CRUISE REPORT

USCGC Icebreaker *Healy* (WAGB-20)
U.S. Law of the Sea cruise to map the foot of the slope and 2500-m isobath of the US Arctic Ocean margin

CRUISES HE-0805

August 14 to September 5, 2008
Barrow, AK to Barrow, AK

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September 20, 2008

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Start Date: August 14, 2008 **Embark:** Barrow. AK
End Date: September 5, 2008 **Disembark:** Barrow, AK

Primary Work Area: Between 77 and 84 deg N, 131 and 168 deg W
Ship Track: see attached figure

OVERVIEW

The United Nations Convention on the Law of the Sea provides an opportunity for coastal nations to extend their sovereign rights over resources of the seafloor and subsurface beyond the present limit of 200 nautical miles, if the continental margin of the nation has certain geologic and morphologic characteristics. In order to gain this extension of sovereign rights, the nation must map the seafloor and demonstrate to the Commission on the Limits of the Continental Shelf that the seafloor in the region meets the specified requirements. In 2001, Congress requested the University of New Hampshire to evaluate U.S. continental margin data and identify where the U.S. may have the opportunity to extend its continental shelf under the Law of the Sea Treaty. A number of areas were identified but the region where the largest gain is possible (and where the least data is available) is on the northern Chukchi Cap in an ice-covered region of the Arctic Ocean.

HEALY 08-05 was the fourth in a series of cruises designed to map the seafloor on the northern Chukchi Cap in order to explore this poorly known region and better understand its morphology and its potential for an extended continental shelf under UNCLOS. The mutlibeam echo sounder on board the HEALY was the primary tool, supplemented by the Knudsen sub-bottom profiler and deep sea dredging operations. The primary targets for the mapping were the delineation of the 2500 m (about 8,250 foot) depth contour and the "foot" of the continental slope – the area where the continental margin transitions into the deep sea floor (usually at about 13,200 to 16,500 foot depth). In addition to its usefulness for Law of the Sea, the seafloor mapping data we collect is also valuable for better understanding seafloor processes, fisheries habitat, and as input into climate and circulation models that will help us predict future conditions in the Arctic.

HEALY 08-05 departed Barrow on 14 Sept and commenced operations with both mapping and the successful recovery of two HARP hydrophones that had been deployed on HEALY 07-03. From the HARP sites we steamed north to pick up mapping of the region thought to represent the base of the slope in the vicinity of 820 N and 1620W. Surveying continued east following the morphologic expression of the base of the slope until approximately 1500W where the character of the morphological expression of the base of the slope changed and we switched to a reconnaissance mode of surveying. This mode of survey continued until we reached the easternmost extent of our survey at approximately 1390W. From this point we traveled westward mapping several regions that we suspected shoaled above 2500 m (they did) and then began dredging operations (on 30 August).

A total of seven dredges were taken. Four on the southern Alpha Ridge, two on ridges north of the Chukchi Borderland and one in the northwestern Northwind Ridge area. Dredge 1 yielded samples from an outcrop of layered sedimentary rock. Dredge 2 contained over 200 pounds of mud and ice rafted debris. Dredge 3 also brought back only mud and IRD. Dredge 4 was predominantly mud and IRD however there where interesting iron concretions and manganese crusts along with one sample of a possible altered ash deposit. Dredge 5 recovered over 1000 pound of mud with about 10 pounds of IRD of various rock types. Dredge 6 was mud free and contained over 200 pounds of what appear to be pillow basalts. Dredge 7 had very little mud but over 700 pounds of rock that probably represented both outcrop and angular tallus from the foot of the steep slope from which it was dredged. Samples from Dredge 7 were of various rock types including sedimentary, metamorphic, and possibly basaltic.

A total of 3114 linear nautical miles were surveyed (5767 km) on HLY0805 covering an area of approximately 34,600 km (assuming an average swath width of 6 km).

The following two ancillary programs were also conducted on HLY0805:

NIC Ice Bouys – Pablo Clemente Colon

The NIC provided microwave and visible imagery, including RADARSAT, OLS, AMSR-E, and QuikSCAT, and sea ice analysis during the cruise. The NIC analyst provided daily sea ice briefings to the skipper. NIC personnel collected hourly observations of sea ice characteristic as the Healy navigated ice infested waters. Recorded observations include estimates of sea ice concentrations, ice type, ice thickness and snow cover during icebreaking operations in the ice pack. Hourly photographs of sea ice conditions were taken complementing the aloft conn and aft camera observations. The NIC team deployed two AXIB seasonal buoy prototypes, one on a multiyear ice floe and another in open water but within the ice pack, which are collecting surface air temperature at 2 m, ice/water temperature, and sea level pressure. Three additional open ocean SVP-B drifters were also deployed during the return track to expand the IABP observing network over ice-free waters. These are collecting surface air temperature, water temperature, and sea level pressure. A science presentation on recent changes in the Arctic sea ice pack was also provided.

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During HEALY-07-03, two autonomous seafloor instruments – High-frequency Acoustic Recording Packages (HARPs) – were deployed to locations along the continental slope north of Point Barrow. These instruments are used to passively monitor and collect acoustic data such as ambient noise, marine

mammal vocalizations, and anthropogenic activities. The primary goal on HEALY-08-05 was to recover these HARPs on the transit north and redeploy them on the return to Barrow. On August 14, Healy arrived at HARP Site B (72° 27.626 N, 157° 23.932 W, 235 meters depth) and reassessed the recovery operation due to bad weather conditions. Once a new plan was established, Healy's 12 kHz hull transducer was used to send a release command to an acoustic release onboard the mooring, at which point the anchor weight was dropped and the package floated to the surface at a rate of approximately 50 meters per minute. Once sighted at the surface, a small RHIB was deployed in order to coil and attach the 10 meter hydrophone cable, and tow the package over to Healy's stern. On the fantail, spectra wire running from a winch through the aft fantail A-frame block was tossed to the RHIB, which was then hooked into the HARP's center bail. The frame was gently brought into the transom and lifted until tag lines could be connected. The A-frame was once again positioned outward until the HARP could then be transferred onto the fantail deck, at which point the operation ended in successful completion. Healy immediately steamed to HARP Site C (72° 47.908 N, 158° 23.880 W, 328 meters depth), where approximately three hours later the same operation mentioned above was carried out, once again in successful completion.

Throughout the cruise, both HARPs were subsequently broken down so the data and hardware could be evaluated for quality. Both instruments were then refurbished and the mooring frames were prepared once again for redeployment at the same locations. On September 4, Healy arrived 500 yards downwind of the northernmost deployment location – HARP Site C – and slowed to ≤1 knot. The package was staged on the fantail directly under the A-frame's 3/8" sheave and the wire attached to a quick release was connected to the center bail; two taglines ran through each of the forward D-rings. Once within approximately 100 meters of the drop location, the two floats and hydrophone attached to a 10 meter cable were lowered to the water and subsequently streamed aft of the transom. The winch and A-frame were then used to pick up the HARP, slowly swing it out and lower it until the frame was submerged just below the water. The quick release was pulled and the HARP sank to the bottom at the location 72° 47.926 N, 158° 23.913 W at 327 meters depth; this ended the operation in successful completion. Healy immediately steamed to HARP Site B, where approximately three hours later the same operation mentioned above was carried out, once again in successful completion. The new location is 72° 27.645 N, 157° 23.947 W at 234 meters depth.

The secondary goal of HEALY-08-05 was to opportunistically deploy expendable sonobuoy hydrophones in order to make radiated noise measurements of Healy during various modes of propulsion and ice breaking conditions, and whenever marine mammals were sighted. An omni-directional, vertical line antenna was mounted on Aloft Conn and a radio station was set up in the Meteorological Lab on the bridge. Fourteen sonobuoys (deployment log below) were hand-launched throughout the cruise at times of opportunity to capture acoustic signals including marine mammal vocalizations, ambient noise, and ship-generated noise. Once in the water, a saltwater battery activates for eight hours, a hydrophone drops 400 feet into the water column, and the acoustic signal is transmitted from a float on the surface through RF waves. A bearded seal was monitored on August 23 and a ringed seal was monitored on August 31. In addition, the ship was monitored during medium ice breaking conditions on August 21, and again during heavy ice breaking conditions (i.e. backing and ramming maneuvers) on August 27. To estimate source levels of ship-generated noise, an estimate of transmission loss between the buoy and the ship is required, which is a function of distance between them. To make this estimate, simultaneous recordings were made on the ship's hull-installed hydrophone with each sonobuoy deployment. Timing of receipt of the ship's 3 kHz sub-bottom profiler on both the ship's hydrophone and the sonobuoy will provide an estimate of the distance from the sonobuoy to the ship.

Sonobuoy Deployment Log

Cast	Date/Time (local)	Latitude	Longitude	Water Depth(m)
01	18Aug08 0323	81 58.360 N	166 03.900 W	3566
02	18Aug08 0338	81 58.444 N	165 55.505 W	3573
03	20Aug08 2032	83 01.884 N	159 30.853 W	2553
04	22Aug08 2014	81 26.717 N	152 58.808 W	3763
05	26Aug08 2055	81 43.196 N	144 27.637 W	3225
06	26Aug08 2121	81 44.226 N	144 17.617 W	3273
07	28Aug08 1405	82 04.283 N	142 36.016 W	2717
08	28Aug08 1445	82 03.868 N	142 27.890 W	“
09	28Aug08 1549	82 03.440 N	142 29.436 W	“
10	28Aug08 1617	82 03.278 N	142 29.773 W	“
11	30Aug08 2346	81 24.028 N	151 57.127 W	3535
12	31Aug08 0104	81 24.164 N	151 59.010 W	3292
13	31Aug08 1826	81 18.435 N	153 51.701 W	3445
14	03Sep08 1030	78 31.595 N	156 40.140 W	3820

Cruise Track

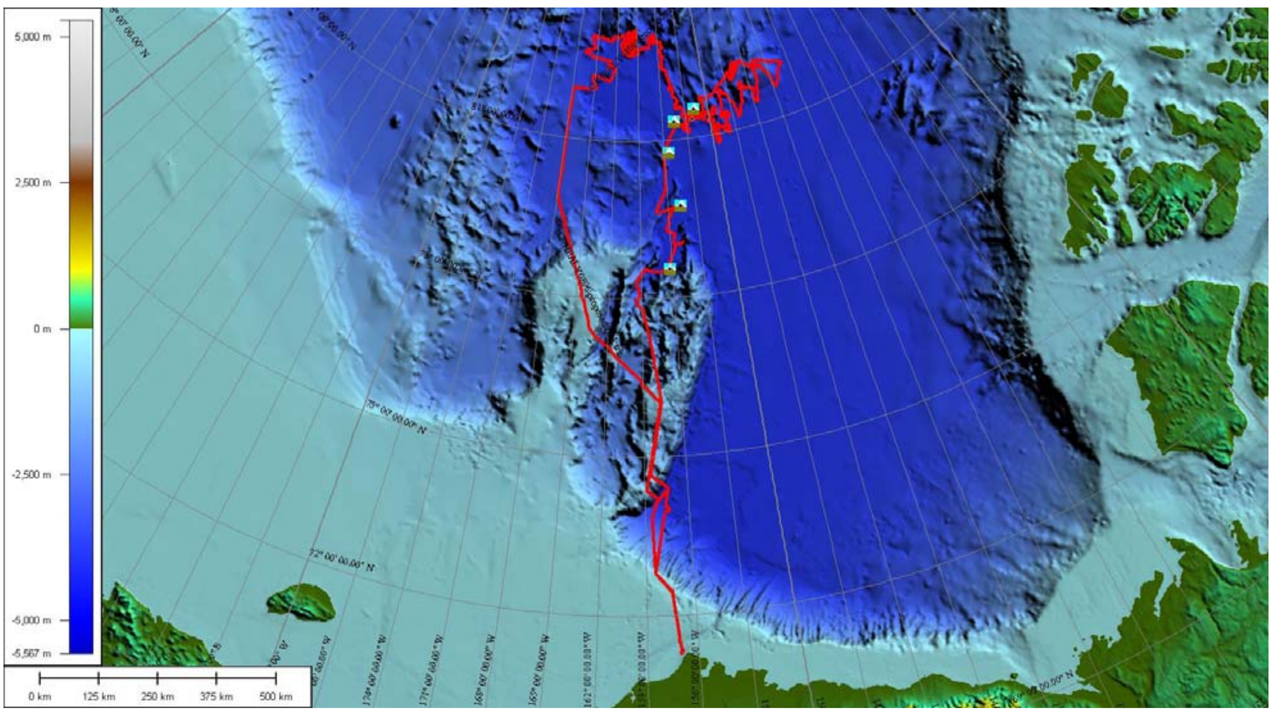

Figure 1. Healy 08-05 Ship Track 14 Aug –5 Sept. 2008 – Dredge sites indicated by small blue icons

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INTRODUCTION AND BACKGROUND

HEALY-0805 was the fourth in a series of cruises (HEALY-0302, HEALY-0405, and HEALY-0703) aimed at collecting high-resolution seafloor mapping data in areas of the Arctic Ocean that may potentially qualify for an extended continental shelf under Article 76 of the United Nations Convention on the Law of the Sea (UNCLOS).

Under Article 76 of UNCLOS, coastal states may, under certain circumstances gain sovereign rights over the resources of the seafloor and subsurface of "submerged extensions of their continental margin" beyond the recognized 200 nautical mile limit of their Exclusive Economic Zone. The United States has not yet acceded to the UNCLOS. However, increasing recognition that implementation of Article 76 could confer sovereign rights over large and potentially resource-rich areas of the seabed beyond its current 200 nautical mile (nmi) limit has renewed interest in the potential for accession to the treaty.

A detailed analysis of the relevance of current U.S. data holdings to a potential U.S. submission under Article 76 was conducted by Mayer, Jakobsson and Armstrong (2003). Included in this analysis is the identification of regions where the collection of new, modern multibeam sonar data would substantially improve the quality of a potential submission for an Extended Continental Shelf (ECS) under Article 76. Among the areas where new multibeam echo-sounder data would improve a submission, the Arctic is outstanding in that the existing database is far too sparse to support a well-defended submission. The data are especially sparse in areas where the perennial ice cover has prevented surface ships from operating. The collection of new high-resolution multibeam sonar data in these regions of the Arctic would also significantly add to the scientific base of data needed to support the growing recognition of the critical role that the Arctic Ocean plays in the climatic and tectonic history of the Earth. The new bathymetric and high-resolution subbottom profiler data (as well as associated CTD measurements) will help define the nature of
deep circulation in the Arctic Basin as well as the history and distribution of ice in the region, a key component of the global climate system.

The United Nations Convention on the Law of the Sea defines the conditions under which a coastal state may extend its continental shelf over regions beyond their current recognized 200 nmi limit (UN, 1982). These conditions involve the definition of a juridical or legal "continental shelf" that differs significantly from standard morphological descriptions of continental margins. A key element of this definition is the demonstration that the extended area is a "natural prolongation" of the nation's landmass, known in legal parlance as the "test of appurtenance." There are no explicit guidelines for demonstration of "natural prolongation" of a state's land territory. The determination must be based on a general knowledge and interpretation of the bathymetry, geology, and nature of the seafloor in a region. For example, if a coastal state has a narrow physiographic shelf bounded by a seaward subduction zone (that clearly indicates the transition from continental to oceanic crust) there is little chance for demonstration of a natural prolongation of the continental shelf.

Once a natural prolongation is demonstrated, a coastal state may extend their "continental shelf" beyond the 200 nmi limit based on either of two formulae. The distance formula allows an extension of the shelf to a line that is 60 nmi beyond the "foot of the continental slope" (defined to be the point of maximum change in gradient at its base). The sediment thickness formula allows the extension of the shelf to a point where the sediment thickness is 1 percent of the distance back to the foot of the slope. Whichever formula line is most advantageous to the coastal state may be used and they can be combined for the most advantageous extension. There are limits to the extension (limit lines) – the ECS shall not extend beyond

100 nmi from the 2500 m isobath or not beyond 350 nmi from the territorial baseline (the officially defined shoreline). Again these limit lines can be mixed in whatever way is most advantageous to the coastal state. Thus the definition of the extended continental shelf under UNCLOS Article 76 is based on a combination of bathymetric data (defining the 2500 m contour and the foot of the slope) and geophysical data (defining the thickness of sediment). When a nation accedes to the Law of the Sea Treaty, it has 10 years to submit all data and evidence supporting its submission to the Commission on the Limits of the Continental Shelf (CLCS) who evaluate the veracity of the submission and offer recommendations on it.

The largest potential for an extended continental shelf beyond the current 200 nmi limit of the U.S. EEZ is found in the area of the Chukchi Borderland, a tightly clustered group of generally high-standing, N-S-trending bathymetric elevations that form a natural prolongation from the Chukchi Shelf north of Alaska.

The Chukchi Borderland juts out between eastern Siberia and western Alaska into the deep Amerasia Basin north of the Chukchi Sea. The borderland occupies a rectangular area about 600 by 700 km, or some 4 percent of the Arctic Ocean. This area encompasses three, approximately north-south-trending segmented topographic highs: the Northwind Ridge, the Chukchi Cap and Rise, and the western (Arlis, Sargo, and T3) plateaus (which are located beyond (westward of) the agreed boundary line with Russia). The plateau-like crests of the Chukchi Borderland rise, in some cases, as much as 3,400 m above their surroundings and they are relatively shallow (depths between 246 and 1,000 m). The ridges have steep flanks, which in some places exhibit remarkable linearity over hundreds of kilometers, especially along the east side of the Northwind Ridge. Between these ridges lie the Northwind, Chukchi, and Mendeleyev “abyssal plains”. These lie at depths between 2,100 and 3,850 m

Congress (through NOAA) funded the University of New Hampshire’s Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) to explore the feasibility of using a multibeam sonar-equipped ice breaker to collect the data needed to make a submission for and extended continental shelf in ice-covered regions of the Arctic. This was in recognition of the fact that a submission for an ECS under Article 76 must be substantiated by high-quality bathymetric and geophysical data, and that the existing bathymetric database in the Arctic is, in many areas, inadequate. The USCGC Healy (WAGB-20), equipped with a SeaBeam 2112 (12 kHz, 121 beam) swath mapping system, was chosen for this task.

PREVIOUS CRUISES

(Detailed cruise reports from each of these cruises can be found at http://www.ccom.unh.edu).

HEALY 0302 Overview

A 10 day, 3000 km long exploratory mission (HEALY-0302, September 1-11, 2003) from Barrow, Alaska, to the Chukchi Borderland demonstrated the viability of using the multibeam echo-sounder in ice-covered waters to follow specific bathymetric targets. The 2003 cruise began at the US-Russian boundary line at 78°-30’N 168°-25’W and followed the 2500 m contour around to 78°-35’N 159°-07’W (Figure 1). The cruise collected ~3000 km of high-resolution multibeam echo-sounder data and made several significant discoveries that include:

- substantially changing the mapped position and complexity of the 2500-m isobath (a critical component of a Law of the Sea submission for an ECS),
- found further evidence for pervasive ice and current erosion in deep water (flutes and scours),

- finding evidence for gas-related features (pock-marks), and
- discovering a previously unmapped seamount that rises more than 3000 m above the surrounding seafloor. This NE-SW trending feature, some 18 km wide and 40 km long with a slightly concave and northward tilted crest, has been officially named Healy Seamount.

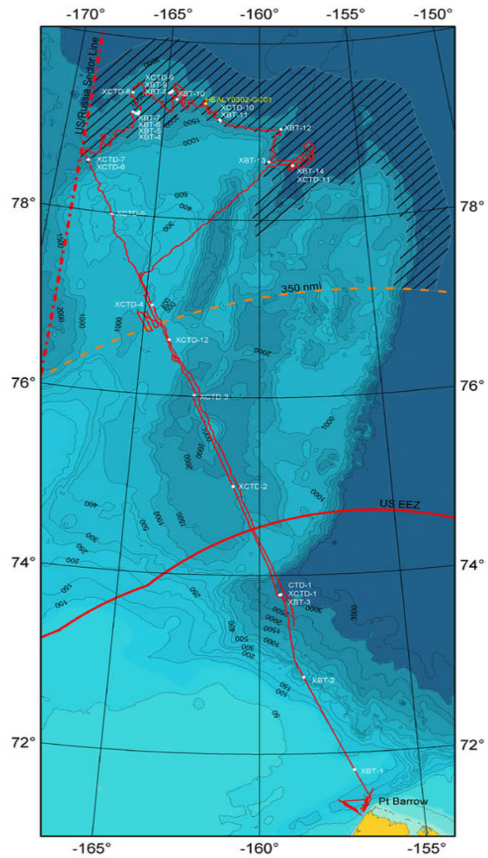


Figure 2. Track of HEALY-03002, September 2003

HEALY-0405 Overview:

In 2004 a second, 20-day cruise, HEALY-0405 was conducted from October 6 to October 26, 2004, originating in Nome and ending in Barrow, Alaska. The cruise covered approximately 6700 km in 20 days and completed most of the mapping of the 2500-m isobath (begun on HEALY-0302) as well as a detailed survey of the "foot of the slope" over a segment of the continental margin east of Barrow, AK. The total area surveyed during HE-0405 was approximately 20,000 sq. km (5830 sq. nmi). The cruise transited northward from Nome over the Northwind Ridge until it intersected the 2500-m isobath at approximately 77° 10'N, 154° W, the point where the 350 nmi cutoff limit from the coast of northern Alaska intersects the 2500-m isobath on the eastern flank of the Northwind Ridge. Ice was first encountered ice at about 76˚N and by 77˚N the ice was very heavy (9/10 to 10/10) with many ridges and very few leads. Progress was slow and we often had to backup and ram but, nonetheless, we managed to continue mapping the 2500-m isobath up the Northwind Ridge until approximately 78° 45'N. During this time, we covered approximately 100 nmi in 4 days. Data was difficult to collect in these conditions but we were able to continuously map the 2500-m isobath to its furthest north point. About 5000 sq. km (1458 sq. nmi) of seafloor was mapped during the transect to the north and back.

At 78° 45’N, the *HEALY* had great difficulty breaking through the ridges (one ridge took more than 8 hours to break through) and the decision was made to move south to the relatively ice-free waters of the continental slope east of Barrow. This area was chosen so that we could define the foot of the slope in the central portion of the northern Alaskan margin. The foot of the slope can be used in this region as a starting point for determination of the “Gardiner Line” – one of the formula lines used for making an ECS submission under UNCLOS Article 76. The survey of the foot of the slope area began on October 18 and continued until October 24. During this time, complete overlapping multibeam-sonar data was collected over a region of approximately 15,435 sq. km (4500 sq. nmi), that ranges in water depth from 800 m to 3800 m. The survey not only delineated the foot of the slope, but it also revealed a complex margin with drift deposits, suggesting contour currents, that are cut by numerous canyons.

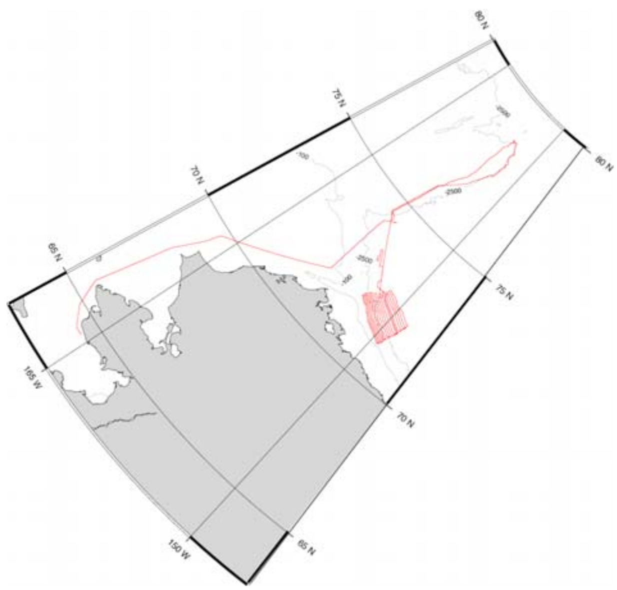


Figure 3. Cruise track for HEALY-0405

HEALY-0703 Overview

HEALY-0703 was conducted from August 17 to September 15, 2007, with both embarkation and disembarkation via helicopter transfer from Barrow, Alaska. The cruise track covered approximately 10,000 km (5400 nm) in 30 days (Figure 4). The primary objectives of the cruise were: 1- to complete the mapping of the 2500 m isobath that began on HEALY 0302 and HEALY 0405; 2- to begin to define the “Foot of the Slope” around the the northern and eastern edges of Chukchi Cap; and; 3- to further map an area of pockmarks originally discovered on HEALY-0302. Secondary objectives included the recovery and re-deployment of two High-Frequency Acoustic Recording Packages (HARP’s), autonomous recording packages designed to record ambient noise levels at the ice margin for periods up to one year, and: the deployment of up to four ice buoys and continuous ice-observation by representatives of the National Ice Center. All objectives were achieved, far beyond expectations.

Using a nominal swath width of approximately 7 km, the total area surveyed during HE-0703 was approximately 70,000 sq. km (20,400 sq nm). The cruise departed Barrow at approximately 1800L on 17 September and steamed northward approximately 50 miles and successfully recovered the first of two HARP buoys. The second was recovered 25 miles further to the northwest. Details of this recovery as well as a description of the purpose and capabilities of the buoys can be found in the HARP Buoy Report later in the cruise report. We next conducted a patch test and a deep CTD cast at the steep southeastern edge of the Chukchi Cap. We first encountered ice at approximately 76N. It was large pieces of thick, multi-year ice but, broken up enough to allow relatively easy passage at 3- 6 knots (though we did have to back and ram occasionally). We continued northwest to the intersection of the 2500 m isobath and the U.S./Russian maritime boundary line where we then began an exploratory, zig-zag pattern to better define the foot of the slope. No definitive foot of the slope was apparent until a long excursion to the north revealed a clear transition between the slope and flat-lying abyssal plain sediments at approximately 81 15N. We made several more north – south transits and consistently found this same slope/plain transition occurring on the northern end of the cap above 81N. We continued to run a zig-zag pattern in the north-east quadrant of the cap and also found and developed several prominent topographic highs, one which shoaled above 2500 m and may allow the re-definition of the 2500 m isobath.

A well-developed foot of the slope was traced down and then back up the eastern side of Northwind Ridge, revealing a very sharp and clear slope/abyssal plain transition with the abyssal plain sediments consistently occurring at a depth of approximately 3820 m. Following this transition to the north allowed us to define a continuous foot of the slope around the northern most extreme of Chukchi Cap to the northern most point or our survey (82 17N); at this point, the slope/plain transition appears to continue to the north and east. Returning south, we mapped a seamount that rose from abyssal plain depths (3820m) to less than 2200 m at approximately 80 47N and 171 50W and then proceeded to transit southwest to carry out a detailed survey of a region in which pockmarks were discovered on a previous leg. We left the ice at about 77N but ran into occasional large packs of flows until about 75 N.

Throughout this period (17 Aug to approximately 5 August) ice conditions were variable but for the most part very light considering the latitudes we were at allowing survey speeds to average about 6 knots. Ice flows large enough to support deployment NIC ice buoys were difficult to find but three flows were found and three buoys deployed. A fourth buoy was deployed in open water at the far western extreme of our survey. Details of the ice buoy deployments and ice observations can be found in the NIC trip-report included in this document.

On HEALY-0302, several large and well-defined pockmarks (probably related to gas extrusion) were discovered in a shallow region of the Chukchi Cap at approximately 76 30N and 163 50W. NOAA's Office of Ocean Exploration asked us to further expand this survey and generate a better map of the distribution of these pockmarks. Our plan called for a survey of two areas, one where the pockmarks were already discovered and one slightly to the north and the east of the pockmark area where there is more of a depth transition and thus we might better understand the relationship of depth to pockmark formation. Our survey of the second (not previously surveyed) region revealed no pockmarks but did show a remarkable series of closely spaced, NW-SE oriented, parallel grooves in depths of approximately 400 to 500 m. Given the remarkably parallel nature of these features, they appear to be related to ice-sheet flow rather than individual icebergs scours. Even more intriguingly, south of these grooves, as the water depths get a bit deeper, there appear to be a series of large, dune-like features that appear erosional in origin in the high-resolution subbottom profiles. We speculate that these may be related to flow under an ice-shelf that is not grounded but with near the seafloor.

When we reached the pockmark area, just a few miles south of the scoured region, the winds and seas greatly increased (50 knot winds, 15 foot seas) creating less than optimal mapping conditions but the size and stability of the HEALY allowed us to continue. An approximately 40 km x 14 km area was mapped revealing numerous pockmarks of various sizes, but typically about 300-400 m in diameter and 30 – 50 m deep. Simultaneous collection of subbottom profiles revealed an apparent relationship to subsurface faulting but the nature of this relationship will need further study. Most remarkable was a circle of pockmarks (approximately 20 of them) forming a ring that is approximately 4 km in diameter.

Upon completion of the pockmark survey, the HEALY transited south to re-deploy the two HARP buoys that were recovered at the beginning of the leg. These buoys were successfully re-deployed approximately 90 and 75 miles off Barrow, to be recovered next year. The HEALY arrived off Barrow at

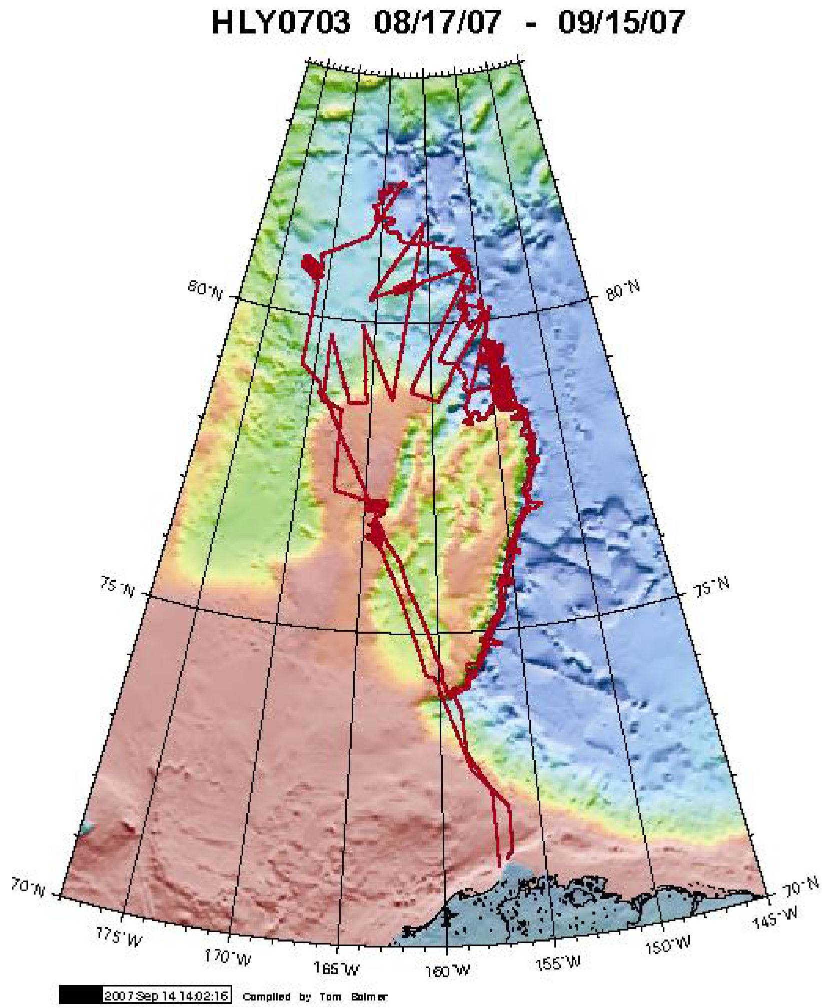


Figure 4. Ship-track for HEALY 0703

0700L on the 15th of Sept with transfer of the science party by helo commencing at approximately 0900L.

HEALY-0805 Overview:

HEALY 08-05 was the fourth in a series of cruises designed to map the seafloor on the northern Chukchi Cap in order to explore this poorly known region and better understand its morphology and its potential for an extended continental shelf under UNCLOS. The mutlibeam echo sounder on board the HEALY was the primary tool, supplemented by the Knudsen subbottom profiler and deep sea dredging operations. The primary targets for the mapping were the delineation of the 2500 m (about 8,250 foot) depth contour and the "foot" of the continental slope – the area where the continental margin transitions into the deep sea floor (usually at about 13,200 to 16,500 foot depth). In addition to its usefulness for Law of the Sea, the seafloor mapping data we collect is also valuable for better understanding seafloor processes, fisheries habitat, and as input into climate and circulation models that will help us predict future conditions in the Arctic. Three ancillary programs also took place during HEALY-0805: 1- the recovery of High-Frequency Acoustic Recording Packages (HARP's) that are designed to make long-term measurements of ambient noise in the Arctic and that had been deployed on HEALY-0703; 2- the deployment of several different types of ice-monitoring buoys by personnel from the National Ice Center (NIC), and; 3- the daily observation by a specialist from the Fish and Wildlife Service of both bird and marine mammal sightings. Summary reports of each of these activities are presented at below.

HEALY 08-05 departed Barrow on 14 Sept and commenced operations with both mapping and the successful recovery of two HARP hydrophones that had been deployed on HEALY 07-03. From the HARP sites we steamed north to pick up mapping of the region thought to represent the base of the slope in the vicinity of 82^0 N and 162^0W. Surveying continued east following the morphologic expression of the base of the slope until approximately 150^0W where the character of the morphological expression of the base of the slope changed and we switched to a reconnaissance mode of surveying. This mode of survey continued until we reached the easternmost extent of our survey at approximately 139^0W. From this point we traveled westward mapping several regions that we suspected shoaled above 2500 m (they did) and then began dredging operations (on 30 August). A total of 3114 linear nautical miles were surveyed (5767 km) on HLY08-05 covering an area of approximately 34,600 sq. km (assuming an average swath width of 6 km).

A total of seven dredges were taken on HEALY-0805, four on the southern portions of the Alpha/Mendeleev Ridge complex, two on ridges north of the Chukchi Borderland and one in the northwestern Northwind Ridge area. The first dredge site on the southern Alpha/Mendeleev Ridge complex yielded samples from what appeared to be an outcrop of layered sedimentary rock that appeared on shipboard examination to be non-marine in origin. The second dredge from the same vicinity contained over 200 pounds of mud and ice rafted debris. The third dredge, from another feature on the southern Alpha/Mendeleev Ridge Complex, also brought back only mud and IRD. The fourth dredge, from the same general vicinity as the third, was predominantly mud and IRD however there where interesting iron concretions and manganese crusts along with one sample of a possible altered ash deposit. The fifth dredge, from the northern extend of the Chukchi Borderland, recovered over 1000 pounds of mud with about 10 pounds of IRD of various rock types. The sixth dredge from a very steep (about 60 degree) slope on the northern Chukchi Borderland was mud free and contained over 200 pounds of what appear to be basalts. Finally, the seventh dredge from the western wall of Northwind Ridge had very little mud but over 700 pounds of rock that probably represented both outcrop and angular tallus from the foot of the steep slope from which it was dredged. Samples from this dredge represented a range of rock types including sedimentary, metamorphic, and possibly basaltic.

