturer states that, at the 15-ms pulse length used during this survey (deep mode), the system is capable of depth accuracies of 0.3 to 0.5% of water depth. An Applanex POS/MV 320 version 3 inertial motion unit (IMU) (with TrueHeave) was interfaced to a NovAtel OEM2-3151R global positioning system (GPS). The IMU provided roll, pitch and yaw at accuracies of better than 0.1˚ at 1 Hz. The TrueHeave component of the POS/MV virtually eliminated residual heave at the start of each line thereby requiring only a 5-minute run-in for each line. The MBES system can incorporate transmit beam steering up to ±10˚ from vertical, roll compensation up to ±10˚ and can perform yaw corrections as well to provided position fixes with an accuracy of ~

±5 m. All horizontal positions were geo-referenced to the WGS84 ellipsoid and vertical referencing was to mean sea level.

The Simrad EM120 is capable of simultaneously collecting full time-series acoustic backscatter co-registered with bathymetry. 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 superficial seafloor. However, the interpreter must be cautious because the 12-kHz acoustic signal undoubtedly penetrates the seafloor to an unknown, but significant depth, thereby generating a received signal that is a function of some combination of acoustic impedance, seafloor roughness and volume reverberation.

Water-column sound-speed profiles during the mapping were to be calculated by two different methods. A Brooke Ocean Technology Ltd Moving Vessel Profiler (MVP model 300) was planned to be used to measure profiles of sound speed in the upper 300 m of the water column. However, the system was damaged during the transit and there were insufficient spares aboard ship to repair it. Sippican T-7 expendable bathythermographs (XBTs) were used to measure temperature to 760 m maximum depth as required by refraction effects caused by deeper water layers. Two CTD instruments were aboard as backups to the XBTs.

In addition to the MBES, continuous high-resolution 3.5-kHz seismic-reflection profiles and gravity measurements were collected along all tracks. The 3.5-kHz system is a Knudsen 320B/R digital chirp profiler that collects seismic images of the upper ~50 m of the sediment column. The Carson gravimeter (Carson Gravity Meter and Instrument

Co. model 6300), a refurbished LaCoste-Romberg Model S-33 meter, was run on a hands-off basis, not to interfere with the MBES operations.

The University of Hawaii (UH) designated the entire 60-day cruise *KM0514* whereas the University of New Hampshire designated Leg 1 as *KM0514-1* and Leg 2 *KM0514-2*. All raw MBES files were initially labeled with a unique UH file designator but were changed to goa05_Line_X, where X is a consecutive line number starting with 1 and was incremented at the change of Julian Day (0000 UTC) and at the end of each survey line (see Table 3). Turns were not recorded.

The Area: The U.S. Gulf of Alaska Margin

The specific area mapped during these cruises (Fig. 4) was defined in Mayer et al. (2002) as the areas in the Gulf of Alaska where a potential U.S. claim beyond the U.S. EEZ could be made under UNCLOS Article 76. Although the Mayer et al. study states that the 2500-m isobath will not necessarily be a useful criteria for a potential claim in the U.S. Gulf of Alaska, the entire area between the 2000 and ~4500-m isobaths were mapped as a contingency so that if any questions about the 2500-m isobath are raised in the future the data would be in hand.

The area of interest in U.S. Gulf of Alaska is bounded on the north and east by a plate-boundary fault (von Huene, 1989) that separates the Pacific Plate from the North American Plate (Fig. 4). The eastern boundary of the map area is marked by the right-lateral to slightly compressional Queen Charlotte-Fairweather transform fault system (Riddihough and Hyndman, 1989) and the northern boundary is defined by the right-lateral and compressional Transition Fault (von Huene, 1989). Water depths in the area are as deep as ~4900 m.

The western boundary of the mapped area is the Kodiak-Bowie seamount chain (sometimes referred to as the Pratt-Welker seamount chain, i.e., Batiza, 1989), a linear system of seamounts that may be the result of a hot spot (Silver et al., 1974) or some other, more complex origin (von Huene, 1978; Batiza, 1989).

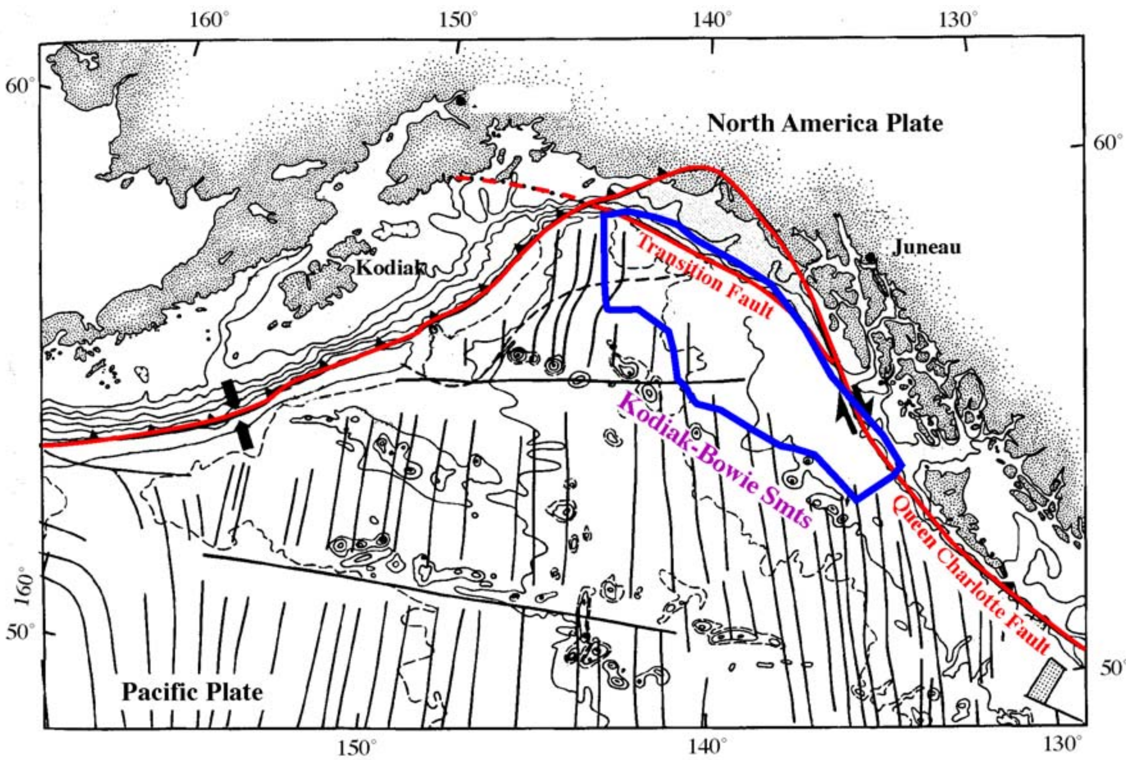

Figure 4. General map of Gulf of Alaska showing seafloor magnetic anomalies (black lines), major plate-boundary faults (red lines) and survey area (blue polygon). Queen Charlotte-Fairweather Fault system label "Queen Charlotte Fault". Modified from von Huene 1989.

The continental margin immediately west of the fault systems has a narrow continental shelf and slope. The steep margin is interrupted by a marginal plateau that contains as much as 5 km of sediments with oceanic crust gently dipping toward the continent (von Huene et al., 1978).

The Alaska Abyssal Plains west of the two fault systems is buried by two large submarine fan systems; the Baranof Fan to the south and the Surveyor Fan to the north (Stevenson and Embley, 1987), both of which are thought to have been active for the past ~10 my (Late Miocene through Quaternary). Consequently, both fans have translated northward as the Pacific Plate migrated to the north, suggesting the initial sediments of both fans were derived from the Cordillera off present-day British Columbia and southern Alaska. With time, the source areas of both fans shifted to areas farther north until today the source area for Baranof Fan is off SE Alaska and that for Surveyor Fan is the area of the elbow of Alaska. The proximal parts of both fans lie within the survey area (Fig. 5).

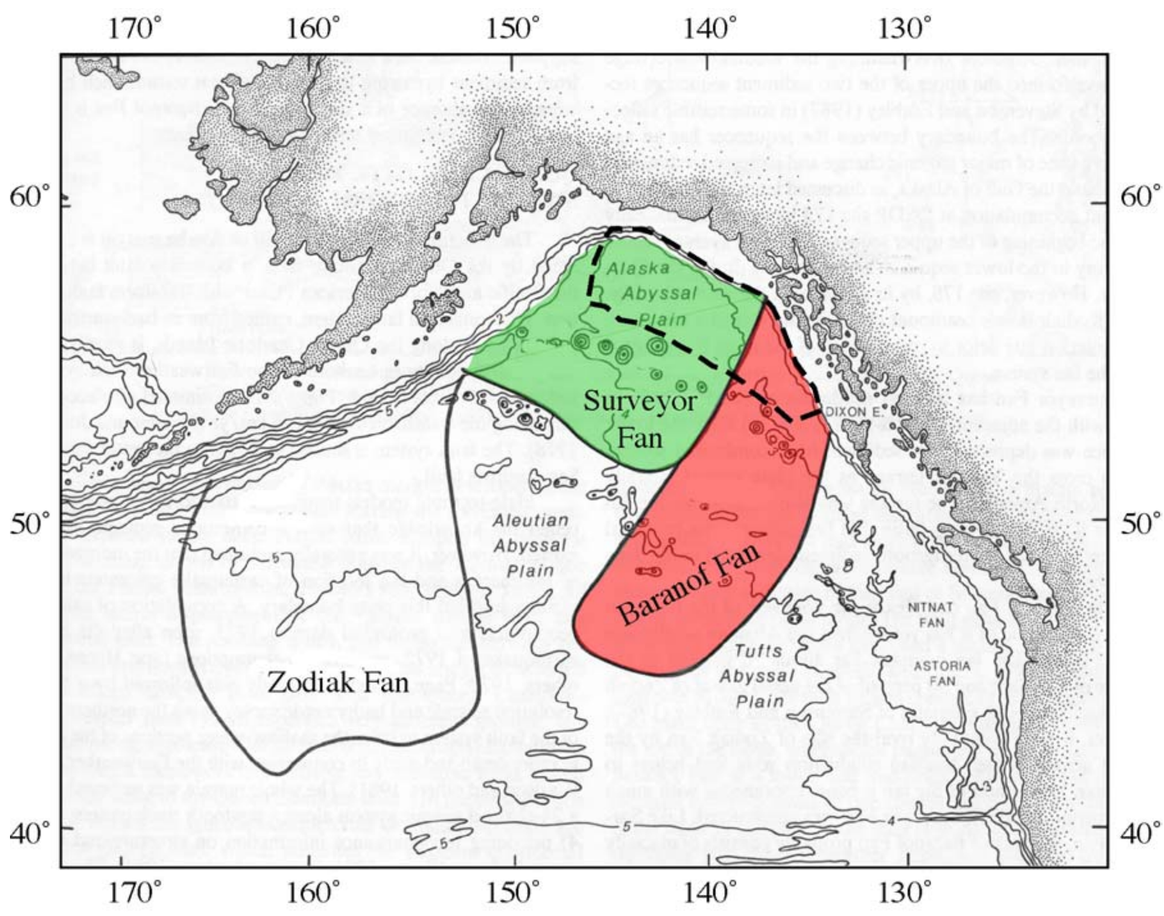

Figure 5. Locations of Baranof (red) and Surveyor (green) Fans relative to survey area (black dashed line). Modified from von Huene (1989).

The Maps

The mapping of the Gulf of Alaska was subdivided into 2 map sheets for generating overview maps of bathymetry and acoustic backscatter (Fig. 6). Each map was gridded with a 100-m cell size because our 10 to 12 kts mapping speed allowed at least 3 sounding to fall within in each footprint regardless of water depth. The maps in Appendix 3 of this report show the combined North and South areas.

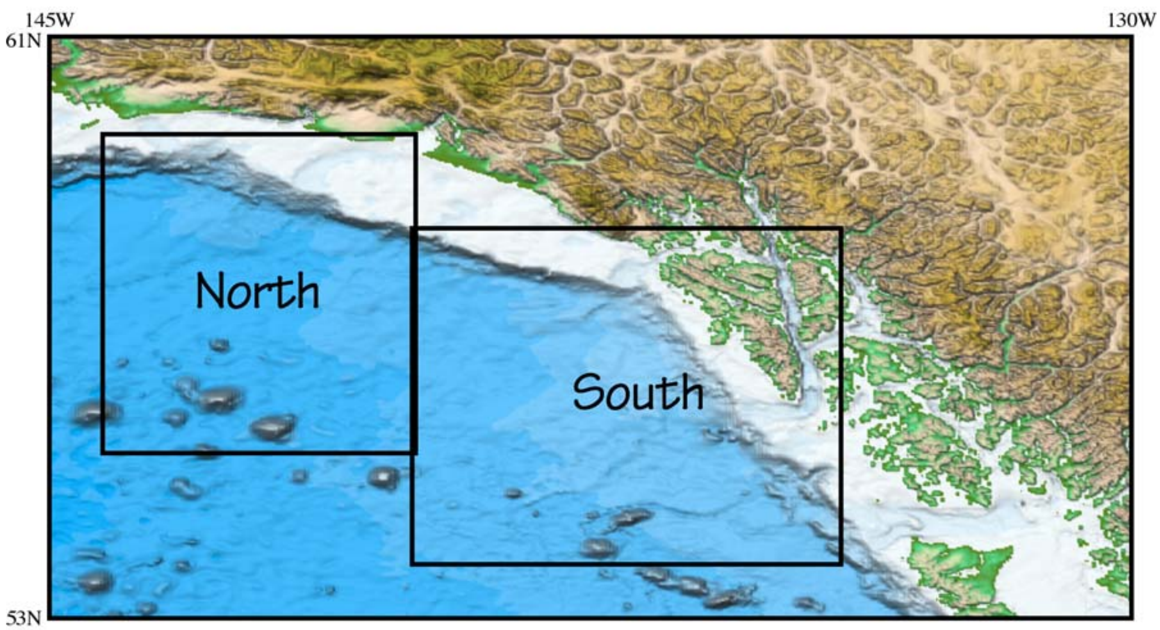

Figure 6. Index of map sheets (see Appendix 3 Figures 30 and 31).

In addition, for convenience in correcting any mapping problems, the survey area was subdivided into 27 small temporary area sheets (Fig. 7) that help to isolate where problems occur during the data-processing stage. These temporary area sheets were also gridded at 100-m spatial resolution. The two map sheets were combined into an overview map of the entire area mapped at the completion of the survey. This map (see Appendix 3) was gridded at 200-m spatial resolution.

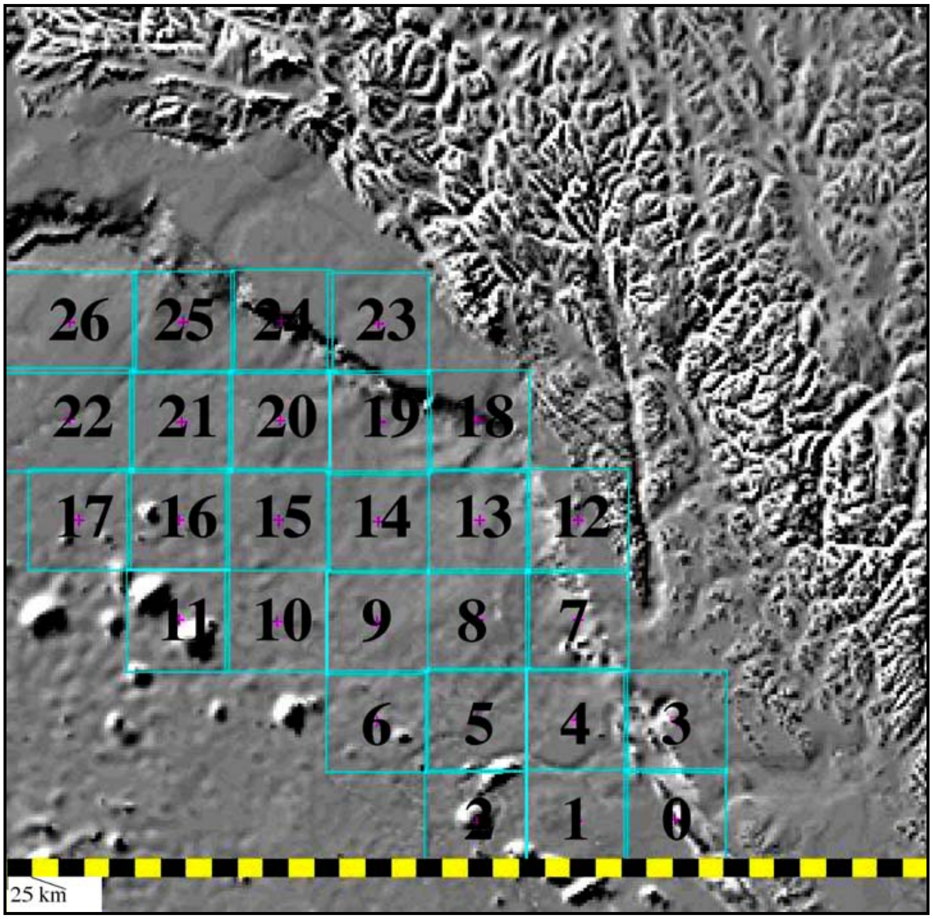

Figure 7. Location of individual temporary area sheets. Number indicates area sheet.

Daily Log Leg 1

June 24, 2005 (JD 175)

The ship departed the berth at Sand Island, Honolulu, HI at 0800 L (1800 UTC) and steamed to the fuel dock in Pearl Harbor. The ship was not fueled prior to the cruise because its deep draft (26 ft) could not be accommodated at the Univ. of Hawaii berth if the ship was fully fueled. The fueling was completed at 1500 L and we steamed out of Pearl Harbor to begin the transit to the Gulf of Alaska.

All of the survey systems (MBES, 3.5-kHz profiler, and gravimeter) were turned on and all but the gravimeter experienced typical teething problems that occur at the beginning of a cruise. The MBES settled down quickly and was collecting high-quality data almost immediately. We did not collect any sound-velocity profiles to conserve XBTs so a profile from the library was used instead. The Knudsen profiler was turned on but did not find the bottom. The ETs started working on it to find the problem.

June 25, 2005 (JD 176)

Continued the transit to the Gulf of Alaska at ~12 kts. The MBES and gravimeter were working but the 3.5-kHz profiler was not working properly. The ETs continued to work on the profiler but to no avail. In addition, the MVP fish had to be terminated and, once completed, it was deployed. However, it quickly shorted out again and had to be re-terminated.

Another problem that continued to crop up was that the heave-accuracy light on the POS/MV display periodically changed to red for a minute or two at a time. The light would eventually turn back to green for a few minutes and then go red again. The ship was experiencing very little heave during these red-light periods and the problem could not be tracked down. The MBES data along the transit line showed no indication of residual heave in the bathymetry, so the problem was not considered serious.

A T-7 XBT was launched at 1600 L to improve the sound speed profile feeding into the MBES. The system requires a new line each time logging is stopped, so a new transit line was started

June 26, 2005 (JD 177)

Continued the transit to the Gulf of Alaska at ~12 kts. The MBES and gravimeter were working but the 3.5-kHz profiler and the MVP were not. Work continued sporadically on both.

We dropped the second T-7 XBT at 1505 L to check on how quickly the water-column structure changes with distance in the middle of the North Pacific gyre (Fig. 8).

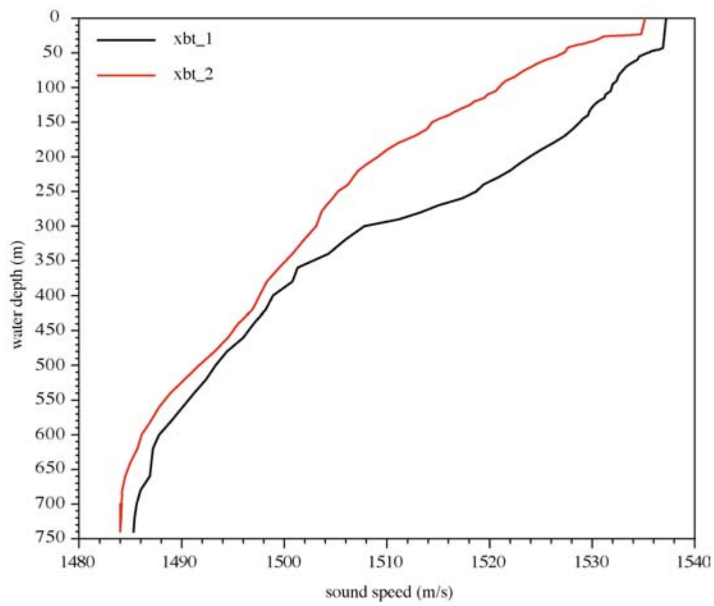

Figure 8. Comparison of two XBT casts 24 hr apart collected during transit to the Gulf of Alaska.

June 27, 2005 (JD 178)

Continued the transit to the Gulf of Alaska at ~12 kts. The MBES and gravimeter were working. The MVP finally worked and one cast to 800 m water depth was made. It appeared to be ready for action.

June 28, 2005 (JD 179)

Continued the transit to the Gulf of Alaska at ~12 kts. The MVP finally worked and made one cast to 800 m water depth. It appeared to be ready for action. We crossed into cooler conditions of both air and water temperatures and fog. So far the breezes have been 10 to 15 kts and no problem. The MBES is working fine and the data across the Pioneer and Mendocino Fracture Zones is spectacular.

June 29, 2005 (JD 180)

Continued the transit to the Gulf of Alaska at ~12 kts.

June 30, 2005 (JD 181)

Continued the transit to the Gulf of Alaska at ~12 kts. We ran the MVP for a 12 hour test, making a cast once per hour to insure all was working properly, which it was.

July 1, 2005 (JD 182)

Continued the transit to the Gulf of Alaska at ~12 kts. The MVP, 3.5-kHz profiler, gravimeter and MBES were all up and running. The MVP made casts once per hour but, because the MBES logging had to be stopped and a new line started for each new SVP profile, the new profiles were not loaded into the Simrad. This procedure of not using the new SVP was used only on the transit.

July 2, 2005 (JD 183)

We arrived at the patch test area at 0800 L (183/1600Z) and hove-to to collect deep MVP and XBT profiles to compare to one another. The conditions were perfect; cloudy and cool, 15 kt breeze out of the SW and 3-ft seas. The ship hove-to and a 3000-m cast with the MVP was made, along with an XBT. The MVP logging stopped at 2000 m so a second deep cast was made. The second cast also did not log beyond 2000 m so the retrieve was logged to see if the system would log at 3000-m depths. The MVP software logged the entire water column from 3000 m to the surface but the profile had lots of excursions, presumably due to ship-motion heave on the cable. This clearly suggests that only the down cast is good for SVPs. A third MVP cast was made after fiddling with the logging settings. The MVP computer continued to truncate the data file at ~2000 m water depth. The retrieval of the third cast tube-locked the MVP fish and it required a new mechanical termination.

The profiles from the 2000-m MVP cast and the XBT cast were virtually identical so we used the 2000-m cast in the Simrad software and continue with the patch test using that SVP. The first patch test line ran up the southern flank of a seamount at 12 kts, followed by a line run down the southern flank at 6 kts. The two lines were used for timing and pitch calibration.

The first run to the NE did not run over the seamount so we offset 10 km to the SE and ran SW to find a steep slope but, because the bridge had already taken one engine off line, we ran the SE line at 6 kts.

The results of the timing and pitch test showed no static offsets were necessary. The next test was to check for any yaw bias. Two parallel lines, offset by 5000 m were run over a channel. The yaw test showed no static bias. The last test was a roll test run over a flat area of seafloor. A +0.05˚ roll bias was found but, curiously, it did not appear to affect the data. No effect was found when a value of –0.05˚ or +0.05˚ was put into the mergeNav script for the value of the –right flag. Consequently, the value of –right was left at 0.00 and the patch test was completed at 1900 L (184/0300Z). We commenced collecting data on the first dip line (gom05_line_1) that runs up the margin.

Dropped beams started becoming apparent on the Simrad Ping Display along dip line 1 (Fig. 9). Typically 10 to 60 beams of each ping were dropped but they were not consistently the same beams and they were not restricted to the outer beams. The signal level was consistently at about –30 dB. The dropped beams did not occur only during periods of severe refractions and they occurred on flat seafloor as well as in rough seamount bathymetry.

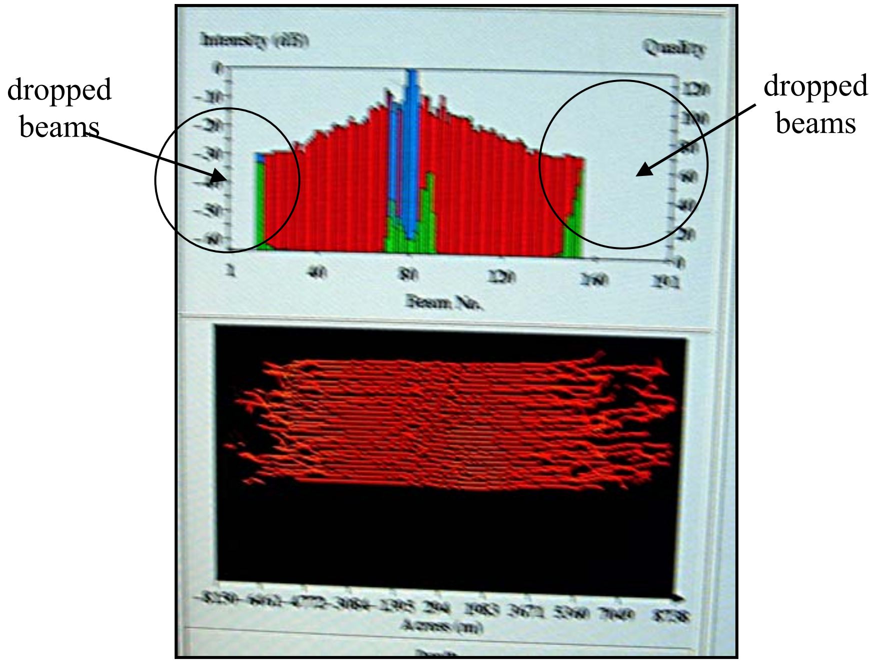

Figure 9. Snapshot of Simrad Ping Display showing 40 dropped beams on a flat bottom. Green bars are Simrad-determined poor quality bottom detection of beams.

July 3, 2005 (JD 184)

Dip line 1 was completed and we transited to the SE to begin the survey. Weather and sea conditions were ideal for mapping. However, refraction was severe throughout the dip line as we crossed into the Alaska Current. Each new SVP was radically different than the previous one and this created severe changes in the bathymetry. At 0600 L (1400Z) the MVP lost signal and had to be recovered and re-terminated. The ship was slowed to 5 kts for the recovery.