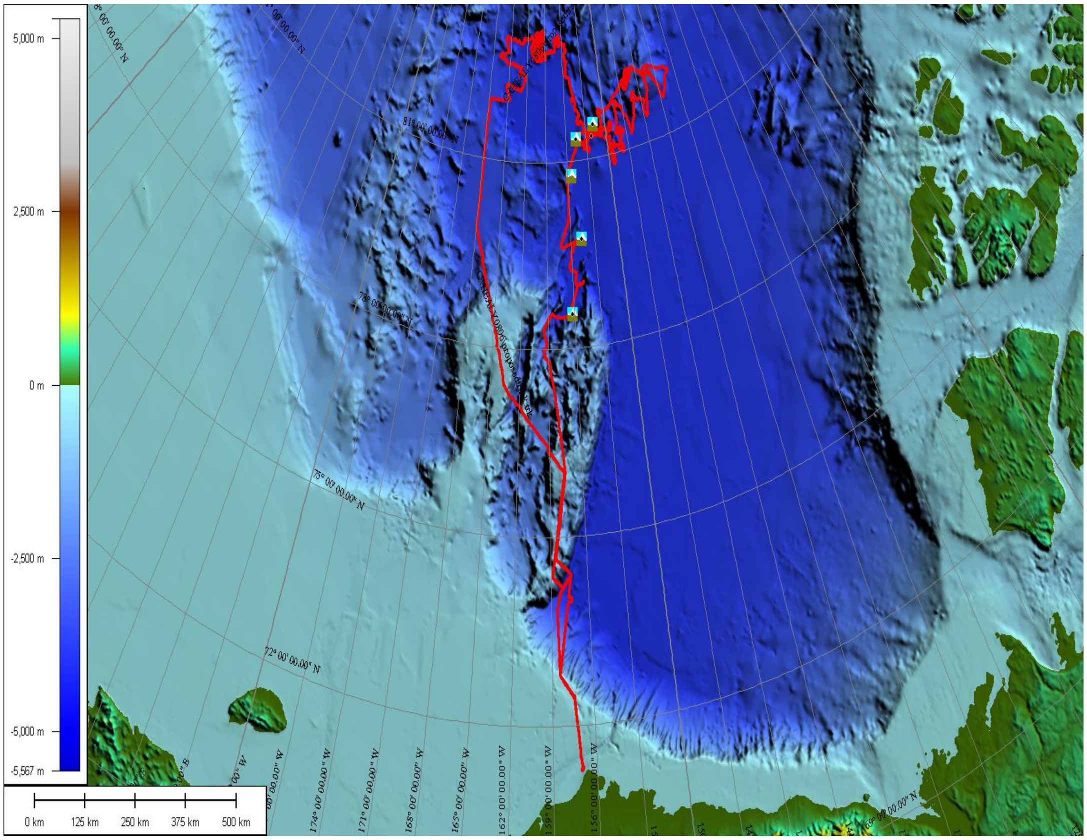


Figure 5. . Healy 08-06 – Ship Track 14 Aug –5 Sept. 2008 – Dredge sites indicated by small blue icons. Dredges are numbered sequentially (1—7) from north to south, Dredge Sites 1 and 2 are at the same location and represented by a single icon; dredge sites 3 and 4 are at the same location and represented by a single icon.

Chief Scientist Log

12 August 2008 – 5 Sept 2008
Barrow to Barrow

NOTE: Log has started in local Alaska Time (ADST) GMT – 8

12 August 2008 = JD 225

2100L Most of HEALY0805 team (20) arrives in Barrow. We have been preceded here by Ethan Roth, Alex Andronikov, John Hall and Sam Greenaway. We are brought to the gym in Barrow where 50 cots have been set up and pizza delivered. An interesting evening mostly because of the very warm temperatures in the gym. Eventually cooled down and most were able to sleep a bit.

HEALY and helo team would like to start transfers on the 13^{th}. We are happy to accommodate this. Only problem is that two NIC folks are not scheduled to arrive until 1926 flight on 13^{th}. We will see what happens.

13 August 2008 = JD 226

0700L: Contact with HEALY at 0800L – they are now off Pt. Barrow and awaiting helo certification flights. Helo certification flights go well and personnel transfer begins at about 0930 with 2 CG personnel. Transfers of baggage and people go smoothly and all science personnel on board by about 1530. UNH computers all installed and networked without problem. Even serial wire with NMEA nav string for our nav computer was there and waiting for us. Now just need to wait for NIC personnel. Helo pilots have agreed that they will be able to fly until about 2130L. Tracking of NIC folks finds them in Fairbanks – flight delayed – scheduled arrival in Barrow 2100.

1600L: Provide bridge with locations of two HARP buoys which will be first waypoints. First buoy (HARP-1) is located approximately 70 nm from Pt. Barrow, second buoy (HARP-2) is located 27 miles beyond that.

2115L: Helo arrives with NIC people. We have sat around waiting for them since about 1530L.

2200L: Underway!!! All systems (Seabeam, Knudsen, etc) seem to be functioning in their normal state). Baker and Bogucki join watch. Heading to HARP 1 at 11 knots – ETA ~0415l so there should be sufficient light. Kelley Brumley will stand and unofficial watch from 2400 – 0400L, LM will come on at 0400L. We will begin official watch schedule and official watch log immediately after recovery of HARP-2 (scheduled for midday on the 14^{th}).

14 August 2008 = JD 227

0400L: Mayer on watch – approaching HARP site – conditions not the best – winds about 20 -24 knots, sea state about 8-10 foot seas. Bridge briefing on buoy recovery – quite concerned about sea state and wind. Will move ahead cautiously.

0500L: On site – cautiously testing conditions to come up with recovery plan.

0600L: Ops reports that Capt. is uncomfortable with multitude of plans and has said that everyone will go off and think and come back after breakfast to regroup. We will wait for that but will not be able to spend too much more time.
NOTE – I HAVE SWITCHED NAV COMPUTER CLOCK TO GMT (ADST + 8) – ALL TRACK PLOTS WILL NOW BE IN GMT – WILL SWITCH THE CHIEF SCIENTIST LOG TO GMT TOO!!!

1415Z: Crew has come up with a plan to recover buoy safely – the plan is to use the WHOI TSE winch with a Spectra wire trailed aft. Recovery will take place after breakfast.

1600Z: maneuvering to recall mooring.

1630Z: Armstrong on watch

1700Z: buoy on deck

1715Z: underway to HARP2

1935Z: stop Seabeam as we approach HARP2 recovery site

2000Z: mooring sighted

2030Z: completed recovery of HARP2. Underway to Patch Test site

2050Z: Seabeam profile display disappeared; reboot required.

2107Z: Seabeam online

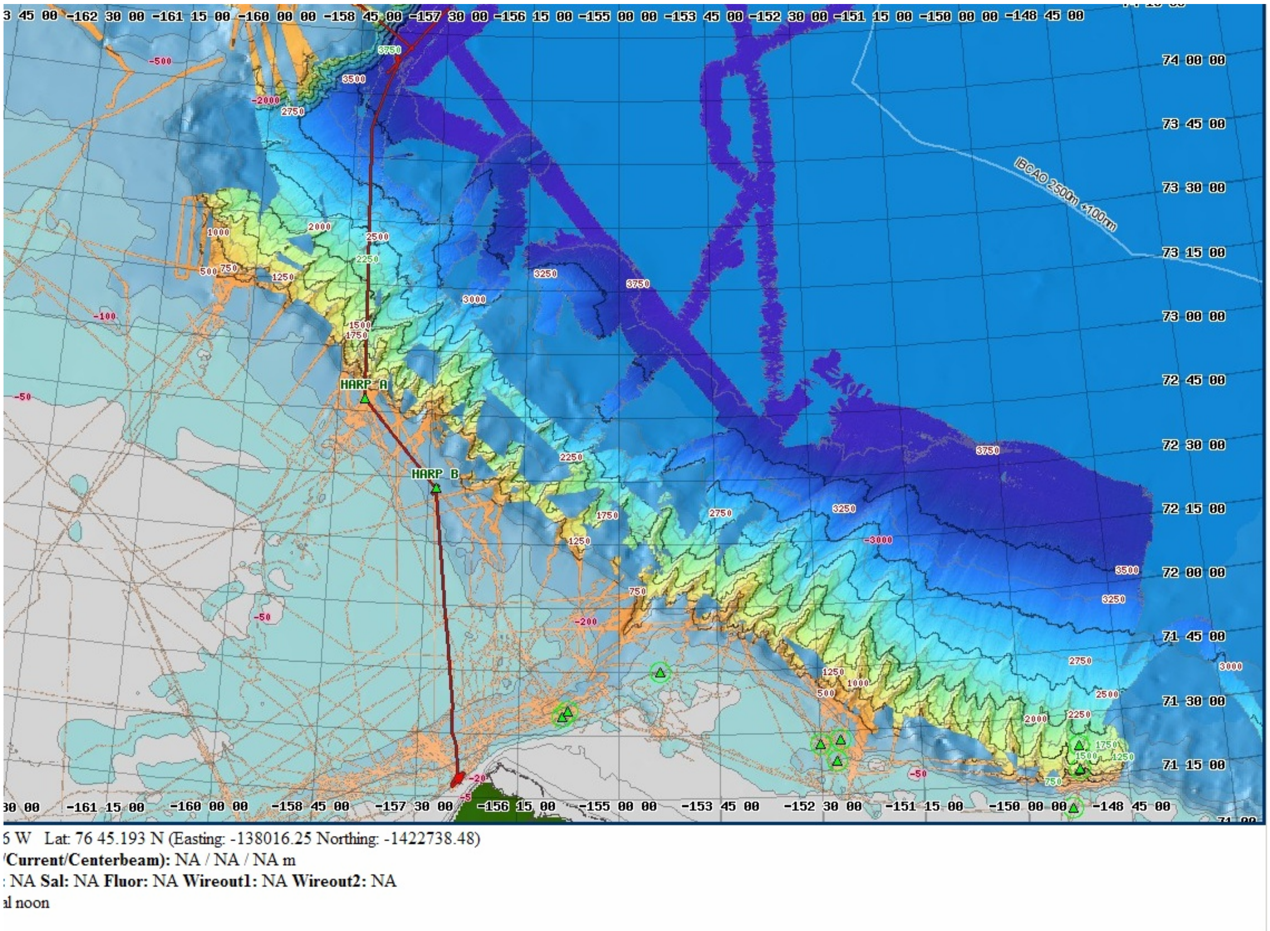


Figure 6. Julian Day 227 ship track.

15 Aug 2008 = JD 228

0000Z: Watch relived; Hall, Wigley, Tinmouth.

0310Z: IBS time input to Seabeam from bridge system dropouts appearing

0330Z: At Waypoint: change course to approach CTD site

0340Z: Time input to Seabeam is stable but incorrect; acceptable at this time will need to reset before Patch Test.

0357:Z Stopped for CTD; lat 74-08.340 lon 158-12.99 3750 m;

0401Z: Commence CTD; drifting slightly to W while maintaining vertical wire

0415Z: IBS reported back in operation.

0600Z: Mayer on watch

0615Z: CTD on deck

0647Z: XBT taken – ran full out

0712Z: CTD SV sound profile applied to Seabeam

0728Z: Enroute to waypoint A of patch test – found a hill in middle of line that comes up almost 100 m – decide to do a Williamson Turn and go on reciprocal course and continue further to the northeast.

0900Z: Begin roll line one – 8 miles at 8 knots – beautiful onlap of sediments onto slope that was dropping off to the Northeast. Now sediments and seafloor are flat-lying. Position: 74 15.404N 157 48.764W – depth is 3850 m
1009Z: End roll line one - begin Williamson turn to run reciprocal line at 8knts.

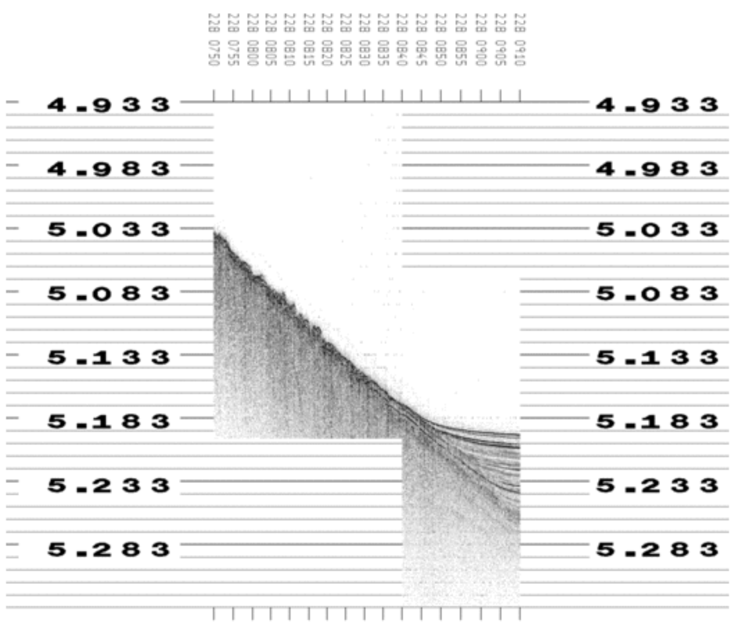


Figure 7. Sediment onlap just at beginning of roll-bias patch test line

1138Z: End of Roll line two. Still running but this point ends the flat seafloor
Will continue on about 3 miles and turn to the north up an down the slope – for pitch test – up slope at 11 knots – down slope at 11 knots – up slope at 5.5 knots.
Steve Roberts SeaBeam analysis shows that the roll bias is -0.02 degrees

1156Z: Start Pitch line run – another beautiful onlap at base of slope – but this one has a bench. Running at 11 knots

1256Z: End of Pitch line – starting run down the slope – 11 knots.

1400Z End down-slope pitch line

1407Z: Begin upslope timing line --- 5.5 knots

1617Z: End of upslope timing line – come up to full speed and transit east until we intercept preplanned track line (western one)

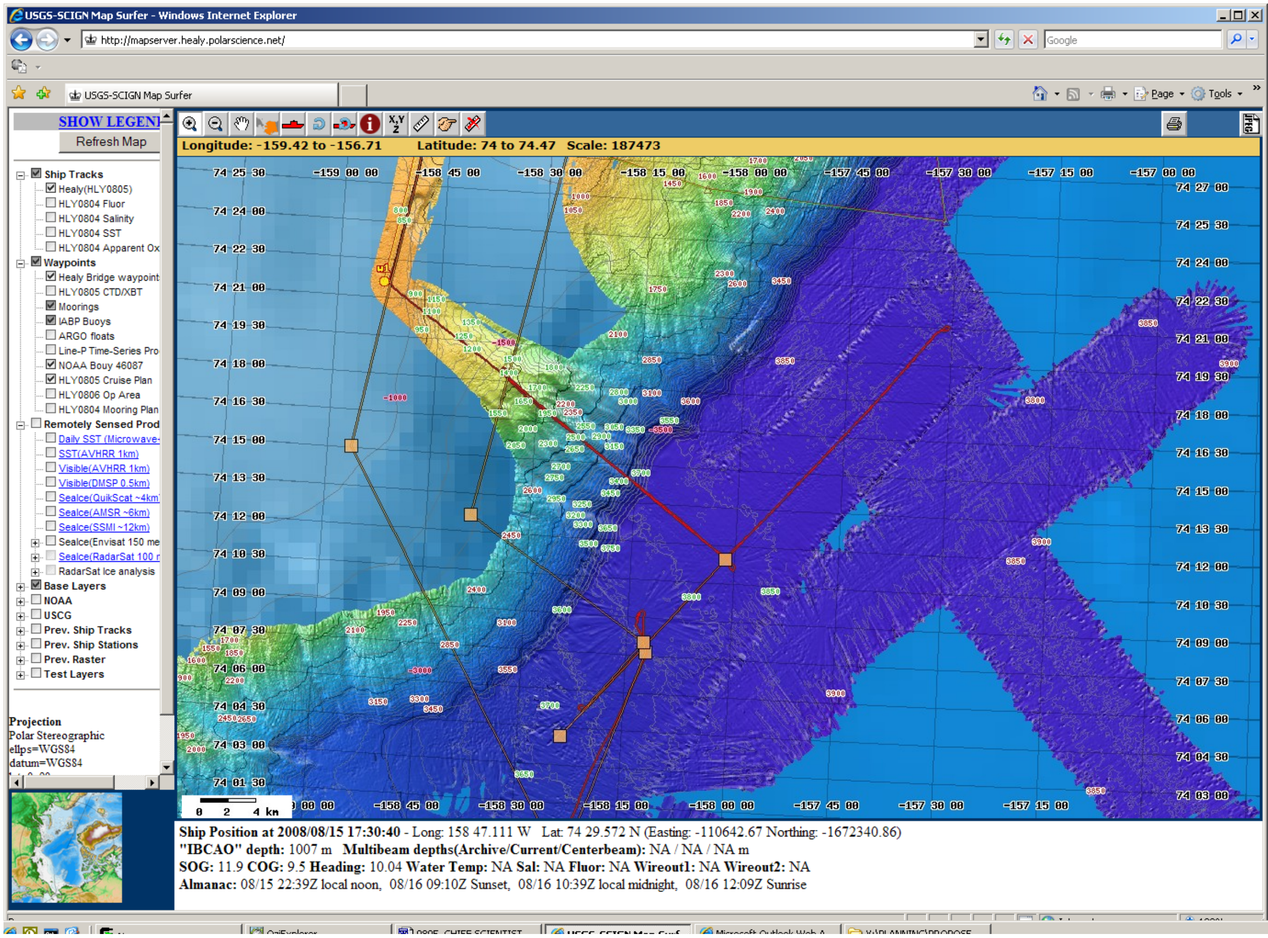


Figure 8. Patch Test Geometry

Brian has run patch test tool in Caris and finds a roll bias of between 0.02 and 0.03 degrees – in agreement with Steve's results. Caris analysis also finds no timing delays and 0 pitch offset. Dale and Steve and I agree that the 0.02 degrees is too small to be concerned about and we will leave the settings as they are.

1650Z: On NE heading line – heading north at 11.9 knots

1858Z: Distinctive features appearing at seafloor surface on subbottom profile record

2335Z: Continuing uneventful steaming with continued appearance of distinctive features on subbottom profile

2345Z: Passing through small area of scattered ice chunks. The ship altered course slightly to avoid and reduced speed.

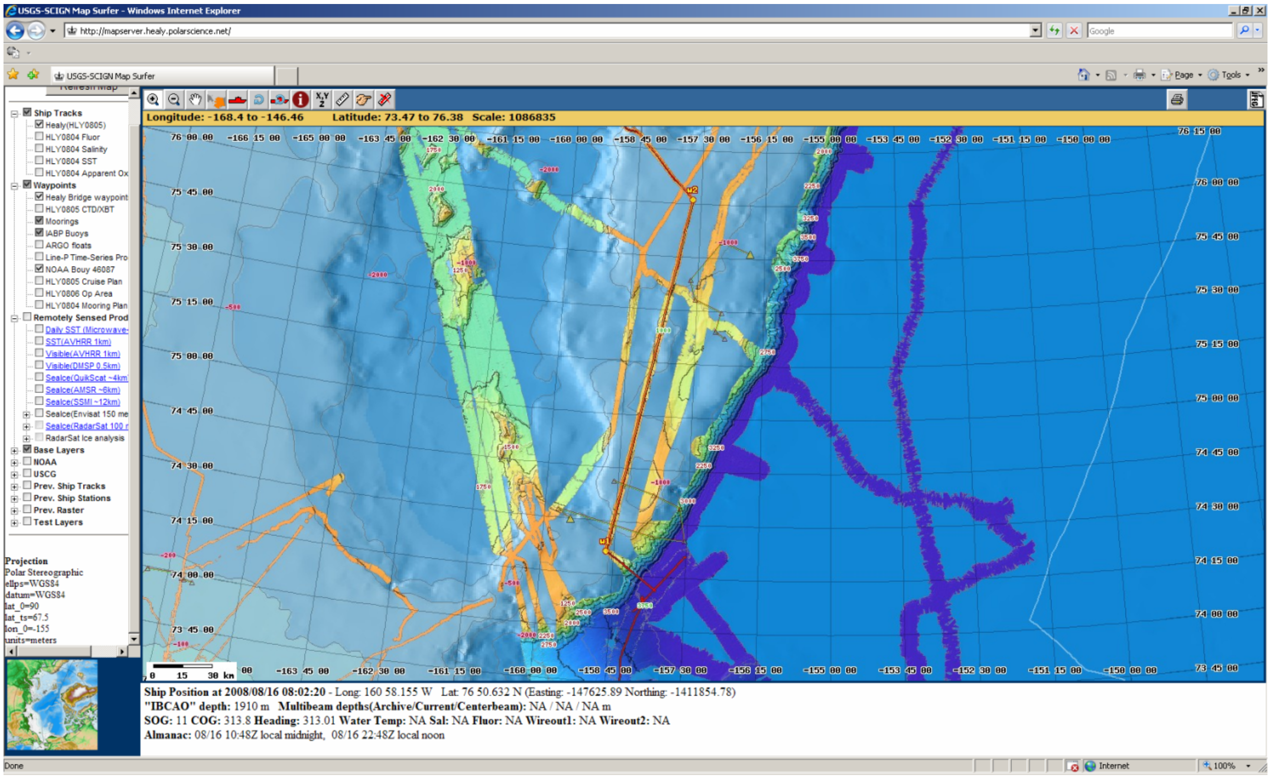


Figure 9. Julian Day 228 ship track

16 August 2008 = JD 229

0121Z: Altered course to follow planned track

0200Z: Passing through an area of small ice floes and bits

0255Z: Dropped XBT; successful drop

0350Z: Maneuvering to avoid minor ice floes, but still managed to find some to hit with intermittent loss of multibeam soundings

0600Z: Mayer on watch – steaming northwest across top of Chukchi – heading towards a position just north and east of the pockmark and groove field we mapped last leg. Occasional ice – either thick first year ice or thin second year ice.

0949Z: First major stretch of ice – Chief Kidd picking his way through and maneuvering off the track to avoid several thick ridges.

1220Z: Crossing beautiful field of iceberg scours – some are not linear though.

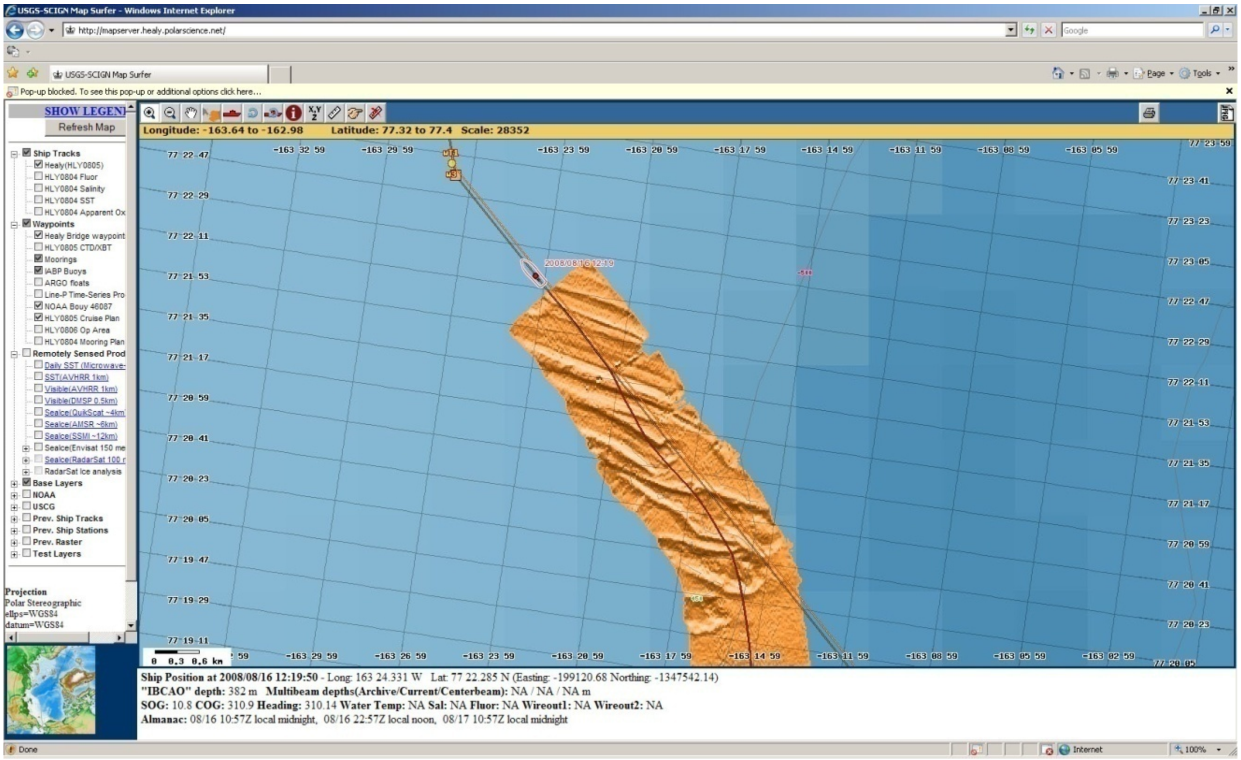


Figure 10. Iceberg scours on top of Chukchi

1600Z: Ozi crashed for a moment – restarted – created a new track file called HEALY0805_ASRUNtrack.plt
XBT taken – Serial # 01053498 – Station T7-007

1645Z: Maneuvering through ice – reduce speed to 4 knots

1700Z: Back up to 10 knots

1800Z: Andy on watch

1900Z: Maneuvering to avoid heavier ice and pass through open area

2052Z: Crossing lots of coherent scour marks (upper image below), but these scours differ in direction from scours crossed to the south (lower image).

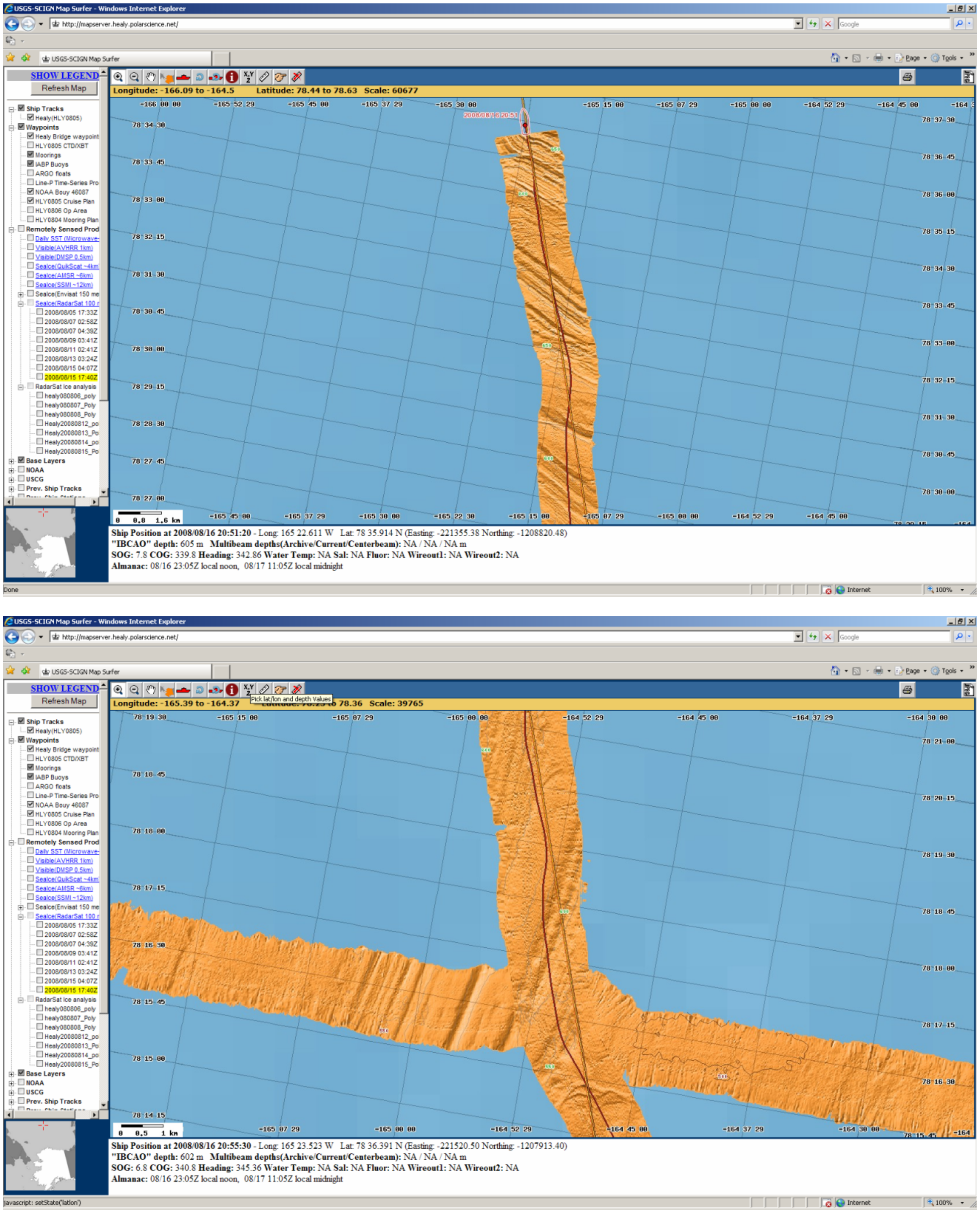


Figure 11. Scours with varying directions

2100Z: Scours changing direction and fading out (image below).

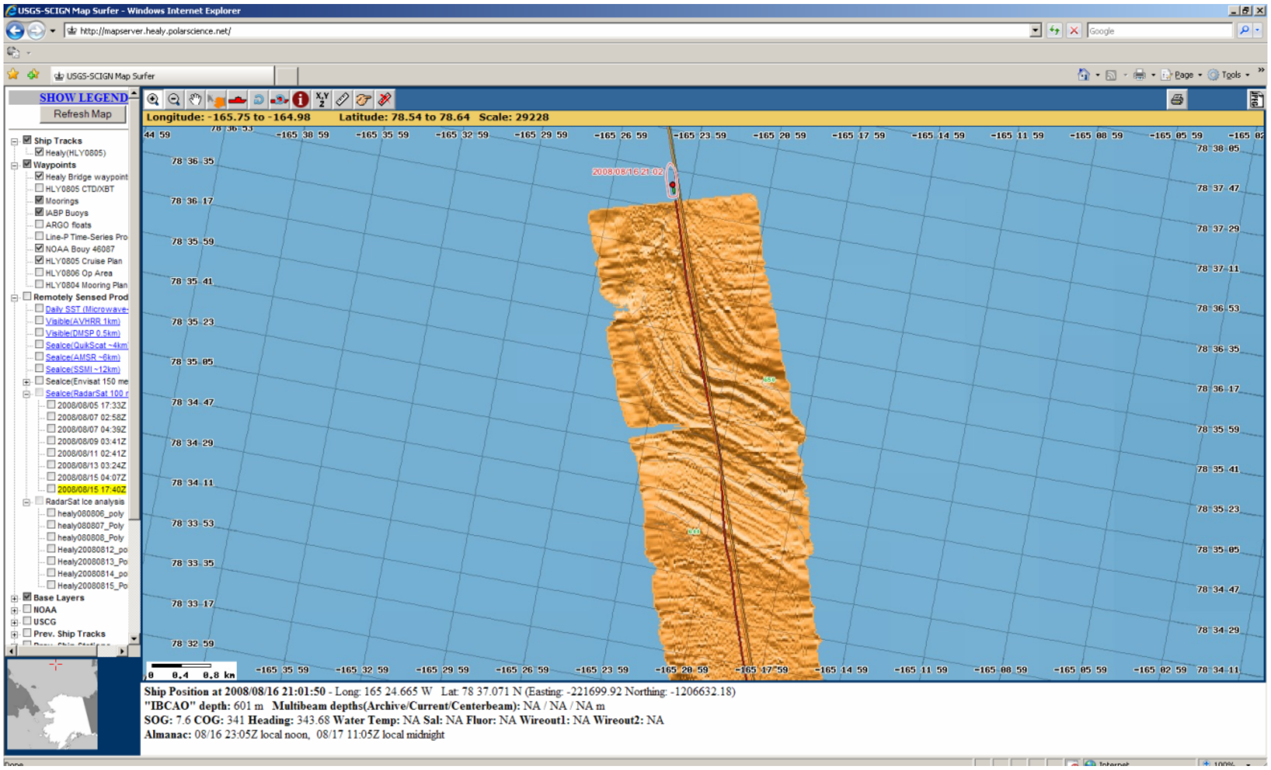


Figure 12. Coherent change in scour direction

BT into the SeaBeam system (Serial # 01053498 – Station T7-007).

17 August 2008 = JD230

0200Z: Losing data intermittently in ice; mostly operating SeaBeam in manual.

0338Z: Off track for a while as the bridge navigation system was improperly updated; Resumed proper track.

0430Z: XBT Launched; T7-00008 ,

0500Z: Applied SVP from T7-00008

0600Z: Mayer on watch

0746Z: Ship stopped – no explanation yet.— seawater pipe in motor room sprang small leak. Temp repair made with hose clamps. Should be underway soon.

0803Z underway again.

1100Z: Stopped – backing and ramming for the first time! After several attempts got through – checked with bridge – they are still on one engine!!!!

1230Z – ice opening up a bit -- varying quite a bit between 10/10 and 8/10 ice cover

1601Z: Stopping for XBT in ice – T5_00009

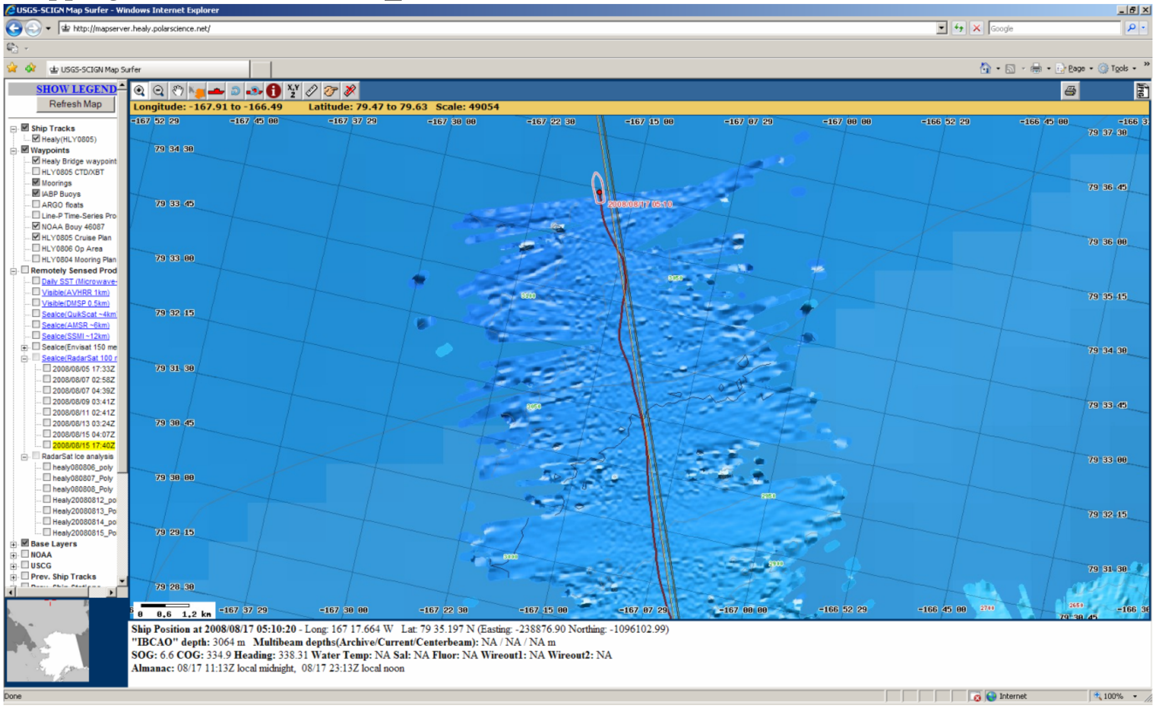


Figure 13. Ragged data resulting from ice.

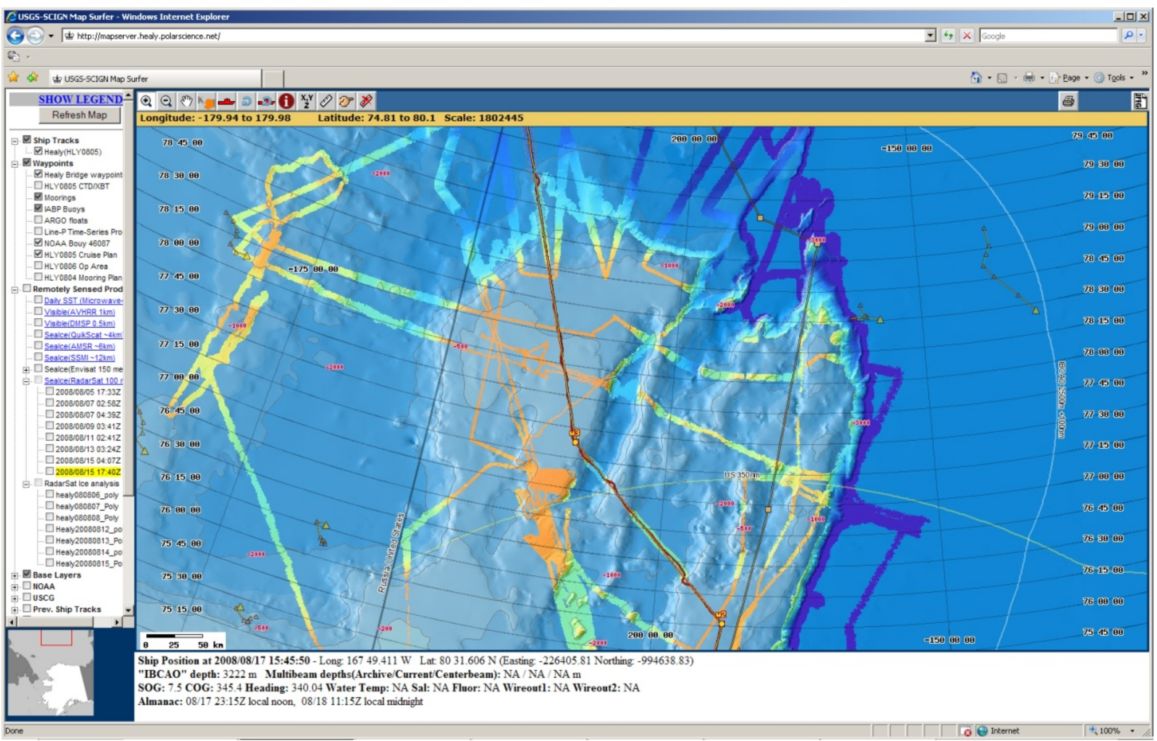


Figure 14. JD 299 ship track

1620Z: XBT completed – getting underway again.

1800Z: Andy on watch

1900Z: Analyzed XBT and determined that changes are minimal and will keep existing SVP in the system

2000Z: Continue to lose considerable data as we break ice.

2130Z: Crossing elevated feature detected on 2007 cruise, minimum depth about 3200 m

2300Z: May be coincidence, but ice was lighter over bathymetric rise and data were improved.

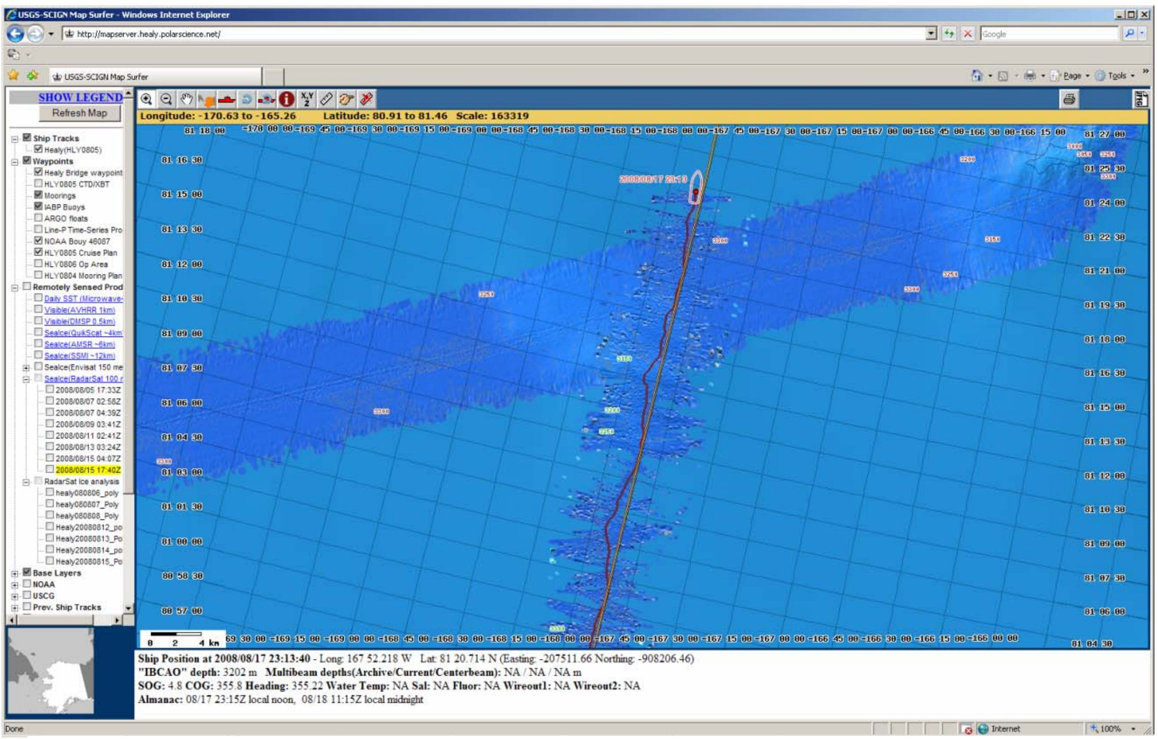


Figure 15. Data improvement over rise

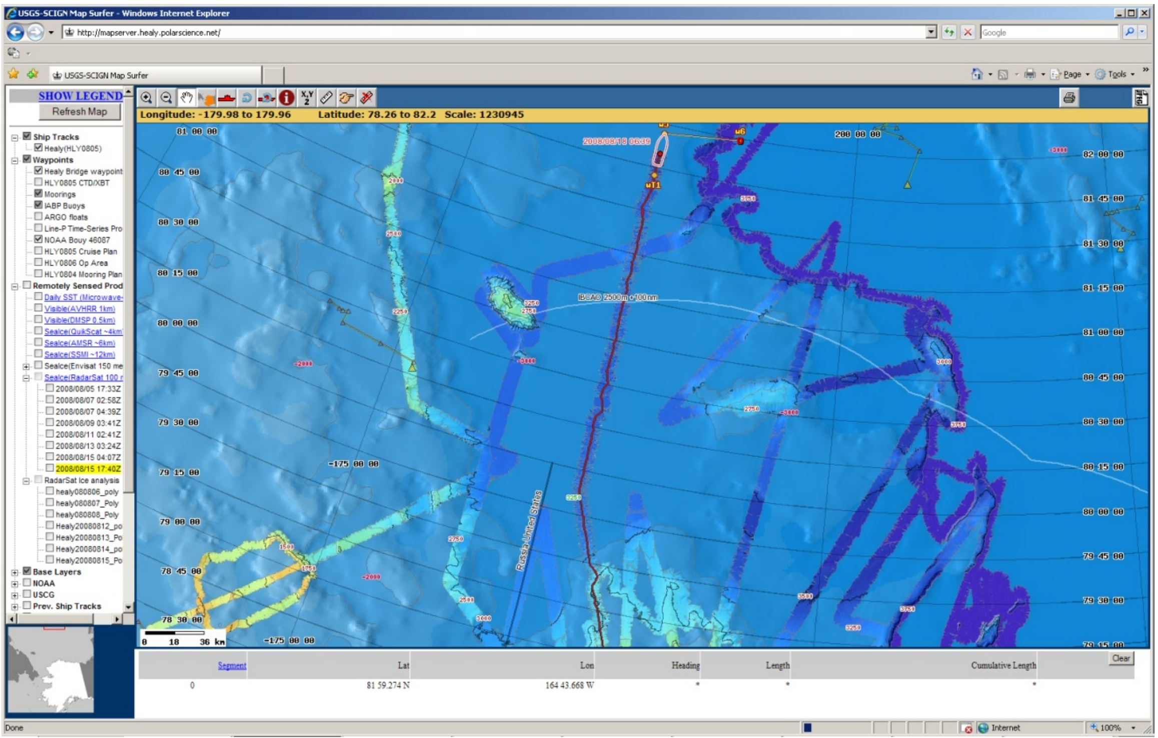


Figure 16. Julian Day 230 ship track.

18 August 2008 – JD 231

0020Z: Reduced speed due to engine casualty. Operating on one engine.

0055Z: Stopped for engine work

0300Z: Engines online; resumed track northward

0430Z: Launched XBT T5 00010; wire broke at ~1600 m as ship gathered too much way and prop turbulence.

0505Z: Updated SVP with data from XBT T5 00010, salinity correction from Levitus.

0600Z: Mayer on watch

0749Z: At waypoint to turn to east to find FOS

0751Z: back and ram -- several times

0815Z: -- beginning turn to the east slowing a bit to improve data and increase pulse 15 width to msec

1125Z: Ethan deploys sonobuoy for testing

1300Z: Crossing FOS—beautiful steep slope and expected stratigraphic relationship

1410Z: Change pulse length to 20 msec – cause of deeper depth and softer sediment

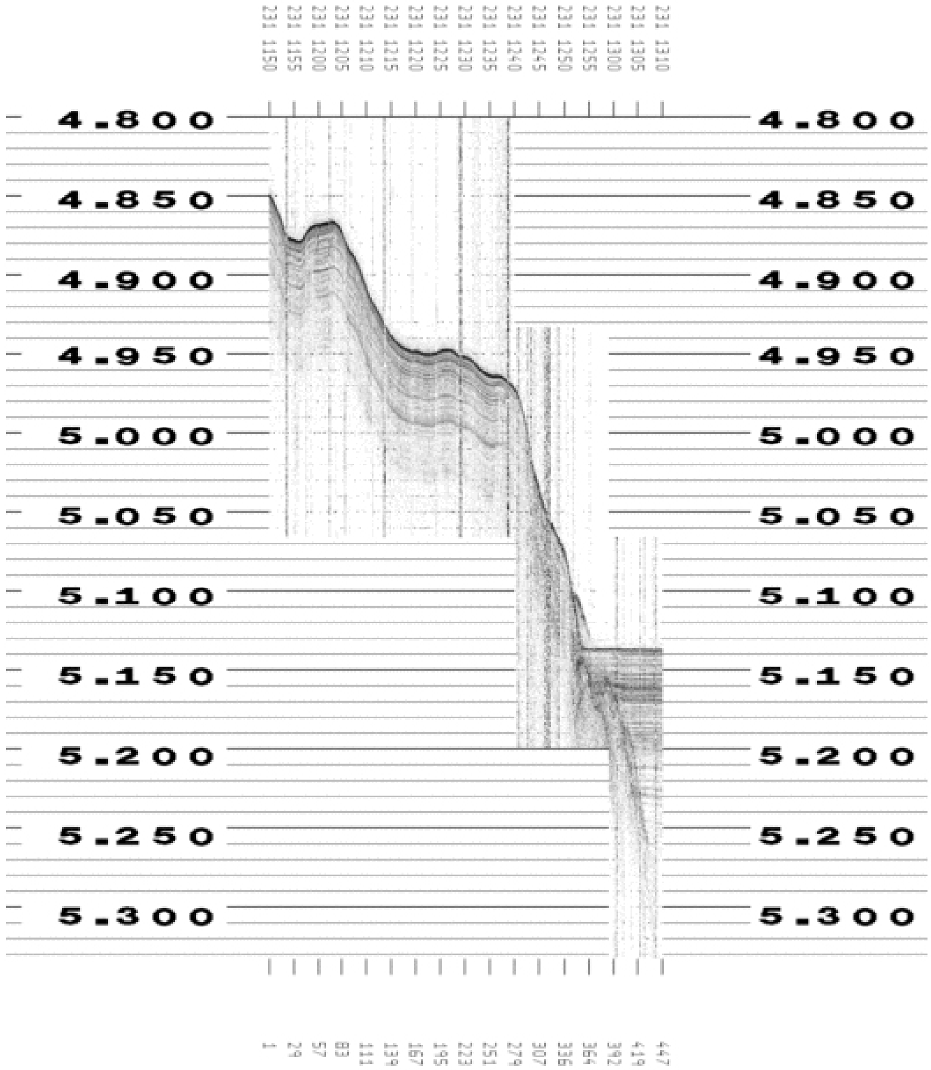


Figure 17. First crossing of the FOS AT 81 59N 164 41W

1620Z: Crossing the FOS again – heading north

1626Z: slowing to take XBT

1636Z: XBT launched T5-00011

1640Z: underway again

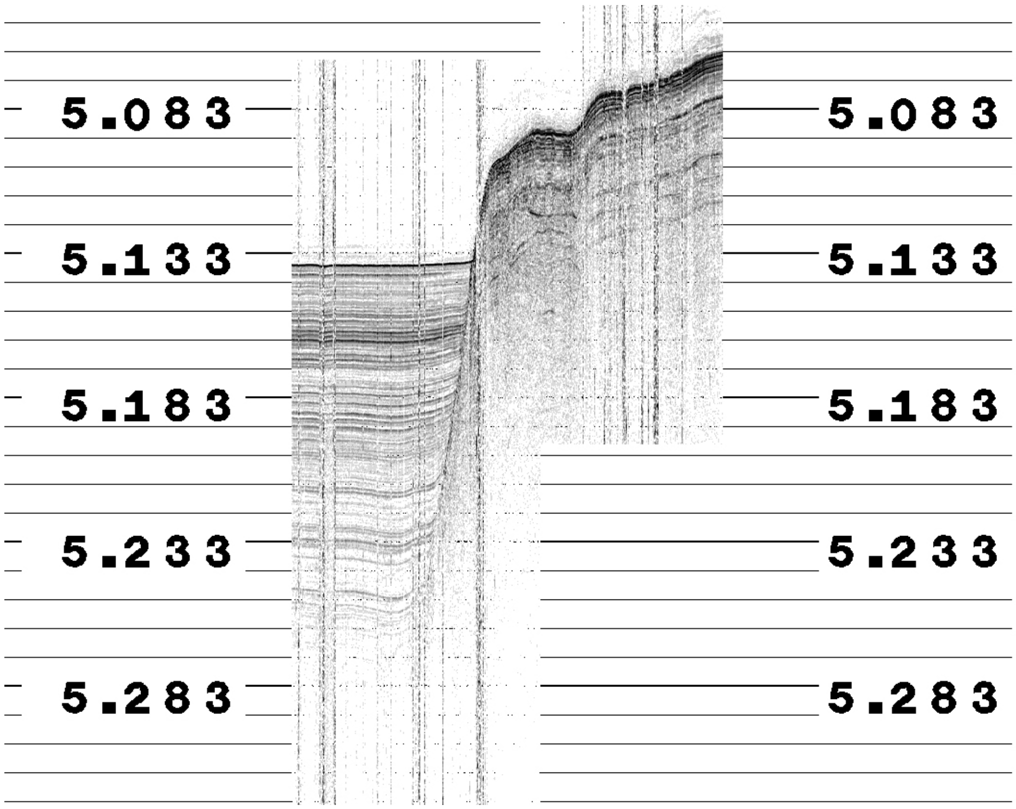


Figure 18. FOS on way north -165.192151, 82.157036 1635Z JD231

1800Z: Andy on watch

2130Z: At final en route waypoint; changing course to ~022° to converge onto foot-of-the-slope feature and thence begin steering by cursor on the SeaBeam real-time display.

2200Z: Began steering by cursor along foot-of-the-slope. We are trying to keep the slope/plain transition (located at ~3820 m) in the center of the swath with the edge of the slope structure just showing on the subbottom profile record. The watch in the computer lab places a cursor on the bathymetry display, which is mirrored on the bridge. The bridge watch steers the ship toward the cursor target.

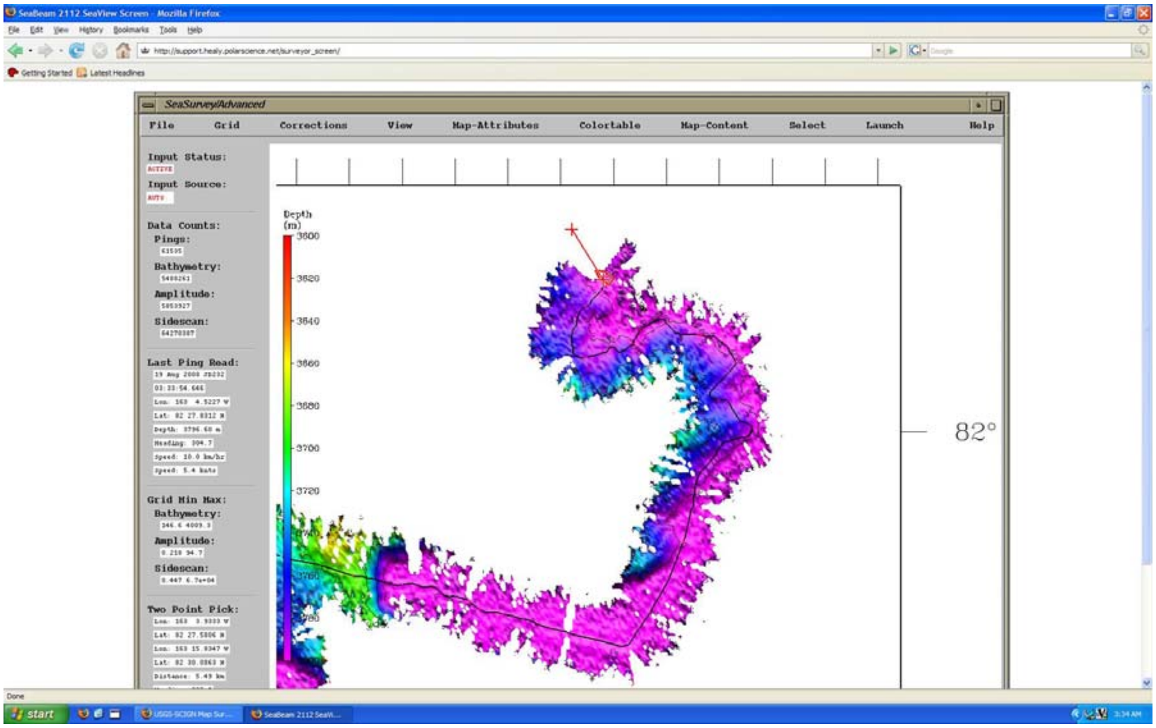


Figure 19. Survey Track Control Screen as seen on bridge

19 August 2008 JD 232

0420Z: Launched T7 XBT, wire broke. Stopped ship to launch a 2nd XBT T7-00013 successfully.

0448Z: Ethan Roth deployed sonobuoy off stern.

0457Z: The foot-of-the-slope feature is consistently located at the 3850 depth range on the subbottom profiler.

0516Z: Some backing and ramming needed to make headway.

0600Z : Mayer on watch

Continuing to follow FOS to in convoluted track to east.

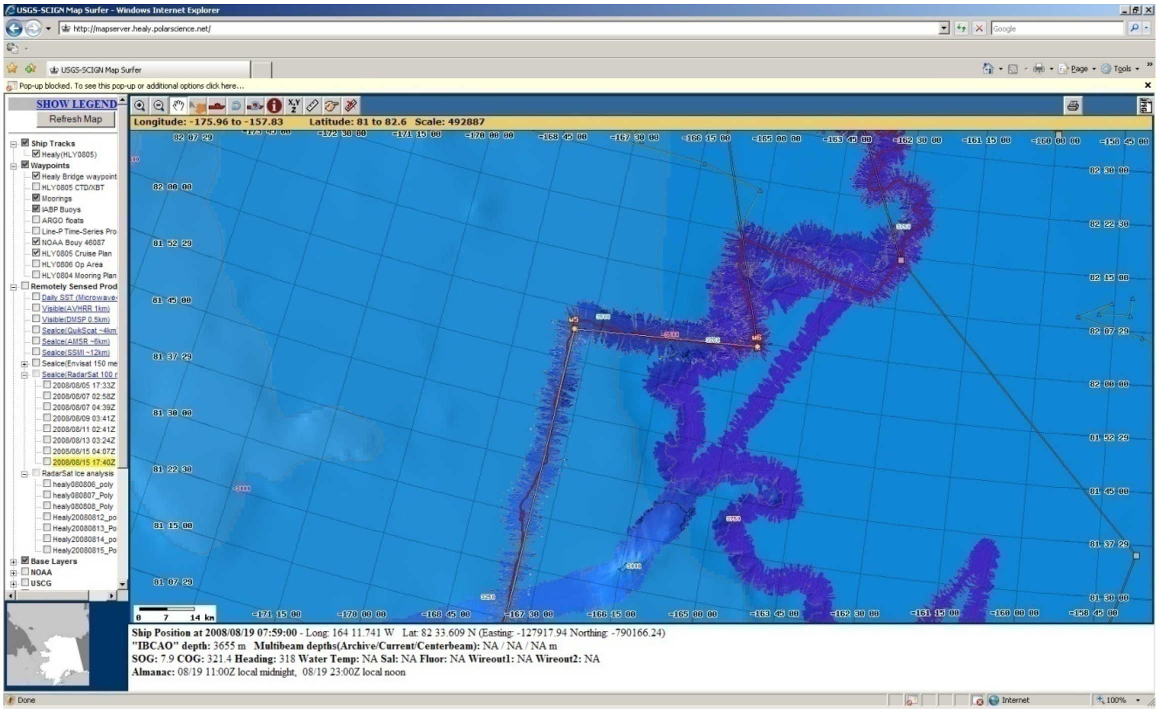


Figure 20. JD 231 Shiptrack

1000Z: FoS continues to go to the east – we are moving in and out of thick ice – getting stuck every once and a while – the stratigraphic relationship is very consistent though the morphological change is more subdued.

1215Z: backing and ramming again

1500Z: We may have finally reached the western extent and can start working our way back east – but who knows…..

1622Z: Stopping for XBT T5-0014

1627Z: CTD launched wire broke at 11-1200m – will use

1718Z: Dale compared XBT results to currently entered SVP profile and there was no difference – will not update SVP

1800Z: Andy on watch

1841Z: Back and ram; 3 times; small area of thick multiyear ice.

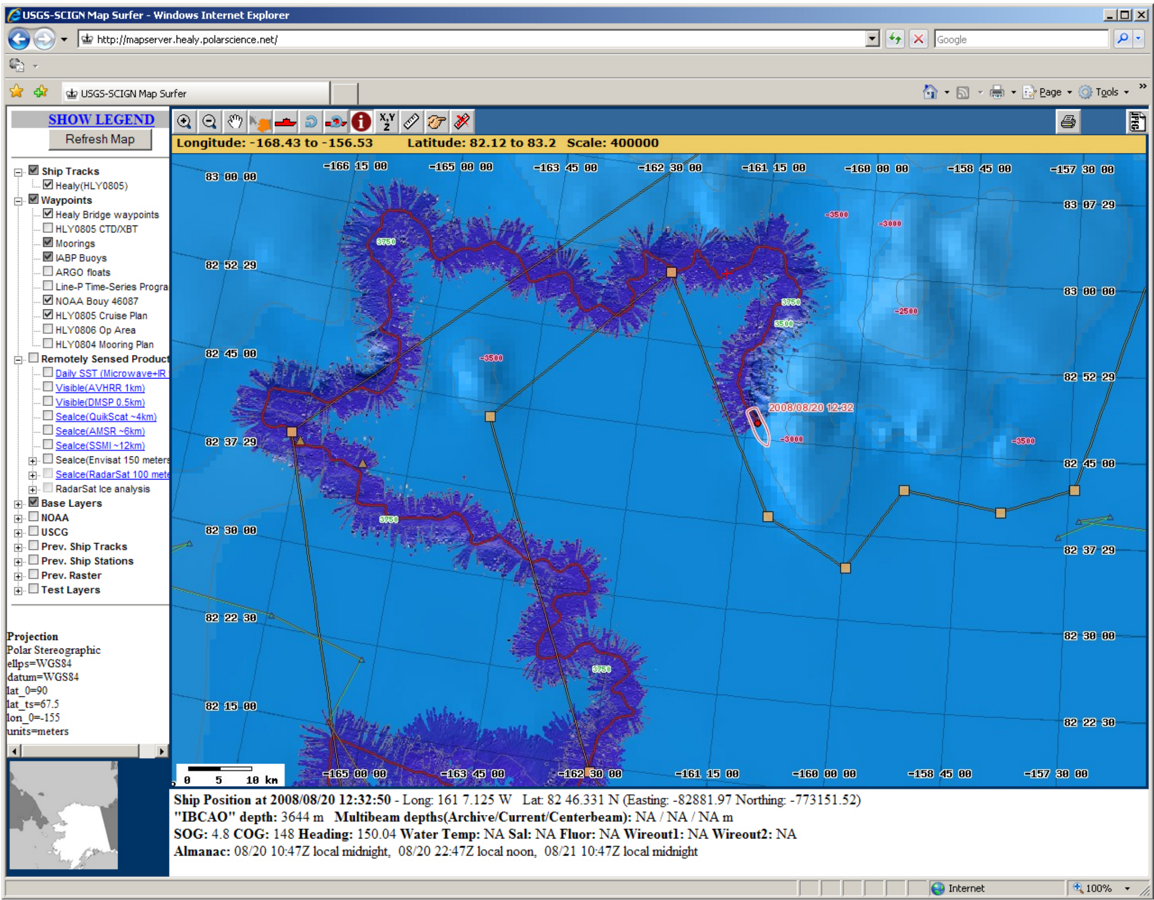


Figure 21. JD231 Shiptrack.

20 August 2008 – JD233

0004Z: We have not seen the FoS manifestation on the subbottom profile in some time. We will ease away from the slope to cross onto the abyssal plain.

0300Z: We have passed over the FoS transition on the subbottom profile out into the abyssal plain and back onto the slope 3 times. The transition remains persuasive even though the bathymetry of the slope slope is more gradual.

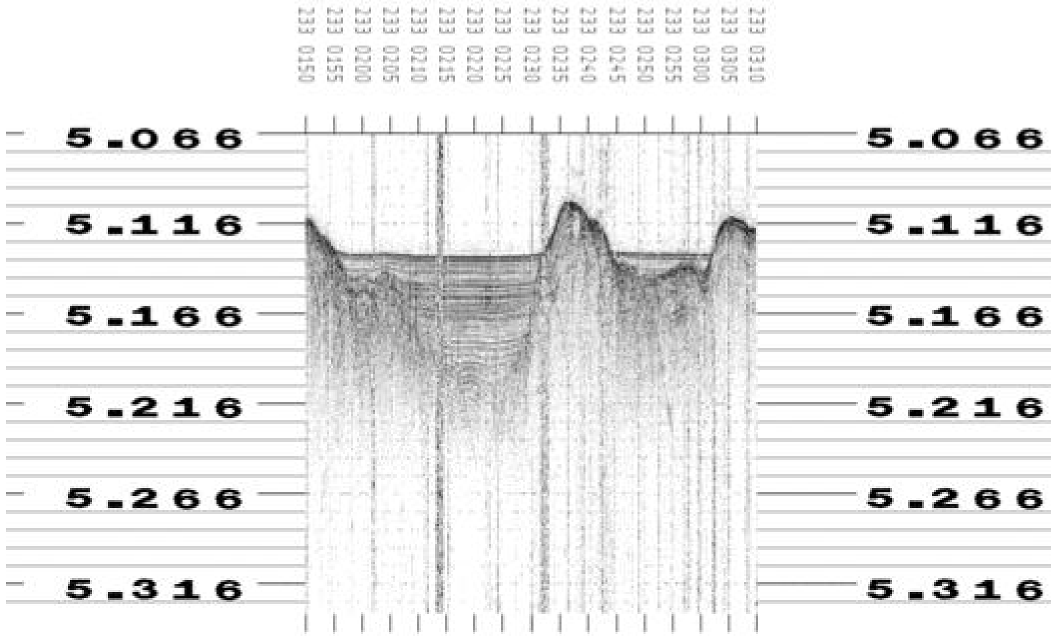


Figure 22. Foot of the slope crossings

0430Z: Launching XBT – T5- 00015; drop successful and SVP with Levitus salinity correction applied.

0600Z: Mayer on watch. Synchronized time on Knudsen subbottom profiler to GPS time. Time on profile had been running 2+ minutes fast. Will begin synchronizing every 2 hours.

0800Z: Knudsen synched

1000Z: Knudsen synched

1200Z: Knudsen synched. We continue south along a well-defined transition from topographic highs to the abyssal plain – we are clearly on the Alpha Mendeleev side of things – the question remains have we been able to follow a continuous morphologic feature? Im not sure.

1351Z: We are coming down the western edge of the massif that contains Hunkins Seamount (83N, 159W or 11527, -769955 in Polar Stereographic coordinates using 160 as the projection meridian. We will take the time to try to do a complete survey of most of it as it should contain an 2500 m contour. I would also like to run some additional lines but this would take two full days. Will discuss with Andy

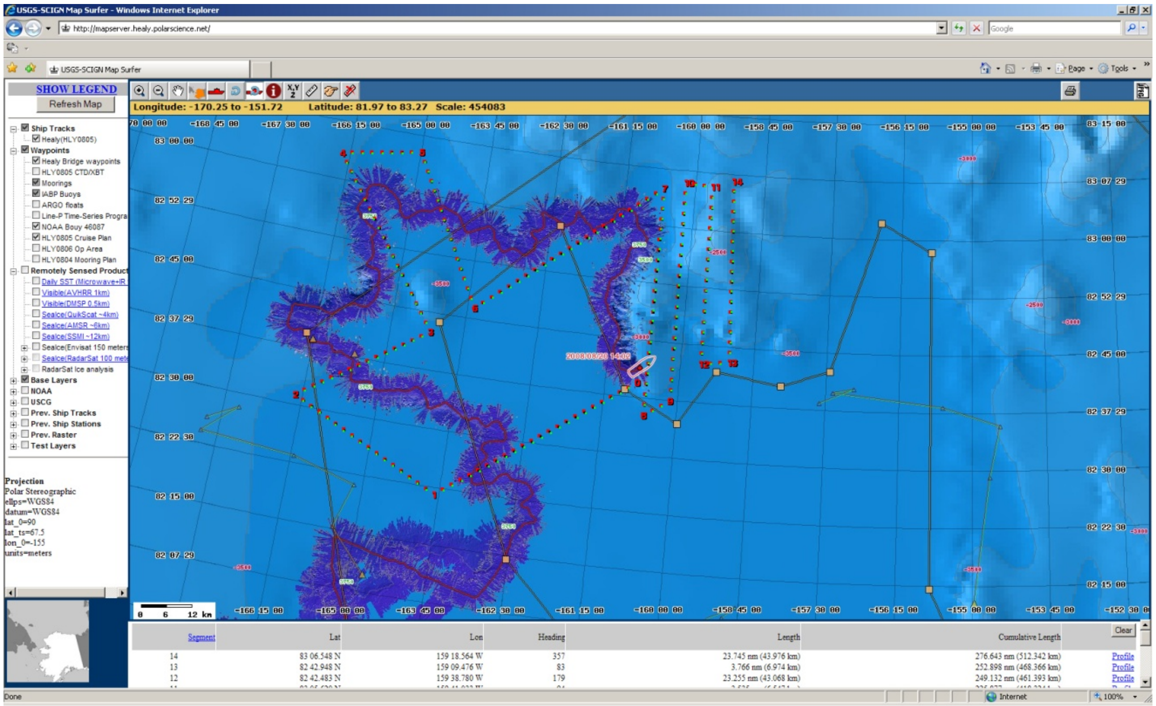


Figure 23. Proposed survey of Hunkins Seamount area and other proposed tracks

1452Z: Menu control station on SeaBeam froze – need to reboot system. Stopping vessel while Dale reboots.

1529Z: Seabeam back in survey mode

1546Z: Underway again – picking up where we left off in midst of Hunkins Seamount survey.

1612Z: Slowing for XBT T7-00016

1615Z: Launch XBT T7-00016

1648Z: Slowing to shift from main engine 3 to main engine 2

1653Z: Back on line – underway again

1715Z: data is looking pretty good so we will try to push up to 7 knots and see what happens

1800Z: Andy on watch

1830Z: SVP from T7-00016 nearly identical to existing profile; did not apply new SVP

1923Z: Briefly stopped while engineers bring on engine #3

2045Z: Reversing direction at northern end of seamount.

2059Z: Ship is commencing engineering drills.

2220Z: Development of Hunkins Seamount continues.