The Knudsen 3.5-kHz sounder was a difficult system to keep track of the bottom. The system does not have an auto-tracking function and the digital record is only that which is displayed on the monitor, not the full scale. Consequently, if the bottom depth is outside the limits set on the display, the file does not contain a record of the profile. In addition, the controls are in meaningless units rendering the operator at the mercy of continuous experimentation. The system requires an average sound speed of the entire water column and when a measured mean value is entered the bottom depth is often off by more than 100 m. Operationally, the Knudsen is very frustrating to maintain bottom track and it requires a watch stander minding it 24 hr a day.

July 4, 2005 (JD 185)

Routine day of mapping. Weather and sea conditions were almost perfect. The EM120 seemed to be excessively noisy in these conditions. The signal-to-noise was about –30dB yet the beams from ~<40˚ from nadir were flapping excessively (Fig. 10). There was no indication of refraction in the data but we collected another SVP anyway but the flapping did not go away. The track line spacing was reduced to give 25% swath overlap to help reduce the effects of the flapping outer beams.

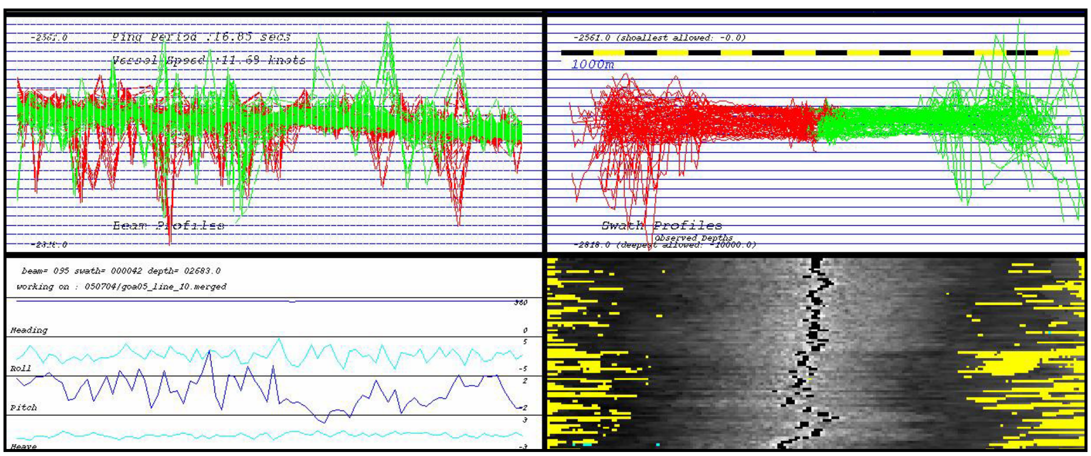

Figure 10. SwathEd screen of typical 60 pings under ideal conditions; no refraction, 140˚ swath, calm seas and relatively reflective bottom. Note the severe flapping of the outer beams and Simrad rejections (yellow area in bottom-right panel).

The dip line crosscheck on the first three survey lines showed that the EM120 was achieving an overall precision of 0.6% but only 83.8% of the data within+/-2 standard deviations (Figs.11 and 12). The MBES system was set to record the full 150˚ swath and the outer beams showed a lot of flapping, presumably because of refraction at the large slant-range distances. XBT and MVP casts were made but they did not improve the outer beams. It was decided not to restrict the swath width to 120˚ yet because the mapping conditions are so ideal.

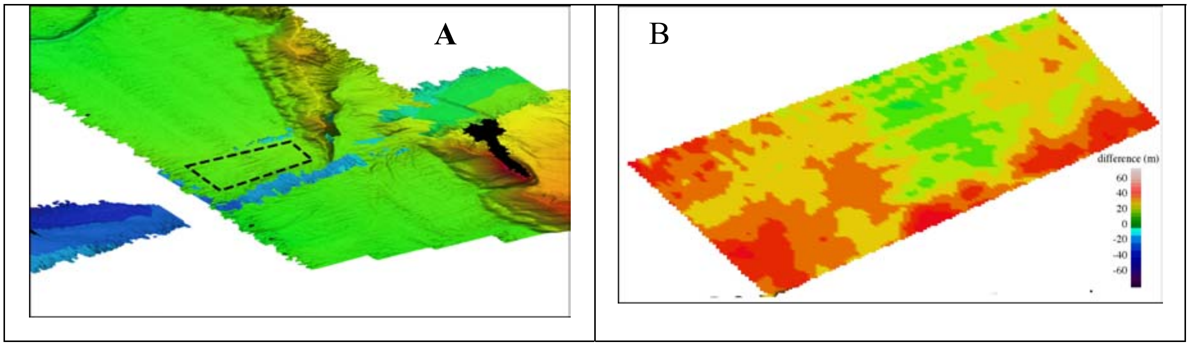

Figure 11. (A) Area analyzed in the cross check. (B) Difference surface comparing dip line 1 to first three survey lines.

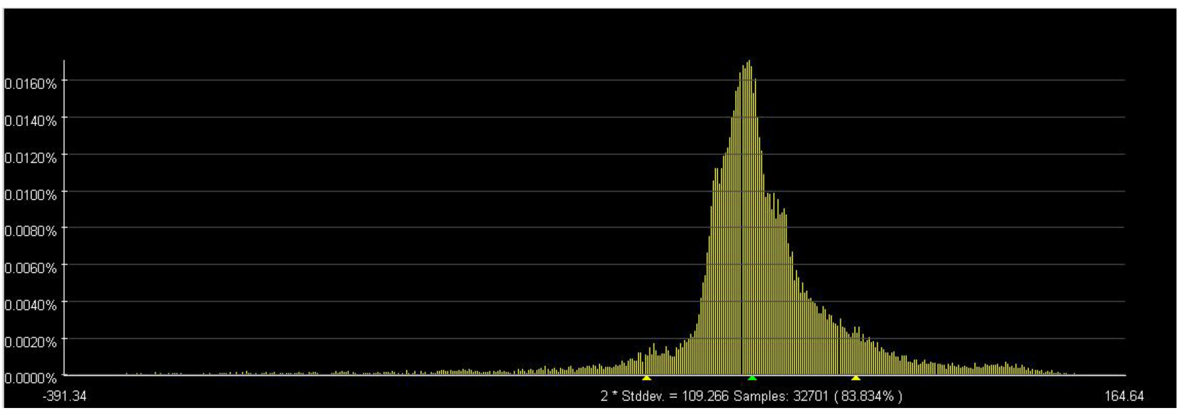

Figure 12. Histogram of sounding comparisons between the first three survey lines and dip line 1.

At 1410 L (185/2210Z the temperature sensor on the MVP died. The ship carried no spare temperature sensor so the MVP became useless for the remainder of the Leg 1 and we relied on T-7 XBTs to measure the water column from here on. At this point in the cruise, we had only enough T-7 XBTs for 4 per day.

July 5, 2005 (JD 186)

The weather deteriorated during the night and the morning brought stiff 25-kt winds from the SE as a significant low-pressure system approached us. The seas were running about 5 ft but the ship was stable and the data quality was good.

The swath width was reduced to +/-70˚ to eliminate the flapping outer-most beams but the data quality did not seem to appreciably improve. The track line spacing was reduced to give a 25% overlap in the hope of reducing the effects of the flapping.

July 6, 2005 (JD 187)

The weather moderated and by morning the seas were down to 3 to 4 ft. Conditions were again nearly perfect for mapping with no ship motion or refraction problems. The noticeable series of beam dropouts became more persistent on Line 12 (Fig. 13). The dropouts occurred at +/-~60˚ from nadir. I went back over the transit data and noticed the dropouts getting progressive worse since July 2. This suggested to us that possibly there is a problem with the EM120 electronics. We ran a Simrad built-in self test (BIST) on the EM120 on the turn to make certain the system was functioning properly. The BIST test required rebooting both the EM120 computer and the POS/MV. We had to steam in a circle to reset the POS/MV and then ran the BIST test for EM120 status. The EM120 passed the BIST test with no errors.

We reset the EM120 runtime parameters to +/-70˚ swath, in-between mode and commenced mapping on Line 14. The line was run for 20 minutes and then put back into equidistance mode for a comparison.

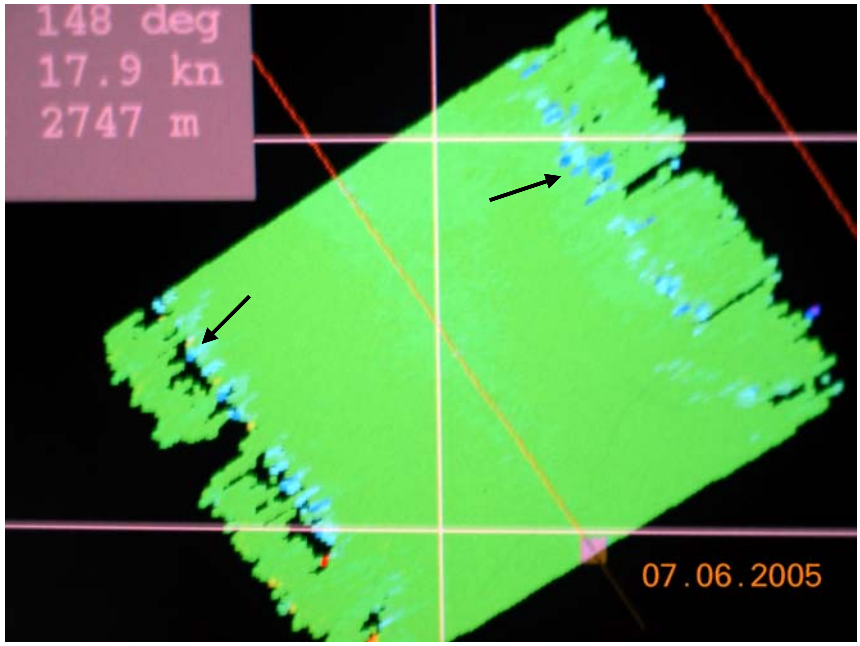

Figure 13. Snapshot of Simrad display showing persistent bad beam at +/-61.4° (black arrows).

Once the EM120 was restarted along Line 14, the data quality was much worse than it was before the BIST test. The Simrad console showed the system was not achieving any bottom detection for each beam and it appeared as if a severe ping-to-ping roll had been introduced to the system. However, the POS/MV did not indicate any ship roll. Line 14 was run for 2 hours and then the file was ended and the data were processed. It was immediately clear that the bathymetry side of the EM120 was not performing correctly. The backscatter image from the 2-hr line 14 looked normal but the bathymetry showed a radical induced roll. The mapping was stopped at 188/0038Z (050706/1630L) until the technicians could figure out the problem.

The problem was isolated to the SPRX board, a board that performs signal processing on the raw data. The board was replaced with a spare and a 2-hr test line was run starting at 188/0414Z to confirm the fix. The test confirmed that the system was restored to the state it was in before the failure. However, the data continued to have numerous (20 to

60) dropped beams on almost every ping, poor Simrad quality flags especially around +/-60˚, and the outer 20˚ of beams (70˚ to 50˚) were very flappy.

Line 14 was rerun and the data appeared acceptable for mapping.

The first block of tracks was completed at 0600 L and we ran a dip line up the margin along the southern border of the second block. The dip line was used as a test line to experiment with various settings on the EM120. Weather and sea conditions were nearly perfect for mapping.

July 7, 2005 (JD 188)

We continued to experiment with various settings on the EM120 to try to determine if the cause of the problems was ship noise. A routine switch of the four engines was made but none of the combinations of port or starboard engines made any difference to the data. Next, various pumps were shut down and again no indication on the MBES data. Dip line 2 was completed and we began to map in the second block. Conditions were ideal for mapping. After experimentation on the dip line, it was finally decided to reduce the swath width to +/-67˚, a compromise between achieving a wide swath and having to deal with flappy outer beams. The data appeared very clean at a swath width of +/-67˚.

July 8, 2005 (JD 189)

Routine day of mapping. Conditions nearly perfect for operations. We continued to run tests on the EM120 during turns. Our main efforts were to locate and document and any ship-related noise. We found that the system seemed to shift when the water depth increased to ~1450 m from a full +/-75˚ swath to a +/-65˚ swath and dropped beams began to appear. We eliminated any affects from the Knudsen 3.5-kHz profiles.

The Captain reduced the ship speed to 11 kts (from 12 kts) to conserve fuel. This was a puzzling decision because we were told by the Univ. of Hawaii Port Captain that a survey speed of 12 kts was fine, as well as the Captain told me several times during the cruise that we were doing fine on fuel.

July 9, 2005 (JD 190)

Routine day of mapping. Conditions nearly perfect for operations.

July 10, 2005 (JD 191)

Routine day of mapping. Conditions nearly perfect for operations.

July 11, 2005 (JD 192)

Routine day of mapping. Conditions nearly perfect for operations.

July 12, 2005 (JD 193)

Routine day of mapping. Conditions nearly perfect for operations. Although refraction was not a major problem to this point, the water column changed enough that we continued to use about 4 XBTs each day.

July 13, 2005 (JD 194)

A low-pressure disturbance moved in over the area and the winds came up to 20 to 25 kts and the seas to 6 to 8 ft. The ship rode the seas smoothly during the day and the data quality continued to be excellent. However, by evening the wind had increased to 30 kts and the seas had continued to build so the ship slowed to ~9 kts when heading SE to reduce the pounding as we steamed into the seas. The data quality continued to be good through this motion.

July 14, 2005 (JD 195)

The winds continued through the night making for a bumpy ride. However, the data quality continued to be good. A speed of 11 kts was maintained while steaming to the NW.

July 15, 2005 (JD 196)

Routine day of mapping with diminishing seas and winds throughout the day.

July 16, 2005 (JD 197)

Routine day of mapping in nearly perfect conditions.

July 17, 2005 (JD 198)

Routine day of mapping. We had a 20 to 25 kt wind and 5 ft sea on our port quarter that produced rolls and pitches of ±5˚. This motion showed up in the data, but well below the 0.5% of water depth.

The data continued to be vexed by dropped or poor quality beams in beams 10 to 25 and beams 160 to 175. There has been an increasingly noticeable roll artifact (below the 0.5% water depth) that seems to correlates with the maximum rate of change in pitch. The artifact is most noticeable during large ship motions but it is apparent even when there is little or no ship motion.

The mean water depth reached ~3100 m so the swath width was reduced to ±62˚ at 198/2004Z to trim the increasingly raggedy outer beams. The dropped and bad-quality beams followed the reduced swath width and continued to show up for the same beam numbers.

July 18, 2005 (JD 199)

Routine day of mapping with 20-kt winds and 5- to 7-ft seas on our port quarter. The winds died down during the early afternoon but the seas did not. The data continue to be OK.

Crosscheck analyses were made each time we crossed Dip Line 2. The analyses all showed that the precision of the soundings were ~1% of water depth, although the significance of the analyses is doubtful because of the problems encountered with the EM120 while collecting Dip Line 2. More reliable analyses will be made after collecting Dip Line 2.

July 19, 2005 (JD 200)

Routine day of mapping with 15-kt winds and 3- to 5-ft swells on our beam. A depth artifact started occurring on Line 50. The soundings from the outer beams along the entire NE side of the line are 3 to 15 m below the soundings from the overlapping adjacent Line 48 (Fig. 14). There appears to be a subtle increase in artifact amplitude with time. This artifact created a sharp gutter along the join of the two lines. Both lines were checked for refraction effects but none were found. After puzzling over the potential causes of the artifact, we decided to run the next line and then reanalyze the data.

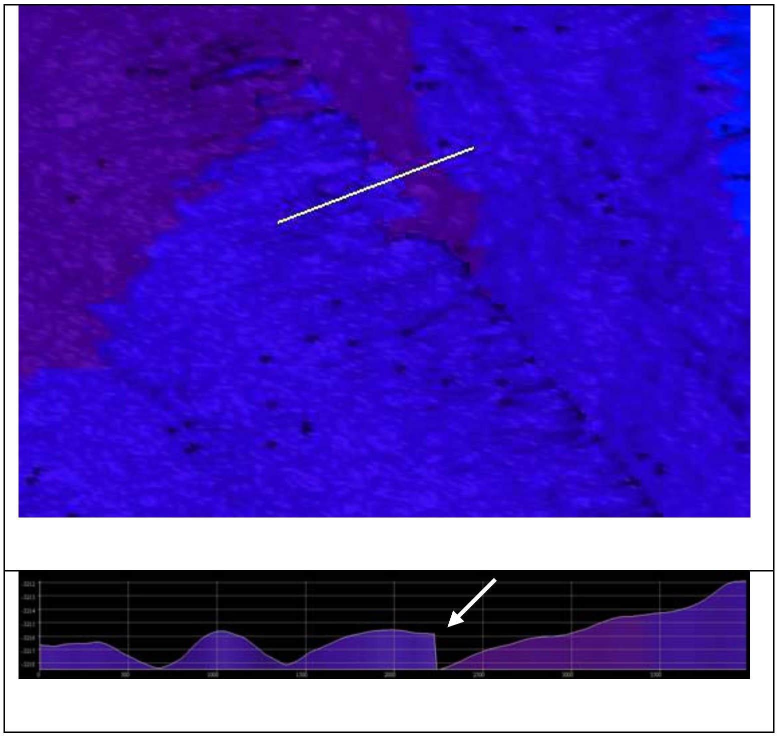

Figure 14. (upper panel) DTM of Line 50 (lower left) gridded with Line 48 (upper right) with profile (white line). (lower panel) Profile crossing the overlap of Line 50 and 48 showing a sudden 12 m offset in depths.

Line 51 was run and processed and the DTM showed a pronounced static roll (Fig. 15) that was determined by using *swathed –locate* to be a –0.15˚ static roll. This artifact has appeared over the last few lines because it was not apparent earlier in the mapping of this block; consequently, it appears to be either water-depth related or is getting progressively worse with time. The lines were independently processed with CARIS HIPS and the same static roll was found.

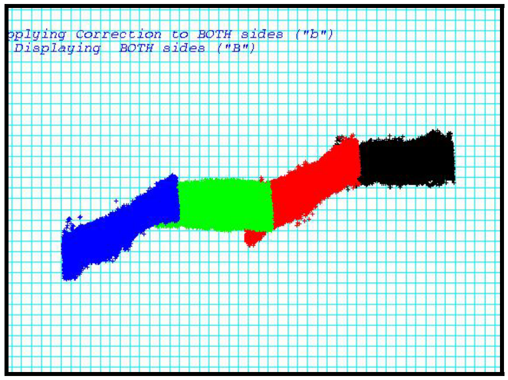

Figure 15. Analysis of +0.15° static roll. Each color is a separate line.

The files were reprocessed using *unrollOMG –draft 8.3 –roll_offset 0.15* and the artifact was removed.

July 20, 2005 (JD 201)

The bridge and lab navigation computers malfunctioned during the night and started reporting erroneous positions on the screens. However, the navigation data were properly recorded and no data were lost. Rebooting the bridge and lab navigation computers eventually corrected the problem. Routine day of mapping but the +0.15 static roll continued to show up and had to be corrected by reprocessing each line.

The gravity meter froze up at 0411Z. The cause of the freeze-up was not immediately apparent.

July 21, 2005 (JD 202)

Routine day of mapping in ideal conditions; no wind or swell, flat seas and warm temperatures. We completed mapping block 2 at 1200 L and started Dip Line 3. Figure 16 shows the locations of all 76 XBTs collected in mapping blocks 1 and 2.

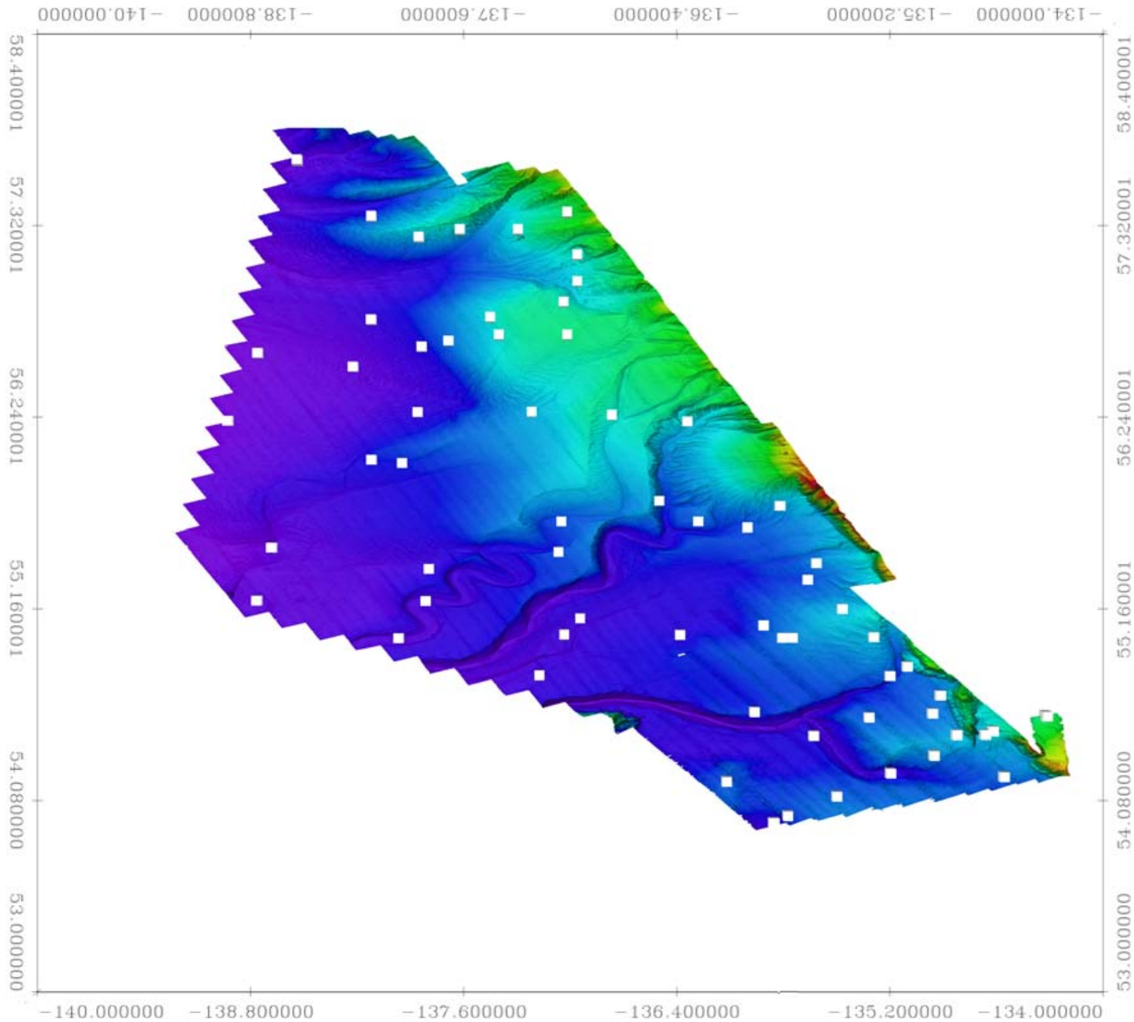

Figure 16. Location of XBTs (white squares) taken in mapping blocks 1 and 2.

The velocimeter that measures the sound speed at the transducer was replaced during a turn between Lines 53 and 54 to see if that makes any difference in the performance of the EM120. It did not, thereby removing the surface sound speed as a factor in our problems with the EM120.

We made a full 270˚ turn onto WP54 for the transit to Dip Line 3 so that the POS/MV could adjust the GAMS just in case it had drifted off.

It was decided to use Dip Line 3 to also test out various settings to try to isolate the cause(s) of the problems with the performance of the EM120. Weather and sea conditions were nearly perfect for the test; no wind, 1- to 2-ft swells, no pitching or rolling. The tests on Dip Line 3 (Line 58) were run with the settings shown in Table 1.

Table 1. Settings and times for dip line 3 test.

day	Time (Z)	Line	swath width[1]	beam spacing	Pitch stabile	Yaw steering
050721	2220	goa05_59	+/-75°	in-between	on	on
050721	2320	goa05_59	+/-65°	in-between	on	on
050722	0024	goa05_59	+/-60°	in-between	on	on
050722	0128	goa05_59	+/-75°	in-between	off	on
050722	0220	goa05_59	+/-65°	in-between	off	on
050722	0320	goa05_59	+/-60°	in-between	off	on
050722	0420	goa05_59	+/-75°	in-between	on	off
050722	0453	goa05_59	+/-75°	in-between	on	on

[1]angular coverage set to auto

It was clear after the last test that yaw steering made a significant difference in the quality of the data, but it did not affect the presence of dropped/poor quality beams. Earlier testing of the mode (equiangular, equidistant or in-between) showed absolutely no affect on the dropped/poor quality beams. In fact, none of the settings in Table 1 made any difference in the presence of dropped/poor quality beams. Consequently, the test was terminated at 050722/0453Z and the system was set at ±75° with both yaw steering and pitch stabilization on and in the in-between mode for the remainder of the dip line.

The gravity meter was brought back up at 1031Z but there will be a small tare in the data from JD201/0411Z to JD202/1031Z.

July 22, 2005 (JD 203)

Dip line 3 was completed during the night and a line was run to the SE to start the first, shallow water, line of the third mapping block. Unfortunately, the night watch made a decision not to log the SE line so no data were recorded. The first line of the third mapping block (Line 61) commenced at 0630 L (1430Z). The EM120 was configured for a ±67˚ swath, in-between mode with both yaw steering and pitch stabilization on. Conditions were nearly perfect for mapping with no ship motion at all.

The Knudsen profiler went down for repair at 1600Z and was back online at 1900Z.

At the request of Simrad, we switched out the SPTX with the spare on a turn, but the spare was bad so the original SPTX board was replaced. The system was rebooted and the dropped beams, to a large degree, disappeared. The bad quality Simrad flags continued to show up but not the dropped packets of beams. However, the EM120 was still not achieving the specified swath width of <5 time the water depth in these depths. We were getting a swath width of ~3.5 x water depth in 3200 m depths.

July 23, 2005 (JD 204)

Routine day of mapping under ideal weather and sea conditions. The swath width was reduced to ±60˚ because the outer beams became very floppy in the 3100+ m water depths we were mapping in.

July 24, 2005 (JD 205)

Routine day of mapping under ideal weather and sea conditions. The internet connection went down during the night, leaving us unable to communicate with the shore other than satellite phone.