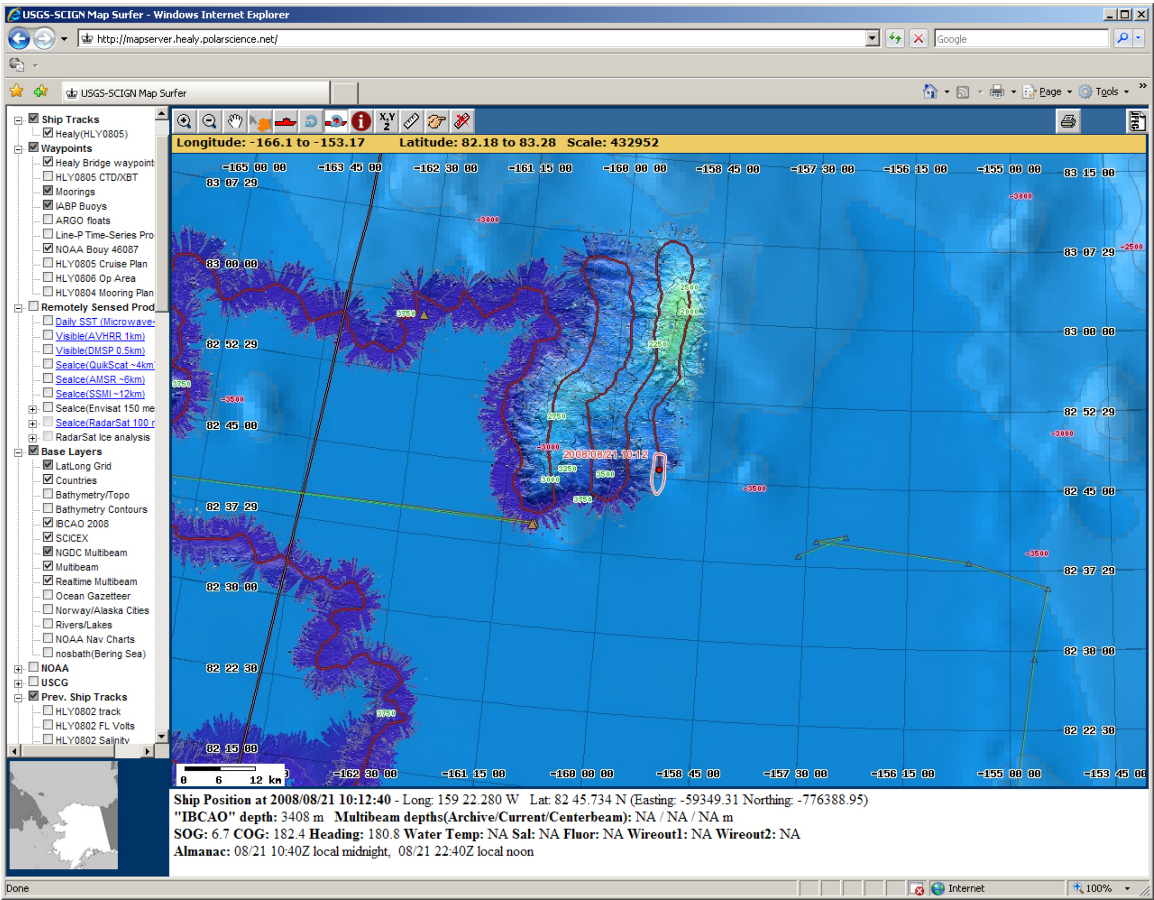


Figure 24. JD233 Shiptrack

21 August 2008 JD234

0033Z: Reversing course in open water to continue development of Hunkins Seamount

0330Z: Depths less than 2500 m being recorded

0425Z: Launched XBT T-7 00017

0433Z: Ethan deployed sonobuoy

0520Z: At north end of Hunkins Seamount development, reversing direction to run swath south.

0600Z: Mayer on watch

1000Z: Just about finished with survey on Hunkins Seamount – shoals to about 2000m. We will come off seamount to south and run a bit into the abyssal plain to show the transition. Then we will take off in pursuit of FoS again – heading east.

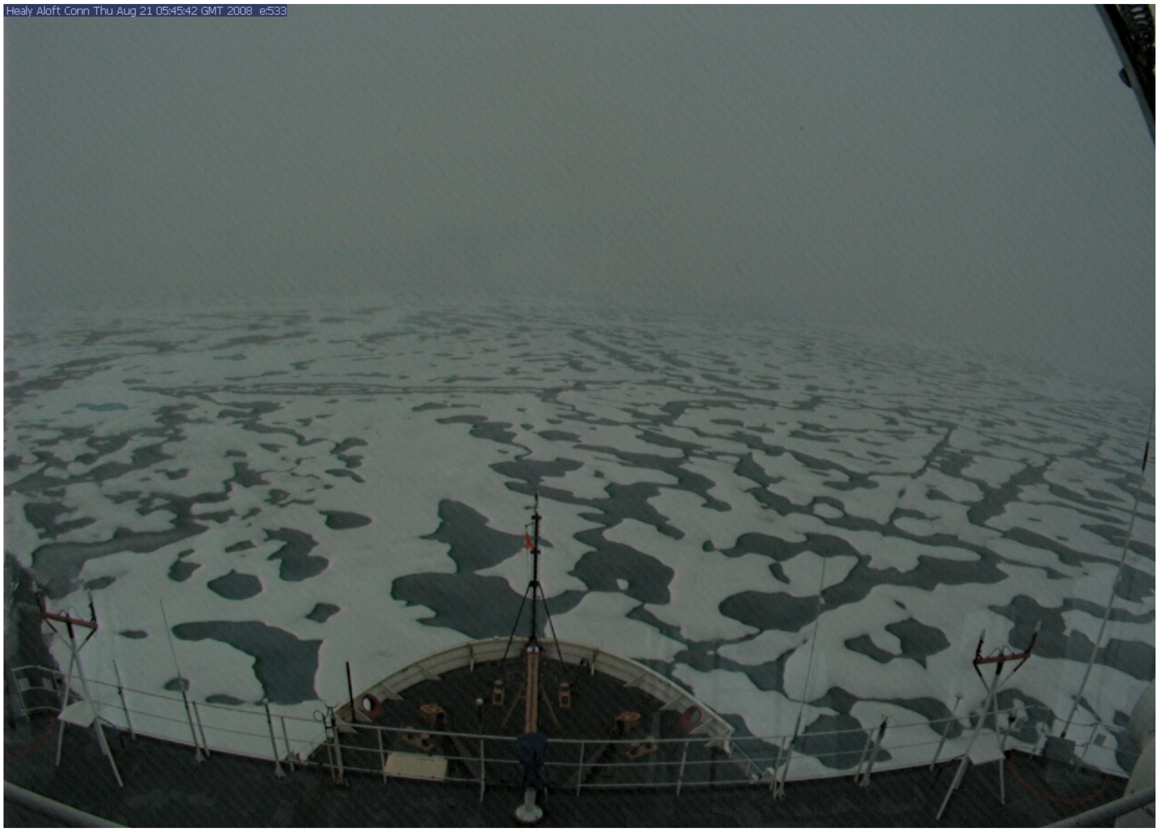


Figure 25. Typical ice conditions during Hunkins Seamount development

We have been wondering why the data quality this year is significantly worse than previous years except when in the heaviest ice. My suspicion is that there is nothing particularly wrong with the system (it is as bad a usual) – data collected before we entered the ice was fine. The problem seems to be the nature of the ice this year. While we occasionally hit thick, multiyear ice, for the most part, the ice appears to be first year and is relatively thin (less than 1 m) and soft. My suspicion is that this ice moves under the hull and interferes with the sonar more than the broken-up pieces of multiyear ice that we ran into last year. These pieces of multiyear ice moved around the ship rather than under it. Just a guess.

1200Z: Coming south and finishing up the survey of Hunkins Seamount – shoals to about 2000 m. Will run out on the abyssal plain to get a good record of the transition.

1400Z: -- Finishing up at the base of the seamount – will now start trying to pick up the FoS to the north and east.

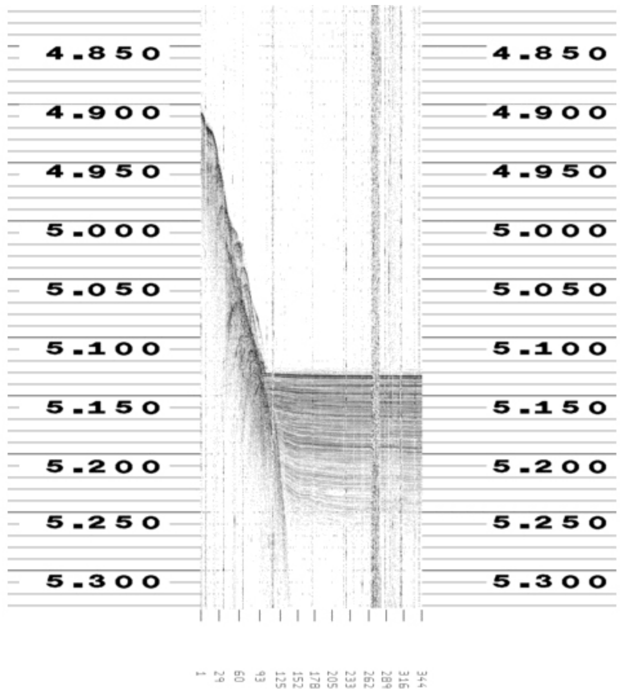


Figure 26. Transition to abyssal plain at base of Hunkins Seamount

1623Z: slowing to launch an XBT T7 00018

1630Z: T700018 successfully completed – getting back underway

1800Z: Andy on watch

2031Z: Applied XBT T7-00018 Levitus-corrected SVP

2120Z: Beginning a loop to assess an indentation in the slope.

2140Z: Unfortunately, we turned too fast and did not cross the FoS transition on the outward portion of the loop. We will cross on the return before resuming along the track.

22 August 2008 JD 235

0012Z: Running south to cross off shelf into flat-lying sediment. Stopped by hard ice; backing and ramming.

0045Z: Second engine online to increase ice breaking capacity. Successfully negotiated large multiyear floe with 2nd engine and steering around to west.

0130Z: Crossing off the slope, across the FoS on a gentle slope into the abyssal plain.

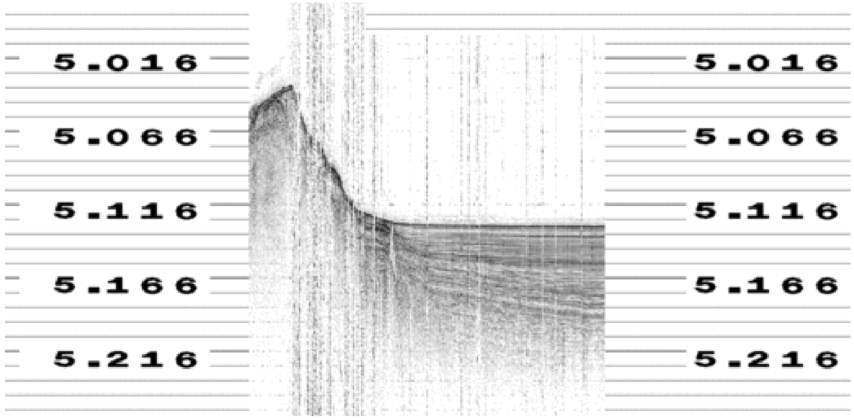


Figure 27. Transition to Abyssal Plain east of Hunkins Seamount

0150Z: Turning south and then east to resume following the FoS to the east.

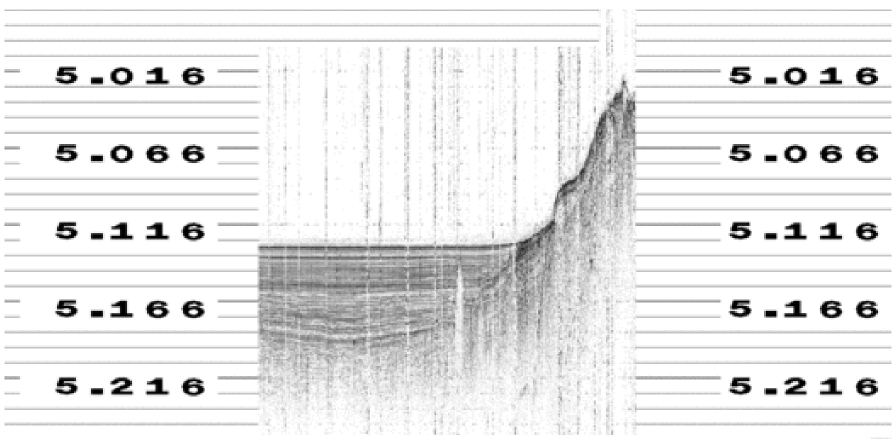


Figure 28. Transition to Slope east of Figure 21 area

0327Z: Referring to Figures 27 and 28, there may be a morphological argument that there is a “rise” in this region.

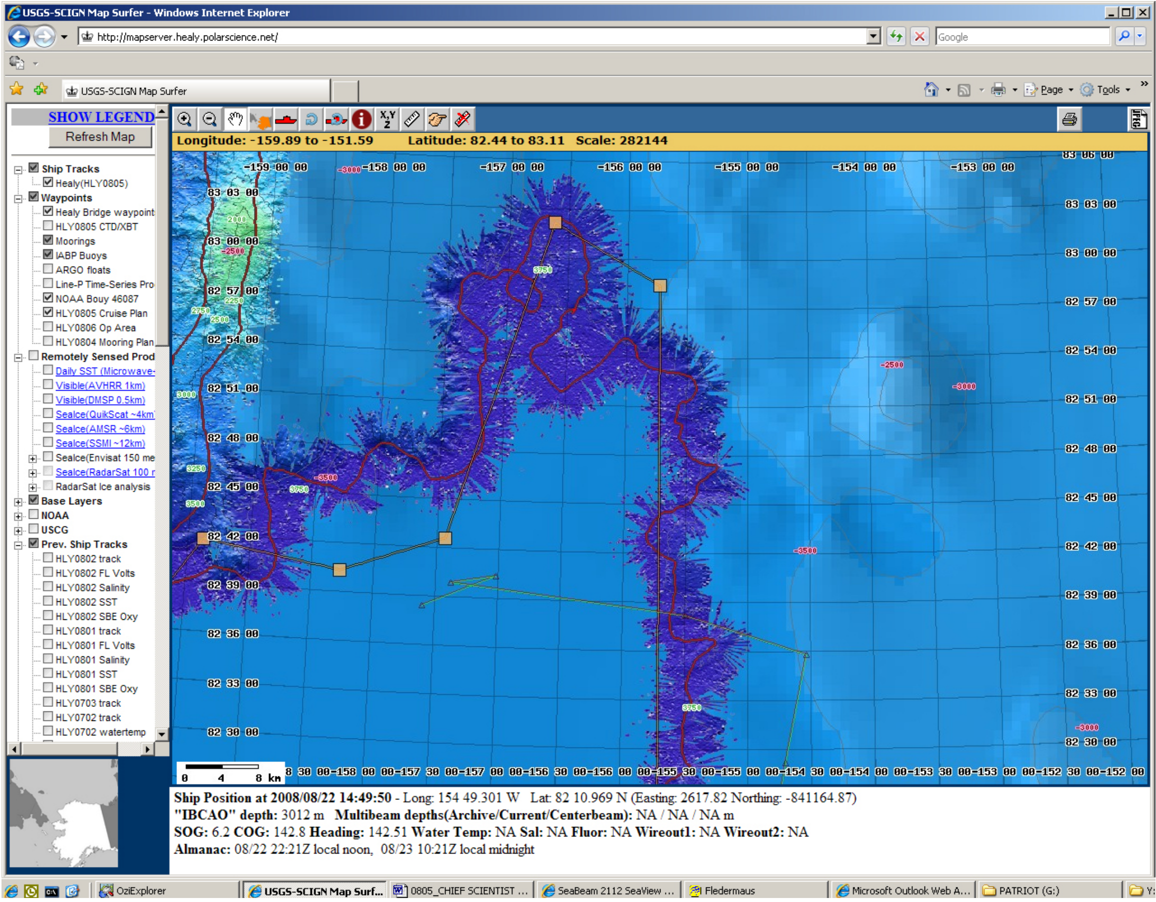


Figure 29. – JD 234 Shiptrack

0430Z: Stopped ship and successfully launched XBT T7-00019.

0501Z: Applied SVP with levitus salinity correction.

0600Z: Mayer on watch – continuing to trace the edge

1300Z: Lots of heavy ice – need to back and ram frequently – bridge has called and they will go around a large piece of very heavy and slushy multiyear ice. Kelley has a compilation of HEALY and submarine gravity data – this is very important!!! The Fos along this southward transect is very well developed but interestingly the flat-lying abyssal plain sediments are punctuated by small features that appear to be associated with the higher-standing slope (see Fig 30)

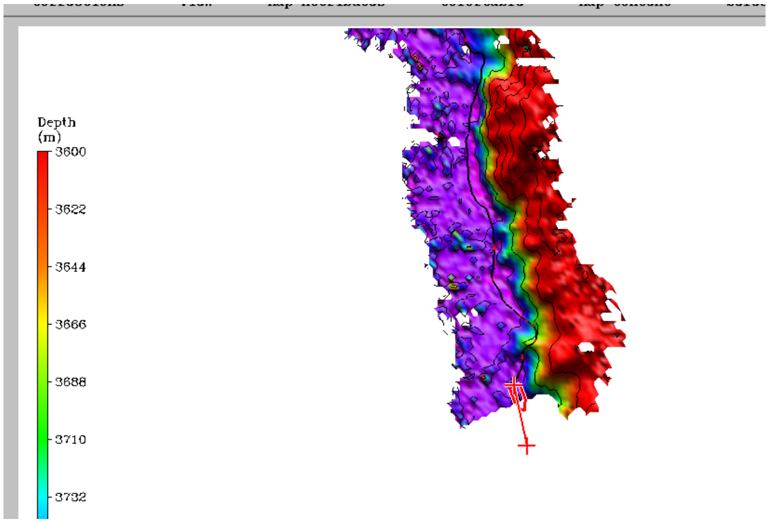


Figure 30. FoS region with numerous small, bathymetric peaks.

1616Z: Slowing to take XBT – T7-000

1619Z: XBT launched – cut off at about 200 m will try again.

1625Z: Good XBT T700027 – to 760 m

1644Z: Data looking good – relatively ice free – will increase speed to 8 – 9 knots and see how data looks.

1655Z: begin a slow turn to starboard to start cross slope transect.

1730Z: ending transect line – coming around on reciprocal course to return to tracing FoS

1737Z: XBT T700022 entered and applied

2048Z: Continuing along FoS

2230Z: FoS made abrupt turn to the southwest with a saddle above the FoS transition. We are following the feature and will use this as an opportunity to cross from the slope to the abyssal plain

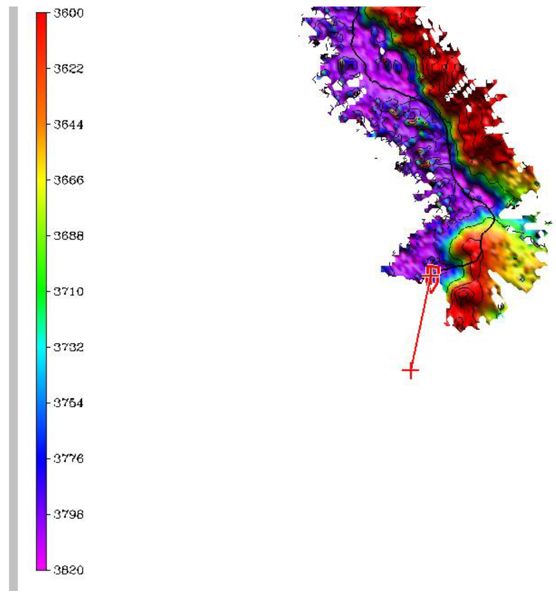


Figure 31. Abrupt turn in FoS

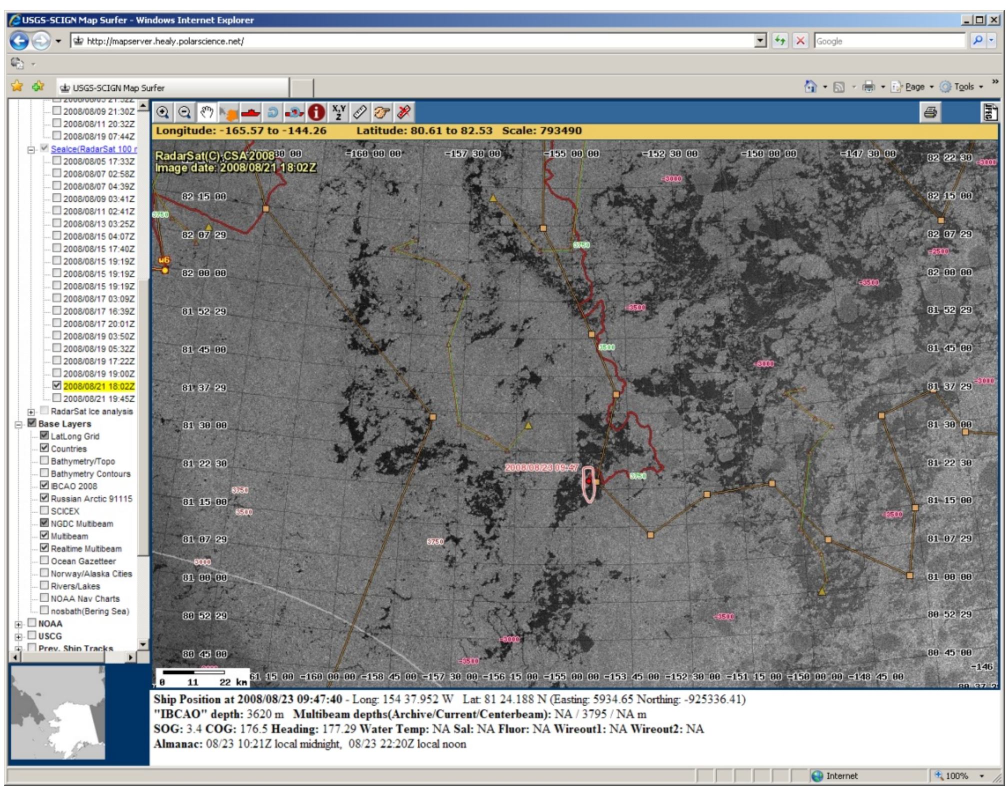


Figure 32. JD235 Shiptrack plus radarsat image

23 August 2008 JD 236

0300Z: Large, hard ice floe, backing and ramming

0414Z: Bringing 2nd engine on line. Ethan deployed sonobuoy.

0600Z: Mayer on watch

0610Z: XBT T500023 taken – good -- entered and applied
From last year's cruise report – Chukchi Color map and optimum shading parameters:

- Ambient – 47.4
- Specular – 21.6
- Soft Shadow – 68.1
- Vertical Scale – 10.0
- Sun Direction - 131
- Sun Angle – 5

1300Z: First polar bear spotted – originally off starboard bow – then crossed over to port quarter. Evaluation of data quality to date. Data was fine until we entered the ice. Once in the ice the data was degraded, more so than we have seen in the past (Fig 33). We attribute this to the nature of the ice – the thin, slushy first year ice is more prone to be dragged under the hull and along the transducers than the thick multiyear ice which is typically pushed aside.

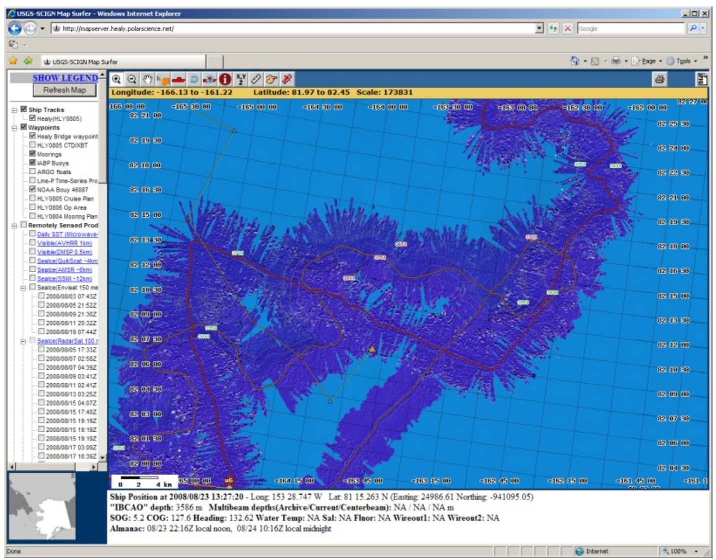
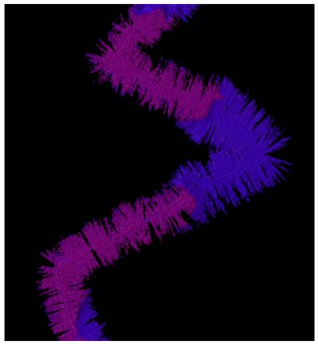


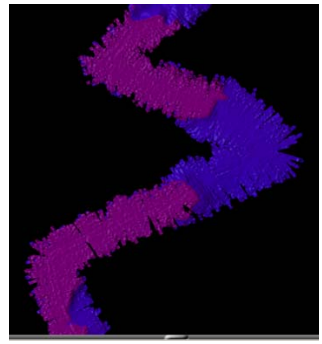
Figure 33. Comparison of last year's data quality (brown tracks) with this year's (red track)

The next issue is how to clean it up. There are two aspects here. One aspect is the sparsety of the data in some areas, and the other is the approach to cleaning it. Our standard approach of a grid size that is commensurate with the beam footprint size at a given water depth (see table in Data Processing Guide – Appendix XX), leave too many gaps in the data when ice conditions result in infrequent returns.

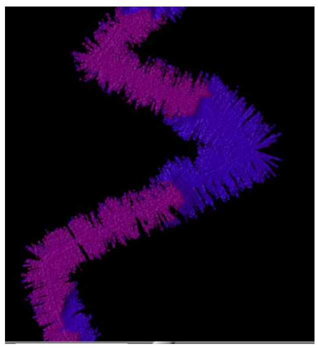
To address this I have taken some of the worst data sets and experimented with different grid sizes and filter weighting (Figure 34). Conclusion is that for those data sets that are really ratty – we are probably best using a cell-weighting factor of 5 and a in worst cases increasing grid size form 75 to 100 m. Will use 75-5 for now.



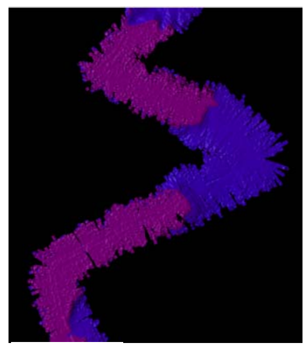
75-3



75-5



100-3



100-5

Figure 34. JD231 filtered at various grid scales (75 and 100m) and various cell weightings (3 and 5).

The second issue is the approach to cleaning of the data. Brian has taken great care to ensure some consistency amongst the editing watches. The majority of editing has been done with CARIS using the swathed mode. The standard instruction has been to focus mainly on outliers and to not be too aggressive in cleaning the data. Brian's concern is to respect, as much as possible, the integrity of the data – and to minimize subjective decisions about what should or shouldn't be edited. This is very reasonable but the result has been consistent curl-up of outer beams when seafloor is flat (e.g. on abyssal plain – Fig 35). I am concerned that in leaving these outer beams in we are including soundings that we know are incorrect and that produce a false impression of the nature of the seafloor. If we were attributing the data with uncertainty and if the ultimate audience for these data (the Commission on the Limits of the Continental Shelf) were sophisticated multibeam sonar users, then this might be OK, but my concern is that an understanding of the distribution of uncertainty with beam number will be lost over time and the data presented will be misinterpreted. We have discussed this and decided to re-edit and remove these noisy outer beams.

155Z: Slowing for XBT

1557Z: XBT launched – T700024 -- good XBT to 760 m

1630Z: XBT T700024 entered and applied

We are at the southern extent of tracing the FoS on the eastern side across from Chukchi. This region would be an excellent place to dredge in (to see if rx matched those on Chukchi side) but we have not

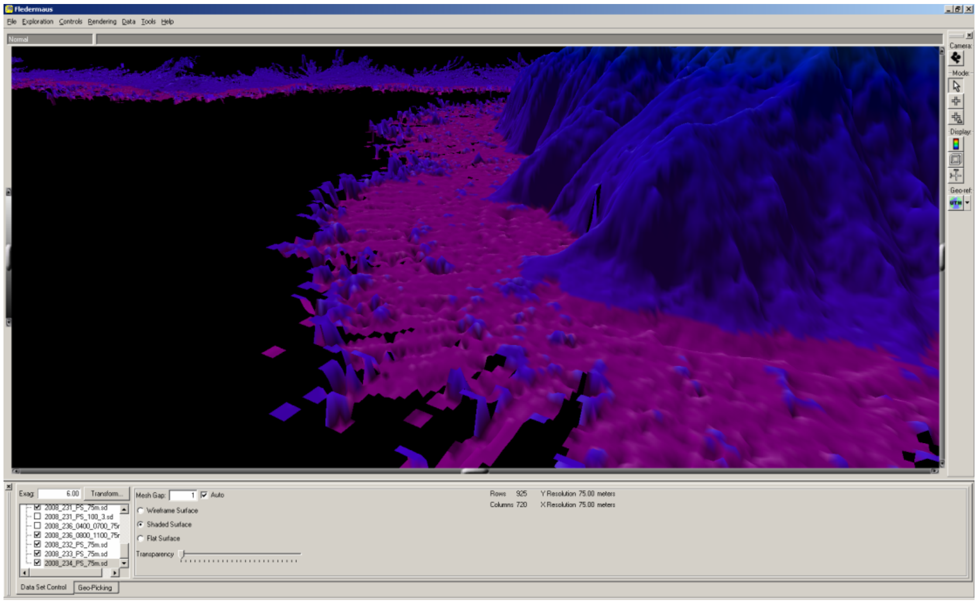


Figure 35. Characteristic noise on outer beams

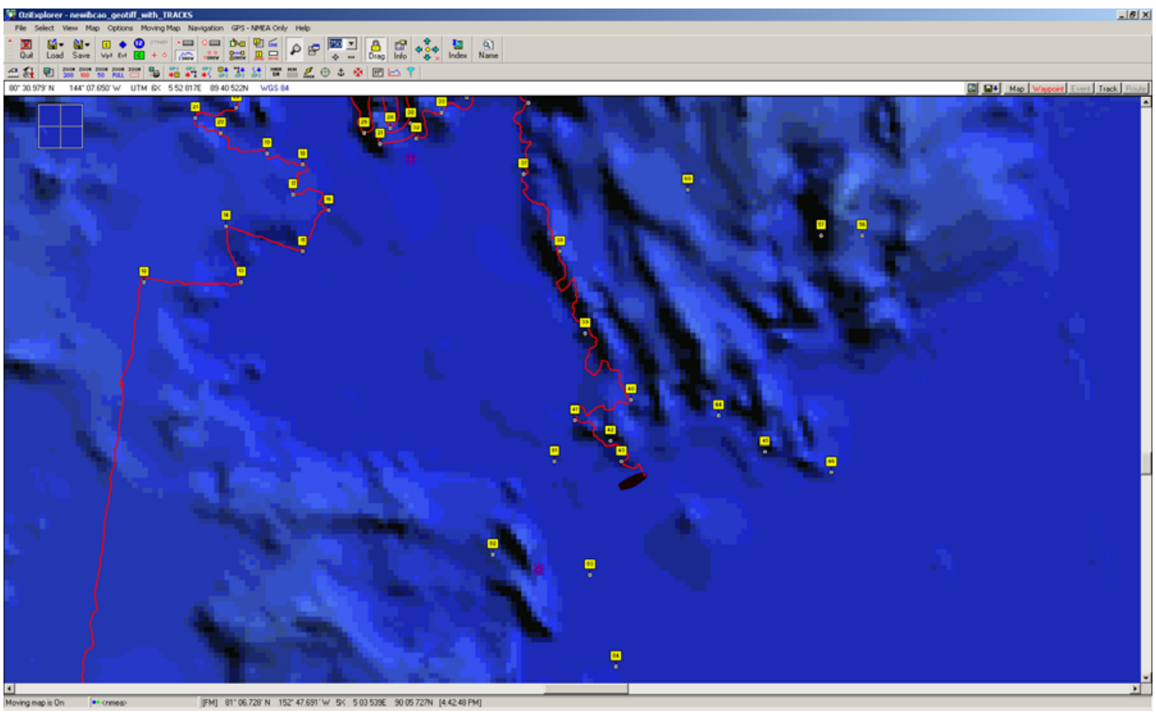


Figure 36. Track plot as of 1643Z 23 August

seen a good dredging target yet (Fig. 36).
1730Z: Backing and ramming

1120Z: Continuing north and east along FoS. There may be an isolated elevated area to the southeast, but the indications may only be the typical outer beam noise we have seen. If there were any elevation, it would be outside the FoS and therefore irrelevant to our main priority. We will continue tracing the continuous FoS.

24 August 2008 JD 237

0420Z: Launched XBT T7 00025; broke at 650 m, but should be satisfactory

0600Z: Mayer on watch

0910Z: In very thick ice – backing and ramming – difficulty maneuvering

1028Z: Backing and ramming again. We have traveled about 6 nm up a beautiful box-like feature that has finally ended – the south-eastern wall (on inside) is very steep and may be a good dredging target (Fig. 37)

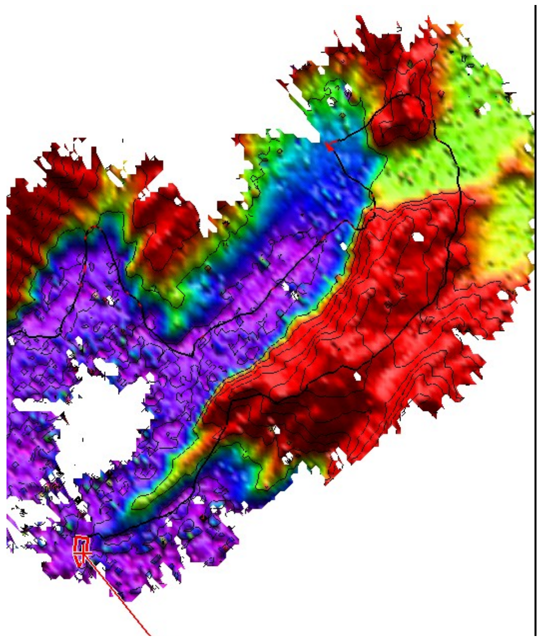


Figure 37. Large embayment –may contain potential dredging targets

1133Z: Stuck—backing and ramming again -- not making much progress – bridge says there is a lead heading northeast. Inasmuch as this is the way we eventually want to go we will head towards it.

1440Z: Ship suddenly takes 90 degree turn to west. Called bridge – said that they had been pushed off by a flow – will try to come back around.

1618Z: Slowing for XBT

1620Z: XBT taken T700026 – good to 760 m.
1800Z: Andy on watch. SVP from XBT nearly identical to existing SVP; T7 00026 not applied.

2000Z: Continuing to follow FoS to south.

2300Z: FoS continues to the south along a series of highs with saddles between.

25 August 2008 JD 238

0030Z: Encountered very large ridge; bridge has altered course to try to get around. We will just keep cursor aimed at where we want to go, and bridge will seek best way to get there.

0200Z: it appears we have finally reached the southern extent of the string of highs we have been tracing along. We have rounded the feature and are now tracking the FoS northward.

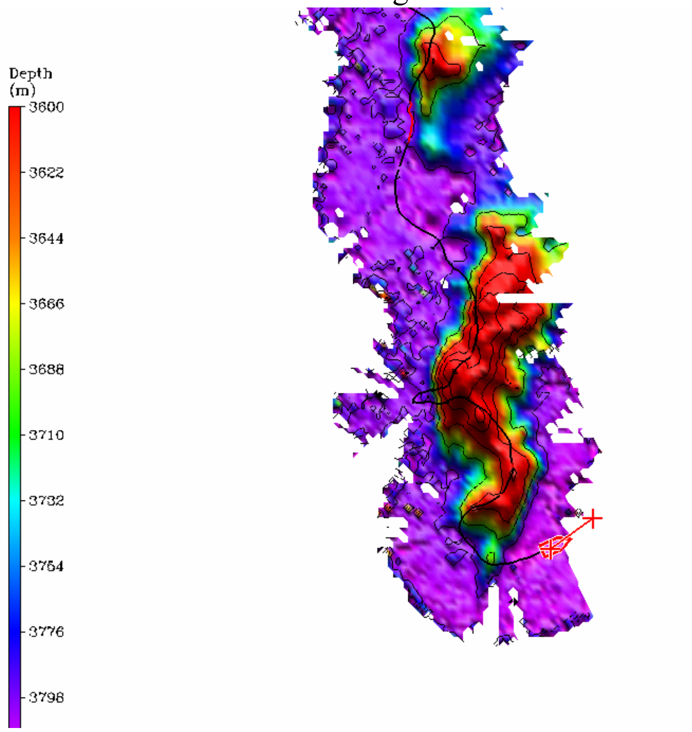


Figure 38. Southern tip of series of bathymetric highs.

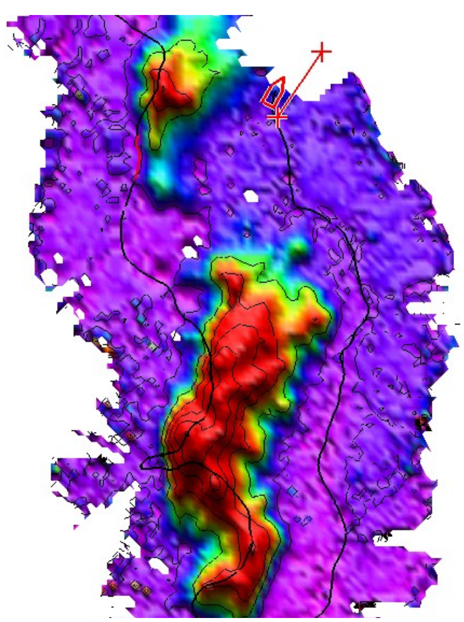


Figure 39. Very gentle ledge of slope.

0415Z: We have followed the FoS around this southern tip, but we now appear to be on a very, very gentle part of the slope (or we have some mbes artifact). It is not entirely clear in which direction we should proceed. Will head north eastward.

0430Z: Dropped XBT T5-00027

0505Z: Entered SVP from XBT T5-00027 even though it was very similar to existing SVP.

0600Z: Mayer on watch
We are in a pickle. The feature we were following appears to be an isolated high as we come around its southern end, the question now is where is the morphological break that we want to associate with the FoS. As we cross from the topographic high to the deeper seafloor surrounding it, it is clear that the sediments do not have the "abyssal plain" behavior of the sediments we have seen in the past. The debate is whether the transition between the steep topography and these differently behaving sediments or the transition between the differently behaving sediments (which lie about 10 – 20 m shoaler than the flat-lying abyssal plain sediments) represent what we would consider the FoS. My feeling is that even if there is a slight topographic break at the base of these other sediments they would be more rise-like and we are better off tracing the base of the topographic highs.

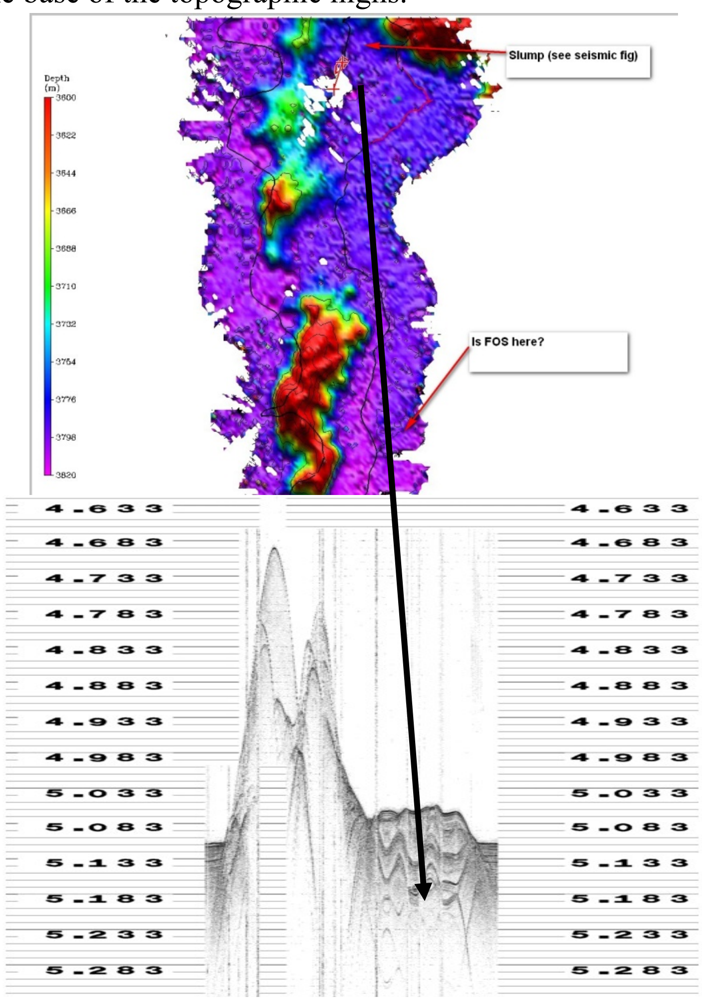


Figure 40. Confusion over FoS.

0756Z: stopped – backing and ramming

0946Z: stopped – backing and ramming

1053Z: stopped – backing and ramming

1111Z: stopped – backing and ramming – this time for at least 20 minutes – called to see if they would put on a second engine – "they will discuss with oncoming OOD" was response.

1354Z -- I think we now have the evidence we need to separate the "normal abyssal plain" from the sediment we have been seeing (Fig 41)

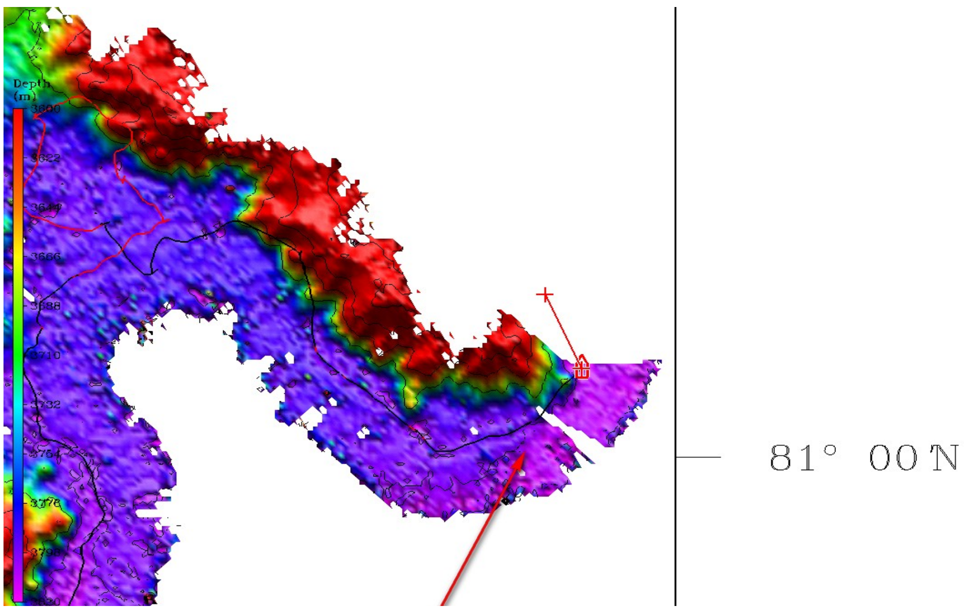


Figure 41. Transition back to "normal" abyssal plain sediments

Looking at the Knudsen as we came across the purple pink boundary we see a definite difference in depth – unfortunately the topo high was in between so we will do a loopty-loop and come back to cross orthogonally to see relationship on Knudsen. The shoaler sediments are most likely the result of downslope movement in the embayment.

1456Z: stopped – back and ram

1540Z: Crossed transition from "shoaler" sediments to "normal" abyssal plain sediments – clear but I don't think this would make a convincing FoS (Fig 43).

1552Z: slowing for XBT – T7-00028

1555Z: XBT taken – good to 760m; identical to existing SVP; not applied.

1720Z: Backing and ramming

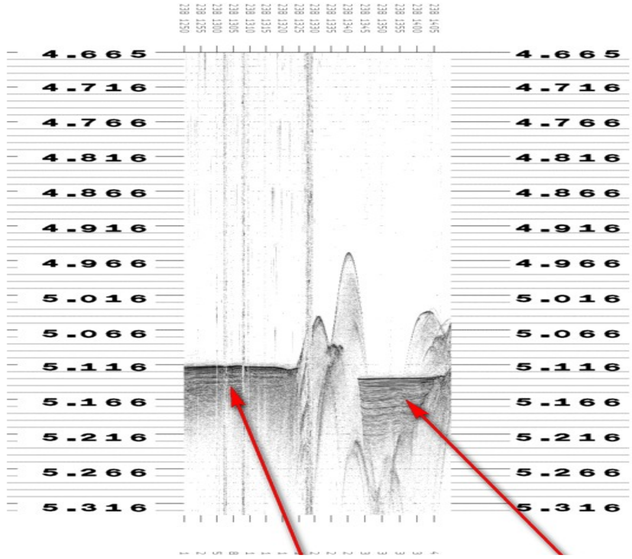


Figure 42. Transition from "shoaler" sediments to normal abyssal plain sediments.

1800Z: Andy on watch

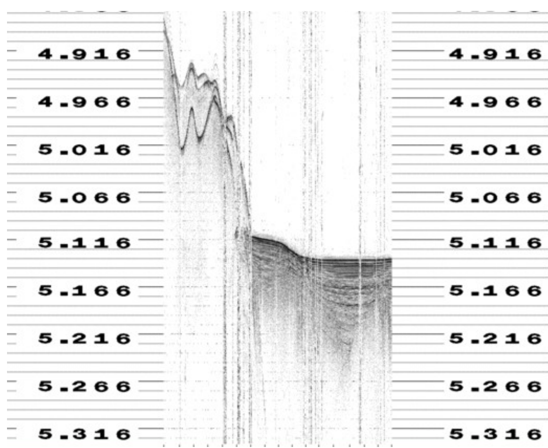


Figure 43. Transition from shoaler sediment to normal abyssal plain sediments.

26 August 2008 JD 239

0300Z: We have been tracing low-relief transitions from elevated seafloor the flat seafloor throughout the watch. It has been unclear again where the FoS will actually be found. It may be that we have to look at a fairly long section of profile to select a location.

0340Z: We are changing our strategy for location of the FoS. We will begin running a series of upslope-downslope profile lines to establish the general morphology in this area.

0427Z: Launched XBT T7-00029; full profile. Applied SVP.

0530Z: Crossed onto an elevated plateau with layered sediments (Fig 44)

0600Z: Mayer on watch

0945Z: Ending northward line – turning to the southeast

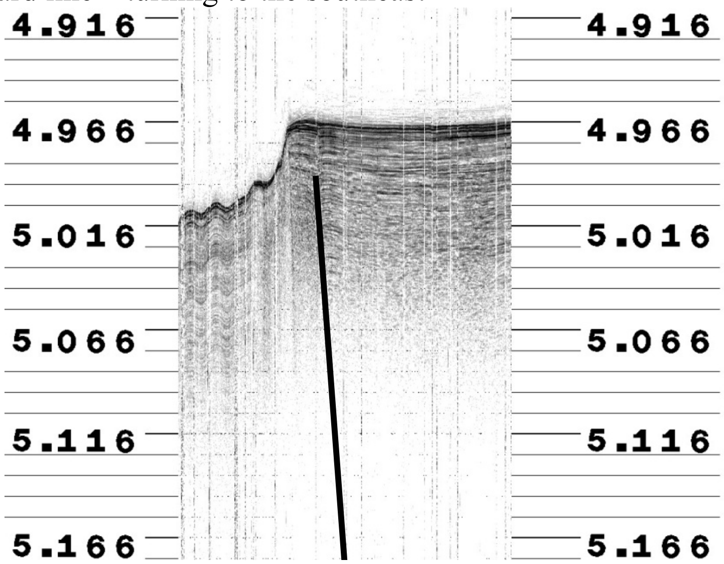


Figure 44. Elevated plateau seen steaming north.

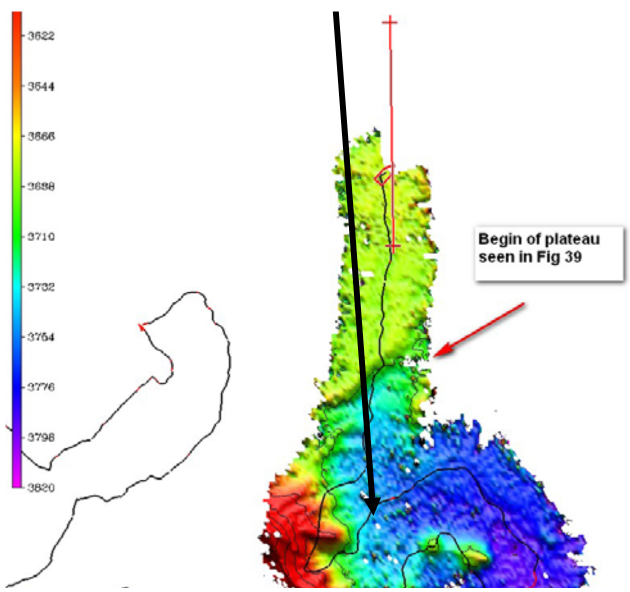


Figure 45. Beginning of zig zag mode to scope out overall morphology and location of elevated plateau.

1000Z: Have switched to waypoint mode – have given the bridge a waypoint to head to.

1020Z: A preliminary plan for the rest of the leg (Fig. 46).

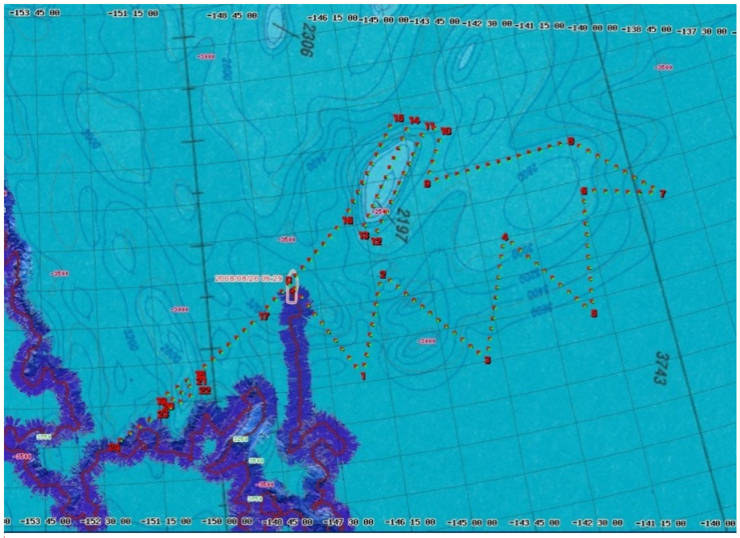


Figure 46. Plans as of 26 August.

1330Z: We have come to the nominal end of the first southeastward recon line (0-1 on Fig 46) and have not come on to "normal" abyssal plain sediments. The seafloor is sediment covered and the sediments are somewhat flat-lying but much chaotic in appearance than the "normal" abyssal plain sediments. They also show a continuous gentle slope deepening to the south.

1548Z: There is a small notch in the Knudsen record – probably indicating the transition to the "abyssal plain" (Fig 47). Unfortunately at the same time we have run into very thick ice and they have to back and ram and maneuver around the ice. As we have moved through it appears the sediment packet is still sloping to the south and not quite at the depth of the "normal" AP sediments

1615Z: Slowing for XBT -- good XBT T7-00030

1623Z: We crossed another small notch and change in slope on the Knudsen (Fig 47). This is happening exactly at 3850m (Knudsen depth) which has been the depth for the AP sediment transition (on the Knudsen). THIS ONE APPEARS TO BE IT – continues flat lying.

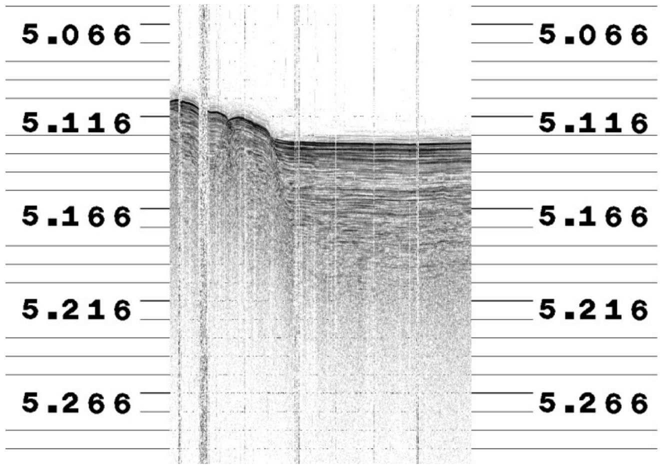


Figure 47. Many steps down to final step to "normal" abyssal plain sediments.

1728Z: XBT T700030 entered and applied.

1800Z: Andy on watch

2125Z: Crossed over high point on IBCAO indicated high. We saw a shoalest depth of just over 2600 m; there may be a 2500 isobath here (west of our track), but it seems unlikely.

2245Z: Altering course to port to cross over another IBCAO high.

2300Z: Cyclo-converter tripped. Stopped to troubleshoot and restart.

2320Z: Making way again

2330Z: It appears that the Russian contour map has the elevated features more accurately placed than IBCAO. We have probably already moved north of the shoalest points on these highs.

27 August 2008 JD 240

0200Z: At northern end of profile line; turning with some difficulty to start new profile downslope.

0439Z: We are in very heavy ice with almost no relief, backing and ramming with reduced data and not much headway. The bridge will seek the best way out.

0450Z: Deployed sonobuoy and dropped XBT T7-00031.

0500Z: Looping around to seek open or at least passable path through the ice.

0600Z: Mayer on watch – open water now – Chief Kidd trying for 12 knts – see what data looks like. Bridge has been steering a heading (160) but we have diverted quite a bit to avoid ice – will give bridge a way point so that they know where to head.

0735Z: Seabeam seemed to have lost the bottom – while in complete auto mode – switched to manual and eventually recovered.

0808Z: Looks like we have the transition back to the normal abyssal plain sediments (Fig 48).

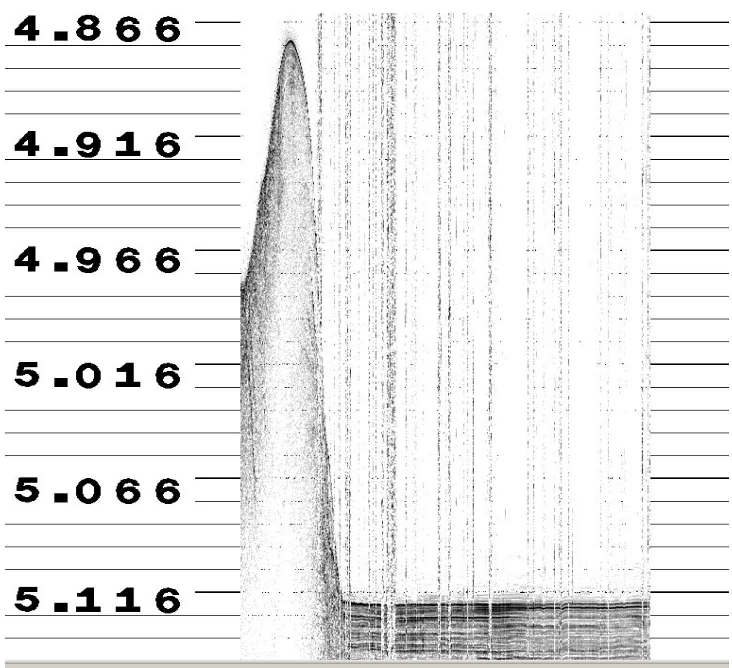


Figure 48. Transition to abyssal plain.

0913Z: called end of line – turning to the northeast – gave them waypoint – but generally a heading of about 014

1040Z: Lots of maneuvering to avoid ice ridges – but it is degrading data – spoke with bridge and asked that turns be more gentle

At **1810Z** on **August 26 (JD 239)** we were coming back north from the abyssal plain crossing onto the transitional sediment pile when we crossed what appears to be a large linear dike that comes down frolm the regional high (Fig 49, 50, and 51)

These are similar to the dikes we see on the Chukchi side. You can also see the transition between the abyssal plain sediments and the shoaler sediments upslope.

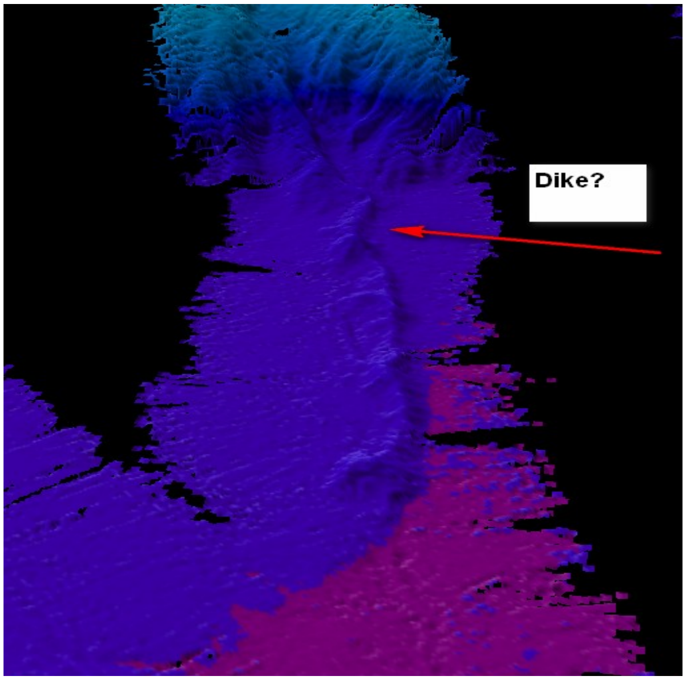


Figure 49. Dike? coming down off high into abyssal plain.

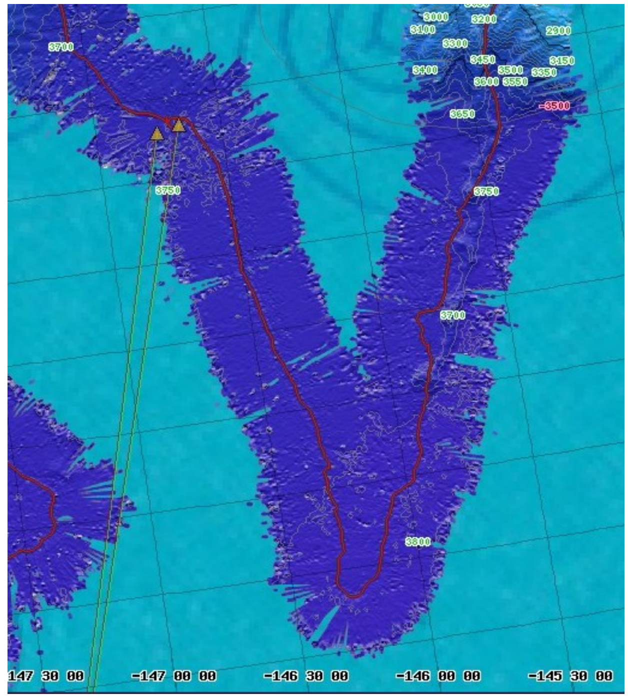


Figure 50. Dike location map

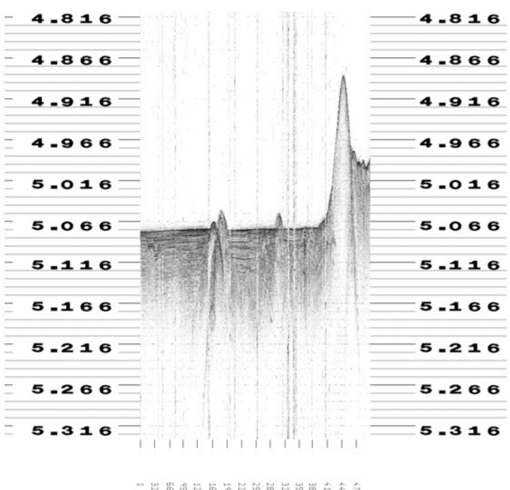


Figure 51. Knudsen profile across dike.

1500Z – backing and ramming – have been doing so for some time.

1620Z: still stuck – bringing second engine on line

1640Z: Second main on line – will take XBT while stuck here. T7-00032

1648Z: T700032 successful to 760m

1715Z: underway again – will work our way to open water and then try to finish up line

1800Z: Andy on watch

1910Z: Seabeam system froze. It took a while for watch to recognize system failure.

1940Z: Turned ship onto reciprocal course to regain position at end of data swath.

2100Z: Have reached point where sounding ceased, holding station while Dale troubleshoots. Engineering drills commencing; ship may maneuver in this vicinity for drill purposes.

2200Z: Drills complete, SeaBeam remains out of service.

2340Z: Seabeam has been returned to service; maneuvering to resume track on nominal heading of 160°.

28 August 2008 JD 241

0218Z: Crossing sloping seafloor with arcuate scarps

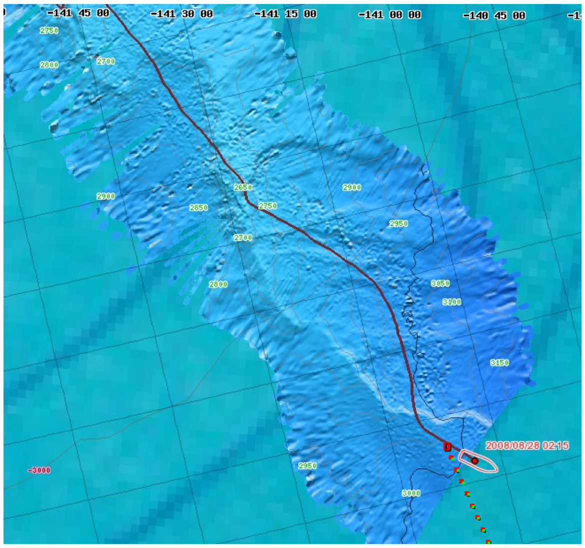


Figure 52. Scarps on seafloor.

0419Z: Stopping before entering ice to drop XBT T7-00033.

0447Z: Entered SVP profile from XBT T7-00033 with levitus salinity.

0449Z: We have crossed onto the abyssal sediment, although unfortunately there was very thick ice that forced the ship to work south and then eastward from the original track before crossing.

0500Z: Ending downslope transect, coming to approx heading 025° to run roughly over transition area.

0600Z: Mayer on watch – continuing our transect to the northeast heading 022. Have quickly come up out of abyssal plain sediments –

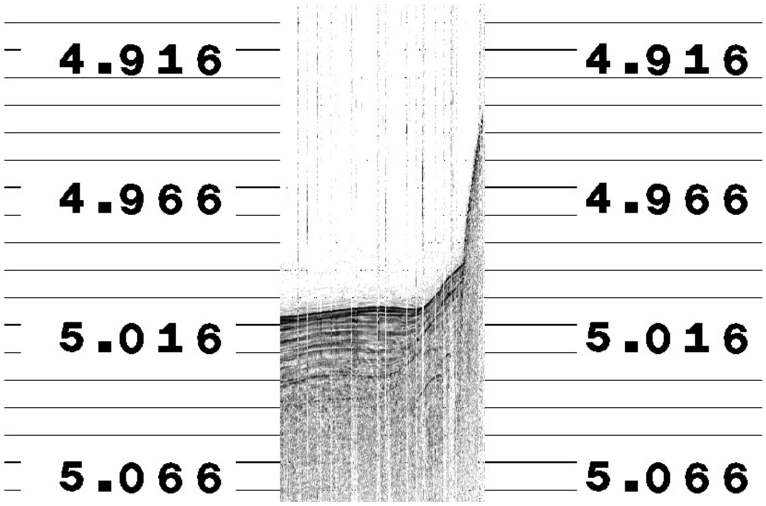


Figure 53. Slope break heading toward A/M Ridge from east to west.

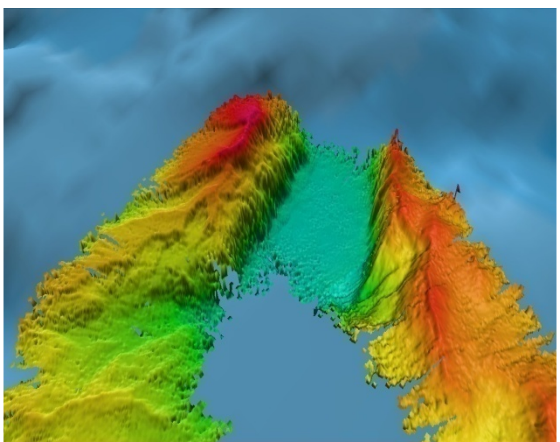


Figure 55. Rift found at northernmost extend of zig-zag.

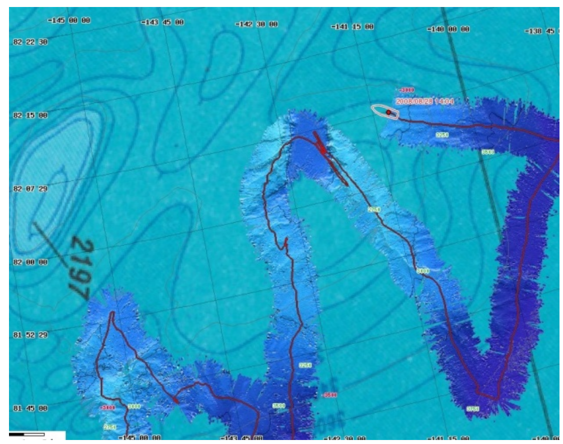


Figure 54. Location of rift.

0941Z: Have finally come down on what look like flat-lying abyssal plain sediments – though much too shallow and too incoherent – will turn soon towards highlands to the west.

1034Z: Crossing the first slope break heading towards west (Fig 53)

1400Z: We are steadily climbing. The plan right now is to survey towards the region that we suspect shoals above 2500 m but enroute to cross the remarkable rift feature that we saw earlier. We also suspect we will run into the very large multiyear ice floe that we had to divert around yesterday. If we find it we will deploy an ice buoy on it.

1538Z: Have crossed the northern part of the "rift" and see that it is not a rift but rather it is closed at the northern end.

1531Z: Backing and ramming as we are approaching the big floe.

1622Z: Bridge is bringing second main online. Ice floes limit movement to less than 0.1nm between backing and ramming events.

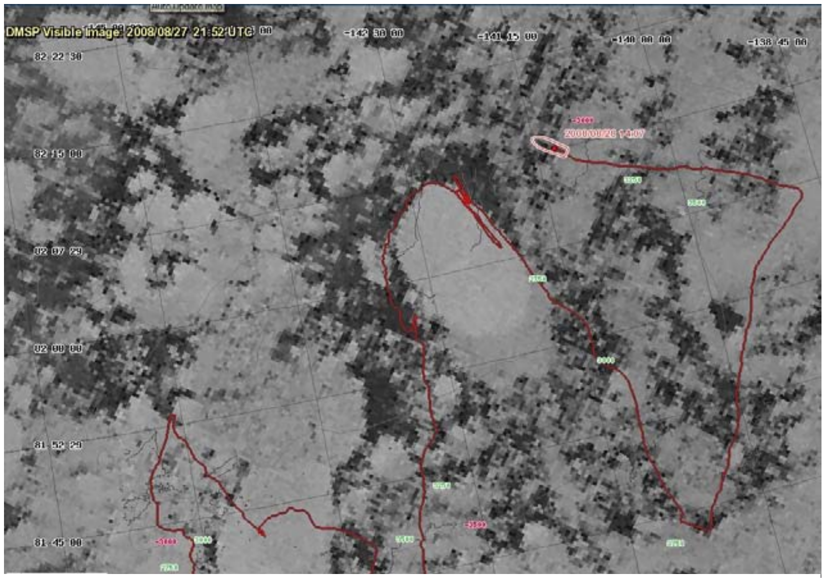


Figure 56. Large iceflow we are aiming for.

1639Z: Stopped to bring second main on-line.

1645Z: Underway, breaking multiyear floes.

1730Z: Requested slower speed from bridge, MB data quality poor.

1733Z: Stopped by thicker ice, back and ram.

1800Z: Andy on Watch, steaming through target area to locate suitable location to deploy ice buoys.

2020Z: Suitable ice floe identified; maneuvering go get alongside.

2200Z: Deployment of buoy complete and successful. Ship is underway again. We will attempt to see if basin located on earlier swaths is closed at southern end.

2205Z: Deployed sonobuoy astern. Backing and ramming. Oooh nooo.

2230Z: Almost no data in heavy ice. Not making any significant headway on completing bathymetry of basin.

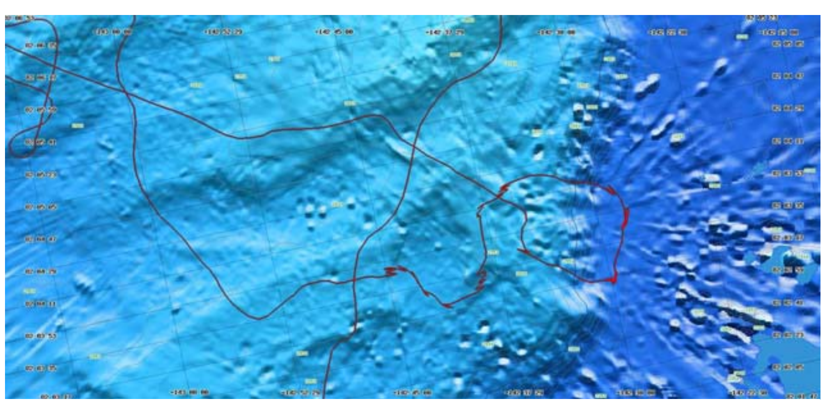


Figure 57. Shiptrack while coming in and out of buoy deployment site – showing backing and ramming

2305Z: Consulted with Bridge; we are now simply trying to reach more open water to the west. When clear, we will transit to the northwest.

0115Z: In fairly open water, re-acquiring subbottom and multibeam. Set course for north end of 2100 m high.

29 August 2008 JD 242

0203Z: Seabeam crash. Ship is loitering in area to resume track where we left off.

0415Z: XBT T5-00034, full depth. SVP was nearly identical, and not entered.

0435Z: SeaBeam back on line, coming to original course to resume mapping.

0600Z: Mayer on watch – approaching shoal region to do overlapping survey of 2500 m contour

0710Z: Begin survey

1340Z: ran into some tough ice – lots of backing and ramming – right over shoal area so don't really want to divert around.