July 25, 2005 (JD 206)

Routine day of mapping. The weather deteriorated and by morning there were 25 kt winds and the seas were building. The sea state produced ±5˚ of both roll and pitch to the ship. The water depths were generally >3200 m and the EM120 was struggling to get decent bottom detection at ±60˚. Our internet connection was still down so we were unable to discuss this continuing EM120 problem with Simrad or the Univ. of Hawaii.

By late afternoon the wind and seas had abated and we were back to mapping in 10 kt winds and 3 to 4 ft seas with only ~2˚ roll and pitch.

July 26, 2005 (JD 207)

Routine mapping. The day started out calm but the wind increased to 15 to 20 kts in the afternoon. However, there was still little ship motions because of the wind and swell. A hull-mounted ADCP (acoustic Doppler current profiler) provided real-time maps of subsurface current structure and it was clear from these maps that we were traversing in and out of a tight anti-cyclonic eddy with a temperature difference of >1˚C (Fig. 17).

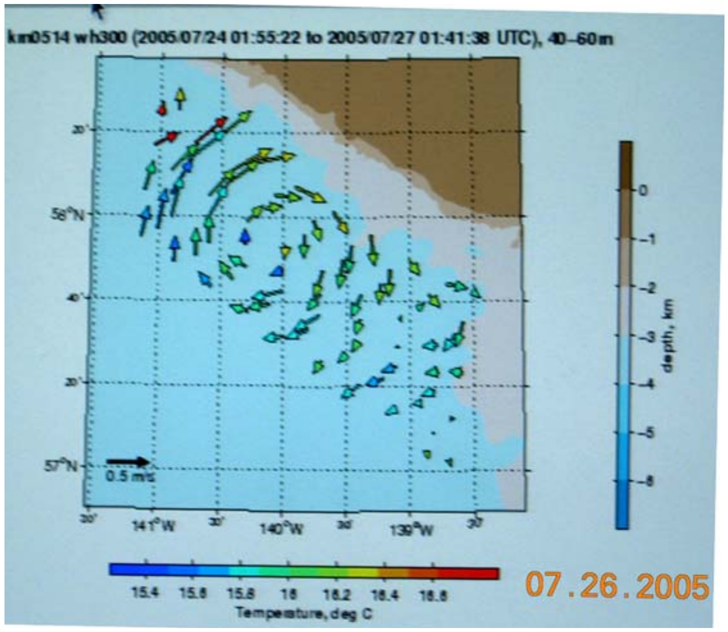

Figure 17. Screen shot of ADCP showing anti-cyclonic eddy that plagued us for the last week of Leg 1.

July 27, 2005 (JD 208)

Routine day of mapping. The wind was blowing a steady 15 kts all day which gave us a ±5˚ roll and pitch. However, the data were still of good quality, although we were still required to keep the swath at ±60˚.

The last line of Leg 1 (Line 75) was completed at 1930 L and we started the transit to Kodiak, AK. We continued to collect all data alone the transit line using ±75˚ swath width, equiangular mode. The Knudsen chirp profiler was secured at the end of the survey line.

Nineteen XBT casts were made in mapping block 3 (Fig. 18).

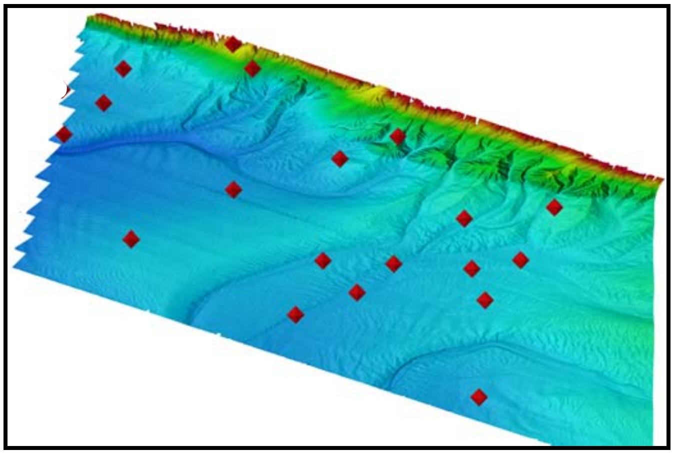

Figure 18. Location of XBT casts (red diamonds) in block 3.

July 28, 2005 (JD 209)

Transited all day to Kodiak, AK, collecting gravity and EM120 data.

Daily Log Leg 2

July 29, 2005 (JD 210)

Arrived Kodiak, AK at 0800 L. Abu Mustapha, Brian Calder, Tony Withers and Andrew Gagnon (SAIC) arrive on board.

Note: At this point the style of the narrative changes reflecting that of the Leg 2 scientific staff.

July 30, 2005 (JD 211)

Set up the network for the ISS-2000 line planner in the main computer lab, 1800Z. The system data collection is going on over VLAN1 (192.168.1.x), while main ship's network is going out over VLAN2 (192.168.2.x). VLAN3 (192.168.3.x) appears to not be used. The POS/MV controller is running separately on a cross-over cable to the primary controller, with a separate serial stream out to the EM120 (according to the configuration). This means that the system cannot be controlled or monitored from the ISS-2000 as currently specified. Discussed situation with the ETs on board, and determined that it was OK with them to put in a 10/100bT switch in the connection from the POS/MV topside (green) box to the controller server, and then repatch to the controller with a new Ethernet cable. We will then go through into this new switch with the cable from the ISS-2000. This should allow the POS/MV to remain on a separate Ethernet, as required, but also allow the ISS-2000 to be connected so that it can talk to the POS/MV and log data as required. The only concern is whether the 10/100bT switch available (a LinkSys) has the cross-over capability on the uplink port but was tested and appears to work OK – the POS/MV controller on the ship's system still reports information, and the ISS-2000 now also reports information on the state as expected.

Discovered that there is a difficulty in getting both this private network to the POS/MV and the ship's VLAN1 to work because they are both on the same network address group (not normally a good infrastructure choice). To resolve this, the sub-net mask was made for the POS/MV private network link on the ISC 255.255.255.254, which instructs the rest of the system not to send anything except traffic for 192.168.1.80 and 81 to this port (there is nothing on either of these that we need to talk to: 192.168.1.81 is the local end of the connection at the ISC). Hence, when pinging 192.168.1.22 & 23 (the MBES systems), the network traffic gets routed to the other Ethernet connector (that is configured as usual with sub-net mask 255.255.255.0 so that it can see 192.168.1.x), and we can now see the other systems on VLAN1 (previously they were hidden because traffic was being routed to the wrong Ethernet controller). Note that this only works because the POS/MV broadcasts its information, so that we still receive it even with the sub-net mask turned almost off. All that the POS/MV controller software on the ISC is doing is filtering the broadcast packets so that it only listens to the incoming data from (private) 192.168.1.40, the POS/MV topside box.

The helm display was set up next to the rest of the monitoring gear in the front row of switches so that the information from all sensors are available in the same place. After seeing the bridge, it was concluded that there is no place to put the helm display; therefore, it is probably best kept in the lab for now. Set this up to be a separate network from the ship's with an Ethernet from the back of the ISC to a GBit switch next to the Raytheon fathometer display, and then a cable to the CCOM laptop. Configured the ISC port to be 192.168.10.1, and the laptop to be 192.168.10.2. System appeared to be working fine, but over the course of the day, it developed a problem that caused the Ethernet card to disappear from the configuration, and then the computer to freeze during subsequent testing. As of 2230Z, the system does not appear to boot, and the inbuilt LCD does not appear to be energized. External display is likewise unresponsive. Laptop appears to be dead and we may have to do without a helm repeater unless another machine can be found and reconfigured.

ISC was configured to talk to the POS/MV and through an expander cable, hooked into the 1PPS and confirmed to synch to the signals. After synchronization, ISC's TAIM application reported synchronization at less than 2 μs, and average time difference on the order of 20 ms between input time and system time. POS/MV was reconfigured to output the appropriate messages on the Ethernet interface for ISS-2000. Original configuration was to log packets 1, 2, 4, 5, 101, 104, 111, 10001, 10101, 20101 and 20102 at 200 Hz. Final configuration was to log packets 1, 2, 3, 11, 102, 106, 107, 108, 111 at 50 Hz.

POS/MV controller still shows a significantly higher load average than might be expected, ~74%. This appears to be weakly correlated with the logging frequency, since it had been ~84% before turning the logging down from 200Hz, but is still higher than might be expected.

The serial repeater set was configured to report GGAs from the navigated solution showing in the real-time display onto COM6 on the ISC digi-board expander at 4800 8N1 at 1Hz. Tested on SAIC laptop and appears to match the data reported in the real-time display.

From the SABER processing done by the ship-board staff during Leg 1, it was found that a PFM grid was available for all of the area covered. Using the SABER conversion tool, a coverage grid was prepared and then transferred to the scratch space on the ship's SNAPserver (\\192.168.1.14\scratch). This was copied to the support directory on the ISC associated with the project (E:\support\coverage\<project>\layers) and renamed to have a *.cov extension. So prepared, the coverage grid is offered as background for either planning or real-time acquisition, although new data will not be further incorporated. This is not the route normally taken for generating coverage grids, and the update function will need to be tested later. Note that the real-time module is configured by default to use automatic UTM zone determination. Therefore, if the coverage grid is in a different zone from the ship, it can appear to draw in the wrong place – essentially, it is drawing at the right coordinates, but one zone over. This can be resolved using a disable switch in the configuration option. The procedure is to enable the automatic determination, get to the appropriate zone, and then disable the feature again. This locks down the zone and the coverage grid.

Larry Mayer and Doug Wood (NOAA) arrive on board.

July 31, 2005 (JD 212)

In port in Kodiak – much of day spent ferrying people to and from airport -- Jim, Srinivas, Hugo and Clive departed. Mark Van Waes and Duane Fotheringham (Simrad) arrived.

Have decided to set up CARIS processing laptop to also run OziExplorer. We will mount the scratch disk on all machines through the network and put the RAID array on the CARIS laptop but make it a shared disk. Gabe briefs all of us on Simrad problems – Duane has also brought a Seapath IMU to provide check against POS/MV if problems are arising from POS/MV. Duane will check over settings and set up the Seapath but basically wait until the test trip to see how system performs.

August 1, 2005 (JD 213)

In Kodiak. Most of day spent continuing to set up systems and train the new crew. Mark, Brian, Larry and Doug (only U.S. citizens) trained on use of ISS-2000 by Andy Gagnon of SAIC. Larry switched Dell Precision (Flipper) to serve as CARIS processor and OziExplorer display and general PC access to cruise report. Moved the RAID array and other 250 Gig (Metal Gear Box) external drive as well as Larry's small Lacie directly on that. Mounted HIG's scratch drive (192.168.1.14) on Flipper. Mapped each of those drives on Jim and Larry's M60's – (Seagoing PC = Jim's and Fugu= Larry's). Jim's PC will now become the dedicated Linux box.

August 2, 2005 (JD 214)

Departed Kodiak 1400L – completed safety meeting with the Capt (1000L) and then held the first science meeting. Presented overview of goals and plan and then got down to details of processing flow and responsibilities. Duane fired up the Simrad EM120 leaving port. Observations:

1. Real-time coverage plot is working fine. Duane (Simrad) suspects that too large an area was requested (must save memory for entire area) which caused crashes. Can also just show hatch marks no matter what size array – View/show/coverage.

2. Learned that HIG does not have license to Neptune but basic acquisition software does include line-planning software and grid coverage. Later learned that they actually do have a Neptune license but that the Sun workstation that has the license no longer has Neptune on it – bottom line – there is much confusion about what they do and don't have.

3. HIG personnel seemed to pay no attention to Simrad file names (the original .raw) – these appeared to be set by computer that will create duplicate line numbers but always unique names. HIG seems to fix this when they copy to .mb56 file.

4. HIG personnel knew nothing about the stave display

Duane replaced the power amp – he does not believe that this is the root of the problem but the installed one didn't power up. Tim says this happens sometimes. We are keeping the old one just in case but running with new one.

Duane started the systems (both EM1002 and EM120) immediately upon departure. Both systems working – EM1002 beautiful. EM120 – ok but water still very shallow (100 to 150 m). Stave display is showing occasional high noise bands across all staves. Not always at the same range but generally mid-range.

Transited to the area where the outer-beam problem started. Sixty-two dB noise level in the middle swath and about 70 dB in the outer beams and Duane (Simrad) thinks it is due to weather conditions. Duane thinks that EM120 is designed for a noise level of 49 dB. Sea was pretty rough (Sea state 3 to 4). Winds 25 to 30 kts from the east (e.g., we are heading right into the sea). Knudsen is off while data is being collected with EM120 and EM1002. EM1002 data showing severe refraction so the first XBT was launched but didn't seem to have much of an effect. We were still in just 90 m of water so not concerned for now.

August 3, 2005 (JD 215)

Continuing to steam along the track that Leg 1 took into Kodiak – water getting progressively deeper and still no sign of bad beams or severe wobble despite bad weather. All in all, the system was functioning as per spec for this water depth and weather conditions. Crossed over the trench wall to >4 km depths and still no problems – but we also noted that there were no severe beam losses on Leg line until further east (see Figure 19). Keep steaming east to the area where beam loss was obvious on Leg 1 – still no problem. We will now try all peripherals – e.g. ADCP, Knudsen, and will exactly duplicate their filter settings.

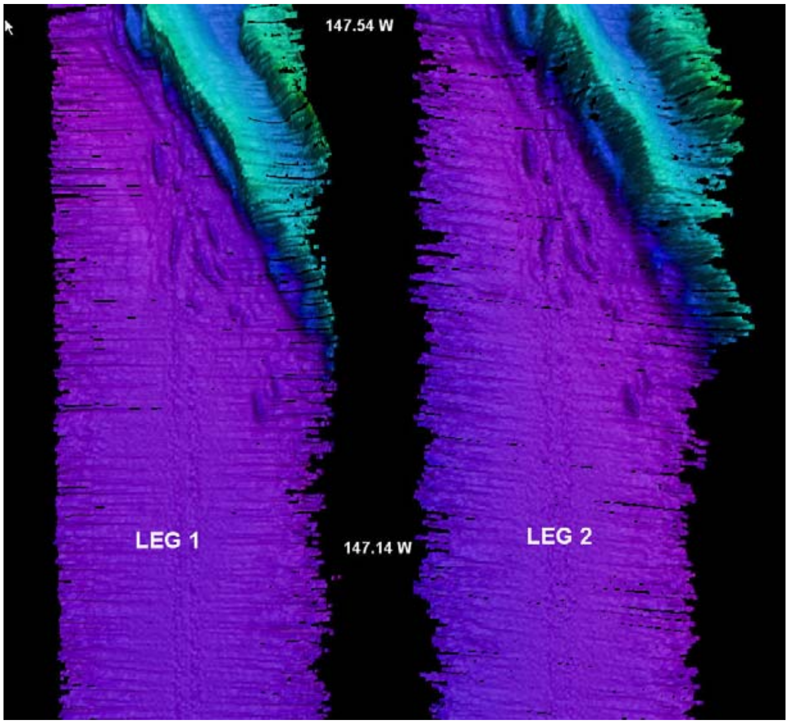

Figure 19. Comparison of Leg 1 and Leg 2 data in 4800 m of water just seaward of trench.

The interference filter seems to make a difference – it was off during Leg 1 – designed to remove any interference – either other equipment or multiple. This was set to 0x86 = $1000\ 0110_2$ = 134_{10}. This appeared to not change anywhere during leg 1.

INTERFERENCE FILTER – if second bit set to 0 = off 1 = on

SPIKE FILTER xxxx xx00 = off, 01=weak, 10=medium , 11=strong

0000 01xx = slope filter on

xxxx 1xxx = sector tracking on

0xx0 xxxx = range gates normal, 0xx1=large, 1xx0=small

1xx1 xxxx = range gates on

xx1x xxxx = aeration filter on

x1xx xxxx = interference filter on

Manual notes that recommended setting is interference filter OFF – so Leg 1 had in suggested mode.

Even with the interference filter on, the problems seem to be present (Figs. 20 and 21) – they are unquestionably related to interference from the multiple – we have a very hard bottom here. Perhaps the very rough weather *en route* suppressed the intensity of the multiple but now that conditions are calming down a bit we are seeing it more pronounced. Duane will log some more data and then start swapping boards.

Now in the area where Leg 1 had bad dropped beams problems. Unfortunately we are seeing the same thing – with our without the interference filter. Duane is now swapping boards. First board to swap is the SPTX board. Data looks better. We are swapping back to the old SPTX board to see if it degrades again. Will run back on our line and see how data look. If OK will proceed with CTD and XBT before patch test.

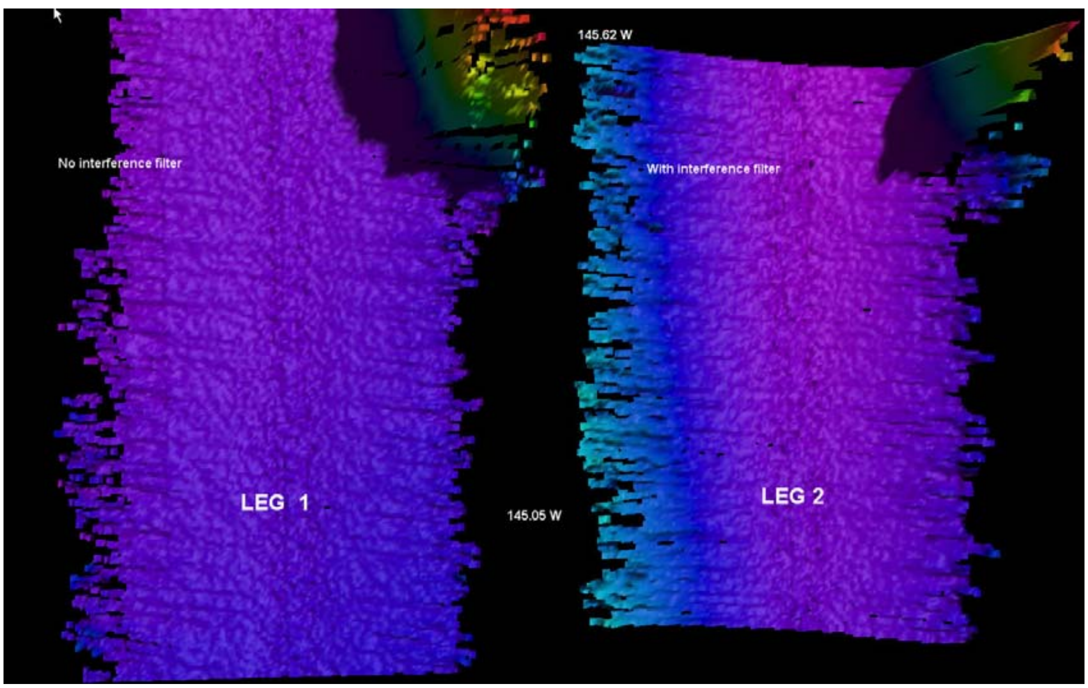

Figure 20. Comparison of Leg 1 without interference filter to Leg 2 with interference filter.

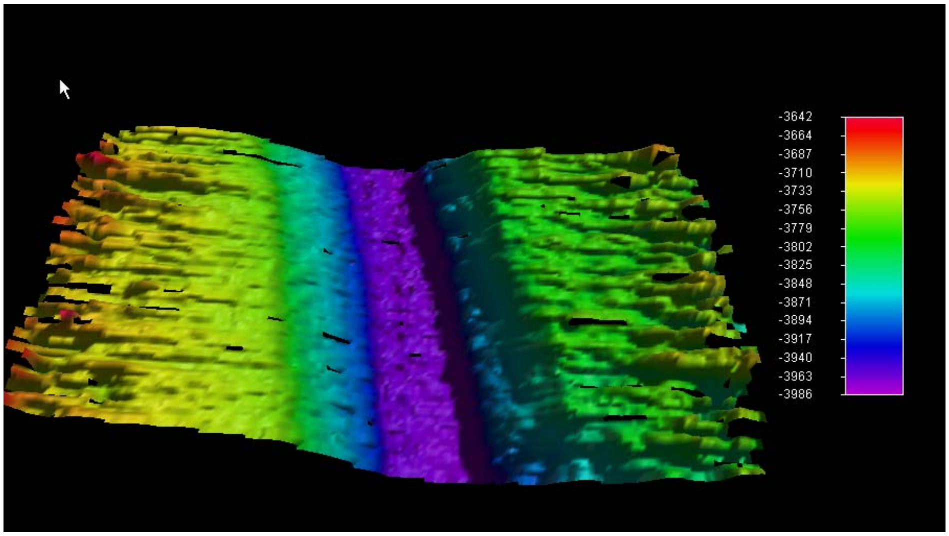

Figure 21. Data collected with new SPTX board, in 3800 m of water, show no improvement over Leg 1 results.

The POS/MV had been showing 'Accelerometer Bias Error' lights for most of the day, and matching 'IMU Status: Warning' on the POS Controller software. Reverse direction to head back to the site for CTD has caused this to reset to nominal operation: warnings are now gone.

Final test was to swap out the SPRX – this seems to make no difference – if anything it made the problems a little worse – probably because the new software update is not fully compatible with other software installed. Will head just west of channel for CTD and XBT – then patch test.

2100 – 2330L -- CTD taken in 3740 m of water at approx. 57 42.0N 144 42.8W. CTD 20050804-051727 – applied to EM120 before patch test.

Roll BIAS test showed a roll bias of 0.10˚ – done independently with Simrad and CARIS software (CARIS showed 0.07˚ whereas Simrad was easier to read). The Simrad system already had a -0.3˚ bias set in – the adjustment will be made to the Simrad system so the new roll bias adjusted in the raw.all file will now be -0.2˚.

0225 L - -began the latency and pitch test – crossing channel at 320˚ at 10 kts.

0255L – end 320 – line turn to reciprocal line at 10 kts

0343L – end 140 line turn back to 320˚ at 5 kts

Pitch and latency show no change to Simrad values.

Steamed to start of dip line – we will run north on the dip line and see how things look. Simrad (Horten) called and wants Duane (Simrad) to do a major stave analysis that will take about 10 hrs with the MBES down – we could do this enroute to Cordova.

0920L Started up the ADCP's

0951L – Started dip line – goa05_line76 (dip4). Line showing many of same problems as Leg 1.

2023Z Started of testing for problems with EM120. Duane shut off the EM120 and then swapped to 2°x2° mode in order to isolate half of the transmit array – will run like this for a while to see whether there is any significant difference. Logging again 2026Z.

2205Z Previous test did not appear to have resolved the problem. Stopped logging at 2205Z to switch to 2°x4° system in order to do the same test on the receive array. Started logging 2209Z. Meanwhile, Duane will get ready to swap the cabling to the front and back of the transmit array so that we can go back to 2°x2° mode, but using the back of the transmit array. Duane notes that this will generate some distortion in the data, because the beam forming, etc. expect that the array is in one place, whereas we're working with only half of the array. However, this shouldn't be a significant problem – he's done this before and it worked out OK.

2229Z Now 12-hrs since last XBT, so requested a new profile for comparison. XBT at 2249Z shows a mixed layer at 1505 m/s to approx. 25 m depth and then a steep thermocline to 1470 m/s above 35 m depth, much the same as the previous cast. Thereafter, the profile follows basically the same shape as the previous XBT cast to depth. Applied by HMRG 2255.

2258Z Break line again – previous test showed no significant improvement. Duane now switching to 1°x2° system and swapping the transmit-receive boards to see if this changes or improves things. Pinging again 2315Z.

August 5, 2005 (JD217)

0013Z. Conclusion is that last swap did not significantly improve things. Therefore, logging stopped to allow Duane to replace BSP (Beamformer Signal Processor) cards. Top card swapped to bottom slot, and top slot replaced with a new card. Sounder sub-rack with controller PC failed to boot at all. Cards replaced as originally installed, and started troubleshooting. System finally woke up after reseating the ROM board but it was back to sub par performance.

0220Z. Captain reports that the port side engine has a mechanical problem that causes it to arc at the commutators. Suggestion is that this might cause the system to spread some noise either electrically or mechanically either through the hull, cables or water path to the EM120 that is also in the port pontoon hull. Engine secured temporarily, and recording data to see whether this is significant or not. Observation at 0234Z indicates that there is not significant difference with the engine off. Returning to both shafts.

0307Z. Swath reduced to 58° in order to test if the problem really is multiple related; if it is, then the problem should completely go away. Although the data got better, the problems didn't really get resolve and the reduced swath severely limited the survey performance.

0411Z. Meanwhile, Duane noticed that the problem had occurred on previous data – including some data when the ship was just out of dry-dock after the TX array refit. This seems to imply more clearly that the problem is one of transducer misconfiguration rather than a new hardware problem that has developed recently. This implies further that the full stave-by-stave checkout is a good idea. This will take place at the end of the dip line. In the meantime, Duane secured logging in order to swap back to a 2°x4° system in order to change out the Transmit-Receive boards – at 4°, only one is used, so if one is faulty, this should show up clearly.

0433Z. No significant difference from last test. Back to 1°x2° for now.

0509Z. Manual mode on EM120 to test whether power is significant. This reduces the swath-width, so it looks better, but of course it is just because we are looking at less of the seafloor. There is no significant improvement – the problems are still there, they are just reduced.

0510Z. At Duane's request, secured power to Knudsen and ADCP to see if this makes a significant difference. Some improvement was observed, although still not significant. Passed the 2500 m isobath around 0545Z, and, just like magic, the bottom tracking on the EM120 started to fail coming up the slope, and much of the side-wall of the 2500 m isobath was not detected. The failed beams all came from the amplitude section of the swath, and showed no energy returning at all, despite all attempts to remove filters, etc.

No apparent reason for this was seen – once up on the ridge, the beams re-locked to the bottom and continued to operate as before.

0605Z. Now at ~1590 m and data is just beautiful … Applying power to the Knudsen and ADCP to see whether they are a contributory factor. No significant evidence of these being a problem in water this shallow.

0636Z. End of dip line and moving to waypoints for EM1002 survey eastward (dipline.route on C-MAP, waypoints #3 and #4). EM120 logging stopped 0646Z for scheduled down-time. EM1002 started at WP#2 and logging. ISS-2000 GSF name incremented (kmmb{a,b}05217.d02). Have added waypoints #4 and #5 to dip line route and transferred to bridge. This is a 500 m offset towards coast to keep EM1002 in its depth range.

0900Z –switched to UTC (Z) time. Noted refraction frown on EM1002 and requested XBT – also requested standing order for XBT every 6 hrs. HRMG attempting XBT but having problems with electronics – ET called. XBT loaded at 1017Z but still severe frown – surface sound speed seems to be changing rather rapidly – probably entering new water mass. Will take another XBT to check – second XBT is identical to first and quite different from last nights. Tried using the old XBT and it made things look much worse – I suspect we are seeing the fresh water influence of the outflow of the glaciers in Icy Bay and Yakutat Bay. Knudsen also is showing the edges of the fan deposit from the outwash.

1134Z – end line 01 of EM1002 – bridge wants to do 1 mile run-up – stop logging of EM1002 and Knudsen

1142Z –start logging EM1002 and Knudsen –

1155Z – NavMgr – ABNEXT: Abnormal exit – From signal: Memory Access Violation – stopped and disappeared. NavMgr was located in Configuration>Program Selection>Toggle>

1530Z – Duane has finished all of the checks of the transducer wiring – found some ambiguous results and retested but concluded that nothing was obviously amiss. He has reconfigured in 2 x 2 mode to check that – we are running to deep water to give it a try and then that's about it for testing.

1710Z – end EM1002 line 06. Stop logging EM1002 and started up EM120 – in 2x2 mode for brief run to deep water.

1914Z – End EM120 Test line – turning towards start point of primary survey – Duane will now return EM120 to standard 1x2 mode. Also, for completeness, swapping the master and slave Beamformer Signal Processor (BSP) boards.

2017Z: Duane suggests one more test – an upgrade of the software version – dangerous as the datagram structure has changed slightly and we don't know if SIS-2000 or CARIS software will be compatible, but we will give it a try. Need to test in deep water so we will just hang out here and give it a try. Assured that we can recover if it fails.

2124Z: System failed to lock to bottom at first try in deep water – most of the swath marked as amplitude, much in excess of what would normally be expected. Resolved after modified for correct array configuration, but still showing the same problems as before. Running up-hill towards start of first line, trying to resolve the bottom. System is still having a very hard time around the 2500 m isobath with lots of dropped beams and big holes in the coverage at around 2500-2000 m depths. Upgrade to new software appears to have broken the connection to the ISS-2000, which now reports that it cannot receive either SVP echoes or installation parameters from the EM120 – but does see depths.

2203Z: Confirmation from Duane that the system is as good as it is likely to get, and, therefore, we're ready to start the first line of leg 2. Asked bridge to run up to the waypoint, turn to port and then start on line. There doesn't seem to be a consistent Knudsen naming convention from the last leg, and therefore choosing to use 'km0514_2_$SEQID_$JD_$TIME(HHMM)" as the base name, where $SEQID is a sequential ID from 0001, $JD is the Julian day and $TIME is the time it started in UTC HH:MM.

2234Z: Logging first line of KM0514-2. Started with new Simrad software. Simrad Merlin software failed to establish connection properly, and therefore there is no coverage plot on the Simrad console. Resetting seemed successful and we were back to logging.

2355Z: Mapping, but seeing large holes in the data as we go along track – in general, anywhere where we see significant bottom slope along-track. May also be depth correlated, but this is not especially clear; may show evidence of being worse at 1500 m and 2500 m or so (just as seen on the dip line yesterday).

August 6, 2005 (JD218)

0005Z: XBT taken and applied to Simrad system via the HMRG station. XBT stations now every six hrs (0000, 0600, 1200, 1800Z), unless otherwise indicated by evidence of refraction in the real-time display.

0545Z: Holes observed in data going uphill at approx 58/50/07N, 141/10/14W. Observed the stave scope on the Simrad console during this time, and did not notice any gross characteristics of the beams that were failing that would mark them out as 'odd' or unlikely to be phase detected – the returns looked as good as, or better than, other beams that did have successful detects. The scope also showed the data in the appropriate place, indicating that the bottom prediction was functioning properly. The only significant difference was that the phase variance being reported was higher than the other beams – sometimes on the order of 30 to 50 (units not specified), rather than the 1 to 2 that might be expected for a normal good phase detect.

0645Z: XBT taken after some effort and applied to the EM120. USB connector on Sippican upload terminal is a little flakey, but an alternate exists if it fails.

0735Z: Completed line 76 (first line of leg 2) and broke to allow ship to transit to Yakutat in order to drop off Duane. Warmed up the Simrad EM1002 with latest XBT-derived SSP for transit; commenced logging with the EM1002 at bottom capture range, and with EM120, after heading vector settled.

0810Z: Logging primarily with EM1002 because EM120 data is fairly poor in water depths ~200m. XBT taken on schedule for informational purposes.

1200Z Duane reinstalling original software version

1630Z all software installed and everything back and running as before, except raw stave display. BSP is not working – Duane thinks it may be the battery.

1730Z arrived in Yakutat and deployed Rescue boat with Duane.

1915Z Recovered Rescue boat is underway to resume mapping.

2151Z Underway for start of next line. Severe halocline in the approaches to Yakutat Bay means that both MBES are severely refracted (down at the wings). Therefore, not logging either system until we get on station and fix a good XBT. Knudsen logging data in the meantime, looking good in ~300 m water. Filenames as described above cause difficulties because it allows the system to auto-increment names. Therefore, setup requires:

1. Choosing 'PC Generated' on the 'Configure' menu's dialog box;
2. Selecting 'Line Number', 'Julian Day' and 'Time' as the filename structure. Lines are then recorded as '0001_219_0234.sgy' for line #1, JD 219 and starting at 0234Z.
3. De-selecting 'Automatic Line Numbering' check-box on the right of the screen.
4. Entering the line number to match the MBES line numbers (after translation – i.e., sequential from #1 at start of Leg 1) before each line is started. This allows the automatic line transfer script to find the Knudsen lines and copy them to the appropriate place on the RAID disc.

August 7, 2005 (JD219).

0035Z: On-line for Line 77. EM120 logging to survey km0514_2, line 2. Knudsen logging to line 0077_219_x. Requested XBT to adjust to current conditions, although last SSP seems to be sufficient now that we are out of the plume of fresh water from Yakutat. Salinity reads 31.86 psu water temperature 15.56°C at surface.

0059Z: EM120 in deep mode, sounding at almost full capacity. System is reporting swaths of 8 to 9 km to port and 2 to 3 km to starboard in 1500 m water depths. Inexplicably, the problems with slopes causing drop-outs that were observed last night are not now being observed.

0609Z: Continued collecting good data with the EM120, although it appears that there may be some correlation with the Knudsen after all – in 1500-2000 m water depths, turning the Knudsen power up to 4 reliably caused the EM120 to loose lock in the characteristic manners (Fig. 22). This is not exclusive: other small drop-outs are observed, but none of the severity observed previously. Knudsen has been left at power 1 for the remainder of the line. Note also that seas are currently extremely flat, which also be a factor (wind speed currently ~4-5 kts).

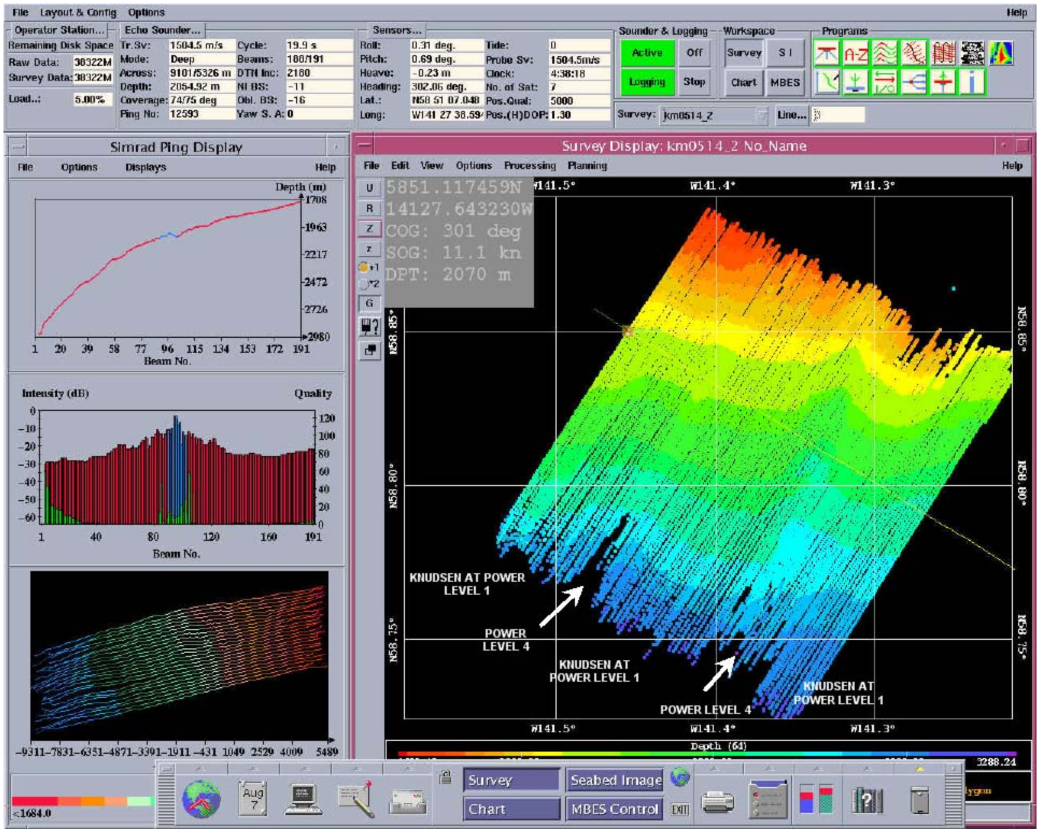

Figure 22. Swath display when Knudsen echo sounder is turned on with a power setting of 4. Note the beam dropouts.

0610Z: XBT taken on schedule and applied to the EM120. Water conductivity 4.05 S/m, salinity 32.16 psu, temperature 15.7°C.

0950Z Several more dropouts observed but these are associated with very steep slopes – tried securing the Knudsen but had no effect in this case. Despite dropouts swath is still 72˚/75˚ (7227/3879 m in 2000 m of water).

1144Z EOL 79 – a beauty

1150Z SOL 80 offset 10 km based on coverage from previous line

1210Z XBT taken and input

1810Z XBT taken and input; all continues well in 3200 m water – with 74˚/70˚ swath widths of 8700/8100 m.

2050Z: EOL 80. Continued after nominal EOL to fill some space in the coverage plot.

2132Z: SOL 81. Offset 12 km based on previous coverage. Coverage generally good, 69°/72° and 8500 m/9950 m with nadir 3380 m.

2203Z: Line 80 showed evidence of refraction in line with the exit of Yakutat Bay, on the order of 0.8% of depth. At this time, there appears to be evidence of the same thing happening on line 81. Consequently, requested new XBT. Conductivity 4.04 S/m, salinity 32.14 psu, temperature 15.58˚, at 58° 30.334'N 141° 06.588'W. Applied 2220Z.

August 8, 2005 (JD 220)

0030Z: XBT taken and applied. Conductivity 4.06 S/m, salinity 32.19 psu, temperature 15.88°C.

0630Z: XBT taken and applied. Surface conductivity 4.01 S/m, salinity 32.04 psu, temperature 15.47°C.

0730Z: EOL 81. Line 82 set for offset of 14 km from line 81 based on observation of ~8 to 9 km swath in most parts of the line.

0811Z SOL 82 – Offset 13 km from 81.

0900Z with nadir depths now about 4000 m the outer beams are getting a bit ratty and swath widths achieved have been more on the order of +/-65˚ (about 18 km). This is within specification for soft bottoms. Will keep full swath for awhile and see what happens.

1130Z took a look at the Fledermaus composite of the 3 lines already collected. Noted serious problems of lines not matching (vertical) as well as problems between swaths. Can't believe overlap is not enough so wonder about editing. Took a look at data in CARIS HIPS subset editor and there is plenty of overlap but big differences (up to 50 m) at swath overlap. The misfit doesn't look consistent enough to be a roll bias, but perhaps refraction. We had to edit out the outer beams. Had to go through the data again using CARIS subset editor and produce consistent swath using beams closet to nadir from adjacent swaths. Also looked for a consistent trend that might explain why swaths are offset. Line 79 seems to be the worst, so maybe refraction? Took a look with the refraction editor but saw nothing obvious. However, it was hard to tell because the swath spans 2500 m vertically.

1202Z - Outer beams getting really ratty – swath not more than 67˚ and 70˚ so narrowed the swath to ±67˚. In doing this, it was noticed that the beam spacing was set to equidistant. This is not ideal for the backscatter so it was reset it to in-between. Then worried that Leg 1 may have been using equidistant and would like backscatter to look the same from let to leg. The Leg 1 cruise report says it was equidistant, so the beam spacing was reset back to equidistant at 1250Z and contacted the Leg 1 Chief Scientist to confirm.

1258 Z – getting shallower so tried +/- 72˚

1302 Z – too ratty on outer beams bring in to 70˚/70˚

1421 Z – bring swath in to 67˚/67˚

1700Z – looking at processed data, the general thought is that we are seeing a refraction problem, perhaps related to the surface sound speed. Asked how sound speed profiles are created from XBTs. In order to check the calibration of the sound speed logger (which is a velocimeter in a well near the transducer) we took the thermosalinograph's salinity, conductivity and temperature reading at a particular time and calculated sound speed (using the Unesco Equation of State (http://www.ioc.unesco.org). The sound speed calculated matched that recorded by the transducer speed sensor – so it seems OK but we will investigate more.

Looking at the ADCP it is also clear that the current structure is complex on the eastern side of our survey area (where our problem is more pronounced (Fig. 23).

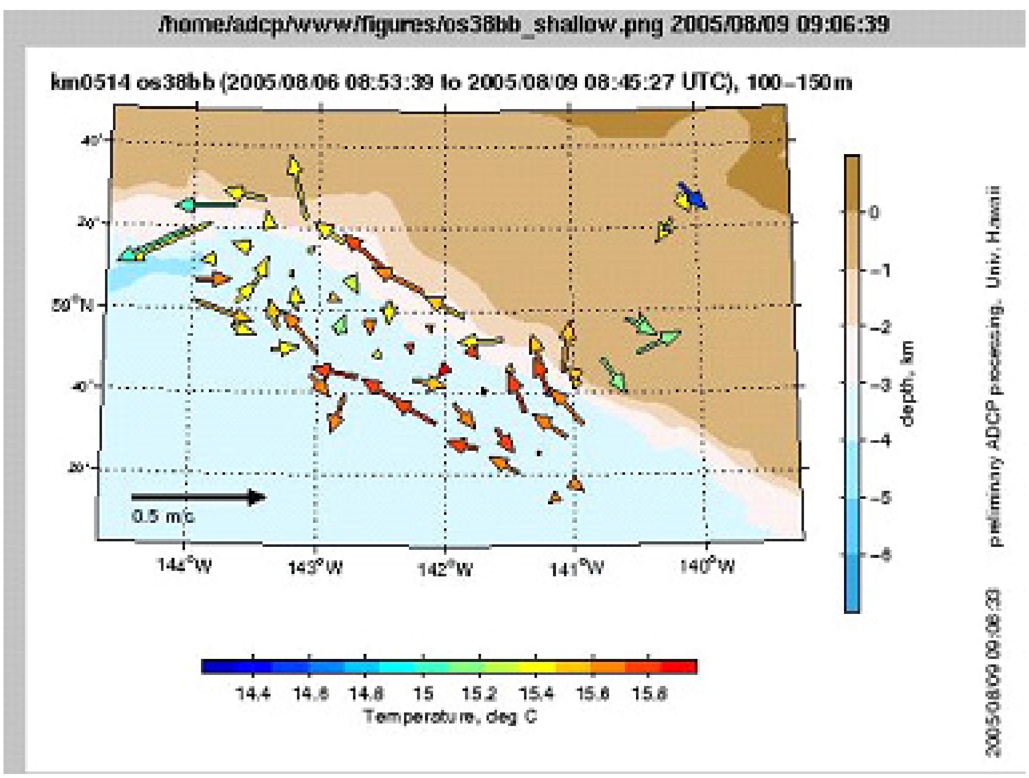

Figure 23. ADCP screen capture showing complex current structure.

1749Z – EOL 82

1819Z – xbt taken -- Thermosalinograph: temperature = 15.59°C Conductivity. = 4.05 S/m, Salinity = 32.2 psu

1834Z SOL 83 – offset 12 km

August 9, 2005 (JD 221)

0009Z: XBT taken, and applied. Conductivity 4.04 S/m, temperature 15.65°C, salinity 32.15 psu and predicted sound speed = 1505.43 m/s. Measured sound speed at sea-chest 1505.5 m/s. Salinity assumed in conversion of XBT was 32.7 psu in order to make the sound speed match at the transducer depth (which makes a sound speed of 1506.04 m/s). The effect of this assumption on the SSP generated was examined.

0218Z: Examination of previous leg data shows that most of the data was collected in equidistant mode. However, after line 59 (22 July 2005), the system was switched to in-between mode with the exception of one transit line to Kodiak (Line 34).

0410Z: EOL 83. Rebooted ISS-2000 as instructed by SAIC by e-mail in order to resynchronize the system clock with the IRIG-B card. Now appears to be working as before, although EM120 echo of parameters and SSP are still not being received correctly – reasons unknown.

0451Z: Alarm on the Simrad console indicated that the SSP (surface sound speed from the profile) and the measured surface sound speed SP didn't match. Investigation by HMRG showed that the SSP had been reset to one from 2003(!) There was no evidence that this had been sent intentionally – may have been picked up by the Simrad itself? May also have been sent from the ISS-2000 during boot? Therefore, Line 83 may have some strange effects at the very end of the line. Reset to latest XBT after alarm was cancelled and before the start of lLne 84.

0450Z: SOL 84.

0457Z: Investigated the SSP issue above. Appears that the ISS-2000 automatically sends the 'latest' SSP to the Simrad console when it boots in order to make sure that they stay synchronized.

0629Z: XBT taken and applied. Conductivity 4.03 S/m, salinity 32.25 psu and temperature 15.40°C from thermosalinograph, implying sound speed 1504.7 m/s; measured surface sound speed at transducer 1504.9 m/s. Assumed salinity for XBT was 32.7 psu.

Leg 1 divided the region into "Mapping Blocks" (Fig. 24).

Figure 24. Mapping blocks for Legs 1 and 2. Leg 1 mapped blocks 1, 2 and part of block 3.   Leg 2 will map block 4 and the rest of block 3.

1210Z – XBT taken and applied. Conductivity 4.04 S/m, salinity 32.18 psu and temperature 15.59°C from thermosalinograph, implying sound speed 1505.38 m/s; measured surface sound speed at transducer 1506.6 m/s. Assumed salinity for XBT was 32.65 psu

1425Z EOL 84

1455 Z - SOL 85 – offset = 10 km.

1515Z – bring swath width down to +/- 65˚ – outer edges really ratty

August 10, 2005 (JD 222)

0005Z: EOL 85.

0047Z: SOL 86. Offset = 10 km.

0058Z: XBT taken and applied. Conductivity 4.01 S/m, salinity 32.41 psu, temperature 15.02°C. Measured sound speed is 1503.9 m/s, and estimated from thermosalinograph 1503.73 m/s. Assumed salinity for XBT correction was 33.1 psu (would make sound speed 1504.51 m/s).

0630Z: XBT taken and applied. Conductivity 4.04 S/m, salinity 32.21 psu, temperature 15.59°C. Measured sound speed is 1505.5 m/s, and estimated from thermosalinograph 1505.28 m/s. Assumed salinity for XBT correction was 32.7 psu (would make sound speed 1505.82 m/s).

0635Z: MBES still set for ±65°, and outer beams are stable (within limits as seen throughout the leg) for the majority of the area. In the NW corner of block 4, however, some higher than average variability is observed, indicating that deeper water there is having a significant effect. This is a little under what is expected for the EM120 from theory (graph has ~17 km of swath over mud for ~4000m of water [here it is ~3720 m], and we are achieving approximately 15 km), but probably reasonable given the history of the MBES system.

1005Z – EOL 86

1048Z – SOL 87 – offset 10 km – will stick with a swath width of +/- 65˚ for now as we seem to be getting more than 6 km of good data on the uphill side – down slope side a bit less.

1111Z – interestingly, as we steam on to the NW, the starboard (upslope) beams now seem to be noisier than the port beams – is it that the starboard beams are always noisier rather than upslope/down slope?

1126Z- secured Knudsen echo sounder to see if it cleans up starboard side and it did. Will leave the Knudsen off and then turn back on at the end of the line to see if problem re-occurs.

1210Z – XBT taken and entered – Thermosalinograph reads: Temp: 15.24˚, Salinity: 32.23 psu, Conductivity: 4.01 S/m – calculated SS= 1504.33 m/s. Sound speed probe = 1504.1 m/s, Adjusted salinity for xbt = 32.3 psu

1248Z – turn Knudsen echo sounder back on to see if dropped beams start again – water depth 3650 m – they did (Fig. 25) – shut the Knudsen echo sounder off and the dropped beams went away.

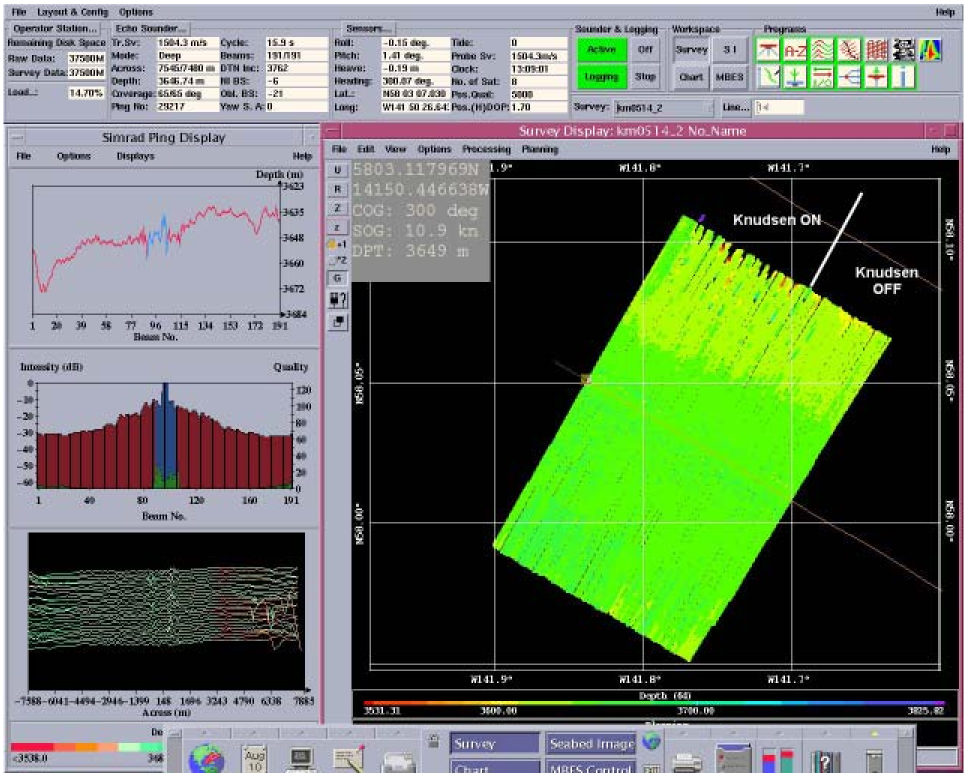

Figure 25. Example of outer beam dropouts associated with Knudsen sounder.

1305 Z – secure Knudsen again

1439 Z – several dropouts noted in outer beams, but there is still plenty of overlap so will go to a swath width of +/-63˚.

2013Z EOL 87.

2055Z: SOL 88. Line offset of 10 km, beams at ±63°. Ship is now averaging 12.5 kts, rather than the 11.5 kts that we have been doing up to this point.

2258Z: Data appears to be a little noisier now that we are traveling at 12 kts on average. Taking speed down to 11kts for 30 min to see if this makes a significant difference.

2328Z: Slow-down seems to make enough of a difference that we should keep the speed down for now. Asked the bridge to stay at 11.0 kts (generally means that we run at ~11.5 kts) for now.

0015Z: XBT taken and applied. Conductivity 4.02 S/m, salinity 32.26 psu, temperature 15.32°C from the thermosalinograph, implying a surface sound speed of 1504.5 m/s. Measurement from surface sensor is 1504.6 m/s. Assumed salinity for XBT conversion was 32.4 psu, implying a surface sound speed of 1504.65 m/s.

0550Z: EOL 88.

0620Z: SOL 89. Line offset = 10 km. This is the last of the short lines in block 4: after this, we will be running ~24-hr-long lines to cover block 4 and the remains of block 3.

0645Z: XBT taken and installed. Thermosalinograph says: C = 4.04 S/m, S = 32.19 psu, T = 15.61°C, implying sound speed at the surface of 1505.35 m/s. Transducer sound speed probe reads 1505.2 m/s. Assumed salinity for XBT conversion was 32.5 psu, implying a surface sound speed of 1505.68 m/s for the cast.

1213Z: XBT taken and installed. Thermosalinograph says: C = 4.01 S/m, S = 32.36 psu, T = 15.03°C, implying sound speed at the surface of 1503.82 m/s. Transducer sound speed probe reads 1504.00 m/s. Assumed salinity for XBT conversion was 32.85 psu, implying a surface sound speed of 1503.99 m/s for the cast.

1526Z: EOL 89

1607Z: SOL 90 – This will be our first attempt at long line (20 hrs) that extends into block 3. Inasmuch as our lines have been offset by about 5 km from the Leg 1 lines we are “splitting the difference” with this long line – we are starting at about 11.3 km offset on the NW end and ending with about 5 km offset at the far southwest line. This should give us sufficient overlap throughout the extent of the line (even with the Leg 1 block 3 section) and then set us up for standard 10-km offsets for the rest of the survey. This greatly minimizes turns and thus saves us lots of time.

1921Z We have now moved into deeper water (bottom of channel) where depth is >3800 m and we see dropouts on outer beams (Fig. 26).