1503Z: stopping to put on 2nd main

1509Z: underway again – two mains

1513Z still have to back and ram – even with two mains

1600Z: taking XBT

1605Z: XBT taken T7-00035

1800Z: Andy on watch

2130Z: Completed development of submarine elevation; started transit to next development site.

2140Z: Crossing an elevated segment of the seafloor with layered sedimentation lying parallel to the seafloor. This layered sediment is remarkably similar to the remnant of layered sediment on the top of the recently (0710Z – 2130Z) developed seamount.

2208Z: End of layered sediment. The scarp of the elevated plain is still apparent to port in multibeam swath.

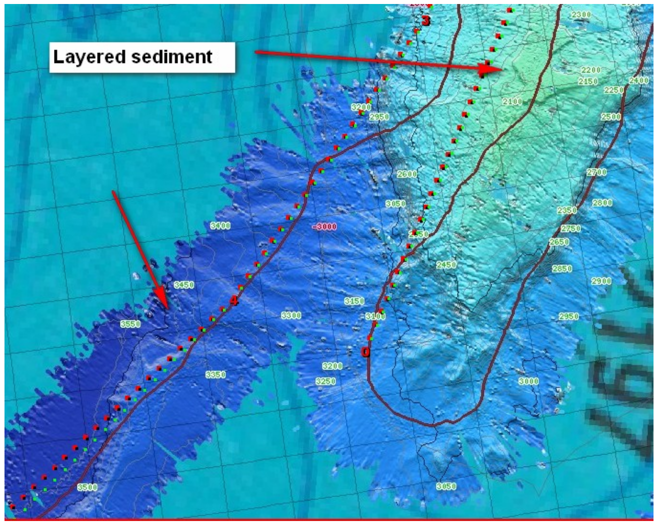


Figure 58. Layered sediment areas on seamount and on nearby plain.

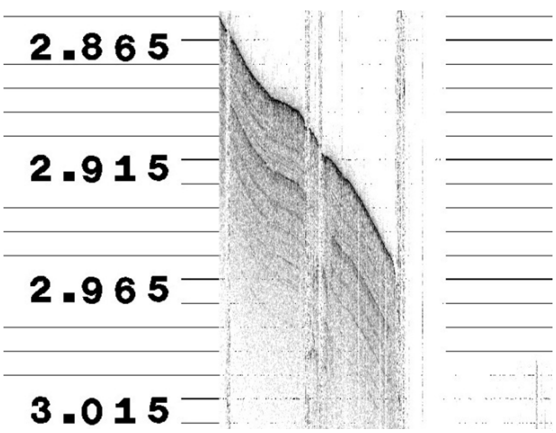


Figure 60. Layered sediment remnant on seamount.

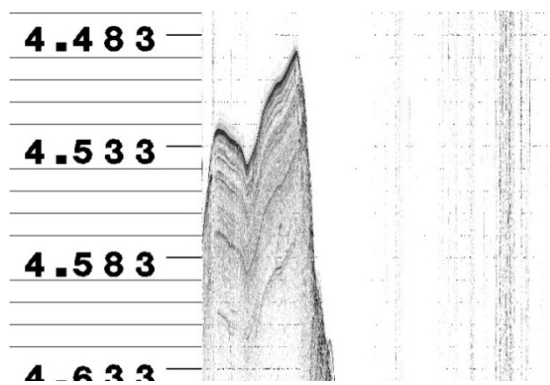


Figure 59. . Layered sediment on plain.

30 August 2008 JD 243

0300Z: Starting development of seafloor highs.

0413Z: In first turn; heavy ice, backing and ramming.

0450Z: Bridge reports they unable to continue turn. They will turn back and try to work over to the new line.

0530Z: Our track has led us along the ridge, and has developed the 2500 m contour.

0600Z: Mayer on watch

0615Z: Very heavy ice; will have to abandon plan to develop high area, and will proceed along likely spine of feature.

0656Z: will divert about a quarter mile to the east to get around large flow

0900Z: working our way slowly down the spine of the ridge – ice still heavy – a nice small 2500 m contour found.

1355Z: backing and ramming – putting on second engine

1405Z: Approaching potential dredge site – very heavy ice. Begin surveying over the dredge site.

1729Z: Pre-dredge briefing – uncertain issues are 1-weak link and 2- a jig was not made for cutting wire should it be hung 3- pull test on tension meter showed large discrepancy between the pull on winch (18000lbs via dynomometer) and tension meter reading (5000lbs) this will be discussed as we maneuver towards site. Should note that where we are right now (about 4 miles NE of site) – there are some the largest ridges I have ever seen.

Figure 61. Gant ice ridges near dredge site. (the photo doesn't do justice to the size)

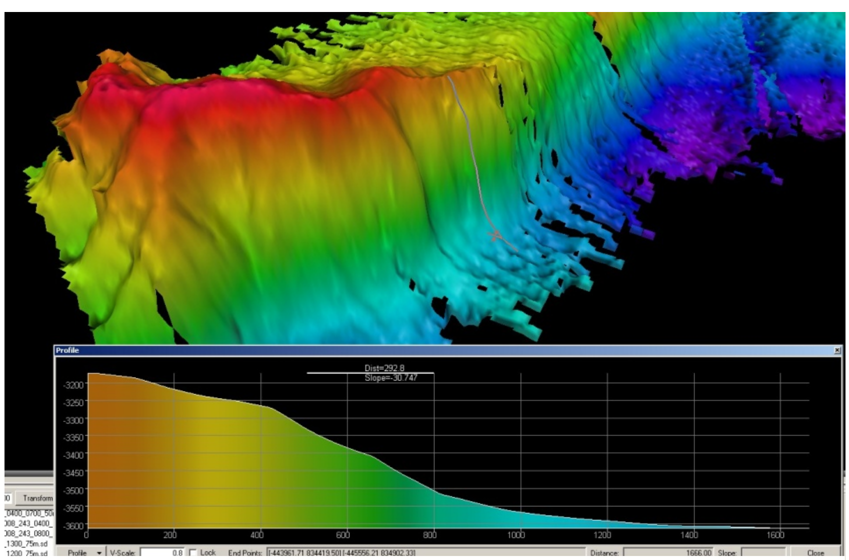


Figure 62. 3-D perspective of first dredge site HLY0805-D1.

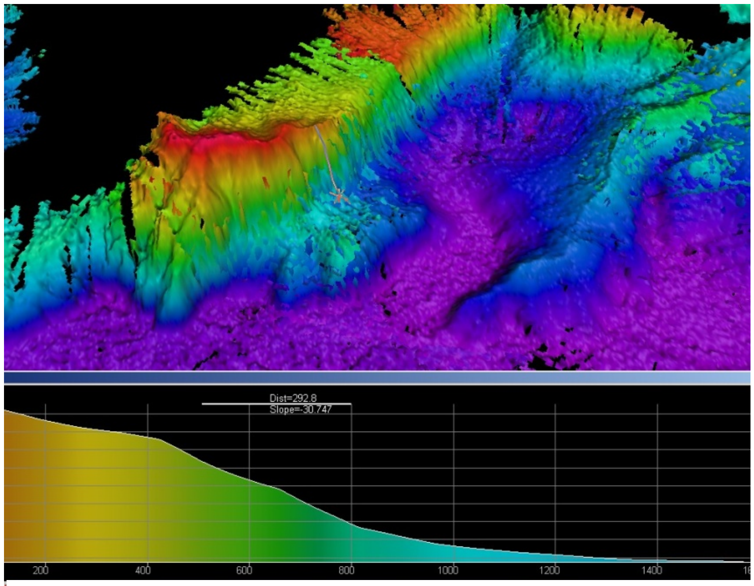


Figure 64. . overview of dredge site HLY0805-D1.

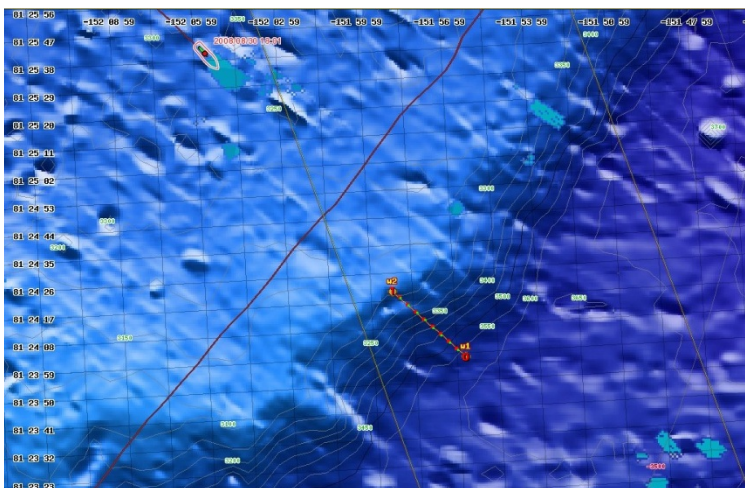


Figure 63. Dredge plan for HLY0805-D1

1948Z: Start running reciprocal lines along dredge line to clear ice

2143Z: Finished breaking ice along dredge track. Transferring control to AftConn in order to commence dredging operations

2221Z: Dredge rigged (actually re-rigged so that original tow-point is used rather than swivel offset on side) and ready for deployment. Maneuvering to free stern of ice.

2225Z: Dredge over the side. Kelley keeping log of tension and times.

31 August 2008 JD 244

0300Z: Dredge on deck; mud with some rock fragments included.The dredge had a number of reasonably large (10 – 20 cm) pieces of interbedded mud and sandstones (the mudstones were very red) that had a manganese coating on the outside and were fresh or near fresh surfaces on the inside. It looks like we did break off in situ pieces and it looks like they are old sedimentary rocks – that may be terrigenous in origin or if not represent deposits proximal to the continent. There were many other small fragments and even rounded quartzite materials – probably rafted debris.

0305Z: Underway to take station for second dredging attempt. Will spend some time running engines under load and re-breaking ice in vicinity of target.

0548Z: Second dredge underway HLY0805-D2.

0748Z: Ethan deployed sonobuoy.

0906Z: Dredge coming up – great difficulty holding position

1010Z: Dredge on board – small amount of mud and perhaps some small rocks but we will see. Will start small survey on way to next dredge site.

1100Z: thick ice – backing and ramming. Avg speed ~4 knts

1200-1230Z: avg speed about 2 knts!

1450Z: Continuing to struggle with ice – FINALLY adding 2nd engine!

1503Z: Second main on

1532Z: Having trouble even with 2 engines – giving up trying to collect additional data and will just try to find a route to the dredge site.

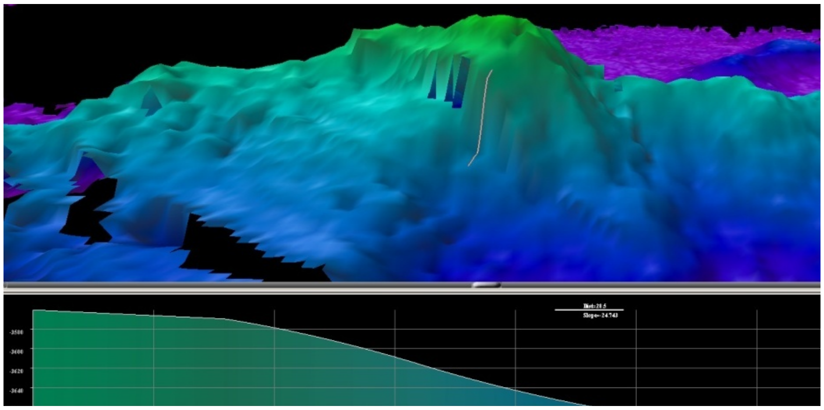


Figure 65. Planned dredge site 3 – abandoned due to heavy ice

0700Z: Unable to reach planned dredge site 3 in very heavy ice. Have identified alternate site about 10 nm to northwest, where ice imagery suggests less ice.

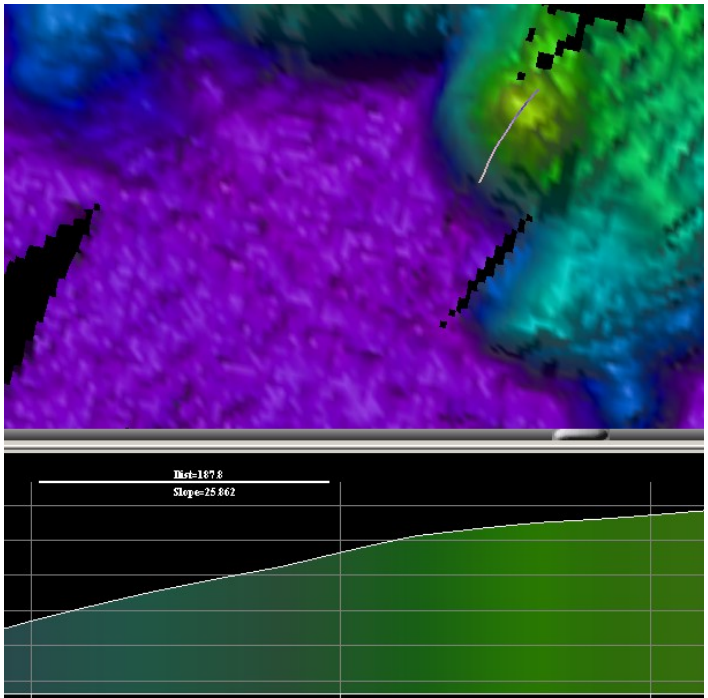


Figure 66. Alternated Dredge Site 3.

0845Z: Arrived at alternate dredge site 3; light ice with nearby open water to the east, and heavier ice to the west.

0920Z: Completed assessment of set and drift; set is toward the SW, although the drift track was curved, suggesting a small counterclockwise gyre. Beginning some up/down track runs to break up ice along the dredge track.

Figure 67. Drift test with curved track.

1045Z: On station to begin dredge.

1102Z: Dredge in the water

01 September 2008 JD 245

0002Z: Dredge on deck. Some mud with small dark fine-grained rock fragments (basalt?). Given these results and the fact that this is one of the few relatively ice-free spots in the area we will try again here.

0100Z: We have been maneuvering to set up for the dredge and the ice moved in – will try to find another spot.

0300Z: We have been going around in circles (literally) trying to find an area that will allow us to dredge on the target slope but that is not covered in heavy ice – the ice is moving rapidly – ice images show ice most everywhere else over nearest other dredge targets and we would like to sample again on this side of basin so we will keep circling and trying.

0500Z: Each time we approach area of steep slope the ice moves in. We finally have found some open water over less steep slope – not ideal but best we can do. We'll try here.

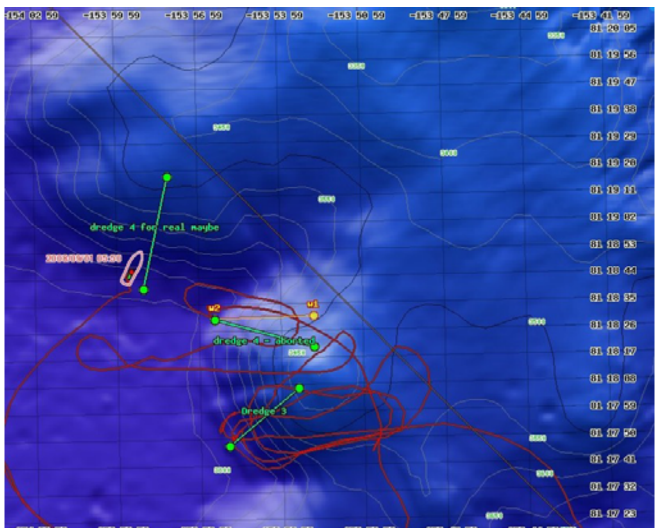


Figure 68. Dredge 3 and 4 lines.

0528Z: Dredge launched

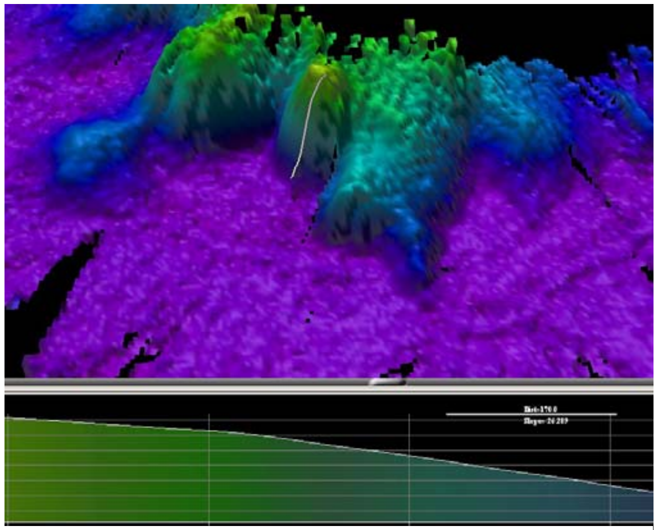


Figure 70. 3-D perspective of Dredge Site 3 - avg slope = 25 deg.

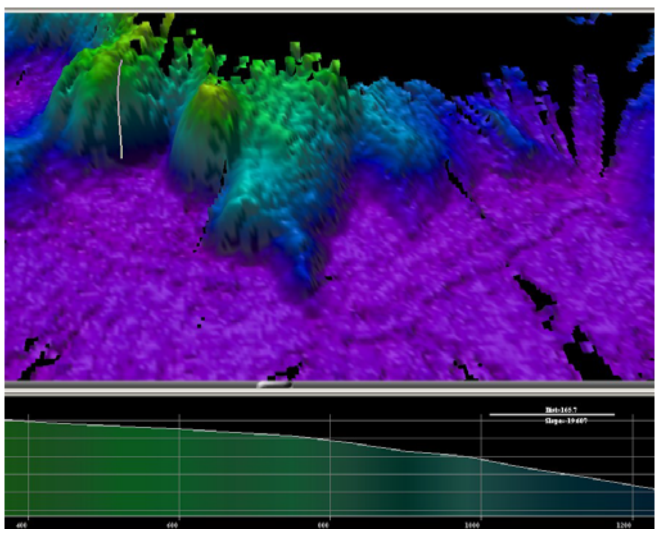


Figure 69. 3-D view of dredge line 4 - avg slop e 20 deg.

0658Z: Dredge HLY0805-D4 – on the bottom.

0847Z: Dredge on way up –several good bites with tension over 8K lbs – dredge is 500 – 600lbs heavier than on way down.

0943Z: Dredge on deck – very full – is it just mud???

1035Z: Deployed Legnos ice buoy in water from crane

1040Z: Enroute to Dredge 5 site on Northern Chukchi – warned bridge that Chinese R/V Xuelon

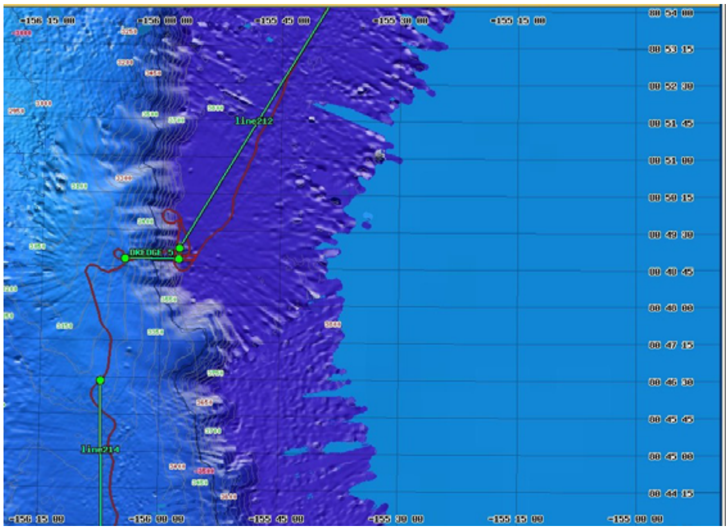


Figure 71. Dredge Site 5.

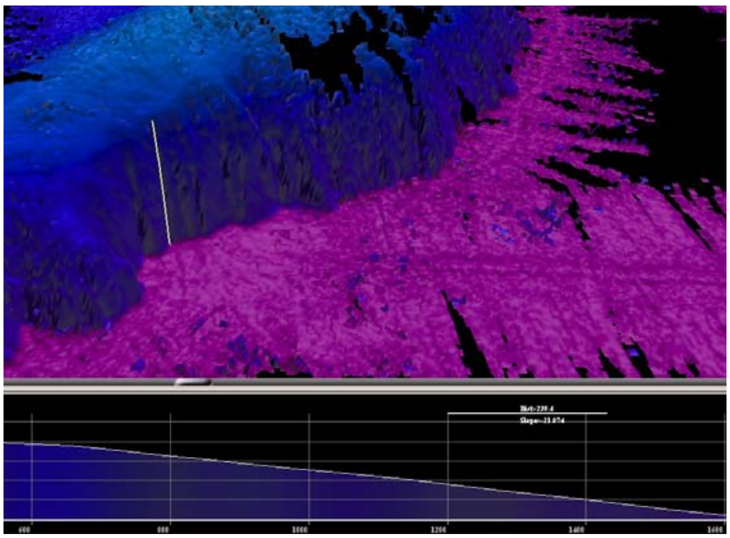


Figure 72. 3-D view of Dredge Site 5 – avg slope = 20 deg.

1600Z: Approaching Dredge Site 5

1620Z: Getting set up for drift test

1627Z: Commencing drift test

1810Z: Dredge deployed

2003Z: Dredge on bottom

2130Z: Dredge on way up

2200Z: Winch begins to freewheel – dredge on bottom. Emergency brake put on – situation being evaluated.

2215Z: Winch seems to be repaired – ops resuming

2253Z: Dredge off the bottom for last time, weight of dredge about 1000 lb greater. Hauling in to recover.

2341Z: Dredge on deck with lots and lots of mud. A few small rock frags – nothing clearly from fresh outcrop – looks like all IRD
2345Z: Underway from dredge site 5 to dredge site 6 with surveying en route.

02 September 2008 JD 246

0120Z: Dropped XBT T5-00037 for full range. Applied T5-00037 SVP using levitus salinity.

0600Z: Mayer on watch – still steaming towards dredge site 6 – 5-6 knots variable ice conditions.

0820 – 0905Z: Crossing transition from abyssal plain flat-lying sediments onlapping onto outcropping deeper beds. Transition takes place at about 3810 m (Fig 73).

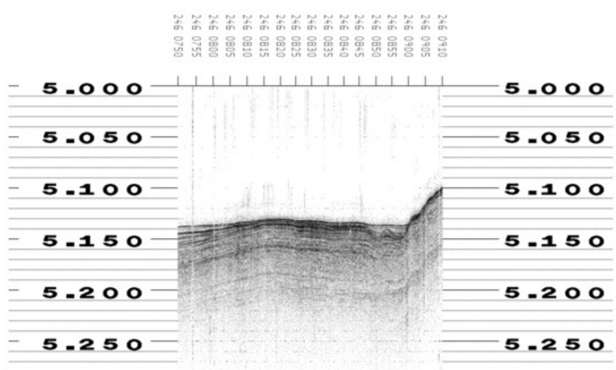


Figure 73. Onlap of AP sediments on older sediments - Northern Chukchi transition.

1020Z: We have decided to transit south a bit longer to see how the high in Fig. 73. develops and we found ourselves crossing a series of large parallel grooves at depths of between 3700 m and 3600 m! – Hmmm. (See Fig 74 and 76).

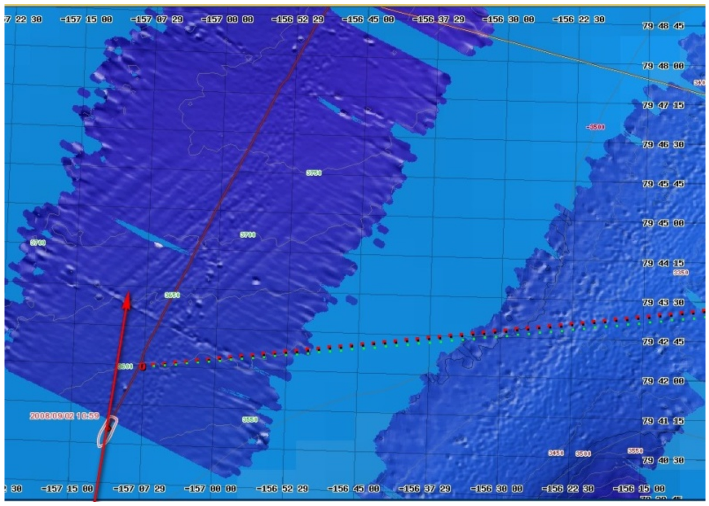


Figure 74. 60 Grooves at 3600m.

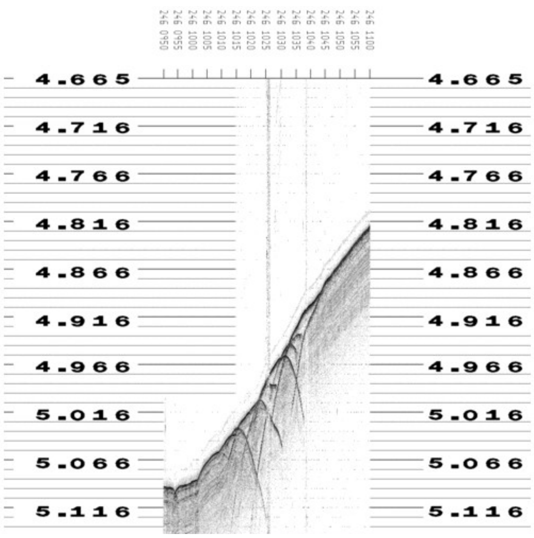


Figure 76. Grooves on Knudsen

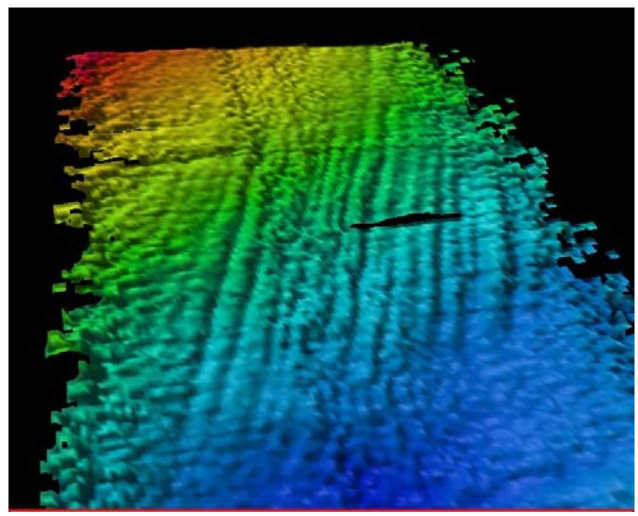


Figure 75. Grooves in 3-D.

1509Z:-Approaching Dredge Site 6 –stopping to evaluate drift

1600Z: On site – commence lowering dredge

1638Z: Aborted dredge as ship was out of position – will recover dredge and maneuver to appropriate site.

1700Z: Dredge on board.

1719Z: Deploying dredge again.

2035Z: Reached top of slope. Hauling in dredge. Several tension jumps occurred during the dredge, suggesting strong grabs on the seafloor.

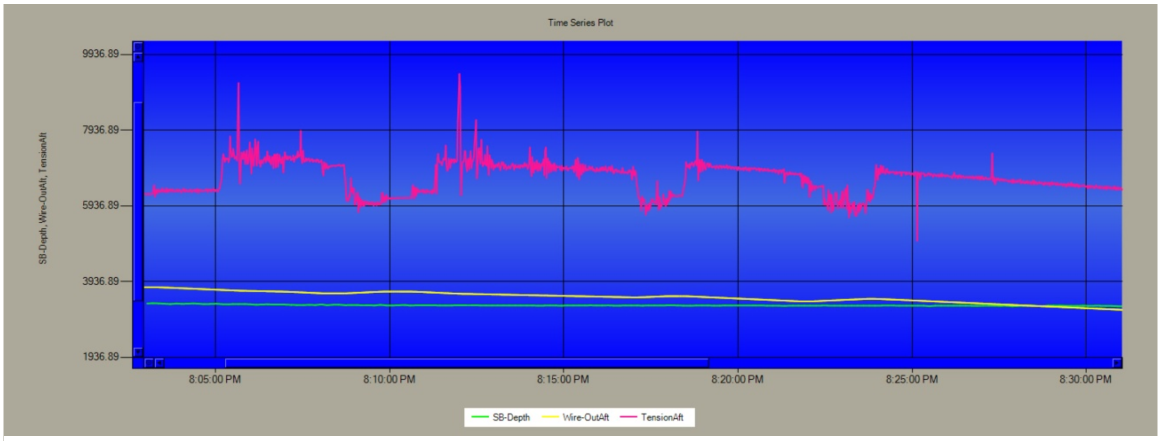


Figure 79. Wire out/Tension/Depth plot for Dredge 6.

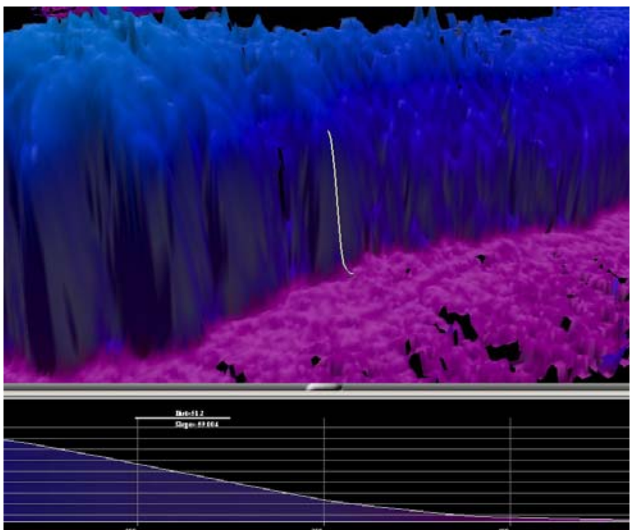


Figure 78. Dredge Site 6 - 3-D view slope = 59 degrees.

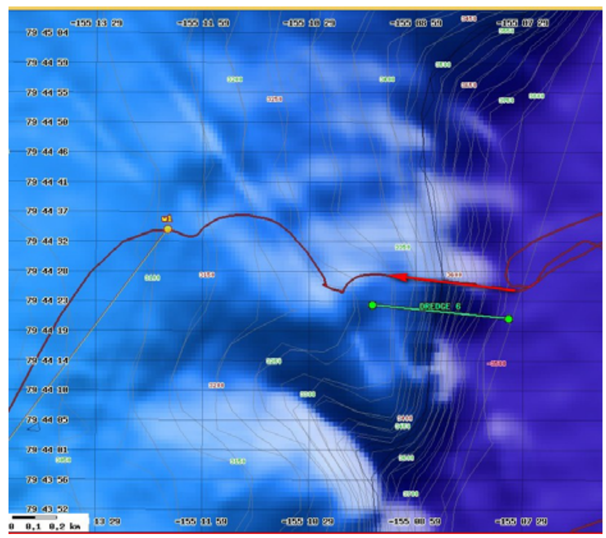


Figure 77. Dredge 6 - red line is actual dredge line.

2126Z: Dredge on deck. The dredge contains several rocks, no mud.

2130Z: En route to next dredge site.

2336Z: Ran into large ice flow – backing off and will go around to the west.

03 September 2008 JD 247

05030Z: In very heavy ice, trying to work a little east toward a dredge site.

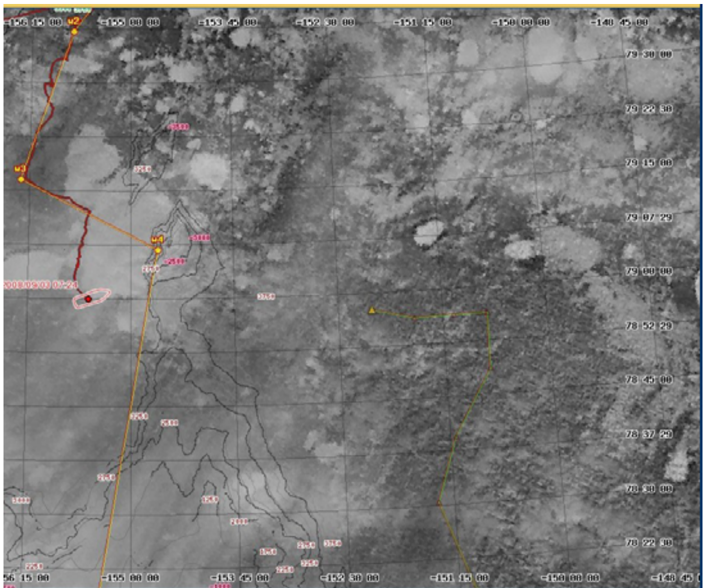
0511Z: Dropped XBT successfully

0548Z: Entering SVP from XBT T7-00038

0600Z: Mayer on watch

0615Z: Polar bear spotted on stb side – vessel maneuvering for better view.

0630Z: Underway again – we will try to swing around large ice flow working our way to the east to potential dredge site 7



9/3/2008 7:26:44 AM

Fig 63. Working our way around large flow to dredge site 7 (W4)

0900Z: We have beat our way around the ice flow but as we approach the dredge site the ice is thick and the fog is great – it just isn't going to be easy and will take a very long time to dredge in this area (which we just don't have). Have decided to head southwest towards HEALY Seamount and if we can get there in time we may be able to dredge on either the HEALY seamount side of the steep feature to the east of HEALY seamount.

Chose to go to the east of Healy seamount as it is part of Northwind Ridge. We have been steaming a relatively straight line there though we needed to avoid ice here and there.
1423Z: Approaching Dredge Site 7 – will drift for 30 minutes to assess drift

1440Z: Begin drift

1515Z: Finish drift test – enroute start point of dredge 7

1539Z: Dredge going over side

Figure 80. Working our way around large flow to dredge site 7 (W4).

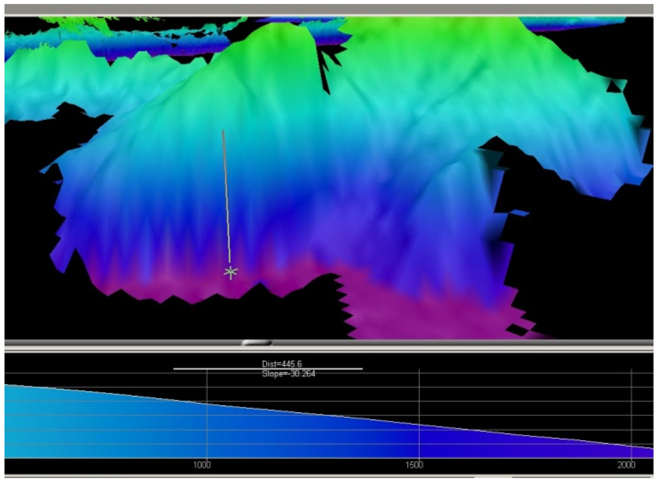


Figure 81. 3-D view of Dredge Site 7 Avg Slope = 30 degrees.