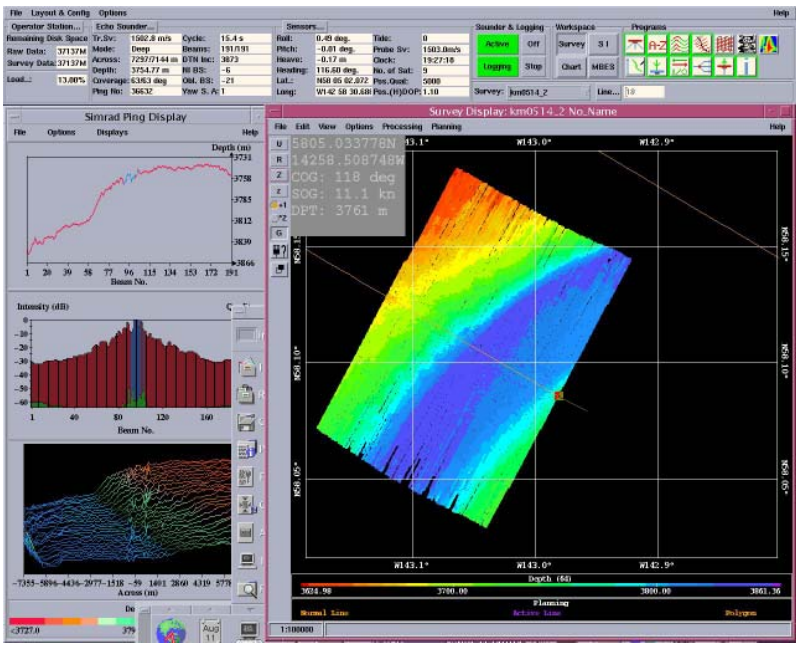

Figure 26. Outer-beam dropouts as water depth goes beyond 3800 m.

2330Z: Observed that the current track line would probably not give us sufficient overlap on the last line of block 3, which we will approach in approximately one hour (the lines from leg 1/block 3 and leg 2/block 4 do not quite coincide, so there is an offset of approximately 3.5 km between the outer swaths of line 89 and line 75). Consequently, requested that the bridge plot a short offset course of ~500 m port of line 89 for one mile before and one mile after the crossing point into block 3 (i.e., straddling the area where coverage would be limited). Started immediately, so that the turns would not cause gaps in the swath due to excessive yawing, and asked the bridge to smooth back onto line 89 in the same manner. This will, of course, leave us a little short (by about the same amount) on overlap for line 91, but we should have sufficient overlap there anyway given the offsets that we are currently using to be able to afford it.

August 12, 2005 (JD 224)

0015Z: XBT taken and applied. Thermosalinograph reads C = 4.02 S/m, S = 32.19 psu, temperature = 15.37°C, implying a surface sound speed of 1504.61 m/s. Surface sound speed probe measures 1504.7 m/s. The assumed salinity in converting the XBT was 32.3 psu, implying a surface sound speed of 1504.69 m/s.

0100Z: Covered gap with block 3 with about 1.5 km overlap after pushing the beams out to ±65°, and then 67° port side only in order to spread the swath a little. The data appears to be stable at ±65°, so leaving it there until we start to see degradation.

0440Z: Passing 57°12.74'N, 140° 08.28'W. Outer edges of the swath showing evidence of significant anomalous oscillation (a.k.a., flapping). This occurred continuously although abated occasionally for short periods of time. The flapping started occurring as we dropped into slightly deeper water (although only around 3400 m), at the edge of one of the significant channels. Nothing else seems to have changed, although the conductivity and salinity are dropping more than they have for the last few days: currently, readings are C = 3.98 S/m, S = 31.84 psu, T = 15.38°C. This implies a speed of approx. 1504.22 m/s; transducer probe reads 1504.5 m/s. Reduced swath to ±65° on both sides, but this doesn't seem to help – all beams are still being reported as good, with good quality flags.

0454Z: Requested an XBT. Conductivity falling rapidly, now C = 3.95 S/m, S = 31.60 psu , not in themselves big changes, but bigger by a factor of about 5 than anything that has been seen in the last few days, so probably indicating some significant change in the water mass.

0500Z: XBT taken and entered. Thermosalinograph has C = 3.96 S/m, S = 31.60 psu, T = 15.54°C, implying surface sound speed of 1504.37 m/s; transducer probe reads 1504.6 m/s. Assumed salinity for conversion of XBT was 31.9 psu.

0512Z: Surface water properties now mostly stable at C = 3.98 S/m, S = 31.59 psu, T = 15.73°C. Maybe we are now in the eye of an eddy in the water (see Fig.17)? Outer-beam behavior is now more reasonable, but still more mobile that expected after the behavior of the last couple of days.

0609Z: Surface water recovering towards levels seen in the last few days: C = 4.03 S/m, C = 31.93 psu, T = 15.81°C.

0900Z: EOL Line 89

0949Z: SOL 90 Offset 9 km

In processing line 90, we find that the logging of the line was stopped before we had mapped across the survey area. There is another line on the scratch disk – em120-224—4-714-0019 that is the continuation of line 90 that was originally em120-223-16-714. It appears that the Simrad system automatically changes file name after 12 hours.

1210Z: XBT taken and entered. Thermosalinograph has C = 3.99 S/m, S = 31.81 psu, T = 15.53°C, implying surface sound speed of 1504.76 m/s; transducer probe reads 1505.10 m/s. Assumed salinity for conversion of XBT was 32.30 psu.

1509Z: wobbles on outer beams getting worse – bringing swath width in to +/-63˚

2149Z: EOL 92/SOL 93

August 13, 2005 (JD 225)

0045Z: XBT taken and applied (slightly later than schedule: but we had to wait for the paint to dry on the back deck). Thermosalinograph shows C = 4.01 S/m, S = 32.35 psu, T = 15.04°C, implying surface sound speed of 1503.78 m/s – reading is 1503.8 m/s. Assumed salinity in converting the XBT was 32.48 psu, implying a surface sound speed of 1503.86 m/s.

0254Z: EOL 93.

0328Z: SOL 94. Offset = 10km.

0622Z: XBT taken and entered. Thermosalinograph reading C = 4.00 S/m, S = 32.35 psu, T = 14.97°C, implying surface sound speed of 1503.52 m/s; transducer reading is 1503.8 m/s. Assumed salinity for the XBT conversion was 32.7 psu, implying a surface sound speed of 1503.89 m/s.

1230Z: XBT taken and entered. Thermosalinograph reading C = 4.00 S/m, S = 31.89 psu, T = 15.35°C, implying surface sound speed of 1504.28 m/s; transducer reading is 1503.6 m/s. Assumed salinity for the XBT conversion was 31.83 psu, implying a surface sound speed of 1503.6 m/s.

~1520 – seemed to have dropped an entire ping across the whole swath

1538Z – EOL 94/SOL 95.

2020Z: EOL 95.

2051Z: SOL 96. Offset = 10km.

August 14, 2005 (JD 226)

0016Z: XBT taken and installed. Thermosalinograph reads C = 4.01 S/m, S = 31.85 psu, T = 15.77°C, implying surface sound speed of 1505.39 m/s; current probe reading is 1505.6 m/s. Assumed salinity for conversion of XBT was 31.98 psu, implying a surface sound speed of 1505.58 m/s.

0617Z: XBT taken and installed. Thermosalinograph reads C = 4.01 S/m, S = 31.96 psu, T = 15.68°C, implying surface sound speed of 1505.19 m/s; probe reading is 1505.4 m/s. Assumed salinity for conversion of XBT was 32.5 psu, implying a surface sound speed of 1505.90 m/s.

0851Z EOL 96 SOL 97

0900Z – outer beams on starboard side looking ratty (outermost beams dropped on and off)

1220Z: XBT taken and installed. Thermosalinograph reads C = 4.02 S/m, S = 32.35 psu, T = 15.21°C, implying surface sound speed of 1504.37 m/s; current probe reading is 1504.3 m/s. Assumed salinity for conversion of XBT was 32.57 psu, implying a surface sound speed of 1502.29 m/s.

1404Z: EOL 97

1440Z: SOL 98 – offset 10 km

August 15, 2005 (JD 227)

0020Z: XBT taken and entered. Thermosalinograph reading C = 4.01 S/m, S = 31.93 psu, T = 15.62°C, implying surface sound speed of 1505.06 m/s; probe reading is

1505.1 m/s. Assumed salinity for XBT conversion is 32.2 psu, implying surface sound speed of 1505.36 m/s.

0240Z: EOL 98/SOL99.

0618Z: XBT taken and entered. Thermosalinograph reading C = 4.01 S/m, S = 31.78 psu, T = 15.82°C, implying surface sound speed of 1505.50 m/s; probe reading is 1505.5 m/s. Assumed salinity for XBT conversion is 32.0 psu, implying surface sound speed of 1505.76 m/s.

0750Z: EOL 99

0820Z: SOL 100 – Offset 9 km

1220Z: XBT taken and entered. Thermosalinograph reading C = 3.99 S/m, S = 31.62 psu, T = 15.83°C, implying surface sound speed of 1505.80 m/s; probe reading is 1505.3 m/s. Assumed salinity for XBT conversion is 31.85 psu, implying surface sound speed of 1505.31 m/s.

2020Z: EOL 100/SOL 101.

August 16, 2005 (JD 228)

0020Z: XBT taken and entered. Thermosalinograph reading C = 4.05 S/m, S = 32.35 psu, T = 15.45°C, implying surface sound speed of 1505.10 m/s; probe reads 1505.2 m/s. Assumed salinity for XBT conversion was 33.21 psu, implying surface sound speed of 1506.0 m/s.

0207Z: EOL 101. Mapped a little beyond the edge of the survey area to determine probable extent of large channel right on the survey boundary. Also recording a line during run-in to next survey line waypoint in order to image channel again.

0300Z: SOL 102. Offset = 9 km.

0630Z: XBT taken and entered. Thermosalinograph reading C = 4.05 S/m, S = 32.31, T = 15.56°C, implying surface sound speed of 1505.34 m/s; probe reading is 1505.4 m/s. Assumed salinity for XBT conversion was 32.6 psu, implying a surface sound speed of 1505.64 m/s.

1200Z: XBT taken and entered. Thermosalinograph reading C = 4.02 S/m, S = 31.89 psu, T = 15.71°C, implying surface sound speed of 1505.65 m/s; probe reading is 1505.5 m/s. Assumed salinity for XBT conversion was 32.09 psu, implying a surface sound speed of 1505.49 m/s.

1500Z: EOL 103/SOL 104

1553Z: bring swath in to 61˚ on both sides because of wobbles.

2028Z: EOL 104. Rebooted ISS-2000 while in turn in order to re-synchronize clock on IRIG-B card. This now has to be done about once per week, which may indicate that the card is not entirely well; it never really synchs up and eventually goes ballistic at some point. Note that when the ISS-2000 goes back into Survey mode after the reboot, it automatically sends the 'latest' SSP to the Simrad console. Its definition of 'latest' isn't necessarily the common version expected. Therefore, it is essential to have help standing by to send the correct profile again from elsewhere.

2116Z: SOL 105.

August 17, 2005 (JD 229)

0019Z: XBT taken and applied. Thermosalinograph reads C = 4.03 S/m, S = 31.75 psu, T = 16.02°C, implying surface sound speed of 1506.14 m/s; probe reading is

1506.0 m/s. Assumed salinity for XBT conversion was 31.82 psu, implying surface sound speed of 1506.17 m/s.

0625Z: XBT taken and applied. Thermosalinograph reads C = 4.06 S/m, S = 32.05 psu, T = 16.01°C, implying surface sound speed of 1506.42 m/s; probe reading is 1506.4 m/s. Assumed salinity in converting XBT was 32.4 psu, implying a surface sound speed of 1506.81 m/s.

0916Z: EOL 105/SOL 106

1210Z: XBT taken and applied. Thermosalinograph reads C = 4.08 S/m, S = 32.27 psu, T = 15.92°C, implying surface sound speed of 1506.51 m/s; probe reading is 1506.4 m/s. Assumed salinity in converting XBT was 33.1 psu, implying a surface sound speed of 1506.4 m/s.

1516Z: EOL 106

1520Z: SOL 107 – short southerly line to capture confluence of channels

1557Z: EOL 107

1600Z: SOL 108

1820Z: XBT taken and applied. Thermosalinograph reads C = 4.08 S/m, S = 32.27 psu, T = 15.47°C, implying surface sound speed of 1505.1 m/s; probe reading is 1505.1 m/s. Assumed salinity in converting XBT was 32.77 psu, implying a surface sound speed of 1505.1 m/s.

August 18, 2005 (JD 230)

0025Z: XBT taken and applied. Thermosalinograph reads C = 4.03 S/m, S = 32.24 psu, T = 15.40°C, implying surface sound speed of 1504.78 m/s; probe reading is

1504.9 m/s. Assumed salinity for XBT conversion was 32.04 psu, implying surface sound speed of 1504.49 m/s.

0127Z: Refraction observed that was not corrected after the last XBT. Requested another XBT to determine if there is anything that we can do to rectify matters. Thermosalinograph reading C = 4.05 S/m, S = 32.18 psu, T = 15.67°C, implying surface sound speed of 1505.58 m/s; probe measurement is 1505.6 m/s. Assumed salinity for XBT conversion was 32.18 psu, implying surface sound speed of 1505.50 m/s. Applied 0140Z.

0209Z: New SSP profile appears to be better; large observed anomaly in water temperature and salinity in the area and ADCP shows significant current east to west across the current area – may be water mass movement associated with storms in the eastern end of the Gulf.

0250Z: Knudsen echo sounder was energized to check for effects of beam-loss on EM120 prior to arriving at southeast end of line where the interesting geological features are. The Knudsen settings were power 1, range 200, phase 36. Monitoring for 20 min. shows no significant degradation of the EM120 output, and, therefore, the system was left running. Note depth is ~3500 m and the EM120 is at ±61°, which may explain why there isn't as much interference potential.

0400Z: EOL 108/SOL 109.

0550Z: Interference from Knudsen on starboard side. Causes occasional drop-outs on outer swath – probably acceptable given the overlap we are getting, given the extra information on the geological structure of the southeast end of the line. However, because of the interference, the Knudsen was turned off.

0618Z: XBT taken and applied. Thermosalinograph reads C = 4.01 S/m, S = 31.75 psu, T = 15.83°C, implying surface sound speed of 1505.52 m/s; probe reading is 1505.6 m/s. Assumed salinity for XBT conversion was 31.1 psu, implying surface sound speed of 1504.75 m/s.

0708Z: Knudsen echo sounder turned on at power 1 for approach to geological features.

0800Z: Knudsen showing shallow penetration with several reflectors

0813Z: Going over a ledge and dropping down into "caldera-like" feature – Knudsen now showing thick sedimentary section with many sub-bottom reflectors – Gravity steadily decreasing as we go across feature. *NOTE THAT TIME LABELS ON KNUDSEN ARE WRONG – THEY SEEM TO BE 10 HOURS BEHIND – 2232Z 17 August – REALLY 0832Z 18 August. RESET CLOCK ON KNUDSEN PC TO CORRECT TIME AT 0832Z.*

Have just caught the edge of a structural high with clear onlap of reflectors on "basement" high – top of feature is irregular but we have only small sector of edge.

0840Z: Knudsen clock did not reset.

Have decided to take a couple of hours and run over top of structural high. Stopped logging main lines and logged as separate files – keeping Knudsen echo sounder going. Made 1 hr run due north and then came back on join line. This ends Line 109.

0955Z: Finished 000 line – now coming back on 187 to cross again and return to original line. This is Line 110

1035Z: end small excursion – Line 111

1037Z: back on original survey line – started logging Line 112

1158Z: EOL 112 - Secured Knudsen

1205Z: XBT taken and applied. Thermosalinograph reads C = 4.06 S/m, S = 31.99 psu, T = 16.03°C, implying surface sound speed of 1506.53 m/s; probe reading is 1506.0 m/s. Assumed salinity for XBT conversion was 31.51 psu, implying surface sound speed of 1506.0 m/s.

1815Z: XBT taken and applied. Thermosalinograph reads C = 3.98 S/m, S = 31.70 psu, T = 15.59°C, implying surface sound speed of 1504.82 m/s; probe reading is 1505.5 m/s. Assumed salinity for XBT conversion was 31.7 psu, implying surface sound speed of 1505.5 m/s.

August 19, 2005 (JD 231)

0020Z: XBT taken and applied. Thermosalinograph reads C = 4.02 S/m, S = 32.30 psu, T = 15.31°C, implying surface sound speed of 1504.48 m/s; probe reading is 1505.3 m/s. Assumed salinity for XBT conversion was 32.28 psu, implying a surface sound speed of 1504.48 m/s.

0034Z: EOL 113/SOL 114.

0612Z: EOL 114/SOL 115

0640Z: System left logging during turn segment, making this line 115 (start 0612Z, end 0640Z). Not to be used for further processing. EOL 115

0642Z: SOL 116.

0645Z: XBT taken and applied (delayed until start of next line). Thermosalinograph reading Conductivity = 4.01 S/m, Salinity = 32.28 psu, Temperature = 15.13°C, implying surface sound speed of 1503.98 m/s; probe reading 1504.1 m/s. Assumed salinity for XBT conversion was 32.51 psu, implying surface sound speed of 1503.02 m/s.

There seems to be a severe tilt to the swath with port side down. This is not consistent from line to line (e.g., not a simple roll bias) nor is it consistent along the line, thus, there appears to be a relationship with water mass?

0800Z: XBT taken and applied. Thermosalinograph reading C = 4.02 S/m, S = 32.30 psu, T = 15.21°C, implying surface sound speed of 1504.20 m/s; probe reading 1504.3 m/s. Assumed salinity for XBT conversion was 32.62 psu, implying surface sound speed of 1504.3 m/s.

The tilted swaths consistently occur at the end of the long lines; in each case, the tilt grew progressively worse as the line got longer, suggesting a problem with the POS/MV drifting. The test came with line 109 where we broke off to visit the seamount. This line had a severe tilt problem (Fig. 27) until the turn was made; but when the line was run after the turn, the tilt was gone. Several lines were checked and this appears to be the scenario most of the time, but some times are definitely worse than others. This problem may have to do with wind and ballasting of the vessel. The ship's engineers say they are constantly shifting ballast to try to keep vessel level because the vessel very susceptible to wind. More interestingly, the engineers say they adjust the ballast based on the POS/mv, not the bubble, so if the POS is drifting to zero roll, then the engineers don't make the adjustment when it is needed. The engineers say they have noticed a discrepancy between POS/MV and bubble, but they always trusted the POS/MV.

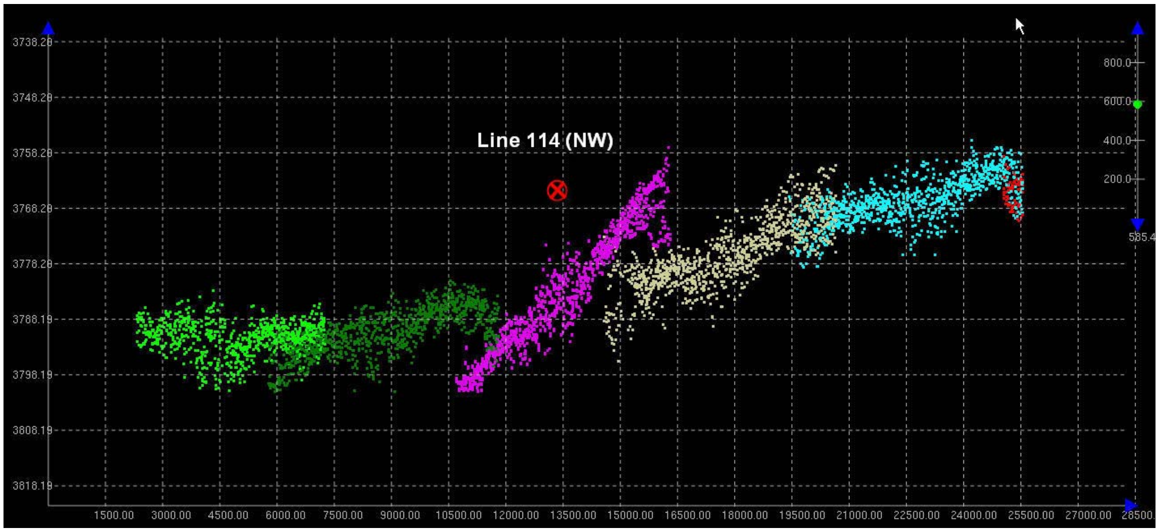

Figure 27. Example of tilt at end of Line 114.

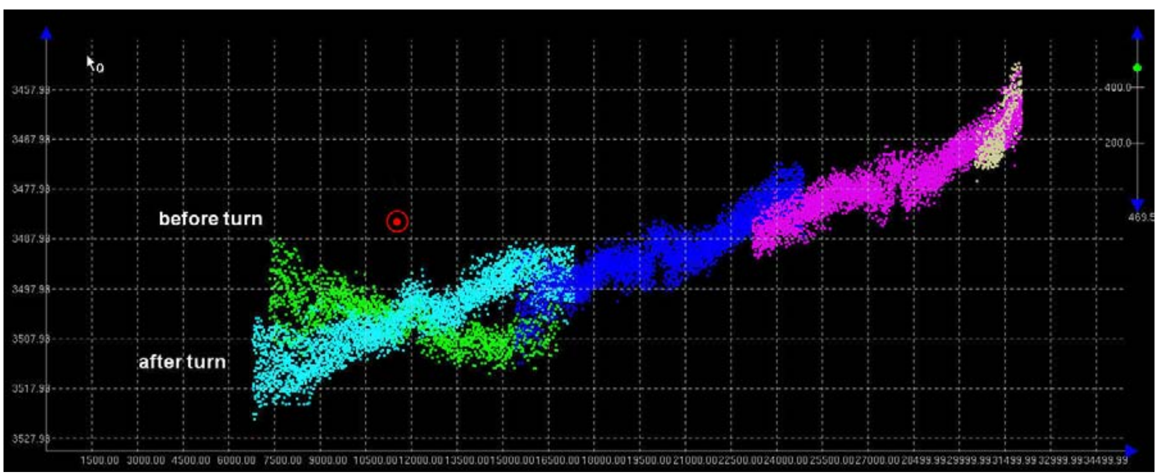

Figure 28. Example of effect of "spin" on tilt of a line.

1135Z: changing swath width to 63˚/63˚ to map over a seamount

1144Z: change swath on starboard side to 65˚ to map over a seamount

1147Z: change swath on starboard side to 70˚ to map over a seamount

1200Z: change swath on starboard side to 67˚ to map over a seamount

1212Z: change swath on starboard side to 65˚ to map over a seamount

1230Z: change swath on starboard side to 63˚ to map over a seamount

1216Z: XBT taken and applied. Thermosalinograph reading Conductivity = 4.03 S/m, Salinity = 32.32 psu, Temperature = 15.33°C, implying surface sound speed of 1504.72 m/s; probe reading 1504.8 m/s. Assumed salinity for XBT conversion was 32.67 psu, implying surface sound speed of 1504.81 m/s.

1255Z: change swath on both sides to 61˚/61˚ as we turned on the Knudsen echo sounder for a pass over upcoming seamount

1256Z: Started Knudsen

1422Z: Secure Knudsen – back to 61˚/61˚ swath.

1542Z: logging stopped for Williamson turn to reset POS EOL 116

1552Z: turn back on line

1602Z: Start logging SOL 117

After the spin there is a clear improvement in the "tilt" (Fig. 28).

1820Z: XBT taken and applied. Thermosalinograph reading C = 4.01 S/m, S = 31.77 psu, T = 15.85°C, implying surface sound speed of 1505.72 m/s; probe reading 1504.99 m/s. Assumed salinity for XBT conversion was 31.8 psu, implying surface sound speed of 1504.99 m/s.

August 20, 2005 (JD 232)

0023Z: XBT taken and applied. Thermosalinograph reading Conductivity = 4.08 S/m, Salinity = 32.24 psu, Temperature = 15.98°C, implying surface sound speed of

1506.56 m/s; probe reading is 1506.7 m/s. Assumed salinity for XBT conversion was 32.71 psu, implying surface sound speed of 1507.07 m/s.

0054Z: EOL 117.

~0140Z: SOL 118.

0619Z: XBT taken and entered. Thermosalinograph reads C = 4.02 S/m, S = 31.75 psu, T = 15.92°C, implying surface sound speed of 1505.82 m/s; probe reading is 1506.0 m/s. Assumed salinity for XBT conversion was 31.82 psu, implying a surface sound speed of 1505.86 m/s.

0931Z: EOL line 118 – for Williamson turns

0959Z: SOL line 119

1210Z: XBT taken and applied. Thermosalinograph reading C = 4.02 S/m, S = 32.15 psu, T = 15.40°C, implying surface sound speed of 1504.74 m/s; probe reading is 1504.5 m/s. Assumed salinity for XBT conversion was 32.32 psu, implying surface sound speed of 1504.49 m/s.

1410Z: increased swath width to 67˚ on starboard side to cross a seamount

1440Z: bring starboard swath back to 61 deg

1513Z: EOL 119 for Williamson turns

1530Z: SOL 120

1530Z: XBT taken and entered. Thermosalinograph reads C = 4.01 S/m, S = 32.28 psu, T = 15.17°C, implying surface sound speed of 1504.17 m/s; probe reading is 1504.3

m/s. Assumed salinity for XBT conversion was 32.55 psu, implying a surface sound speed of 1504.3 m/s.

1932Z: EOL 120

2007Z: SOL 121.

2359Z: EOL 121 for Williamson turn sequence to reset POS/MV (now just about visible effect on the Real-Time display).

August 21, 2005 (JD 233)

0025Z: SOL 122.

0045Z: XBT taken and entered. Thermosalinograph reads C = 4.04 S/m, S = 32.30 psu, T = 15.52°C, implying surface sound speed of 1505.15 m/s; probe reading is 1505.3 m/s. psu

0425Z: EOL 122 for Williamson turn sequence as above.

0500Z: SOL 123.

0704Z: XBT taken and converted. Thermosalinograph reading C = 4.02 S/m, S = 31.81 psu, T = 15.93°C, implying surface sound speed of 1505.84 m/s; probe reading is 1506.2 m/s. Assumed salinity for conversion of XBT is 31.89 psu, implying surface sound speed of 1505.97 m/s.

1016Z: EOL 123 for Williamson turns

1038Z: SOL 124

1204Z: XBT taken and converted. Thermosalinograph reading C = 4.07 S/m, S = 31.95 psu, T = 16.21°C, implying surface sound speed of 1507.04 m/s; probe reading is

1506.8 m/s. Assumed salinity for conversion of XBT is 32.07 psu, implying surface sound speed of 1506.8 m/s.

1524Z: EOL 124

1552Z: SOL 125 – offset 9 km

1820Z: XBT taken and converted. Thermosalinograph reading C = 4.07 S/m, S = 32.22 psu, T = 15.99°C, implying surface sound speed of 1506.67 m/s; probe reading is 1506.6 m/s. Assumed salinity for conversion of XBT is 32.52 psu, implying surface sound speed of 1506.6 m/s.

2102Z: EOL 125 for Williamson turns.

2143Z: SOL 126.

August 22, 2005 (JD 234)

0006Z: XBT taken and converted. Thermosalinograph reading C = 4.02 S/m, S = 31.79 psu, T = 15.88°C, implying surface sound speed of 1505.73 m/s; probe reading is 1505.9 m/s. Assumed salinity for conversion of XBT is 32.11 psu, implying surface sound speed of 1506.07 m/s.