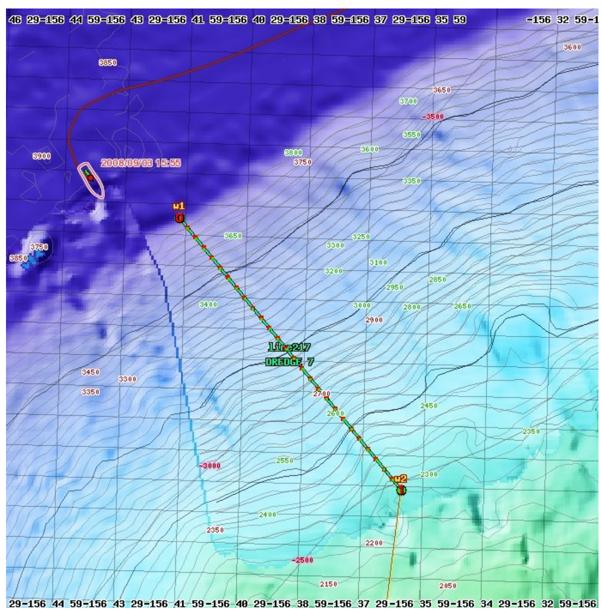


Figure 82. Dredge Site 7 track.

2040Z: Dredge aboard with rocks.

2045Z: Underway from dredge site, following route selected to fill in gaps in coverage.

2310Z: Although we have diverted from track to avoid ice, we are passing through some heavy ice and doing some backing and ramming.

04 September 2008 JD 248

0350Z: We have been searching for the best way around the only large ice floe in the region at 16 kt. to make up lost time from last ice diversion.

0430Z: Dropped XBT T7-00039. Dropped full depth, but values were suspect.

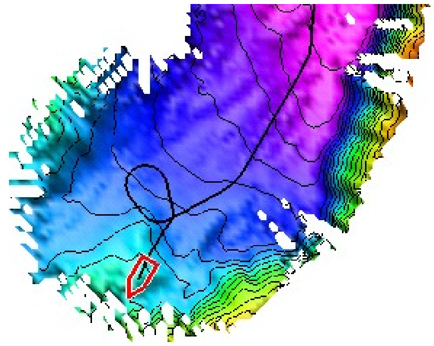


Figure 83. Trying to find a good route through the ice.

0459Z: Dropped XBT T7-00040; obtained more reasonable values and entered SVP with levitus salinity.

0600Z: Mayer on watch – steaming to HARP sites at about 15.7 knots

0642Z: Pablo tossed IABP buoy over

1040Z: Seabeam stopped for a few minutes – will loop back to pick up gap.

1600Z: XBT taken T700041
yuo9874977837430gf8990e4r8e8it4908i594reit9586
1630Z: Third engine put on "for maintenance" -- now doing 17.2 knots

2030Z: Science party partakes in quarters – awarded the Arctic Service Medals – John Hall receives on behalf of science party.
Opo0p9oelr;olr;o4o5[po[w4og[4
2220Z: We are coming onto an elevation in the seafloor associated with the basement rising through the flat-lying sediments. Unfortunately, the bridge has picked this moment to alter course to port to calibrate a sensor.

2230Z: I have asked the bridge to return to the west to try to reacquire the feature. I do not recall if it is part of a general trend, or if we have encountered an isolated feature.

2240Z: Appears to be a broader feature; we are resuming our track to the HARP site.

05 Sept. 2008 = JD 249

0107Z: HARP C deployed d
Enroute to next HARP site

0810Z: HARP B deployed – enroute Barrow

Earlier this evening (JD 248 – 1650 – 1725Z) we ran across some very strange grooves in the seafloor that appear to be associated with a particular stratigraphic layer (see Fig 84 and 85) – interesting.

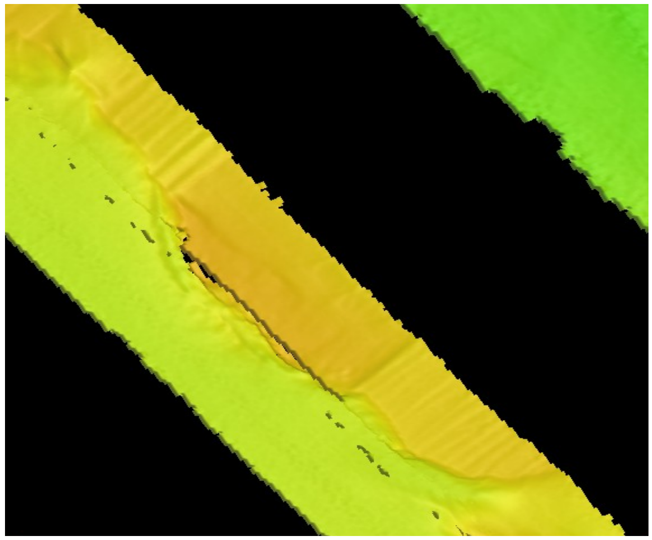


Figure 85. What is it - JD 248 - enroute to Barrow - also on Knudsen - outcropping bedding exposed bedding planes? Is this the same thing as in Fig. 78.?

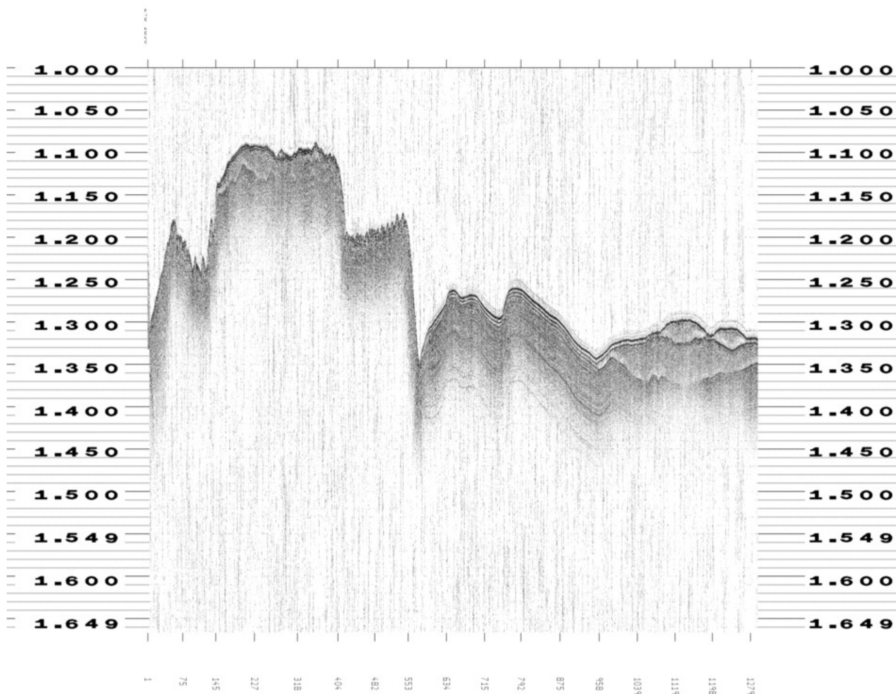


Figure 84. Grooved seafloor on either side of topo high.

1330Z: Off airport in Barrow – Official end of cruise.

APPENDIX A: HEALY-08-05 HARP CRUISE REPORT

Ethan Roth
Graduate Student Researcher
Marine Physical Laboratory
Scripps Institution of Oceanography
University of California, San Diego

During HEALY-07-03, two autonomous seafloor instruments – High-frequency Acoustic Recording Packages (HARPs) – were deployed to locations along the continental slope north of Point Barrow. These instruments are used to passively monitor and collect acoustic data such as ambient noise, marine mammal vocalizations, and anthropogenic activities. The primary goal on HEALY-08-05 was to recover these HARPs on the transit north and redeploy them on the return to Barrow. On August 14, Healy arrived at HARP Site B (72° 27.626 N, 157° 23.932 W, 235 meters depth) and reassessed the recovery operation due to bad weather conditions. Once a new plan was established, Healy's 12 kHz hull transducer was used to send a release command to an acoustic release onboard the mooring, at which point the anchor weight was dropped and the package floated to the surface at a rate of approximately 50 meters per minute. Once sighted at the surface, a small RHIB was deployed in order to coil and attach the 10 meter hydrophone cable, and tow the package over to Healy's stern. On the fantail, spectra wire running from a winch through the aft fantail A-frame block was tossed to the RHIB, which was then hooked into the HARP's center bail. The frame was gently brought into the transom and lifted until tag lines could be connected. The A-frame was once again positioned outward until the HARP could then be transferred onto the fantail deck, at which point the operation ended in successful completion. Healy immediately steamed to HARP Site C (72° 47.908 N, 158° 23.880 W, 328 meters depth), where approximately three hours later the same operation mentioned above was carried out, once again in successful completion.

Throughout the cruise, both HARPs were subsequently broken down so the data and hardware could be evaluated for quality. Both instruments were then refurbished and the mooring frames were prepared once again for redeployment at the same locations. On September 4, Healy arrived 500 yards downwind of the northernmost deployment location – HARP Site C – and slowed to ≤1 knot. The package was staged on the fantail directly under the A-frame's 3/8" sheave and the wire attached to a quick release was connected to the center bail; two taglines ran through each of the forward D-rings. Once within approximately 100 meters of the drop location, the two floats and hydrophone attached to a 10 meter cable were lowered to the water and subsequently streamed aft of the transom. The winch and A-frame were then used to pick up the HARP, slowly swing it out and lower it until the frame was submerged just below the water. The quick release was pulled and the HARP sank to the bottom at the location 72° 47.926 N, 158° 23.913 W at 327 meters depth; this ended the operation in successful completion. Healy immediately steamed to HARP Site B, where approximately three hours later the same operation mentioned above was carried out, once again in successful completion. The new location is 72° 27.645 N, 157° 23.947 W at 234 meters depth.

The secondary goal of HEALY-08-05 was to opportunistically deploy expendable sonobuoy hydrophones in order to make radiated noise measurements of Healy during various modes of propulsion and ice breaking conditions, and whenever marine mammals were sighted. An omni-directional, vertical line antenna was mounted on Aloft Conn and a radio station was set up in the Meteorological Lab on the bridge. Fourteen sonobuoys (deployment log below) were hand-launched throughout the cruise at times of opportunity to capture acoustic signals including marine

mammal vocalizations, ambient noise, and ship-generated noise. Once in the water, a saltwater battery activates for eight hours, a hydrophone drops 400 feet into the water column, and the acoustic signal is transmitted from a float on the surface through RF waves. A bearded seal was monitored on August 23 and a ringed seal was monitored on August 31. In addition, the ship was monitored during medium ice breaking conditions on August 21, and again during heavy ice breaking conditions (i.e. backing and ramming maneuvers) on August 27. To estimate source levels of ship-generated noise, an estimate of transmission loss between the buoy and the ship is required, which is a function of distance between them. To make this estimate, simultaneous recordings were made on the ship's hull-installed hydrophone with each sonobuoy deployment. Timing of receipt of the ship's 3 kHz sub-bottom profiler on both the ship's hydrophone and the sonobuoy will provide an estimate of the distance from the sonobuoy to the ship.

-Sonobuoy Deployment Log-

Cast	Date/Time (local)	Latitude	Longitude	Water Depth(m)
01	18Aug08 0323	81 58.360 N	166 03.900 W	3566
02	18Aug08 0338	81 58.444 N	165 55.505 W	3573
03	20Aug08 2032	83 01.884 N	159 30.853 W	2553
04	22Aug08 2014	81 26.717 N	152 58.808 W	3763
05	26Aug08 2055	81 43.196 N	144 27.637 W	3225
06	26Aug08 2121	81 44.226 N	144 17.617 W	3273
07	28Aug08 1405	82 04.283 N	142 36.016 W	2717
08	28Aug08 1445	82 03.868 N	142 27.890 W	“
09	28Aug08 1549	82 03.440 N	142 29.436 W	“
10	28Aug08 1617	82 03.278 N	142 29.773 W	“
11	30Aug08 2346	81 24.028 N	151 57.127 W	3535
12	31Aug08 0104	81 24.164 N	151 59.010 W	3292
13	31Aug08 1826	81 18.435 N	153 51.701 W	3445
14	03Sep08 1030	78 31.595 N	156 40.140 W	3820

APPENDIX B: HEALY-08-05 NATIONAL ICE CENTER CRUISE REPORT

Pablo Clemente Colon
Chief Scientist
National Ice Center
Suitland, MD.

The NIC provided microwave and visible imagery, including RADARSAT, OLS, AMSR-E, and QuikSCAT, and sea ice analysis during the cruise. The NIC analyst provided daily sea ice briefings to the skipper. NIC personnel collected hourly observations of sea ice characteristic as the Healy navigated ice infested waters. Recorded observations include estimates of sea ice concentrations, ice type, ice thickness and snow cover during icebreaking operations in the ice pack. Hourly photographs of sea ice conditions were taken complementing the aloft conn and aft camera observations. The NIC team deployed two AXIB seasonal buoy prototypes, one on a multiyear ice floe and another in open water but within the ice pack, which are collecting surface air temperature at 2 m, ice/water temperature, and sea level pressure. Three additional open ocean SVP-B drifters were also deployed during the return track to expand the IABP observing network over ice-free waters. These are collecting surface air temperature, water temperature, and sea level pressure. A science presentation on recent changes in the Arctic sea ice pack was also provided.

APPENDIX C: SEABIRD AND MARINE MAMMAL SURVEYS

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PROJECT:

As part of the HLY0805 cruise we surveyed marine birds and mammals onboard the USCGC Healy during its mission in the Chukchi Sea, August 14 – September 6, 2008. The port of call was Barrow, Alaska. The ship's mission was to survey the Chukchi Sea with state-of-the-art acoustical equipment to determine the extent of the prolongation of the United States continental shelf for our possible application to the United Nations Convention on the Law of the Sea (UNCLOS). The seabird and marine mammal data will be archived in the North Pacific Pelagic Seabird Database (U.S. Fish and Wildlife Service, Anchorage, Alaska). This database was established to maintain information on seabirds in North Pacific waters, primarily Alaska, for the purpose of informing management decisions and providing data for ecosystem research. Seabird and marine mammal abundance and distribution in the Chukchi/Beaufort areas are not well documented. Data on the distribution of marine birds and mammals will be used for ESA, Section 7 consultations and NEPA analyses, DPP's and other documentation. The information obtained from these surveys will contribute in development of mitigation measures and strategies to reduce potential impacts.

METHODS:

We surveyed marine birds and mammals from the port side of the bridge (22m above the sea surface), using standard survey protocol during daylight hours while the vessel was underway at cruising speeds over 5 knots. One observer scanned the water ahead of the ship using hand-held 10x binoculars and recorded all birds and mammals within a 300-m arc, extending 90^0 from the bow to the beam. Birds on the water, on ice, or foraging were counted continuously. Flying birds were counted during 'snapshots' at intervals that varied with ship speed, typically about once every minute. Because of the low numbers of birds encountered during this cruise we also separately recorded flying birds when they were observed between 'scans'. In all cases, we recorded the animal's behavior as flying, on water, on ice, or actively foraging. We used strip transect methodology with three distance bins extending from the vessel: 0-100 m, 101- 200 m, 201-300 m. We determined the distance to bird sightings using geometric and laser hand-held rangefinders. Unusual sightings beyond the 300 m strip transect were also recorded for rare birds, for large bird flocks, and mammals.

We used the DLOG2 data entry program (Ford Ecological Consultants, Inc.) to record observations directly into a laptop computer interfaced with the Healy's global positioning system. Every entry by the observer was recorded with location, date, and time stamps, along with associated environmental and observer variables. Location data were also automatically written to the data file in 20 second intervals, and allowed us to simultaneously record changing weather conditions, Beaufort Sea State, ice type and coverage, and glare conditions. We recorded other environmental variables at the beginning of each transect, including wind speed and direction, air temperature, and sea surface temperature.

PRELIMINARY RESULTS AND DISCUSSION:

From 14 August to 5 September, we surveyed on 16 days and recorded 107 transects for a total of 150 hours of 'on effort' survey time. The number of kilometers surveyed can be provided once data are fully edited and analyzed.

Numbers of birds and species diversity were extremely low, thus here we include all birds observed while 'on effort', including those > 300 m from the vessel. We recorded a total of 130 birds, of which 87 % were identified to species. Only four species were positively identified, including northern fulmar, black-legged kittiwake, glaucous gull, and Ross's gull. The remaining birds were unidentified, including 13 jaegers, 2 terns, a gull and a shorebird (Table 1). Black-legged kittiwakes comprised 76 % of all birds, and of these, 88% were observed in ice-free water, primarily during the last days of the cruise.

MARINE MAMMALS

We recorded 41 marine mammals of 3 identified species (Table 1), most of which were off transect (> 300 m from the vessel). The observations of 'off transect' mammals will be used for mapping distribution of species, but will not be used to calculate densities. Unlike the seabirds, the majority of marine mammals were observed where ice was present. Ringed Seals were the most common marine mammal encountered, followed by Bearded Seal, and three observations of Polar Bears. All three Polar Bears were observed alone and on ice.

Common	Latin	Numbe	Percent of
Northern	*Fulmaris glacialis*	3	2.31
Unid.	*Stercorarius spp.*	13	10.00
Ross's	*Rhodostethia rosea*	6	4.62
Glaucous	*Larus hyperboreus*	5	3.85
Black-legged	*Rissa tridactyla*	99	76.15
Unid.	Famil *Laridae*	1	0.77
Unid.	*Sterna spp.*	2	1.54
Unid.		1	0.77
Total		130	
			Percent of
Bearded	*Erignathus barbatus*	4	9.76
Ringed	*Phoca hispida*	26	63.41
Unid.		5	12.20
Unid.		3	7.32
Polar	*Ursus maritimus*	3	7.32
Total		41	

Table 1. Marine birds and mammals observed in the Chukchi Sea during HLY0805, from 14 August to 5 September, 2008.

APPENDIX D: HEALY 0805 GRAVITY REPORT

Bernard Coakley
Univ. of Alaska Fairbanks

Without a gravimeter permanently installed on USCGC Healy, gravity acquisition has been limited by the availability of loaner systems from NAVOCEANO. This situation changed when NSF funded the calibration and tuning and installation of two Bell BGM-3 gravimeters on board USCGC Healy.

Figure 86. Two Bell BGM-3 gravimeters as installed in February 2008 on USCGC Healy. Electronics for both systems are housed in the vertical rack. The two shock mounted black platforms are on the right, mounted on a metal plate attached to the deck.

A grant from NSF, entitled; *Acquisition of Gyro-stabilized BGM-3 Gravimeters for Academic Science and Implementation on UNOLS Vessels* was awarded to Woods Hole Oceanographic Institution (PI Dan Fornari). This grant paid for the acquisition of all BGM-3 gravimeters (7 complete systems), manuals and spares owned by the oil industry contractor FUGRO.

The grant has paid for the hardware, re-calibration of six sensors at Lockheed Martin (successor to Bell Aerospace) in upstate New York, data buffers, stabilized platform tuning and installation of two systems on USCGC Healy. Ownership of these gravimeters has been transferred to the University of Alaska, Fairbanks.

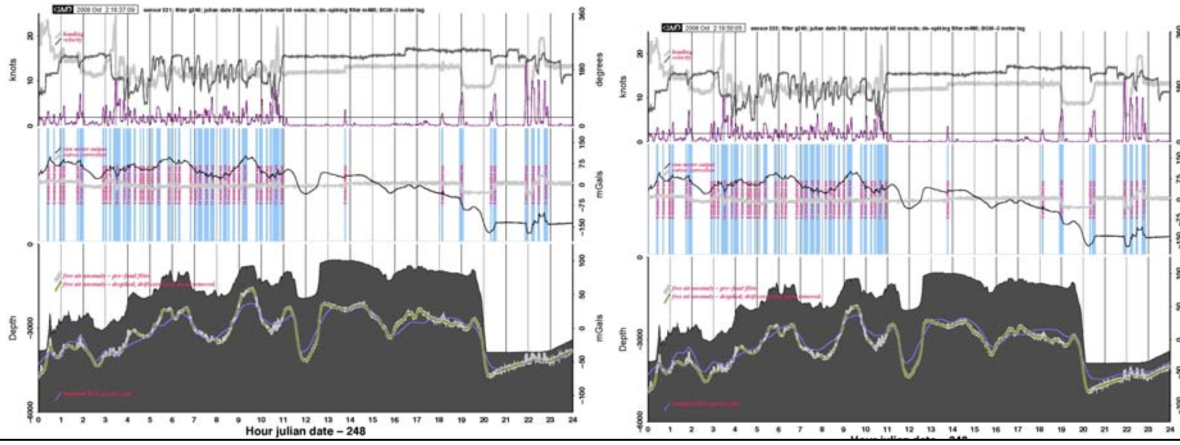

Figure 87. Gravity anomaly and supporting data collected USCGC Healy during HLY0805 during day 229. Data from sensor SN 221 are shown on the left. This meter will eventually be transferred to the new UAF research vessel. Data from sensor SN 222 are shown on the right. This system will remain permanently installed on USCGC Healy. The quality of these data is excellent. Vertical blue bars indicate data automatically edited from the final anomaly due to turns or, in other cases, DNV (Data Not Valid) flags from the BGM-3 platform or sensor.

Both of these systems (sensor SN 221 and 222) were installed on board USCGC Healy (Figure 86) in February 2008. One of the systems will eventually be installed on the new UAF research vessel, the Alaska Region Research Vessel. The other system is now part of the permanent underway equipment on board USCGC Healy. The quality of the gravity anomaly data collected by both systems during HLY-0805 is excellent (Figure 87).

METER INSTALLATION – FEBRUARY 2008

Both gravity systems, associated spares, manuals and data buffers were delivered to USCGC Healy in February. The system was installed in the lower level gyro room, near the ship's centerline, in late February by Randy Herr (retired NAVOCEANO) and Dale Chayes (LDEO, funded by NSF for ship science support on Healy), supported by the crew. During the 2004 and 2005 gravity programs, supported by a loaner gravimeter from NAVOCEANO, the gravimeter was installed in the same place (Figure 86). Existing cables were available to connect the gravimeter to the ship's data system.

Installation consisted of unpacking the system, attaching the electronics to the empty racks, running cables, tuning the platforms and integrating the two systems with the ship's data system. The previous tuning, conducted in Mississippi a few weeks earlier, had not been affected by shipping, handling or elapsed time. The stabilized platforms were well within specification and did not require re-adjustment. The data system was left logging the two gravimeters until the ship got underway for its' first transit leg on 6 March.

GRAVITY TIES

Since the BGM-3 meter [Bell and Watts, 1986)] is a relative gravimeter, it must be regularly calibrated by reference to absolute gravity bases. A "tie" was done during the installation on USCGC Healy. This tie was based on the previously estimated difference between the USCG pier and the absolute gravity base at the University of Washington Marine Science Center pier. While this is adequate for the short term, it is not sufficient, as, particularly near the coast with the influence of tides, the value at the pier can vary by up to a mGal. A closing tie will be done in early December after both systems have been running pierside for about a month and a half.

GRAVIMETER OPERATIONS

Both systems were continuously logged by the Healy's underway data system during HLY-0805. Once each second each Bell BGM-3 delivers an integer count, proportional to the integrated vertical accelerations during that second, through the "data buffer" to the ship's data system. These data are collected during every program undertaken by the ship during each season, including transits.

DATA REDUCTION

The gravity data from this cruise (Figure 87) were reduced using the POS/MV navigation data (NMEA strings GGA and VTG). The data were reduced using the script gravReduction. This script accesses the necessary navigation and gravimeter output files to calculate Free Air gravity anomaly values at a one-minute interval along the track.

Data reduction begins with the raw one-second integer counts generated by the Bell BGM-3 and logged by the Healy's data acquisition system. A four-minute Gaussian filter was used to estimate the vertical accelerations from the 1 Hz integer values collected from the gravimeter's data buffer. De-spiking was accomplished with an eight-minute median filter.

The GPS data stream is used to calculate the latitudinal correction (for the Earth's shape) and the Eötvos correction (for motion across the rotating Earth). Meter drift is estimated from the opening and closing gravity ties and used to correct the gravimeter output. Typically, underway gravity data requires long filters (>6 minutes) to eliminate the effects of heave from the estimated gravity anomaly signal. At the low speeds taken by the Healy (typically 4-8 knots) and with the damping effect of the sea ice, heave is minimal in the Arctic Ocean.

Reduced data were automatically edited to remove turns and the effect of backing and ramming based on a threshold value in the gradient of the Eötvos correction. Data excluded by this procedure are indicated by the vertical blue bars in Figure 87. Final data reduction and crossover analysis will be done after the closing gravity tie is completed in early December.

been evaluated. The affect of replacing individual components (e.g., Gyros) is also not known. Simultaneous acquisition of gravity data from both systems makes it possible to evaluate the continuity of meter drift over time by examining the accumulating difference in gravity values collected by the two independent systems. This analysis should reveal if mid-cruise tares are a real concern.

AN UNUSUAL OPPORTUNITY

Ships typically travel with spares for gravimeters, so as to be able to continue data acquisition in the event of the failure of an individual component. It is unusual to travel with a two functional, well tuned and calibrated gravimeters installed side by side. Offsets between the two signals generated by the independent systems may, in part, be attributed to differences in meter sensitivity, but it is likely that most of the difference will be due to the differing drift of the two systems. How drift accumulates on these systems is not known. Ideally drift accumulates linearly over time, as is assumed when correcting for meter drift between ties, but this has not

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Childers, V., D.C. McAdoo, J.M. Brozena, and S. Laxon, 2001, New gravity data in the Arctic Ocean: Comparison of airborne and ERS gravity, *Journal of Geophysical Research, 106,* doi:10.1029/2000JB900405

Wessel, P. and W.H.F. Smith, 1998, New, improved version of the Generic Mapping Tools Released, *EOS Trans. AGU, 79,* 579.

APPENDIX E: DATA PROCESSING WATCHSTANDER GUIDE

MODIFICATION STATUS OF THIS DOCUMENT

Date/Time	Author	Comment
2007-230/0600	Brian Calder	Initial revision
2007-230/1730	Brian Calder	Modified output products required
2007-231/0230	Brian Calder	Modified required frequency of output products
2007-231/2345	Brian Calder	Small comments on output file name conventions
2007-232/0610	Brian Calder	Added explicit instructions on sub-field sheets, and procedure for GIS-index file generation
2007-233/2319	Janice Felzenberg	Modified things to do (copy processed Knudsen images to local hard drive)
2007-234/0420	Brian Calder	Modified location for the ASCII sounding data at end of day to ArchiveData to match original intent
2007-234/0715	Brian Calder	Added instructions for converting the OziExplorer 'as run' route to HyPack/ArcGIS
2007-235/0025	Brian Calder	Reconfigured product creation to reflect making the projected grids in AvgGrid to beat out system noise.

DATA LOCATIONS

Raw data is on Healy's SnapServer, copied from a number of different systems; this is the source of all of the data you'll need for the processing. If the data directory isn't already mounted, then mount `\\hly-snap1\data` on `Z:` locally. You will need to authenticate against the server with your Healy username (first.last) and password. It shouldn't matter who does this, since we all have the same access level.

It is very important that you copy the data from the SnapServer in a timely manner (as indicated below). The servers can be a little flakey; you don't want to loose the data because of a system crash. Don't leave it until the end of the watch to copy a chunk of data (no matter how tempting that might be).

All data is to be copied to the local hard drive, mounted as E: The data for the current mission is in `E:\Healy0703`, with appropriate sub-directories for raw data (`RawData`), data being processed (`Processing`), and products being created (`StaticProducts`). Other directories reflect GIS/Mapping products, but don't concern the person working on processing the data at this station.

TIME KEEPING

All timestamps on the data are referred to UTC (a.k.a. GMT, more or less). If you make a log entry, or comment in this file, please use this timestamp. Local ship's time is Alaskan standard time, which is eight hours behind UTC. That is, 2100 local time is 0500 UTC in the following day (0500+1).

THINGS YOU NEED TO DO

Copy Data to Local Hard Drive

At the end of each hour, the SeaBeam system generates a new file. When the next hour's file appears in the raw data directory (typically about 10 min. past the top of the hour), copy the previous hour's file to the local RAID drive raw data directory, `E:\Healy0703\RawData\Seabeam\2007-DDD` where `DDD` is the Julian day when the data was collected. You can determine the Julian data from the filename of the SeaBeam raw file: `sb20072291600.mb41` means that the file was collected for the hour starting at

1600UTC on Julian day 229 of 2007 (i.e., August 17, 2007). At the end of each UTC day, you should have 24 files in this directory.

At the end of each Julian day (1600 local time), the POS/MV (motion and attitude sensor) completes a file in the `Z:\Raw\pos_mv` directory on the SnapServer. When you see the next day's file appearing, copy the previous day's file to `E:\Healy0703\RawData\POS-MV`. All files will be kept in this same directory. There are many source files in the `Z:\Raw\pos_mv` directory; you need `HLY0703-posnav.y2007dDDD`, `HLY0703-posatt.y2007dDDD`, `HLY0703-posreform2sb.y2007dDDD`, .and `HLY0703-sbsv.y2007dDDD`, where `DDD` is the Julian day for the data.

At irregular intervals during each day, the Knudsen sub-bottom profiler will generate new files in `Z:\Raw\knudsenraw`. When the next file appears, copy all of the components of the previous file (`.kea`, `.keb`, and several `.sgy`) into `E:\Healy0703\RawData\Knudsen320`. All files for all days will be kept in the same directory.

At the end of each hour, PNG images of the post-processed Knudsen sub-bottom profiles appear in the Underway Sensor Products page of the Healy Catalog (http://map-2/cgi-bin/catalog/hly0503/ops/index). To access the PNG images, navigate to 'Other Products' at the bottom of the Underway Sensor Products page and specify 'knudsen' as the product. A list of Knudsen products for the day requested will be presented – Note: only download the data that starts on the hour (e.g. 0800, not 0830). When the new hourly PNG file appears in the catalog, copy the image to the local RAID drive directory, `E:\Healy0703\GIS\Healy2007\ Knudsen_images`. Save as filename `2007MMDDHHHH.png`.

When the next hour's file appears in the catalog, copy the previous hour's file to the local RAID drive directory, `E:\ Healy0703\GIS\Healy2007\ Knudsen_images`.
When we do a CTD or take an XBT, data files will be generated in `Z:\Raw\ctd` or `Z:\Raw\xbt`. When the MST tells you that the data is available, copy to `E:\Healy0703\RawData\CTD` or …`\XBT` as appropriate.

CARIS/HIPS PROCESSING OF DATA

Convert the SeaBeam data into the CARIS/HIPS project in `E:\Healy0703\Processing\HDCS_Data\Healy0703`. Use the "`Healy`" ship model, and construct a new day directory for each Julian day. Use the "SeaBeam" conversion module, and do not filter by either navigation or depth range.
Apply the `zerotide.tid` file to all lines just converted (a tide file is required, even if it's identically zero meters).

Merge all of the lines just converted. A warning that navigation data has not been examined will be issued for each line; this can be ignored.

Construct a new fieldsheet for the lines, or update the current day's fieldsheet if it already exists (select line and use 'Add To…' from the BASE Surface's context menu). Use UPS (Universal Polar Stereographic) projection, and '75NORTH' for zone (this gives projection parameters consistent with the rest of the data for the project).

Create (or update) a BASE Surface for the new lines. Ensure that the 'Shoal' and 'Deep' layers are created. Use the 'Swath Angle' construction method and an appropriate resolution.

Check the newly added line to consistency with any overlap, and particularly any evidence of refraction (either 'smiles' or 'frowns' across-track). The most efficient remediation mode for the data is typically sub-set mode (i.e., 3D spatial editing), although line-oriented mode can sometimes be more useful for particular problems (for example nadir issues in shallow water). Common sense is the most useful guide, rather than a particular editing dogma: use whatever tool suits the problem. Do not re-convert lines after you start editing: all edits will be lost!
Check the shoal and deep layers for any significant outliers, and remove them from the sounding set. After you're done, the shoal, deep and mean depth layers should all show a full range of the color-map in use across the area. If not (e.g., most of the area is one color although you know there's a significant bathymetric difference), then you've probably still got an outlier somewhere.
Once all outliers are removed, recreate the BASE surface(s) (use the 'Recompute' option from their context menu).

PRODUCT CREATION

Product creation doesn't have to happen at the end of every line (although you can do so if you want the practice). You should, however, make a set of products at the end of every 4 hr segment (i.e., after the line at 0300-0400 UTC, after 0700-0800 UTC, etc.) Note that the fieldsheets you might make in CARIS are unrelated to the products that you need to create for archive and visualization.

At the end of each 4 hr segment, follow these steps:

- Select all of the lines in the sub-product, and export as projected ASCII data points:
- File→Export…, use 'HIPS to ASCII'
- Save file in `E:\Healy0703\StaticProducts\2007-DDD` as `2007_DDD_HHHH_HHHH.xyz` (e.g., `2007_232_0000_0300.xyz`). Ensure that 'accepted', 'outstanding' and 'examined' soundings are selected for output.
- Select 'Easting', 'Northing', 'Depth' as the active attributes for output.
- Use UPS projection with '75NORTH' as the zone.
- CARIS/HIPS will add an extra '.txt' on the end of the filename that you need to remove after the export is complete.
- Open AvgGrid, and create DTM/GEO products
- File→Add File to Grid…, select the appropriate file
- Click 'Configure' and set the 'Value to Grid' modified to 'Invert' (to give positive up depths from HIPS default of positive down).
- Select an approximate resolution in meters, and click 'Scan Data'.
- Determine the maximum depth of the data, and select the appropriate grid resolution from Table I; reset the griding resolution to this value; click 'Scan Data' again.
- Check that the output grid is going to be a reasonable size, then click 'Create DTM'; inspect the DTM to make sure it looks approximately right.
- Save the DTM/GEO in `E:\Healy0703\StaticProducts\2007-DDD` as `2007_DDD_HHHH_HHHH_RRm.{dtm.geo}`., where the prefix is as 1(a) above, and `RR` is the resolution in meters.
- Open DMagic, and create SD objects:
- Open the `E:\Healy0703\StaticProducts\2007-DDD` directory [File→OpenProject…].
- Select the appropriate DTM file and click '>>' to make it active.
- Click 'CMap Librarian' and then select the 'colorsinterp' colormap.