0228Z: EOL 126. Bearing 170˚ planned to intersect next line.

0235Z: SOL 127. Line collected on transit after turn so that we have some extra coverage, just in case. Not intended for use in main-scheme products.

0302Z: EOL 127.

0306Z: SOL 128. Offset 9 km.

0639Z: XBT taken and applied. Thermosalinograph reading C = 4.04 S/m, S = 31.91 psu, T = 15.91°C, implying surface sound speed of 1506.00 m/s; probe reading is 1506.1 m/s. Assumed salinity for conversion of XBT is 32.22 psu, implying surface sound speed of 1506.29 m/s.

0822Z: EOL 128 – for Williamson turns

0843Z: SOL 129

1220Z: XBT taken and applied. Thermosalinograph reading C = 4.07 S/m, S = 32.22 psu, T = 15.84°C, implying surface sound speed of 1506.20 m/s; probe reading is 1506.2 m/s. Assumed salinity for conversion of XBT is 32.46 psu, implying surface sound speed of 1506.20 m/s.

1358Z: SOL 130

1809Z: XBT taken and applied. Thermosalinograph reading C = 4.07 S/m, S = 32.19 psu, T = 15.98°C, implying surface sound speed of 1506.60 m/s; probe reading is 1506.60 m/s. Assumed salinity for conversion of XBT is 32.70 psu implying surface sound speed of 1506.60 m/s.

1832Z: EOL 130 for Williamson turns

1855Z: SOL 131

August 23, 2005 (JD 235)

0003Z: EOL 131. Steering 165° for next line, heading SE.

0045Z: SOL 132. Offset 9 km.

0100Z: XBT taken and applied. Thermosalinograph reading C = 4.06 S/m, S = 32.24 psu, T = 15.87°C, implying surface sound speed of 1506.12 m/s; probe reading is 1506.3 m/s. psu

0415Z: XBT taken and applied due to observation of something which might be geology, but is more likely refraction. Thermosalinograph reading C = 4.06 S/m, S = 32.00 psu, T = 16.03°C, implying surface sound speed of 1506.47 m/s; probe reading is 1506.6 m/s. Assumed salinity for conversion of XBT is 32.23 psu implying surface sound speed of 1506.68 m/s. Applied at 0435Z.

0532Z: EOL 132 for Williamson turns.

0604Z: SOL 133.

0624Z: XBT taken and applied. Thermosalinograph reading C = 4.07 S/m, S = 32.15 psu, T = 15.96°C, implying surface sound speed of 1506.42 m/s; probe reading is 1506.6 m/s. Assumed salinity for conversion of XBT is 32.33 psu implying surface sound speed of 1506.57 m/s. Note that XBT finally died and had to be swapped to the spare.

1102Z EOL 133 – end of survey in Blocks 3 and 4 – will now head to Block 1 for small area on southeast side

1108Z: SOL TRANSIT52 –

1145Z: Bridge called to ask if they can increase speed while transiting to Block 1. Vessel speed now 13.0 kts over the ground.

1210Z: XBT taken and applied. Thermosalinograph reading C = 4.06 S/m, S = 32.04 psu, T = 16.02°C, implying surface sound speed of 1506.56 m/s; probe reading is 1505.4

m/s. Assumed salinity for conversion of XBT is 32.48 psu implying surface sound speed of 1505.4 m/s

2036Z: SOL 134 – first line of three in to fill gap on southeast end of Block 1

2050Z: XBT taken and applied. Thermosalinograph reading C = 3.98 S/m, S = 31.45 psu, T = 15.84°C, implying surface sound speed of 1505.24 m/s; probe reading is 1505.4 m/s. Assumed salinity for conversion of XBT is 31.89 psu implying surface sound speed of 1505.69 m/s.

~2300Z: Swath to 69° on starboard to provide better range in shallow water.

2330Z: Swath to 71° on starboard.

August 24, 2005 (JD 236)

0020Z: XBT taken and applied. Thermosalinograph reading C = 4.02 S/m, S = 31.62 psu, T = 16.12°C, implying surface sound speed of 1506.26 m/s; probe reading is 1506.4 m/s. Assumed salinity for conversion of XBT is 32.56 psu, implying surface sound speed of 1507.33 m/s.

0043Z: Swath back to 69° on starboard – excessive hunting of the outer beams.

0155Z: EOL 134. Aperture opens to ±73° to see whether this will hold for the next line. Starboard failed to hold; resetting to -73°/69° for next pass.

0223Z: SOL 135.

0612Z: XBT taken and applied. Thermosalinograph reading C = 4.00 S/m, S = 31.33 psu, T = 16.23°C, implying surface sound speed of 1506.30 m/s; probe reading is 1506.3 m/s. Assumed salinity for conversion of XBT is 32.34 psu, implying surface sound speed of 1507.31 m/s. (? Freshwater issues again?)

0739Z: EOL 135.

0803Z: SOL 136. Offset 6 km.

1330Z: EOL 136

1335Z: SOL Transit 53 – short offset to set up for final line to fill small gap

1403Z: EOL Transit 53

1405Z – SOL 137 – Final line.

1408Z - XBT taken and applied. Thermosalinograph reading C = 4.07 S/m, S = 31.74 psu, T = 16.55°C, implying surface sound speed of 1507.85 m/s; probe reading is 1507.5 m/s. Assumed salinity for conversion of XBT is 32.07 psu, implying surface sound speed of 1507.5 m/s.

1507Z: EOL 137 – Last official survey line

Transited to line run by Leg 1 from Hawaii to the Gulf of Alaska with an 8 km offset to the east and headed back to Honolulu.

1607Z: start logging Transit line 54

2202Z: New standing orders:

- Set the EM120 to collect data at highest achievable quality.
- Split lines every 4 hrs using the Simrad console's auto-log functionality; transfer and log as 'transit' lines.
- Take XBTs every 8 hrs, or sooner if refraction is observed; times should be 0400Z, 1200Z and 2000Z (2000, 0400 and 1200 AKDT).

Consequently, switched Simrad console to 4-hr lines.

2332Z: EOL Transit 54 for turn to rhumb line course for Hawaii.

2343Z: SOL Transit 55, on line. Switched to plan ‘Transit’ on ISS-2000, using Mercado projection to see whether this gives better XTEs (answers a question from previous experience on-line during the surveys).

August 25, 2005 (JD 237)

0426Z - XBT taken and applied. Thermosalinograph reading C = 4.08 S/m, S = 32.11 psu, T = 16.11°C, implying surface sound speed of 1504.66 m/s; probe reading is 1504.5 m/s. Assumed salinity for conversion of XBT is 32.83 psu, implying surface sound speed of 1504.89 m/s.

1218Z - XBT taken and applied. Thermosalinograph reading C = 4.03 S/m, S = 32.32 psu, T = 15.31°C, implying surface sound speed of 1506.84 m/s; probe reading is 1507.1 m/s. Assumed salinity for conversion of XBT is 32.55 psu, implying surface sound speed of 1507.29 m/s.

1815Z: ISS2000 seems to have died; top screen black, bottom screen green background with some icons but no mouse pointer

2110Z: ISS2000 started up again

2110Z: XBT taken and applied. Thermosalinograph reading C = 4.13 S/m, S = 32.36 psu, T = 16.33°C, implying surface sound speed of 1507.88 m/s; probe reading is 1506.7 m/s. Assumed salinity for conversion of XBT is 32.55 psu, implying surface sound speed of 1506.9 m/s.

August 26, 2005 (JD 238)

0045Z: Request from the beach for some more POS/MV data to send to Applanix. Changed logging software to provide POS/MV-Pac data, plus groups 102 and 111, and set to log at 200 Hz for an hour. At the end of the hour, current plan is to do a circle, come back on-track and then log another hour to see if this changes anything.

0048Z: XBT taken and applied due to observed evidence of refraction at 4100m. Thermosalinograph reading C = 4.13 S/m, S = 32.13 psu, T = 16.60°C, implying surface sound speed of 1508.40 m/s; probe reading is 1508.6 m/s. Assumed salinity for conversion of XBT is 32.81 psu, implying surface sound speed of 1509.10 m/s.

0204Z: EOL for 360° turn so that we can gather an hour's worth of 'good' data to send to the beach along with the hour's worth of 'bad' data that we just gathered.

0217Z: SOL for transit. Logging POS/MV data to pospac_output_20050826_line2.log.

0048Z: XBT taken and applied. Thermosalinograph reading C = 4.15 S/m, S = 32.27 psu, T = 16.72°C, implying surface sound speed of 1508.85 m/s; probe reading is 1509.2 m/s. Assumed salinity for conversion of XBT is 32.73 psu, implying surface sound speed of 1509.37 m/s.

1151Z – POS goes out parameters go out of accuracy – up to 15 m error – also sound speed error – probe value 1510.8 – xbt value 1509.37 -- will spin and take and xbt -- didn't help POS – will reboot POS

1210Z: XBT taken and applied. Thermosalinograph reading C = 4.21 S/m, S = 32.41 psu, T = 17.9°C, implying surface sound speed of 1508.85 m/s; probe reading is 1512.67

m/s. Assumed salinity for conversion of XBT is 33.09 psu, implying surface sound speed of 1510.8 m/s.

1230Z – POS/MV coming back slowly but the Simrad complained about not receiving 1PPS. Rebooted and restarted Simrad software.

August 27, 2005 (JD 239)

0430Z: XBT taken and applied. Thermosalinograph reading C = 4.26 S/m, S = 32.61 psu, T = 17.50°C, implying surface sound speed of 1511.57 m/s; probe reading 1511.9 m/s. Assumed salinity for conversion of XBT was 32.96 psu, implying a surface sound speed of 1511.98 m/s.

0610Z: Severe power fluctuations in ship's main power, including black-out for a few seconds. Ship is now falling to zero speed-through-water, with engines off-line. Emergency power and UPS is keeping the ship's systems running, but MBES secured.

0632Z: Started logging again – back to 12 kts and moving at 120 rpm on both shafts.

0703Z: XBT taken since surface sound speed exceeds difference from last XBT. Thermosalinograph reads C = 4.27 S/m, S = 32.49 psu, T = 17.91°C, implying surface sound speed of 1512.51 m/s; probe reads 1515.5 m/s (?). Assumed salinity for XBT conversion was 33.0 psu, implying surface sound speed of 1515.71 m/s. Later investigation showed that the Thermosalinograph pumps had been secured during the power outage, and were only brought back on-line at 0720Z. Readings at that point were C = 4.38 S/m, S = 32.63 psu, T = 18.76°, giving a surface sound speed of 1515.27 m/s.

1255Z: XBT taken and applied. Thermosalinograph reading C = 4.42 S/m, S = 32.72 psu, T = 19.03°C, implying surface sound speed of 1516.30 m/s; probe reading 1516.3 m/s. Assumed salinity for conversion of XBT was 33.01 psu, implying a surface sound speed of 1516.3 m/s.

2120Z: XBT taken and applied. Thermosalinograph reading C = 4.60 S/m, S = 33.20 psu, T = 20.29°C, implying surface sound speed of 1520.26 m/s; probe reading 1519.6 m/s. Assumed salinity for XBT conversion was 32.72 psu, implying surface sound speed of 1519.72 m/s.

2335Z: More engine problems. Lights flickered once more and the ship coasted to a stop with the engines apparently shut down.

2338Z: EOL.

2357Z: SOL –back to speed at 12.5 kts and 114 rpm on both shafts.

August 28, 2005 (JD 240)

0223Z: XBT taken due to increase in surface sound speed over the last XBT's value. Thermosalinograph reading C = 4.67 S/m, S = 33.14 psu, T = 21.10°C, implying surface sound speed of 1522.40 m/s; probe reading is 1522.8 m/s. Assumed salinity for XBT conversion was 33.61 psu, implying a surface sound speed of 1522.92 m/s.

0227Z: Major power loss to all ship's systems; systems on backup power; ship coasted to a halt. Logging stopped in the meantime.

0248Z: Ship's power defect rectified. Recommenced sounding transit line.

0341Z: Ship had to maneuver to avoid traffic. Therefore EOL/SOL to encapsulate the data with turns in one file that can be ignored.

0425Z: EOL: ship's power failed again, and ship slowly glided to a stop.

0443Z: SOL, back on line.

0526Z: XBT taken and applied. Thermosalinograph reading C = 4.73 S/m, S = 33.48 psu, T = 21.30°C, implying surface sound speed of 1523.29 m/s; probe reading 1523.7 m/s. Assumed salinity for XBT conversion was 33.54 psu, implying surface sound speed of 1523.38 m/s.

0701Z: XBT taken and applied due to warning on Simrad console that XBT and surface sound speed values had diverged by over 3 m/s. Thermosalinograph reading C = 4.85 S/m, S = 33.62 psu, T = 22.30°C, implying surface sound speed of 1526.21 m/s; probe reading 1526.5 m/s. Assumed salinity for conversion of XBT was 33.91 psu, implying surface sound speed of 1526.44 m/s.

0719Z: EOL. Ship's power out again.

0757Z: Logging again for now, since we appear to be underway for the time being at 8.5kts and 80 rpm on both shafts.

0915Z: Power loss again – stop logging

0922Z: Start logging again

1305Z: XBT taken and applied. Thermosalinograph reading C = 4.82 S/m, S = 33.59 psu, T = 22.00°C, implying surface sound speed of 1525.43 m/s; probe reading 1525.6 m/s. Assumed salinity for conversion of XBT was 33.95 psu, implying surface sound speed of 1525.6 m/s.

2130Z: XBT taken and applied. Thermosalinograph reading C = 4.91 S/m, S = 33.7 psu, T = 22.76°C, implying surface sound speed of 1527.58 m/s; probe reading 1527.9

m/s. Assumed salinity for conversion of XBT was 34.27 psu, implying surface sound speed of 1527.9 m/s.

2345Z: Stopped logging to allow modifications to be made to the Simrad console offsets and POS/MV settings according to Mark Van Waes' analysis.

2358Z: SOL (Simrad #21, Transit #88), testing the next offsets.

August 29, 2005 (JD 241)

0058Z: EOL (Simrad #21, Transit #88), immediately on to line #22 (Transit #89) in order to keep logging. Post-analysis of the test line showed no significant difference in level of wobble to the previous lines, but there is no way to determine whether there are any biases being introduced (or removed) without stopping to patch test the system (previous test line may have POS/MV induced biases, and does not make a good test line). We are, however, now experiencing bigger seas than we have all leg, and, therefore, any biases that may have been introduced should be much more apparent that before. Consequently, allowing the logging to continue with the new parameters to test further.

0310Z: XBT taken and applied due to deviation of surface sound speed from XBT speed. Thermosalinograph reading C = 5.11 S/m, S = 34.36 psu, T = 23.88°C, implying surface sound speed of 1530.99 m/s; probe reading 1531.4 m/s. Assumed salinity for XBT conversion was 34.69 psu, implying surface sound speed of 1531.31 m/s.

0526Z: XBT taken and applied. Thermosalinograph reading C = 5.22 S/m, S = 34.83 psu, T = 24.37°C, implying surface sound speed of 1532.69 m/s; probe reading

1533.1 m/s. Assumed salinity for XBT conversion was 34.91 psu, implying surface sound speed of 1532.76 m/s.

1330Z: XBT taken and applied. Thermosalinograph reading C = 5.31 S/m, S = 3508 psu, T = 24.97°C, implying surface sound speed of 1534.54 m/s; probe reading 1534.9 m/s. Assumed salinity for XBT conversion was 35.63 psu, implying surface sound speed of 1534.9 m/s.

2226Z: XBT taken and applied. Thermosalinograph reading C = 5.30 S/m, S = 35.00 psu, T = 24.95°C, implying surface sound speed of 1524.26 m/s; probe reading 1534.7 m/s. Assumed salinity for conversion was 35.26 psu, implying a surface sound speed of 1534.55 m/s.

August 30, 2005 (JD 242)

0052Z: Engine room lost power. Stopped logging.

0141Z: Ship power brought back on line. Started logging.

0440Z: Lost power again, stopped logging.

0458Z: Power restored, started logging.

0510Z: Lost power, stopped logging.

0529Z: Restored power and commenced logging, although GAMS solution is intermittent, and positioning is consistently greater than 4.0 m. Possibly poor SV constellation.

0552Z: Request from Chief Mate for all hands to conserve fresh water. Evaporators are being secured to try to prevent damage to them from other power failures.

0634Z: XBT taken and applied. Thermosalinograph reading C = 5.36 S/m, S = 35.17 psu, T = 25.28°C, implying surface sound speed of 1535.26 m/s; probe reading 1535.8m/s. Assumed salinity for XBT conversion was 35.60 psu, implying surface sound speed of 1535.71 m/s.

0710Z: Prime motivator failed and ship stopped until replacement can be found and inserted.

0732Z: Power failure and ship coasting to a stop.

0953Z: Power restored

0958Z: Started logging.

1152Z: Power failed and logging stopped

1206Z: Power restored and logging started

1405Z: XBT taken and applied. Thermosalinograph reading C = 5.50 S/m, S = 35.46 psu, T = 26.31°C, implying surface sound speed of 1538.11 m/s; probe reading 1538.4m/s. Assumed salinity for XBT conversion was 35.92 psu, implying surface sound speed of 1538.40m/s.

2110Z: XBT taken and applied. Thermosalinograph reading C = 5.53 S/m, S = 35.50 psu, T = 26.48°C, implying surface sound speed of 1538.55 m/s; probe reading 1538.8m/s. Assumed salinity for XBT conversion was 35.75 psu, implying surface sound speed of 1538.8m/s.

August 31, 2005 (JD 243)

~0600Z: XBT taken and applied. Thermosalinograph reading C = 5.56 S/m, S = 35.56 psu, T = 26.71°C, implying surface sound speed of 1538.98 m/s; probe reading

1539.6 m/s. Assumed salinity for XBT conversion was 36.77 psu, implying surface sound speed of 1540.30 m/s.

1155Z: A request was received for a series of "wobble tests" – will start them at 1200Z. Plan is to run for an hour with a swath width of +/- 63˚ (we are in 5570 m water depths) with pitch and yaw compensation on (on transmit) and roll compensation on receive. Then run for an hour with yaw compensation off, then an hour with yaw and pitch compensation off. Then repeat the entire experiment with a swath width of +/-60˚.

1200Z: SOL Transit 107: swath width: +/-63˚, pitch stabilization: ON, yaw stabilization: ON, mode re: filtered heading, beam spacing: equidistant. Speed: 10.9 kts, heading: 206˚. USING MARK's OFFSET settings.

1259Z: EOL Transit 107

1300Z: SOL Transit 108: swath width: +/-63˚, pitch stabilization: ON, yew stabilization: OFF, beam spacing: equidistant speed: 10.1 kts, heading: 206˚. USING MARK's offset settings.

1300Z: SOL Transit 108: SWATH width: +/-63˚, pitch stabilization: ON, yaw stabilization: OFF Beam spacing: equidistant. Speed: 10.1 kts, heading: 206˚. USING MARK's OFFSET settings.

1400Z: EOL Transit 108

1400Z: SOL Transit 109: swath width: +/-63˚, pitch stabilization: OFF, yaw stabilization: OFF, beam spacing: equidistant. Speed: 10.1 kts, heading: 206˚. USING MARK's OFFSET settings.

1408Z: XBT taken and applied. Thermosalinograph reading C = 5.58 S/m, S = 35.40 psu, T = 27.13°C, implying surface sound speed of 1539.92 m/s; probe reading 1540.2m/s. Assumed salinity for XBT conversion was 35.79 psu, implying surface sound speed of 1540.2m/s.

1458Z: EOL Transit109

1500Z: SOL Transit 110: swath width: +/-60˚, pitch stabilization: ON, yaw stabilization: ON, mode re: filtered heading, Beam spacing: equidistant. Speed: 10.0 kts, heading: 206˚. USING MARK's OFFSET settings.

1600Z: EOL Transit 110

1601Z: SOL Transit 111: swath width: +/-60˚, pitch stabilization: ON, yaw stabilization: OFF, beam spacing: equidistant. Speed: 10. kts, heading: 206˚. USING MARK's OFFSET settings.

1700Z: EOL Transit 111

1700Z: SOL Transit 112: swath width: +/-60˚, pitch stabilization: OFF, yaw stabilization: OFF, beam spacing: equidistant. Speed: 10. kts, heading: 206˚. USING MARK's OFFSET settings.

1800Z: EOL Transit 112 end of experiments

1800Z: SOL Transit 113: swath width: +/-67˚, pitch stabilization: ON, yaw stabilization: ON, mode: re: heading, beam spacing: equidistant. Speed: 10. kts, heading: 206˚. USING MARK's OFFSET settings.

September 1, 2005 (JD 244)

0016Z: XBT taken and applied. Thermosalinograph reading C = 5.54 S/m, S = 35.18 psu, T = 26.97°C, implying surface sound speed 1539.21 m/s; probe reading 1539.8 m/s. Assumed salinity for XBT conversion was 36.18 psu, implying a surface sound speed of 1540.26 m/s.

0400Z: Maneuvering to avoid fishing vessel in the way – slow turn, so keeping logging for now.

0631Z: XBT taken and applied. Thermosalinograph reading C = 5.56 S/m, S = 35.32 psu, T = 27.00°C, implying surface sound speed 1539.41 m/s; probe reading 1540.0 m/s. Assumed salinity for XBT conversion was 36.08 psu, implying a surface sound speed of 1540.22 m/s.

September 2, 2005 (JD 245)

0023Z: EM1002 turned on to determine whether the power surges of the last few days had done any significant damage. Water depth is now ~600 m, so the system can lock to the bottom with ease.

0030Z: Secured EM120 for end of cruise logging. Turning over the console to HMRG for testing of the high-voltage and SPTX boards.

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Table 2. Cruise Statistics (excluding transits) of data collection.

Leg	JD dates	Line miles (nm)	Line kilometers (km)
1	175 to 210	9792	18,135
2	217 to 236	4722	8745
Total		14,514	26,880

Table 3. Conversion table of UH file names to UNH file names by Julian Day.

JD	Data Folder	HMRG file name .mb56	UNH file name _raw.all	GSF file name .d01
176	**050625**	em120-176-020306-0001	**goa05_line_transit1**	**KMmbb051760203**
176	050625	em120-176-063914-0002	goa05_line_transit2	KMmbb051760639
176	050625	em120-176-064535-0001	goa05_line_transit3	KMmbb051760645
176	050625	em120-176-172408-0002	goa05_line_transit4	KMmbb051761724
177	**050626**	**em120-177-000044-0003**	**goa05_line_transit5**	**KMmbb05170000**
177	050626	em120-177-044345-0004	goa05_line_transit6	KMmbb051770443
177	050626	em120-177-164345-0005	goa05_line_transit7	KMmbb051771644
178	**050627**	**em120-178-000024-0007**	**goa05_line_transit8**	**KMmbb051780000**
178	050627	em120-178-011125-0008	goa05_line_transit9	KMmbb051780111
178	050627	em120-178-011302-0009	goa05_line_transit10	KMmbb051780113
178	050627	em120-178-012243-0010	goa05_line_transit11	KMmbb051780122
178	050627	em120-178-132241-0011	goa05_line_transit12	KMmbb051781322
178	050627	em120-178-183714-0012	goa05_line_transit13	KMmbb051781837
178	050627	em120-178-190808-0013	goa05_line_transit14	KMmbb051781908
179	**050628**	**em120-179-004042-0014**	**goa05_line_transit15**	**KMmbb051790041**
179	050628	em120-179-064549-0016	goa05_line_transit16	KMmbb051790646
179	050628	em120-179-184521-0017	goa05_line_transit17	KMmbb051791845
180	**050629**	**em120-180-061905-0018**	**goa05_line_transit18**	**KMmbb051800619**
180	050629	em120-180-062500-0019	goa05_line_transit19	KMmbb051800625
180	050629	em120-180-181742-0020	goa05_line_transit20	KMmbb05181817
181	**050630**	**em120-181-042408-0021**	**goa05_line_transit21**	**KMmbb051810424**
181	050630	em120-181-164208-0022	goa05_line_transit22	KMmbb051811624
181	050630	em120-181-184201-0023	goa05_line_transit23	KMmbb051811842
181	050630	em120-181-234736-0024	goa05_line_transit24	KMmbb051812347
182	**050701**	**em120-182-002217-0025**	**goa05_line_transit25**	**KMmbb051820022**
182	050701	em120-182-0539117-0026	goa05_line_transit26	KMmbb051820539
182	0507010	em120-182-173910-0027	goa05_line_transit27	KMmbb051821739
182	050701	em120-182-192733-0028-	goa05_line_transit28	KMmbb051821927
183	**050702**	**em120-183-000050-0029**	**goa05_line_transit29**	**KMmbb051830001**
183	050702	em120-183-120050-0030	goa05_line_transit30	KMmbb051831200
183	050702	no -0031		
183	050702	no -0032		
183	050702	em120-183-212202-0033	goa05_line_transit31	KMmbb051832122
183	050702	em120-183-220138-0034	goa05_line_patch1	KMmbb051832201
183	050702	em120-183-225325-0035	goa05_line_patch2	KMmbb051832253
184	**050703**	**em120-184-005217-0037**	**goa05_line_patch3**	**KMmbb051840052**
184	050703	em120-184-012544-0039	goa05_line_patch4	KMmbb051840126
184	050703	em120-184-021344-0041	goa05_line_patch5	KMmbb051840213
184	050703	em120-184-023735-0043	goa05_line_patch6	KMmbb051840237
184	050703	em120-184-031920-0045	goa05_line_1 (dip1)	KMmbb051840319
JD	**Data Folder**	**HMRG file name .mb56**	**UNH file name _raw.all**	**GSF file name .d01**

184	050703	em120-184-115856-0046	goa05_line_2 (dip1)	KMmbb051841159
184	050703	em120-184-131750-0047	goa05_line_3	KMmbb051841317
184	050703	em120-184-153823-0049	goa05_line_4	KMmbb051841538
185	**050704**	**em120-185-011723-0051**	**goa05_line_5**	**KMmbb051850117**
185	050704	em120-185-103042-0056	goa05_line_6	KMmbb051851030
185	050704	em120-185-191840-0057	goa05_line_7	KMmbb051851918
186	**050705**	**em120-186-035746-0058**	**goa05_line_8**	**KMmbb051860357**
186	050705	em120-186-115623-0060	goa05_line_9	KMmbb05181156
186	050705	em120-186-194746-0062	goa05_line_10	KMmbb05181948
187	**050706**	**em120-187-023607-0064**	**goa05_line_11**	**KMmbb051870236**
187	050706	em120-187- 083944-0066	goa05_line_12	KMmbb051870839
187	050706	em120-187-141739-0067	goa05_line_13	KMmbb051871417
187	050706	em120-187-202013-0001	***goa05_line_***	***Bad line-MBES down***
187	050706	em120-187-0515293-0002	***goa05_line_test***	**Test line**
188	**050707**	**em120-188-085443-0006**	**goa05_line_14**	**KMmbb051880854**
188	050707	em120-188-141635-0010	goa05_line_15 (dip2)	KMmbb051881416
188	050707	em120-188-222400-0012	goa05_line_16	KMmbb051882224
189	**050708**	**em120-189-035725-0013**	**goa05_line_17**	**KMmbb051890357**
189	050708	em120-189-155725-0014	goa05_line_18	KMmbb051891557
189	050708	em120-189-194919-0015	goa05_line_19	KMmbb051891949
190	**050709**	**em120-190-074919-0016**	**goa05_line_20**	**KMmbb051900749**
190	050709	em120-190-095932-0017	goa05_line_21	KMmbb051900959
190	050709	em120-190-0215930-0018	goa05_line_22	KMmbb051902159
191	**050710**	**em120-191-010046-0019**	**goa05_line_23**	**KMmbb051910100**
191	050710	em120-191-134031-0021	goa05_line_24	KMmbb051911340
192	**050711**	**em120-192-014031-0022**	**goa05_line_25**	**KMmbb051920140**
192	050711	em120-192-034943-0024	goa05_line_26	KMmbb051920349
192	050711	em120-192-154943-0025	goa05_line_27	KMmbb051921549
192	050711	em120-192-185013-0027	goa05_line_28	KMmbb051921850
193	**050712**	**em120-193-065013-0028**	**goa05_line_29**	**KMmbb051930650**
193	050712	em120-193-095622-0029	goa05_line_30	KMmbb051930956
193	050712	em120-193-215622-0030	goa05_line_31	KMmbb051932156
194	**050713**	**em120-194-020508-0031**	**goa05_line_32**	**KMmbb051940205**
194	050713	em120-194-140508-0032	goa05_line_33	KMmbb051941405
194	050713	em120-194-182629-0034	goa05_line_34	KMmbb051941826
195	**050714**	**em120-195-062629-0035**	**goa05_line_35**	**KMmbb051950626**
195	050714	em120-195-130547-0036	goa05_line_36	KMmbb051951305
196	**050715**	**em120-196-010547-0037**	**goa05_line_37**	**KMmbb0519601055**
196	050715	em120-196-060027-0039	goa05_line_38	KMmbb0519600600
JD	**Data Folder**	**HMRG file name .mb56**	**UNH file name _raw.all**	**GSF file name .d01**
196	050715	em120-196-180026-0040	goa05_line_39	KMmbb051961800

196	050715	em120-196-224327-0042	goa05_line_40	KMmbb051962243
197	**050716**	**em120-197-104327-0043**	**goa05_line_41**	**KMmbb051971043**
197	050716	em120-197-153802-0044	goa05_line_42	KMmbb051971538
198	**050717**	**em120-198-033802-0045**	**goa05_line_43**	**KMmbb051980338**
198	050717	em120-198-080642-0046	goa05_line_44	KMmbb051980806
198	050717	em120-198-200642-0047	goa05_line_45	KMmbb051982006
199	**050718**	**em120-199-003007-0049**	**goa05_line_46**	**KMmbb051990030**
199	050718	em120-199-123007-0050	goa05_line_47	KMmbb051991230
199	050718	em120-199-145809-0051	goa05_line_48	KMmbb051991458
200	**050719**	**em120-200-025809-0052**	**goa05_line_49**	**KMmbb052000258**
200	050719	em120-200-042802-0053	goa05_line_50	KMmbb05200428
200	050719	em120-200-165513-0054	goa05_line_51	KMmbb052001655
201	**050720**	**em120-201-040932-0055**	**goa05_line_52**	**KMmbb052010409**
201	050720	em120-201-135003-0056	goa05_line_53	KMmbb052011350
201	050720	em120-201-223840-0057	goa05_line_54	KMmbb052011350
202	**050721**	**em120-202-055408-0058**	**goa05_line_55**	**KMmbb052020554**
202	050721	em120-202-121101-0059	goa05_line_56	KMmbb052021211
202	050721	em120-202-165730-0060	goa05_line_57	KMmbb052021657
202	050721	em120-202-200551-0061	goa05_line_58	KMmbb052022006
202	050721	em120-202-221918-0062	goa05_line_59 (dip 3)	KMmbb052022219
203	**050722**	**em120-203-101918-0063**	**goa05_line_60 (dip 3)**	**KMmbb052031019**
203	050722	em120-203-143727-0064	goa05_line_61	KMmbb052031437
204	**050723**	**em120-204-003414-0001**	**goa05_line_62**	**KMmbb052040034**
204	050723	em120-204-090233-0002	goa05_line_63	KMmbb052040902
204	050723	em120-204-174252-0003	goa05_line_64	KMmbb052041743
205	**050724**	**em120-205-021500-0004**	**goa05_line_65**	**KMmbb052050215**
205	050724	em120-205-105645-0005	goa05_line_66	KMmbb052051056
205	050724	em120-205-194034-0006	goa05_line_67	KMmbb052051940
206	**050725**	**em120-206-042336-0007**	**goa05_line_68**	**KMmbb052060423**
206	050725	em120-206-132316-0008	goa05_line_69	KMmbb052061323
206	050725	em120-206-220849-0009	goa05_line_70	KMmbb052062208
207	**050726**	**em120-207-070454-0011**	**goa05_line_71**	**KMmbb052070705**
207	050726	em120-207-155338-0012	goa05_line_72	KMmbb052071533
208	**050727**	**em120-208-010900-0013**	**goa05_line_73**	**KMmbb052080109**
208	050727	em120-208-100953 -0014	goa05_line_74	KMmbb052081009
208	050727	em120-208-191354 -0015	goa05_line_75	KMmbb052081913
209	**050728**	**em120-209-034601-0016**	**goa05_line_transit32**	**KMmbb052090346**
JD	**Data Folder**	**HMRG file name .mb56**	**UNH file name _raw.all**	**GSF file name .d01**

209	050728	em120-209-134248-0017	goa05_line_transit33	
210	**050729**	**em120-210-014248-0018**	**goa05_line_transit34**	
********	********	***END OF LEG 1***	***END OF LEG 1***	***END OF LEG 1***
214	**050802**	**em120-214-224830-0001**	**goa05_line_transit35**	**KMmbb052142248.d01**
		em120-214-225147-0002	goa05_line_transit36	KMmbb052142251.d01
		em120-214-225246-0003	goa05_line_transit37	KMmbb052142252.d01
215	**050803**	**em120-215-000011-0004**	**goa05_line_transit38**	**KMmbb052150000.d01**
		em120-215-013912-0005	goa05_line_transit39	KMmbb052150139.d01
		em120-215-023447-0006	goa05_line_transit40	KMmbb052150234.d01
		em120-215-143447-0007	goa05_line_transit41	KMmbb052151435.d01
		em120-215-182545-0008	goa05_line_transit42	KMmbb052151825.d01
		em120-215-225228-0009	goa05_line_transit43	KMmbb052152252.d01
		em120-215-232236-0010	goa05_line_transit44	KMmbb052152322.d01
		em120-215-235622-0011	goa05_line_transit45	KMmbb052152356.d01
216	**050804**	**em120-216-003532-0012**	**goa05_line_transit46**	**KMmbb052160035.d01**
		em120-216-022007-0001	goa05_line_bdtest1	KMmbb052160220.d01
		em120-216-024648-0002	goa05_line_bdtest2	KMmbb052160247.d01
		em120-216-025846-0004	goa05_line_bdtest3	KMmbb052160258.d01
		em120-216-030121-0005	goa05_line_bdtest4	KMmbb052160301.d01
		em120-216-030212-0006	goa05_line_bdtest5	KMmbb052160302.d01
		em120-216-032446-0007	goa05_line_bdtest6	KMmbb052160325.d01
		em120-216-075126-0001	goa05_line_transit47	KMmbb052160751.d01
		em120-216-082607-0002	goa05_line_patch2_1	KMmbb052160826.d01
		em120-216-083530-0003	goa05_line_patch2_2	KMmbb052160835.d01
		em120-216-095146-0005	goa05_line_transit48	KMmbb052160951.d01
		em120-216-102627-0007	goa05_line_patch2_3	KMmbb052161026.d01
		em120-216-105945-0008	goa05_line_transit49	KMmbb052161100.d01
		em120-216-111228-0009	goa05_line_patch2_4	KMmbb052161113.d01
		em120-216-114254-0010	goa05_line_transit50	KMmbb052161143.d01
		em120-216-115837-0011	goa05_line_patch2_5	KMmbb052161158.d01
		em120-216-125027-0012	goa05_line_transit51	KMmbb052161250.d01
		em120-216-175905-0001	goa05_line_dipline4A	KMmbb052161759.d01
		em120-216-202630-0002	goa05_line_dipline4B	KMmbb052162026.d01
		em120-216-220719-0003	goa05_line_dipline4C	KMmbb052162027.d01
		em120-216-231631-0004	goa05_line_dipline4D	KMmbb052162315.d01
217	**050805**	**em120-217-012311-0005**	**goa05_line_dipline4E**	**KMmbb052170123.d01**
		em120-217-041942-0006	goa05_line_dipline4F	KMmbb052170419.d01
		em120-217-043455-0007	goa05_line_dipline4G	KMmbb052170435.d01
		em1002-217-063623-0001	goa05_line_1002_01	KMmba052170636.d01
		em1002-217-073624-0002	goa05_line_1002_02	KMmba052170736.d01
		em1002-217-083624-0003	goa05_line_1002_03	KMmba052170836.d01
		em1002-217-093623-0004	goa05_line_1002_04	KMmba052170936.d01
		em1002-217-102500-0005	goa05_line_1002_05	KMmba052171025.d01
		em1002-217-114236-0006	goa05_line_1002_06	KMmba052171142.d01
		em120-217-171501-0001	goa05_line_EM120test1	KMmbb052171715.d01
		em120-217-174437-0002	goa05_line_EM120test2	KMmbb052171744.d01
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		em120-217-223204-0008	goa05_line_75.5	KMmbb052172232.d01

217	050805	em120-217-224135-0009	goa05_line_76	KMmbb052172241.d01
218	**050806**	**em1002-218-074146-0001**	**goa05_line_1002_07**	**KMmba052180741.d01**
219	**050807**	**em120-219-003610-0001**	**goa05_line_77**	**KMmbb052190036.d01**
		em120-219-014101-0002	goa05_line_78	KMmbb052190141.d01
		em120-219-024729-0003	goa05_line_79	KMmbb052190247.d01
		em120-219-114837-0004	goa05_line_80	KMmbb052191148.d01
		em120-219-213242-0005	goa05_line_81	KMmbb052192132.d01
220	**050808**	**em120-220-081127-0006**	**goa05_line_82**	**KMmbb052200811.d01**
		em120-220-183356-0007	goa05_line_83	KMmbb052201833.d01
221	**050809**	**em120-221-044903-0010**	**goa05_line_84**	**KMmbb052210449.d01**
		em120-221-145540-0012	goa05_line_85	KMmbb052211455.d01
222	050810	em120-222-004725-0013	goa05_line_86	KMmbb052220047.d01
		em120-222-104815-0014	goa05_line_87	KMmbb052221048.d01
		em120-222-205538-0015	goa05_line_88	KMmbb052222055.d01
223	**050811**	**em120-223-062130-0017**	**goa05_line_89**	**KMmbb052230621.d01**
		em120-223-160714-0018	goa05_line_90	KMmbb052231607.d01
224	**050812**	**em120-224-040714-0019**	**goa05_line_91**	**KMmbb052240407.d01**
		em120-224-094944-0020	goa05_line_92	KMmbb052240949.d01
		em120-224-214944-0021	goa05_line_93	KMmbb052242149.d01
225	**050813**	**em120-225-032758-0022**	**goa05_line_94**	**KMmbb052250327.d01**
		em120-225-152758-0023	goa05_line_95	KMmbb052251527.d01
		em120-225-204839-0024	goa05_line_96	KMmbb052252048.d01
226	**050814**	**em120-226-084839-0025**	**goa05_line_97**	**KMmbb052260848.d01**
		em120-226-144040-0026	goa05_line_98	KMmbb052261440.d01
227	**050815**	em120-227-024038-0027	goa05_line_99	KMmbb052270240.d01
		em120-227-082011-0028	goa05_line_100	KMmbb052270820.d01
		em120-227-202011-0029	goa05_line_101	KMmbb052272020.d01
228	**050816**	**em120-228-022023-0030**	**goa05_line_102**	**KMmbb052280220.d01**
		em120-228-030004-0032	goa05_line_103	KMmbb052280300.d01
		em120-228-150004-0033	goa05_line_104	KMmbb052281500.d01
		em120-228-211635-0034	goa05_line_105	KMmbb052282116.d01
229	**050817**	**em120-229-091635-0035**	**goa05_line_106**	**KMmbb052290916.d01**
		em120-229-152045-0036	goa05_line_107	KMmbb052291520.d01
		em120-229-160014-0037	goa05_line_108	KMmbb052291600.d01
230	**050818**	**em120-230-040014-0038**	**goa05_line_109**	**KMmbb052300400.d01**
		em120-230-090558-0039	goa05_line_110*	KMmbb052300905.d01
		em120-230-095746-0040	goa05_line_111*	KMmbb052300957.d01
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		em120-230-103707-0041	goa05_line_112	KMmbb052301037.d01
230	050818	em120-230-123426-0042	goa05_line_113	KMmbb052301234.d01
231	**050819**	**em120-231-003426-0043**	**goa05_line_114**	**KMmbb052310034.d01**
		em120-231-062938-0044	goa05_line_115*	KMmbb052310629.d01
		em120-231-064240-0045	goa05_line_116	KMmbb052310642.d01
		em120-231-160217-0046	goa05_line_117	KMmbb052311602.d01
232	**050820**	**em120-232-012301-0047**	**goa05_line_118**	**KMmbb052320123.d01**
		em120-232-095904-0048	goa05_line_119	KMmbb052320959.d01
		em120-232-152958-0049	goa05_line_120	KMmbb052321529.d01
		em120-232-200726-0050	goa05_line_121	KMmbb052322007.d01
233	**050821**	**em120-233-002535-0051**	**goa05_line_122**	**KMmbb052330025.d01**
		em120-233-050017-0052	goa05_line_123	KMmbb052330500.d01
		em120-233-103837-0053	goa05_line_124	KMmbb052331038.d01
		em120-233-155214-0054	goa05_line_125	KMmbb052331552.d01
		em120-233-214306-0055	goa05_line_126	KMmbb052332143.d01
234	**050822**	**em120-234-023704-0056**	**goa05_line_127***	**KMmbb052340237.d01**
		em120-234-030602-0057	goa05_line_128	KMmbb052340306.d01
		em120-234-135827-0059	goa05_line_130	KMmbb052341358.d01
		em120-234-185533-0060	goa05_line_131	KMmbb052341855.d01
235	**050823**	**em120-235-004501-0061**	**goa05_line_132**	**KMmbb052350045.d01**
		em120-235-060438-0062	goa05_line_133	KMmbb052350604.d01
		em120-235-110838-0063	goa05_transit52	KMmbb052351108.d01
		em120-235-203524-0064	goa05_line_134	KMmbb052352035.d01
236	**050824**	**em120-236-022316-0065**	**goa05_line_135**	**KMmbb052360223.d01**
		em120-236-080307-0066	goa05_line_136	KMmbb052360803.d01
		em120-236-133611-0067	goa_05_line_transit53	KMmbb052361336.d01
		em120-236-140455-0068	goa05_line_137	KMmbb052361404.d01
		em120-236-160717-0069	goa05_transit_54	KMmbb052361607.d01
		em120-236-234303-0070	goa05_transit_55	KMmbb052362343.d01
237	**050825**	**em120-237-034301-0071**	**goa05_transit_56**	**KMmbb052370343.d01**
		em120-237-074302-0072	goa05_transit_57	KMmbb052370743.d01
		em120-237-114303-0073	goa05_transit_58	KMmbb052371143.d01
		em120-237-154301-0074	goa05_transit_59	KMmbb052371543.d01
		em120-237-194302-0075	goa05_transit_60	KMmbb052371943.d01
		em120-237-234302-0076	goa05_transit_61	KMmbb052372343.d01
238	**050826**	**em120-238-021739-0077**	**goa05_transit_62**	**KMmbb052380217.d01**
		em120-238-061737-0078	goa05_transit_63	KMmbb052380617.d01
		em120-238-101738-0079	goa05_transit_64	KMmbb052381017.d01
		em120-238-122935-0080	goa05_transit_65*	KMmbb052381229.d01
		em120-238-123038-0081	goa05_transit_66*	KMmbb052381230.d01
		em120-238-123347-0001	goa05_transit_67*	KMmbb052381233.d01
		em120-238-123452-0002	goa05_transit_68	KMmbb052381234.d01
		em120-238-124413-0001	goa05_transit_69	KMmbb052381244.d01
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		em120-238-125051-0003	goa05_transit_70	KMmbb052381250.d01
		em120-238-165052-0004	goa05_transit_71	KMmbb052381650.d01
238	050826	em120-238-205050-0005	goa05_transit_72	KMmbb052382050.d01
239	**050827**	**em120-239-005051-0006**	**goa05_transit_73**	**KMmbb052390050.d01**
		em120-239-045052-0007	goa05_transit_74	KMmbb052390450.d01
		em120-239-063235-0008	goa05_transit_75	KMmbb052390632.d01
		em120-239-103236-0009	goa05_transit_76	KMmbb052391032.d01
		em120-239-143234-0010	goa05_transit_77	KMmbb052391432.d01
		em120-239-183235-0011	goa05_transit_78	KMmbb052391832.d01
		em120-239-235755-0012	goa05_transit_79	KMmbb052392357.d01
240	**050828**	**em120-240-024832-0013**	**goa05_transit_80**	**KMmbb052400248.d01**
		em120-240-034138-0014	goa05_transit_81	KMmbb052400341.d01
		em120-240-044317-0015	goa05_transit_82	KMmbb052400443.d01
		em120-240-075751-0016	goa05_transit_83	KMmbb052400757.d01
		em120-240-092214-0017	goa05_transit_84	KMmbb052400922.d01
		em120-240-132213-0018	goa05_transit_85	KMmbb052401322.d01
		em120-240-172213-0019	goa05_transit_86	KMmbb052401722.d01
		em120-240-212214-0020	goa05_transit_87	KMmbb052402122.d01
		em120-240-235824-0021	goa05_transit_88	KMmbb052402358.d01
		em120-241-005845-0022	goa05_transit_89	KMmbb052410058.d01
241	**050829**	**em120-241-045844-0023**	**goa05_transit_90**	**KMmbb052410458.d01**
		em120-241-085844-0024	goa05_transit_91	KMmbb052410858.d01
		em120-241-125843-0025	goa05_transit_92	KMmbb052411258.d01
		em120-241-164005-0026	goa05_transit_93	KMmbb052411640.d01
		em120-241-204006-0027	goa05_transit_94	KMmbb052412040.d01
242	**050830**	em120-242-004005-0028	goa05_transit_95	KMmbb052420040.d01
		em120-242-014109-0029	goa05_transit_96	KMmbb052420141.d01
		em120-242-045145-0030	goa05_transit_97	KMmbb052420451.d01
		em120-242-052948-0031	goa05_transit_98	KMmbb052420529.d01
		em120-242-073215-0032	goa05_transit_99	KMmbb052420732.d01
		em120-242-095759-0033	goa05_transit_100	KMmbb052420957.d01
		em120-242-120624-0034	goa05_transit_101	KMmbb052421206.d01
		em120-242-160625-0035	goa05_transit_102	KMmbb052421606.d01
		em120-242-200625-0036	goa05_transit_103	KMmbb052422006.d01
243	**050831**	**em120-243-000624-0037**	**goa05_transit_104**	**KMmbb052430006.d01**
		em120-243-040625-0038	goa05_transit_105	KMmbb052430406.d01
		em120-243-080623-0039	goa05_transit_106	KMmbb052430806.d01
	cpm-test	em120-243-120046-0040	goa05_transit_107	KMmbb052431200.d01
	cpm-test	em120-243-130003-0041	goa05_transit_108	KMmbb052431300.d01
	cpm-test	em120-243-140034-0042	goa05_transit_109	KMmbb052431400.d01
	cpm-test	em120-243-145916-0043	goa05_transit_110	KMmbb052431459.d01
	cpm-test	em120-243-160121-0044	goa05_transit_111	KMmbb052431601.d01
	cpm-test	em120-243-170055-0045	goa05_transit_112	KMmbb052431700.d01
		em120-243-180013-0046	goa05_transit_113	KMmbb052431800.d01
		em120-243-220013-0047	goa05_transit_114	KMmbb052432200.d01
JD	**Data Folder**	**HMRG file name .mb56**	**UNH file name _raw.all**	**GSF file name .d01**

244	**050901**	**em120-244-020012-0048**	**goa05_transit_115**	**KMmbb052440200.d01**
		em120-244-060013-0049	goa05_transit_116	KMmbb052440600.d01
244	**050901**	em120-244-100011-0050	goa05_transit_117	KMmbb052441000.d01
		em120-244-140012-0051	goa05_transit_118	KMmbb052441400.d01
		em120-244-180013-0052	goa05_transit_119	KMmbb052441800.d01
		em120-244-220011-0053	goa05_transit_120	KMmbb052442200.d01
		End of Cruise	***End of Cruise***	***End of Cruise***

Table 4. Sensor locations

Sensor	Forward (X)	Starboard (Y)	Downward (Z)
Pos, Port 1	-7.22	8.50	-8.15
Pos, Port 3	0.00	0.00	0.00
Pos, Port 4	3.80	3.98	-23.80
Pos, Ethernet	0.00	0.00	0.00
Tx Transducer	-3.29	-0.04	0.79
Rx Transducer	1.12	-1.21	0.77
Motion Sensor	0.00	0.00	0.00
Waterline			-6.24

Table 5. Installation angles

	Roll (degrees)	Pitch (degrees)	Heading (degrees)
Rx Transducer	0.01	0.00	0.02
Rx Transducer	0.15	0.06	0.30

Table 6. Motion-sensor offsets

	Roll (degrees)	Pitch (degrees)	Heading (degrees)
Offset Angles	-0.30	-0.28	0.00
Delay (ms)	0		
Roll Scaling	0		

Appendix 1. Cruise Calendar

JUNE 2005

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	JD175 24 depart Honolulu 0800 L fuel pier 1600 L	JD176 25 transit
JD177 26 transit	JD178 27 transit	JD179 28 transit	JD180 29 transit	JD181 30 transit		

JULY 2005

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					JD182 1 transit	JD183 2 patch test
JD184 3 started mapping 1st block	JD185 4 mapping 1st block MVP died	JD186 5 mapping 1st block	JD187 6 finished mapping 1st block MBES died	JD188 7 started mapping 2nd block	JD189 8 mapping 2nd block	JD190 9 mapping 2nd block
JD191 10 mapping 2nd block	JD192 11 mapping 2nd block	JD193 12 mapping 2nd block	JD194 13 mapping 2nd block	JD195 14 mapping 2nd block	JD196 15 mapping 2nd block	JD197 16 mapping 2nd block
JD198 17 mapping 2nd block	JD199 18 mapping 2nd block	JD200 19 mapping 2nd block	JD201 20 mapping 2nd block	JD202 21 finish mapping 2nd block	JD203 22 started mapping 3ed block	JD204 23 mapping 3ed block
JD205 24 mapping 3ed block	JD206 25 mapping 3ed block	JD207 26 mapping 3ed block	JD208 27 depart for Kodiak 1930 L	JD209 28 transit to Kodiak	JD210 29 arrive Kodiak 0800 L	JD211 30 in port Kodiak
JD212 31 in port Kodiak						

AUGUST 2005

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	JD213 1 in port Kodiak	JD214 2 depart Kodiak 1400 L	JD215 3 transit & deep water test	JD216 4 system testing dipline	JD217 5 run 1st line - still testing	JD2181 6 stop in Yakutat begin mapping
JD219 7 mapping 4th block	JD220 8 mapping 4th block	JD221 9 mapping 4th block	JD222 10 mapping 4th block	JD223 11 mapping 4th block	JD224 12 mapping 3rd and 4th block	JD225 13 mapping 3rd and 4th block
JD226 14 mapping 3rd and 4th block	JD227 15 mapping 3rd and 4th block	JD228 16 mapping 3rd and 4th block	JD229 17 mapping 3rd and 4th block	JD230 18 mapping 3rd and 4th block	JD231 19 mapping 3rd and 4th block	JD232 20 mapping 3rd and 4th block
JD233 21 mapping 3rd and 4th block	JD234 22 mapping 3rd block	JD235 23 mapping 1st block	JD236 24 end surveying 0700 begin transit	JD237 25 transit	JD238 26 transit	JD239 27 transit
JD240 28 transit	JD241 29 transit	JD242 30 transit	JD243 31 transit	JD244 1 Arrive Honolulu 0700 L	SEPTEMBER	

Appendix 2. Cruise Personnel

Name	Affiliation	Position	Legs
Capt. Bryon Wilson		Ship's Master	1,2
Dr. James V. Gardner	Univ. of New Hampshire	UNH/NOAA Rep.	1
Dr. Larry A. Mayer	Univ. of New Hampshire	UNH/NOAA Rep.	2
Dr. Brian Calder	Univ. of New Hampshire	UNH/NOAA Rep.	2
Dr. Svinivas Karlapati	Univ. of New Hampshire	graduate student	1
Mr. Clive Amgwenyi	Univ. of New Hampshire	graduate student	1
Mr. Hugo Montoro	Univ. of New Hampshire	graduate student	1
Ms. Jennie Morgon	Univ. of Hawaii	multibeam operator	1,2
Mr. Jamie Smith	Univ. of Hawaii	multibeam operator	1
Ms. Amelia Lyons	Univ. of Hawaii	multibeam operator	1,2
Mr. Brad Issler	Humboldt. State Univ.	MATE trainee	1
Ms Colleen McCue	Coastal Carolina Univ.	MATE trainee	1
Mr. Gabe Foreman	Univ. of Hawaii	Electronics Tech	1
Mr. Kuhio Vellalos	Univ. of Hawaii	Electronics Tech	1
Lt. Mark Van Waes	NOAA	watch stander	2
Mr. Doug Wood	NOAA	watch stander	2
Mr. Mashkoor Malik	Univ. of New Hampshire	graduate student	2
Mr. Abubakar Mustafa	Univ. of New Hampshire	graduate student	2
Mr. Taisei Morishita	Univ. of New Hampshire	graduate student	2
CMDR. Anthony Withers	Royal Australian Navy	Visiting Scholar UNH	2
Mr. Dan Fitzgerald	Univ of Hawaii	Electronics Tech	2
Mr. Tim McGovern	Univ. of Hawaii	Electronics Tech	2
Mr. Nile Akel Kevis Sterling	Univ. of Hawaii	multibeam operator	2
Mr. Angelo, Luis Tavera	Texas A&M University	MATE Trainee	2

Appendix 3. Color shaded-relief bathymetry and acoustic backscatter maps of U.S. Gulf of Alaska continental margin.

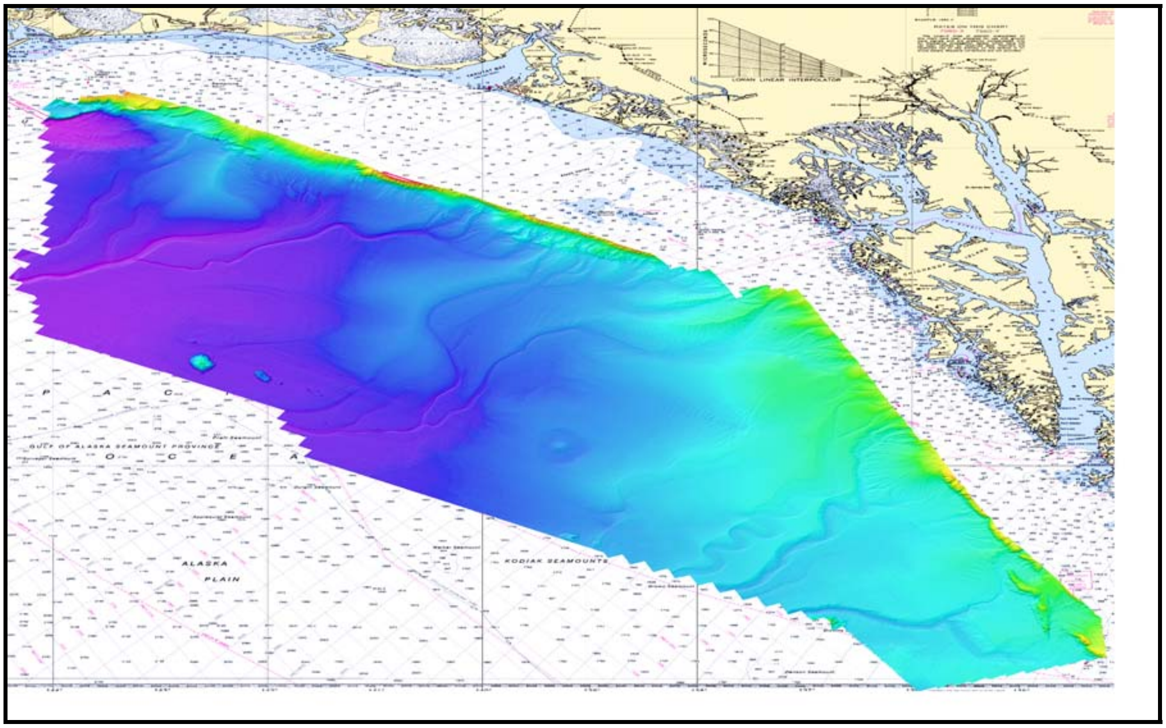

Figure 29. Color-coded bathymetry of Gulf of Alaska margin. Background is NOAA Chart 16016.

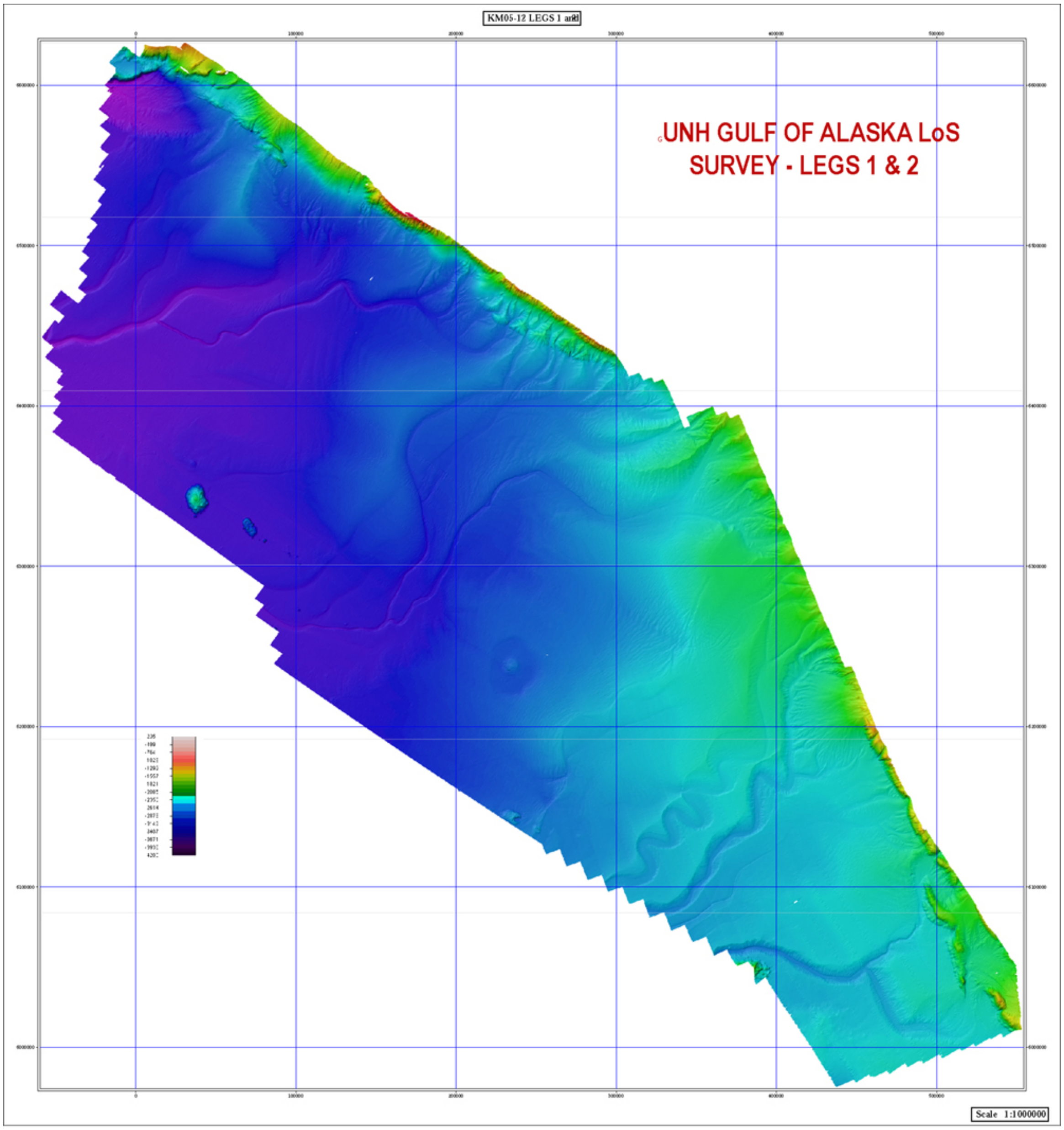

Figure 30. Color shaded-relief map of entire survey area.

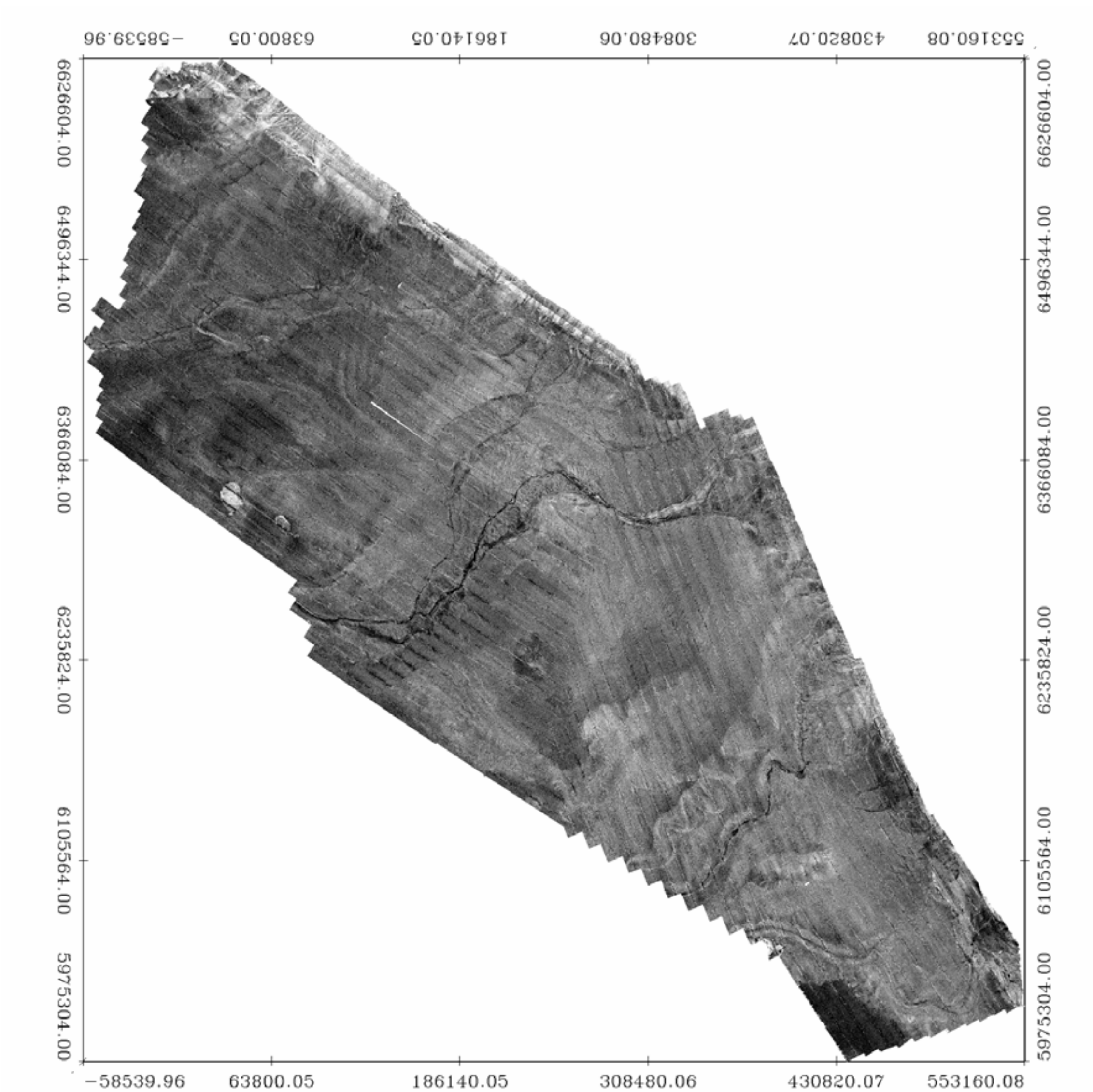

Figure 31. Acoustic backscatter map for entire survey area (UTM ZONE 8).

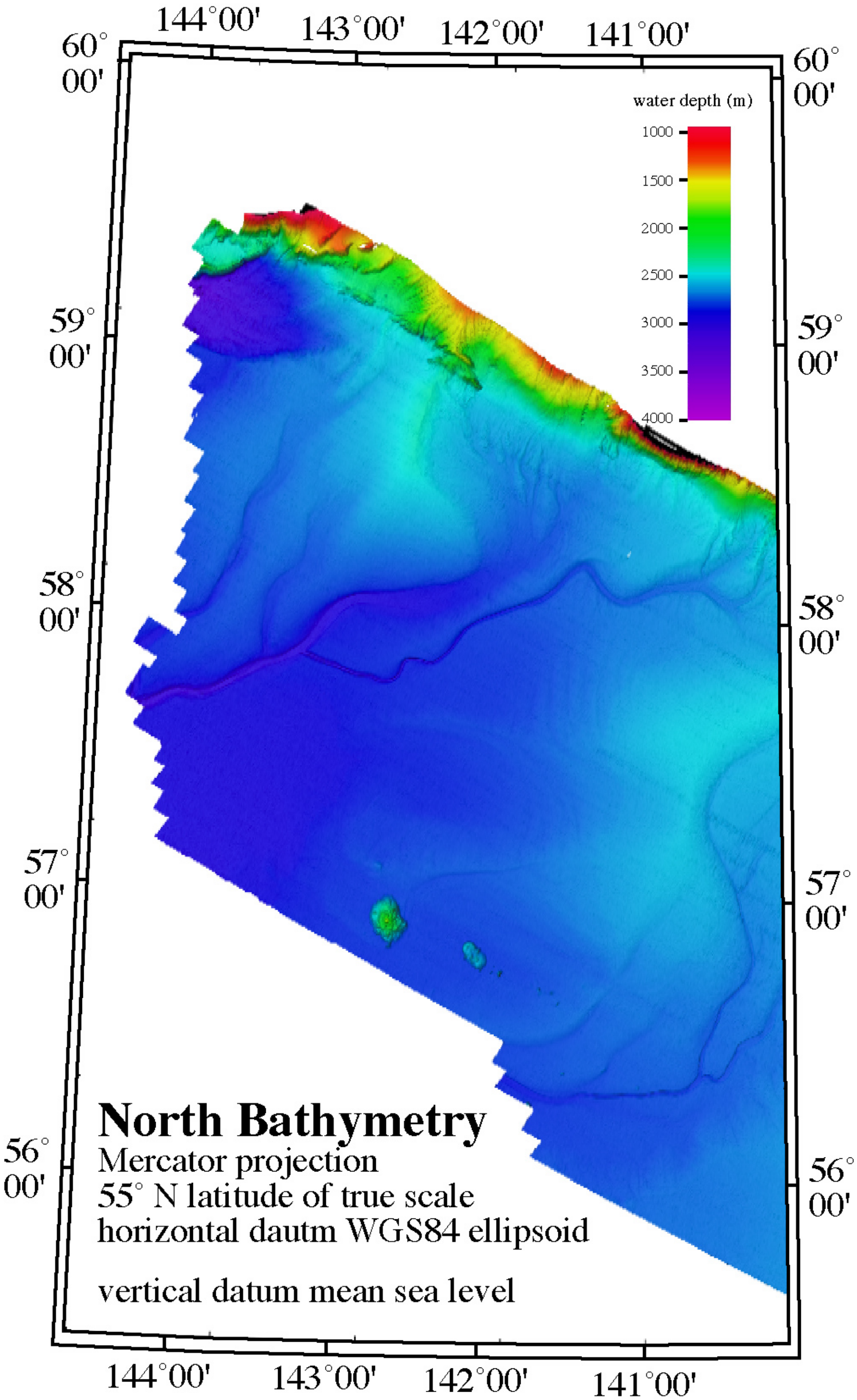

Figure 32. Color shaded-relief bathymetry map of North area.

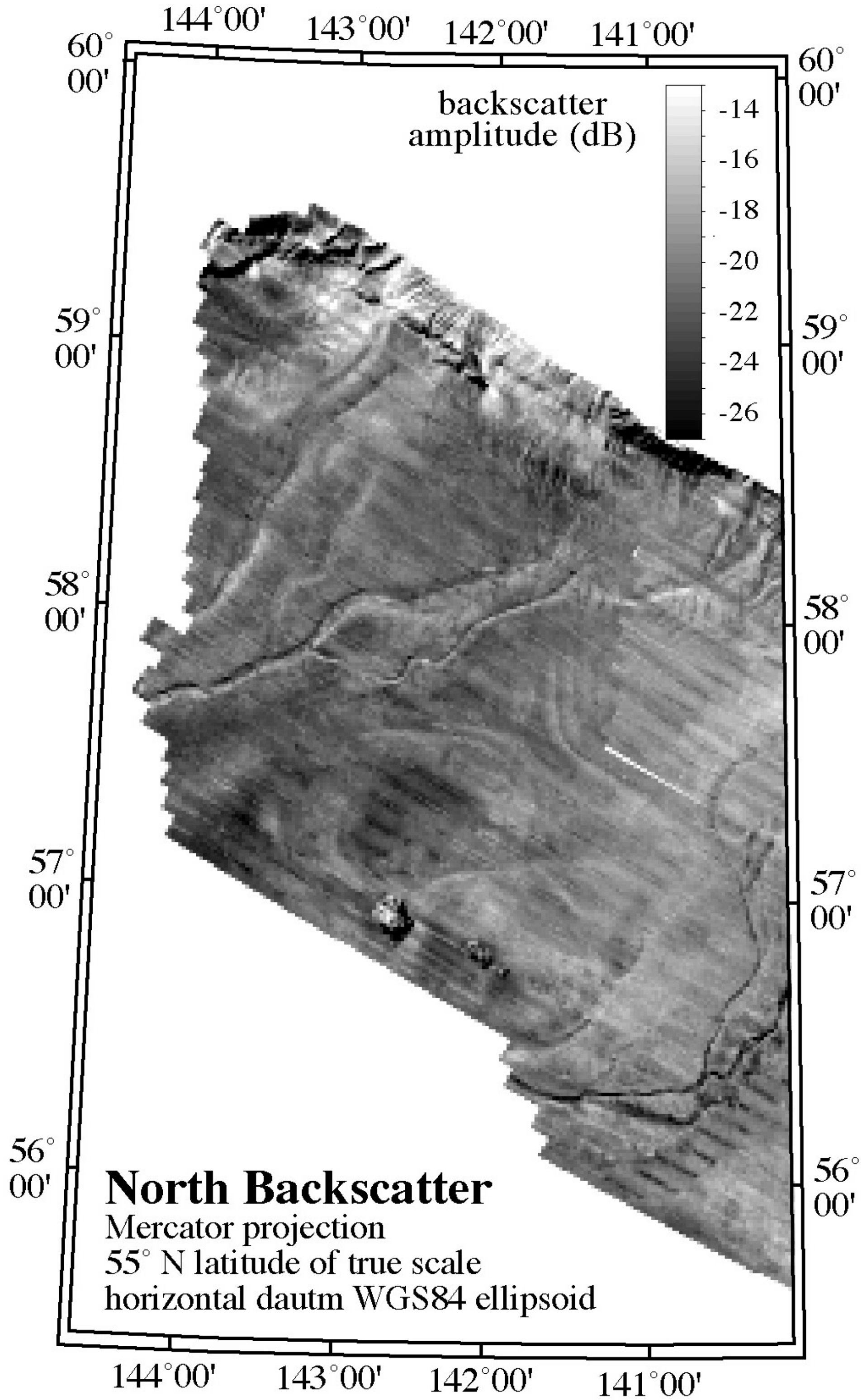

Figure 33. Acoustic-backscatter map of North area.

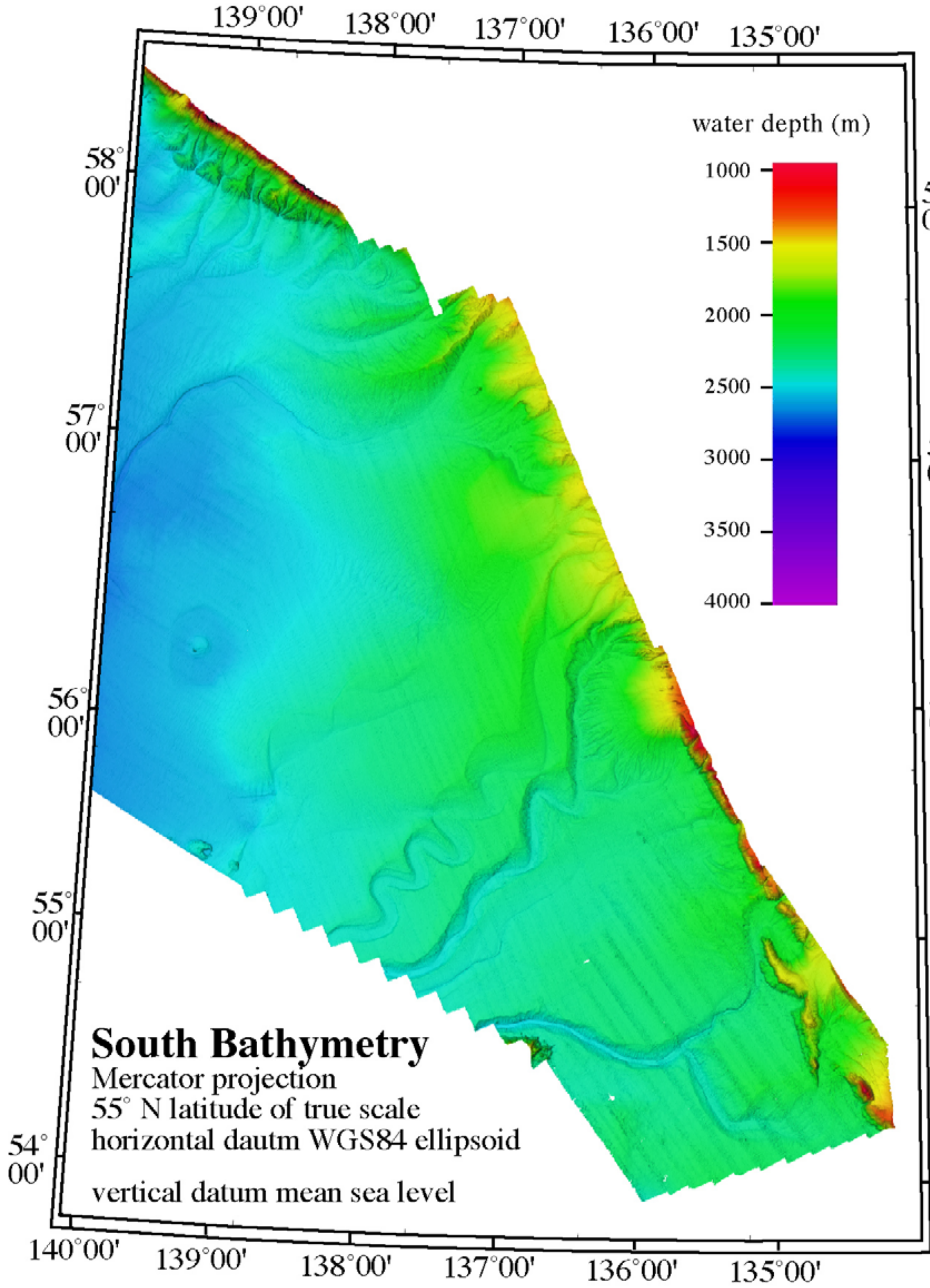

Figure 34. Color shaded-relief bathymetry map of South area.

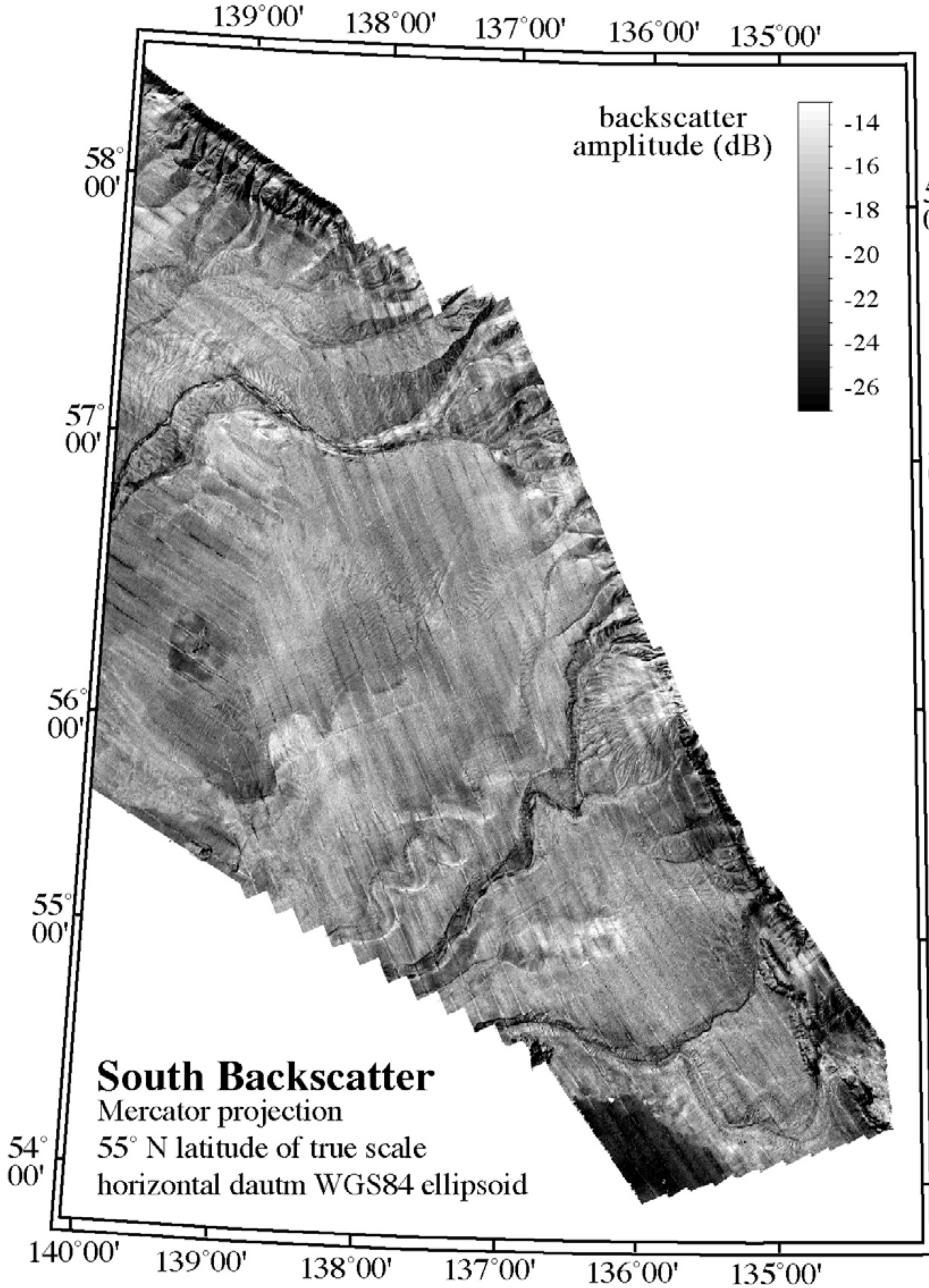

Figure 35. Acoustic-backscatter map of South area.