- Click 'Surface Shader' and shade the object with the default setting; save the shade file using the default name.
- Click 'Assemble Fledermaus Objects' and select the appropriate DTM if required; click 'Build Object' and save with the default name.
- Open the object just created in Fledermaus and ensure that (a) it's in the right place, (b) it looks right, and (c) there are no obvious fliers left in the data. If any of these checks fail, go back to CARIS/HIPS and repeat steps 1-4 until it looks right.
- Select all of the lines in the sub-product, and export as GSF files:
- File→Export…, use 'HIPS to GSF'
- Select `E:\Healy0703\ArchiveData\2007-DDD` as the output directory, where `DDD` is the Julian day.
-

At the end of each Julian day (1600 ship's local time), do the following:

- Export all of the sounding data from the current day as ASCII soundings:
- Choose File→Export…, use 'HIPS to ASCII'.
- Save file in `E:\Healy0703\ArchiveData\2007-DDD` as `2007_DDD_depth.txt`.
- Select 'Longitude (DD)', 'Latitude (DD)', 'Easting', 'Northing' and 'Depth' as the active output attributes (in that order).
- Use UPS projection with '75NORTH' as the zone.
- Open AvgGrid and make 'whole day' projected and geographic objects:
- File→Add File to Grid…, select the appropriate file
- Click 'Configure' and set the 'Value to Grid' to the fifth column; select 'Invert' to ensure positive up depths.
- Select an approximate geographic resolution from Table I; click 'Scan Data'.
- Determine the maximum depth of the data, and select the appropriate grid resolution from Table I. You will probably find that you need a coarser grid for geographic grids than the corresponding projected grid due to the latitude; this could be significant (e.g., almost double). Click 'Scan Data' to register the change.
- Check that the output grid is going to be a reasonable size, then click 'Create DTM'; inspect the DTM to make sure it looks approximately right.
- Save the DTM/GEO in `E:\Healy0703\StaticProducts\2007-DDD` as `2007_DDD_geo_GGs.{dtm,geo}` where `GG` is the 'GeoLabel' column in Table I corresponding to the chosen resolution (i.e., the grid resolution in seconds of arc); for example a grid at $1.8\times10^{-4\circ}$ = 0.6" would be labeled `2007_232_geo_0.6s.dtm`.
- Click 'Configure' again and select columns 3 and 4 as X and Y respectively (you are selecting the projected coordinates for griding).
- Change the griding resolution to the coarsest projected resolution used in the intermediate products during the day, and click 'Scan Data' to register the difference. You may have to click 'Scan Data' again to get DMagic to work out that you've changed coordinate systems.
- Check that the output grid is going to be a reasonable size, then click 'Create DTM'; inspect the DTM to make sure it looks approximately right.
- Save the DTM/GEO in `E:\Healy0703\StaticProducts\2007-DDD` as `2007_DDD_ps_RRm.{dtm,geo}` where `RR` is the resolution in meters.
- Open DMagic and create SD objects for the two grids constructed in step #2 using the instructions as for step #3 of the intermediate products (above).
- Inspect the Fledermaus objects you've just created to ensure that they're stable; rinse and repeat process if required.

- Extract the navigation for the MBES data into the format required for the GIS database. Open a CygWIN window, and do:
- `cd /cygdrive/e/Healy0703/ArchiveData/2007-DDD`
- `nav_to_shape.pl 2007-DDD.gen *.gsf`
- `posgga_to_shape.pl 2007-DDD_posmv_gga_navigation.gen Z:/Datalog/posmv_gga/POSMV-GGA_2007MMDD-000000.Raw`
- If/when the routes file is modified to indicate new 'as run' locations, the file in `E:/Healy0703/Waypoints/HEALY0703_ASRUN.rte` will be updated. This needs to be converted to HyPack and ArcGIS format. Open a CygWIN window, and do:
- `cd /cygdrive/e/Healy0703/Waypoints`
- `ozirte_to_x.pl HEALY0703_ASRUN.rte`

RECOMMENDED GRID RESOLUTIONS

The grid resolutions in Table I are recommendations for product construction at 4hr intervals, and for full-day products when possible. In the case of full-day products where there is a lot of variability in the depth, you may need to make more than one grid to preserve resolution in the shallow areas. Don't make more than 2-3 grids, since it otherwise gets confusing.

The depth ranges in the 'Actual' column here are computed by empirical experimentation, and are approximate. You should endeavor to use the highest possible resolution that results in a grid product without holes; in practice, you should try the next higher resolution as well as the nominal one. So if the maximum depth in your data is 1500m, you would try 30m and 25m (and maybe even 20m) to see if the data will stand up to it, before choosing a final resolution. You can't really tell this from the DTM in AvgGrid; you need to see the Fledermaus object. If in doubt, you can make a grid at the lowest resolution you think is likely, and then examine it to see where the data starts to fall apart. Make the resolution decision in projected coordinates, and then match in geographic coordinates if possible: you may have to drop the resolution somewhat in geographic coordinates because of the latitude at which we're working.

Grid Resolution		Nominal	Actual	GeoLabel
(m)	(deg)	(m)	(m)	
5	4.500E-05	71.59063	<50m	0.2s
10	8.999E-05	143.1813	<300m	0.3s
15	1.350E-04	214.7719	<500m	0.5s
20	1.800E-04	286.3625	<1000m	0.6s
25	2.250E-04	357.9532	<1250m	0.8s
30	2.700E-04	429.5438	<1500m	1.0s
35	3.150E-04	501.1344	<1750m	1.1s
40	3.600E-04	572.7251	<2000m	1.3s
45	4.050E-04	644.3157	<2500m	1.5s
50	4.500E-04	715.9063	<3500m	1.6s
75	6.749E-04	1073.859		2.4s
100	8.999E-04	1431.813		3.2s
125	1.125E-03	1789.766		4.0s
150	1.350E-03	2147.719		4.9s
175	1.575E-03	2505.672		5.7s
200	1.800E-03	2863.625		6.5s
225	2.025E-03	3221.578		7.3s

250	2.250E-03	3579.532		8.1s
275	2.475E-03	3937.485		8.9s
300	2.700E-03	4295.438		9.7s
325	2.925E-03	4653.391		10s
350	3.150E-03	5011.344		11s
375	3.375E-03	5369.297		12s
400	3.600E-03	5727.251		13s

Table 2: Recommended grid resolutions for the SeaBeam 2112 on USCGC HEALY during HEALY 07-03 (2007).

APPENDIX F: HEALY 08-05 WATCH STANDING NOTES

RESPONSIBILITIES OF THE WATCH:

Monitor status of SeaBeam system
Monitor status of Knudsen subbottom profiling system
Monitor status of the ADCP
Monitor status of navigation
Monitor status of thermosalinographs
Help with deployment of CTD, xCTD or xBT when needed
Maintain the digital log book
Wake the next watch as arranged ensuring that there is enough time for overlap with the next watch for the full transfer of information
Keep lab and head next to lab tidy

When you come onto watch please sign into the LDEO digital log. Throughout the watch please enter all parameter changes and significant events in the log. ELOG HEALY0805. Log change of watches, any changes in settings, any interesting event… anything …. No entry is insignificant. More is better.

Your primary responsibility is to ensure that the SeaBeam system is functioning "well." This is done by monitoring a series of windows on the SeaBeam display (SKIMMER).

SEA BEAM:

STATUS WINDOW

This window scrolls a series of messages that usually contain information on ping number, number of beams (-- in shallow water this should be a number about 60; in deep water a number like 100 –110), etc. If this message is green it implies that things are OK. Be sure the scroll bar is kept at the bottom of this window so that the information scrolling is the most recent.

Every once in while a message will appear indicating that a tape-write is taking place. This is white text that says the percentage of the tape full. It changes very slowly. If it ever gets to 95% call the LDEO rep on watch (Steven or Dale). Dale comments that it has never ever gotten that far without crashing – if it does Dale has promised to dance naked on the fantail.

Messages to watch for in this window:

VRU errors – particularly if many of them appear – page LDEO Rep on watch (Steve, or Dale)
"bad data on time device" –indicates that the IBS (integrated bridge system) is sending bad data to the SeaBeam system – CONTACT the LDEO rep on watch
Surface Sound Velocity (SSV) errors or Nav errors – also indicted by strange position or speed values in System State Window.

SYSTEM STATE WINDOW

The System State Window provides lots of useful information about what parameters the system is working with. In deep water most of these will be set automatically; in shallow water the power gain and source level can be manually set. The most important parameter to keep track of here is the sound speed value towards the bottom. **For deep water operation, the system stops working if the sound speed is below 1440 m/s** (which it will do if we have cold, fresh water). If this happens you have to manually enter a value of 1440.1 in the sound speed profile window (use the icon). Choose manual and enter this value. We will have to figure out how to fix the data later.
Login Window – DO NOT TOUCH THIS ONE

SEA BEAM BOTTOM PROFILE WINDOW

The Sea Beam Bottom Profile Window shows the status of the multibeam's bottom detection. The white line is the collection of picked depths across the swath. Where there are drop-outs the bottom was not detected (above some threshold). The pinkish lines represent the gate over which the bottom is searched for. This will be set automatically (on automatic) most of the time but when breaking ice will have to be adjusted manually (through the options – gate pulldown and then the settings buttons) to ensure that the bottom does not mistrack on the noise created by icebreaking. Power level, gain and pulse width should also be set to automatic unless ice or sea conditions make this impractical – and they will then be set manually.

Manual adjustments:

In Bottom Profile Window – you will need to manually set gate and depth.
Click "settings" button
Set Depth
Increase gate to at least 500
Click "manual"

VERY IMPORTANT NOT TO USE THE UP/DOWN ARROWS – RATHER MANUALLY INPUT NUMBER

Also when in ice the SONAR SETTINGS must be changed: Click SONAR Button:
Output, Pulsewidth and Ping gain all should be set to manual.

Be careful to click the icon buttons slowly. The green trace represents the number of hits per beam and should grow steadily away from nadir (to produce a big smile). In shallow water this may not be the case.

SCS MONITOR

The Samsung monitor on the far left should also be regularly checked. This monitors the transmission of data to the ship's logging system. Any item in red indicates that something is not being logged. Notify the LDEO rep or MST on watch to verify that those things not being logged shouldn't or can't be or have them fix it.

To obtain keyboard and mouse control between the "Skimmer" (bottom display) and the Survey displays (on top of bench) use the KVM ServSwitch (black box) on the starboard side of the bench.

ADCP

ADCP Logging

The ADCP monitors is the ViewSonic monitor to the left of the Knudsen monitor. If the display is not updating or if an error message appears, call the MST on watch.

KNUDSON

Subbottom Profiling System

(monitor located to left of the HEALY xserve monitor –Knudsen) – check that the system has properly positioned the bottom within the selected range window – someone will have to show you how to recognize this – check with MST and if he/she can't resolve it page LDEO rep.
To obtain keyboard and mouse control between the Knudson and the ADCP use the KVM ServSwitch (black box) on the port side of the bench.

Nav Status Window

(on "Watch-2" -- Apple monitor on top shelf). Displays important information about speed heading and water depth. The MV POSView monitor has a bunch of green status switches for attitude, heading, position, velocity, and Heave. If any of those turn red call the LDEO rep on watch.

APPENDIX G: SHIP'S CREW

1. HEALY SAILING LIST FOR 13 AUGUST 2008.

A. OFFICER PERSONNEL ABOARD

CAPT FREDERICK J. SOMMER
CDR DALE K. BATEMAN
CDR JEFFREY D. STEWART
LCDR DOUGLAS PETRUSA
LT JASON K. APPLEBERRY
LT SILAS M. AYERS
LT OSCAR R. GALVEZ
LTJG JOSH L. SMITH
ENS ZACHARY C. BENDER
ENS PETER DOLTON
ENS BRYSON C. JACOBS
ENS LISA MYATT
ENS TARA SCHENDORF
ENS TASHA N. THOMAS
CWO3 SEAN R. LYONS
CWO2 VALERIE MILLER
CWO2 JOHN ROSE

B. OFFICER PERSONNEL TDY

LTJG SAM GREENAWAY
LTJG JAMES BRINKLEY

C. ENLISTED PERSONNEL ABOARD

BMCM THOMAS H. WILSON
EMCM CURTIS A. PODHORA
FSCS ANTHONY WILLIAMS
HSCS COREY L. BEASLEY
MKCS GREG E. JONES
BMC WAYNE L. KIDD
DCC GEORGE W. MARSDEN
ETC JAMES M. BERRINGER
MKC JOHN C. BROGAN
MKC DOUGLAS R. LAMBERT
MSTC MARK E. RIEG
OSC SORJEN T. MANANGAN
SKC ABNER RIVERA-MALDANADO
YNC JAMES C. ANGELO
DC1 CHRISTOPHER S. IMGARTEN

EM1 DANIELL E. HURTADO
EM1 HANS D. SHAFFER
ET1 BRIAN A. LIEBRECHT
ET1 SHAWN W. SWANSON
IT1 JEFFREY M. DABE
IT1 DANIEL A. VONKAUFFMAN
MK1 NICHOLAS MURPHY
MK1 ROBERT B. QUICHOCHO
MK1 KENNETH D. RUDIBAUGH
MK1 ALLAN WHITING
MST1 CHARLES M. BARTLETT
MST1 RICHARD L. LAYMAN
BM2 AIMEE E. BUFORD
BM2 GAINES B. HUNEYCUTT
BM2 ANDREW S. YECKLEY
EM2 DONALD LADD
EM2 PAUL IRWIN
ET2 JOHN DAVIS
ET2 MARK E. HARBINSKY
FS2 STEVEN D. DULL
MK2 BETTY BROWN
MK2 JEFFREY A. COOMBE
MK2 BRANDON O'SULLIVAN
MK2 WENDY STARLING
SK2 BOBBY GRIFFIN
SK2 JEREMY LAISURE
BM3 PATRICK KIMMEL
EM3 JAMES OLSON
ET3 GREG POWELL
FS3 ROBIN M. BALDWIN
FS3 HERBERT M. HAMILTON
MK3 ANTHONY E. SICIAK
MST3 THOMAS R. KRUGER
FN PAUL A. BLAS
FN ANGELA FORD
FN KATHLEEN GHOSN
FN ALEXANDER D. WAGNER
SNBM JAMES T. MERTEN, JR.
SN DEIRDRE GRAY
SN CHELSEY R. FERNANDEZ
SN GENE H. MCMANUS
SN JUSTIN MURRAY
SN EMILY L. THOMPSON
SNFS TYSIN ALLEY
SA MICHAEL P. RODERMUND

D. ENLISTED PERSONNEL TDY

DC2 ALBERT MCNEIL

FS2 SARA KNIGHTON
MK2 PATRICK O'CONNOR
ET3 JONATHON COMBAST

E. CIVILIANS

ALEX ANDRONIKOV
ANDREW ARMSTRONG
BETSY BAKER
KEVIN BERBERICH
ROBERT BOGUCKI
KELLEY BRUMLEY
BRIAN CALDER
DALE CHAYES
PABLO CLEMENTE-COLON
ADRIANE COLBURN
DANIELA GONCLAVES
JOHN HALL
DAVID HASSILEV
STEVE HOWARD
KOJI ITO
PYRIYANTHA JINIDASA
PETER LEGNOS
WALT LINCOLN
LARRY MAYER
GEORGE NEAKOK
SHACHAK PE'ERI
MARTY REEDY
STEVE ROBERTS
ETHAN ROTH
VAL SCHMIDT
DAVID SKILLICORN
NEIL TINMOUTH
ROCHELLE WIGLEY
MONICA WOLFSON

2. TOTAL ONBOARD 112

17 OFFICERS (PERM PARTY)
01 OFFICERS (TDY)
60 ENLISTED (PERM PARTY)
04 ENLISTED (TDY)
30 CIVILIANS

APPENDIX H: DATA DISTRIBUTION REPORT

DATA FORMATS FOR HEALY UNDER WAY INSTRUMENTS

Prepared by: Tom Bolmer, David Forcucci, David Hassilev, Steve Roberts, & Dale Chayes
Updated September 4, 2008

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FILE FORMATS OF DATA COLLECTED UNDERWAY

The formats of the Under way data files that were collected on this cruise are in a separate document named HLY0805_Sensors. This is now a separate document due to it's large size. The file HLY0805_Sensors.htm is found in the Meta_Data directory. A PDF version of this file should also be here. To use this html file you will need to have the directory HLY0805_Sensors_files in the same directory as the html file.
Also in the Meta_Data directory are some PDF files for data that was collected but not part of the normal science routine.

ACQUISITION PROBLEMS AND EVENTS

A technicians electronic logbook is utilized on the ship for logging of science related problems and events as they happen. A dump of the logbook is done at the end of the cruise and saved in the Meta_Data directory under the "elog" subdirectory. Several dump formats are made available such as html, csv, xml and raw. These logs should be consulted to help identify instrument and system anomalies affecting data quality. Times are reported in GMT (UTC, Z).

COMMENTS THAT MIGHT HELP WHEN USING THE DATA

The SCS system stops recording occasionally. If this is the case. You should look for the corresponding data in the LDS_Data directories. The data may have been recorded there.

The Knudsen data written into SCS_Data/Knudsen has an inconsistent time in the data. The time that the SCS writes to the start of the file should be used. The Knudsen internal clock adds about 22.8 seconds to the3 internal clock each day near 00:00. But this is reset when the recording program is started up. Use only the SCS time stamp for time in this data and it should be fine.

The SeaBeam data is raw and unedited. This data needs careful editing and often other processing prior to use. There are a few periods when the SeaBeam 2112 failed and took more than a few minutes to get going again.

SBE 21 SEACAT THERMOSALINOGRAPH DATA OUTPUT FORMATS

This is extracted from page 33 of the SBE 21 SEACAT Thermosalinograph User's Manual (SeaBird Manual Version #022, 03/30/07).
The SBE 21 outputs data in raw, hexadecimal form as described below.
The inclusion of some output parameters is dependent on the system configuration - if the specified sensor is not enabled (see *Command Descriptions* above), the corresponding data is not included in the output data stream, shortening the data string.
• SBE 21 Format (**F1**) - ttttccccrrrrrruuuvvvwwwxxx (use this format if you will be using SEASAVE to acquire real-time data and/or SBE Data Processing to process the data)
• SBE 16 Format (**F2**) - #ttttccccrrrrrruuuvvvwwwxxxnnnn (custom format)
where
tttt = primary temperature

cccc = conductivity
rrrrrr = remote temperature (from SBE 38 or SBE 3 remote sensor)
uuu, vvv, www, xxx = voltage outputs 0, 1, 2, and 3 respectively
# = attention character
nnnn = lineal sample count (0, 1, 2, etc.)
Data is output in the order listed, with no spaces or commas between parameters. Shown with each parameter is the number of digits.
Calculation of the parameter from the data is described below (use the decimal equivalent of the hex data in the equations).
1. Temperature
temperature frequency (Hz) = (tttt / 19) + 2100
2. Conductivity
conductivity frequency (Hz) = square root [(cccc * 2100) + 6250000]
3. SBE 3 secondary temperature (if **SBE3=Y**)
SBE 3 temperature frequency (Hz) = rrrrrr / 256
4. SBE 38 secondary temperature (if **SBE38=Y**)
SBE 38 temperature *psuedo* frequency (Hz) = rrrrrr / 256
5. External voltage 0 (if 1 or more external voltages defined with **SVx**)
external voltage 0 (volts) = uuu / 819
6. External voltage 1 (if 2 or more external voltages defined with **SVx**)
external voltage 1 (volts) = vvv / 819
7. External voltage 2 (if 3 or more external voltages defined with **SVx**)
external voltage 2 (volts) = www / 819
8. External voltage 3 (if 4 external voltages defined with **SVx**)
external voltage 3 (volts) = xxx / 819

Example: SBE 21 with SBE 38 and two external voltages sampled,
example scan = ttttccccrrrrrruuuvvv = A80603DA1B58001F5A21
• Temperature = tttt = A806 (43014 decimal);
temperature frequency = (43014 / 19) + 2100 = 4363.89 Hz
• Conductivity = cccc = 03DA (986 decimal);
conductivity frequency =
square root [986 *2100) + 6250000] = 2884.545 Hz
• SBE 38 = rrrrrr = 1B5800 (1,792,000 decimal)
temperature *pseudo* frequency (Hz) = (1,792,000 / 256) = 7000 Hz
• First external voltage = uuu = 1F5 (501 decimal);
voltage = 501 / 819 = 0.612 volts
• Second external voltage = vvv = A21 (2593 decimal);
voltage = 2593 / 819 = 3.166 volts

Note:
SBE 21 always outputs an even number of voltage characters. If you enable 1 or 3 voltages, it adds a *0* to the data stream before the last voltage, as shown below:
• Remote temperature and 1 voltage enabled –
ttttccccrrrrrr0uuu or
#ttttccccrrrrrr0uuunnnn
• Remote temperature and 3 voltages enabled –
ttttccccrrrrrruuuvvv0www
#ttttccccrrrrrruuuvvv0wwwnnnn

Notes:

• Sea-Bird's software (SEASAVE and SBE Data Processing) uses the equations shown to perform these calculations; it then uses the calibration coefficients in the configuration (.con) file to convert the raw frequencies and voltages to engineering units. Alternatively, you can use the equations to develop your own processing software.

• See *Notes on SBE 38 Remote Temperature Data Output Format* below for details on how Sea-Bird handles SBE 38 data.

DATA

Most data are received via asynchronous serial (RS-232C) connections. In SCS a time tag is added at the beginning of each line of data in the form,
mm/dd/yyyy,hh:mm:ss.sss,[data stream from instrument] where:

Format	Value used
mm	2 digit month of the year
dd	2 digit day of the month
yyyy	4 digit year
hh	2 digit hour of the day
mm	2 digit minute
ss.sss	seconds

An example string from the SeaBeam Centerbeam file is:
04/13/2007,06:49:20.920,$SBCTR,2007,4,13,06:49:09.437,57.158792,-165.664322 ,69.15,60*00
All times are reported in UTC. Each SCS file type has it's own NMEA string name ($SBCTR as an example).

The delimiters that separate fields in many raw data files are commas. Care should be taken when reprocessing the data that the field separators are clearly understood.

Directories and Contents:

1_Minute_Averaged_Data:	This directory contains all of the under way data averaged over a 1 minute window in time.
SCS_Data:	This directory contains serial data collected by the SCS version 4 data collection system with each instrument in separate subdirectories. A description of the data contained in this directory is below.
LDS_Data:	This directory contains serial data collected by the Lamont Data System (LDs) with each instrument in separate subdirectories. A description of the data contained in this directory and subdirectories is below.
Raw:	This directory contains raw data as recorded by individual instruments and put into separate subdirectories. A description of the data contained in this directory and subdirectories is below.
Meta_data:	This directory contains documents useful in the post analysis of the data contained in this distribution.
	A collection of data sets which are crated by simple averaging over time.

1_Minute_Averaged_Data:

HLY0805_distance.csv	Cumulative distance along track from the start of the collection.
HLY0805_Averaged.csv	All the Under way data averaged for 1 minute.
HLY0805_Averaged.shp HLY0805_Averaged.shx HLY0805_Averaged.dbf	All of the 1 minute under way data averaged at 1 minute spacing in the ESRI Shapefile (GIS) format.

SCS_Data:

/aft_a_frame	Wire tension, wire out, and wire speed from the Totco measurement system for the wires typically run over the aft A-Frame. Speed in meters/minute, wire out in meters, tension in pounds.
/air_temp_f	Temperature data from the RM Young temperature sensor (in degrees) Fahrenheit. Data is derived from data from files in the rmyoung_air directory
/ashtech_attitude	Vessel attitude (heading, pitch and roll) in NMEA format from the Ashtech ADU5 GPS receiver
/ashtech_gga	Position data in NMEA GGA format from the Ashtech ADU5 GPS receiver
/ashtech_gll	Position data in NMEA GLL format from the Ashtech ADU5 GPS receiver
/ashtech_hdt	Heading data in NMEA HDT format from the Ashtech ADU5 GPS receiver
/dew_point_f	Dew point temperature in degrees Fahrenheit derived from air temp
/flomet_a	Flow meter data just upstream of the A TSG and Fluorometer, liters/minute
/flomet_b	Flow meter data just upstream of the B TSG and Fluorometer, liters/minute.
/fluro_a	Flurometer for A TSG sensor.
/fluro_b	Flurometer for B TSG sensor.
/glonass_gga	Ship's position data in NMEA GGA format from the GLONASS GPS receiver.
/glonass_gll	Ship's position data in NMEA GLL format from the GLONASS GPS receiver.
/gyro_mk27	Ship's heading in degrees in NMEA HDT format from the Sperry MK27gyro compass
/gyro_mk39	Ship's heading in degrees in NMEA HDT format from the Sperry MK39 gyro compass
/ibs_waypoints	Waypoints from the Healy's Integrated Bridge System
/isus	ISUS Nitrate Sensor small file
/isus3v	ISUS Nitrate Sensor 3V full file
/knudsen	Depth data in a PKEL format from the Knudsen 320 B/R serial output
/met3a_sen	Meteorology data from the top of the jackstaff on the bow.
/oxygen_a	Dissolved oxygen values from A TSG.
/oxygen_b	Dissolved oxygen values from A TSG.
/pcode_aft_gga	Ship's position data in NMEA GGA format from the Trimble Centurion GPS receiver
/pcode_aft_gll	Ship's position data in NMEA GLL format from the Trimble Centurion GPS receiver
/pcode_aft_vtg	Course and speed over ground in NMEA VTG format from the Trimble Centurion GPS receiver
/pcode_aft_zda	Time and date in the NMEA ZDA format from the Trimble Centurion GPS receiver

/pcode_bridge_gga	Position data in NMEA GGA format from the Trimble GPS receiver located on the bridge.
/pcode_bridge_gll	Position data in NMEA GLL format from the Trimble GPS receiver located on the bridge.
/pcode_bridge_vtg	Course and speed over ground data in NMEA VTG format from the Trimble GPS receiver located on the bridge.
/posmv_gga	Position data in NMEA GGA format from the POS/MV
/posmv_gst	Pseudorange error statistics in NMEA GST format from the POS/MV
/posmv_hdt	Heading data in NMEA HDT format from the POS/MV
/posmv_pashr	Roll, pitch and heave from POS MV inertial navigation system.
/posmv_vtg	Course and speed over ground in NMEA VTG format from the POS/MV
/posmv_zda	Time and date data in NMEA ZDA format from the POS/MV
/pressure_sen	Pressure sensor in the Uncontaminated Seawater System before the Bio Chem Lab which measures header pressure in PSI
/rmyoung_air	Temperature, humidity, air pressure data in NMEA XDR format from the RM Young meteorological system
/rmyportwind	Wind speed and direction data in NMEA WMV format from the RM Young weather vane on the port side of the Healy.<
/rmystbdwind	Wind speed and direction data in NMEA WMV format from the RM Young weather vane on the starboard side of the Healy.
/samos_data	Meterology data for SAMOS.
/sbd_a_frame	Wire tension, wire out, and wire speed for the starboard A frame sheaves.
/seabeam_center	Center depth data from the Seabeam 2112
/solar_radiometers	Solar Radiometer data for SW and IW.
/sperry_speedlog	ground/water speed data from the Sperry Speed Log
/surface_par	Photosynthetic Active Radiation volts and Microeinstens/m2 se from the surface par sensor
/sv2000	Sound Velocity data from the SV2000 sound velocimeter located in the ADCP BB150 sonar well
/true_wind_port	True wind speed data derived from gyro data and rmyportwind
/true_wind_stbd	True wind speed data derived from gyro data and rmystbdwind
/tsg_a	Thermosalinograph and fluorometer data from the A TSG instruments in the Bio/Chem Lab.
/tsg_b	-Thermosalinograph and fluorometer data from the B TSG the instruments in the Bio/Chem Lab.
/winch_data	Line out and speed data from the winch system.
/wind_sen_a	Wind data from the Jack Staff.
/wind_sen_b	Wind data from the Yard.

Extra files in the directory SCS_Data:

ACQLOG.LOG	Contains the data as to what occurred with SCS data. It shows when data collection was started and stopped.

Incidents_YYYYMMDD-TTTTTT.DTM	Contains any incident data which were triggered in SCS 3.3b.
sensor_YYYYMMDD-TTTTTT.scf	Contains the configuration file for data collection as configured by SCS 3.3b.

LDS_Data:

/AloftConCam	Contains picture files separated by folders named by Year and Day of the Year (YYYYJJJ). The picture files are in 5 minute JPEG format.
/FantailCam	Contains picture files separated by folders named by Year andDay of the Year (YYYYJJJ). The picture files are in 5 minute JPEG format.
/adu5	Contains the data from the ADU5 GPS.
/aggps	Contains the data from the AG GPS.
/ais	/Contains Automatic Identification System (AIS) messages as encapsulated VDM sentences.
/bgm221	Contains the data from the BGM221 Gravimeter.
/bgm222	Contains the data from the BGM222 Gravimeter.
/events	Contains the logs of event for different systems.
/mk27	Contains the data from the MK27 Gyro.
/mk30	Contains the data from the MK30 Gyro.
/posatt	Contains the attitude data from the POSMV GPS.
/posnav	Contains the navigation data from the POSMV GPS.
/posreform2sb	Contains the navigation data from the POSMV GPS reformatted for the SeaBeam.
/sbctr	Contains the center beam data from the SeaBeam.
/sbsv	Contains the surface sound velocity data for the SeaBeam.
/seabeam	Contains the data from the SeaBeam.
/tsg_met	Contains the all data from SIO TSG and Met sensors.
/SwapPingHLY	/Contains ping results for Healy/Louis wireless network(swap) connection.(Experimental testing for HLY0806)
/SwapRoute	/Contains routing table stats for Healy/Louis wireless network(swap) connection.(Experimental testing for HLY0806)
/SwapStatsHLY	/Contains Healy wireless stats for Healy/Louis wireless network(swap) connection.(Experimental testing for HLY0806)
/SwapStatsLSL	/Contains Louis wireless stats for Healy/Louis wireless network(swap) connection.(Experimental testing for HLY0806)

Meta_Data:

/elog	Contains the technician's narrative of important events, which occurred both to the network and to individual sensors.
/Bridge_Logs	occurred both to the network and to individual sensors.
DDMMMYY.doc	The "smooth log" containing events recorded by the bridge watch.

DDMMMYYWX.xls Weather log recorded by the watch.
DDMMMYYNAV.xls Navigation logs recorded by the watch.

Raw:

/adcp75	75 KHz ADCP data
/adcp150	150 Khz ADCP data
/ctd	CTD data in directories by Cast number.
/knudsenraw	Knudsen 320B/R data
/xbt	Expendable Bathythermograph data.

Images:

/Satellite_Image	Contains satellite imagery in jpeg format
/dmsp	dmsp folders labeled by Year, Month, Day
/hrpt	hrpt folders labeled by Year, Month, Day
Ice_observations:	Directories of the Ice Observations taken for the cruise.
knudsen_hourly_plots	Directories of the SIOSEIS plots of the Knudsen 3.5 kHz data are in directories named by year, month, and day. These images are in the png format. There are two plots for each window in time. One is a large sized plot and one is a smaller plot. The files start 10 minutes before the file name and 10 minutes after the hour the file is named for.
SVP:	Sound velocity profiles used for the Seabeam.

MERGED DATA

LDEO Averaged One Minute Data File

The data are summarized into an averaged one (1) minute data file by the LDEO technician. This file takes the average value centered around the minute, (30 seconds either side of the whole minute). The data are the raw values as they are logged. There has been no quality control done on these files. Those wishing more accurate and quality controlled values should process the data in the directories described below in the document

HLY0805_Averaged.csv

25485,2008/07/20 10:15,56.8421422,-173.2905390,354.9,11.3,352.2,158.1,7.546,7.652,33.1845,32.084,1.828,0.183,0.000,0.011,2.97,0.08,367.54,281.33,281.32,1.66,8.05,100.00,1009.72,11.88,298.92,14.40,267.05,12.75,286.31,13.58,251.95,13.35,6.269,7.652,0.083,-6.128,3,-377,8,0,1,-156,1,0,18.73,251.2,6.78,0.51
25486,2008/07/20 10:16,56.8452412,-173.2910445,354.7,11.2,352.0,160.5,7.546,7.666,33.1987,32.086,1.783,0.178,0.000,0.011,2.97,0.20,364.65,281.34,281.33,1.66,8.05,100.00,1009.73,11.87,300.49,14.68,269.73,13.17,287.56,13.94,253.32,13.17,6.263,7.666,0.144,-4.494,3,-377,8,0,1,-157,1,0,19.06,258.4,6.78,0.51

25487,2008/07/20 10:17,56.8483228,-173.2915862,354.4,11.2,351.5,161.9,7.550,7.684,33.2140,32.086,1.754,0.175,0.000,0.011,2.97,0.20,364.71,281.36,281.32,1.66,8.04,100.00,1009.71,11.88,301.11,15.82,271.81,14.19,287.68,13.41,253.85,13.21,6.256,7.684,0.001,-8.363,3,-378,8,0,1,-157,1,0,19.02,261.3,6.77,0.52

Field	Data	Example	Units
01	ID	25485	sample count
02	date	2008/07/20 10:15	date & time UTC (year/month/day hour:minute)
03	lat	56.8421422	$INGGA, POSMV Latitude (decimal degrees)
04	lon	-173.2905390	$INGGA, POSMV Longitude (decimal degrees)
05	cog	354.9	$INVTG, POSMV Course Over Ground (angular distance from 0 (North) clockwise through 360, 1 minute average)
06	sog	11.3	$INVTG, POSMV Speed Over Ground (Knots, 1 minute average
07	heading	352.2	$PASHR, POSMV ship heading (angular distance from 0 (North) clockwise through 360, 1 minute average)
08	depth	158.1	$SBCTR, Seabeam centerbeam depth(meters, 1 minute average)
09	SST	7.546	$PSSTA, SBE3s RemoteTemperature, Sea Chest intake (Celsius, 1 minute average)
10	TSG_InTemp	7.652	$PSTSA, SBE45 internal temperature (Celsius, 1 minute average)
11	TSG_Cond	33.1845	$PSTSA, SBE45 Water Conductivity (millisiemens/centimeter, 1 minute average)
12	TSG_Sal	32.084	$PSTSA, SBE45 Water Salinity (PSU, 1 minute average)
13	SCF-FL	1.828	$PSFLA, SCF Fluorometer (Ug/l, 1 minute average)
14	SCF-FL-V	0.183	$PSFLA, SCF Fluorometer (Volts, 1 minute average)
15	SCF-Turb	0.000	$PSFLA, SCF Turbidity (NTU, 1 minute average)
16	SCF-Turb-V	0.011	$PSFLA, SCF Turbidity (Volts, 1 minute average)
17	tsg_flow_A	2.97	$PSFMA, Flowmeter in-line with PSTSGA, PSOXA, PSFLA (LitersPerMinute, minimum value in 1 minute interval)
18	SWR	0.08	$PSSRA, Short Wave Radiation (W/M^2, 1 minute average)
19	LWR	367.54	$PSSRA, Long Wave Radiation (W/M^2, 1 minute average)
20	LWR_Dome_T	281.33	$PSSRA, LWD Dome Temperature (Deg K, 1 minute average)
21	LWR_Body_T	281.32	$PSSRA, LWD Body Temperature (Deg K, 1 minute average)
22	PAR	1.66	$PSSPA, Surface PAR (uE/Sec/M^2, 1 minute average)
23	MET3A_Temp	8.05	$PSMEA, MET3A Air Temperature (Deg C, 1 minute average)
24	MET3A_RH	100.00	$PSMEA, MET3A Relative Humidity (%, 1 minute average)
25	MET3A_Baro	1009.72	$PSMEA, MET3A Barometric Pressure (millibars, 1 minute average)
26	MET3A_Precip	11.88	$PSMEA, MET3A Precipitation (mm, 1 minute average)
27	JS_WndDirR	298.92	$PSWDA, Jackstaff Relative wind direction (deg, 1 minute average)
28	JS_WndSpdR	14.40	$PSWDA, Jackstaff Relative wind speed (m/s, 1 minute average)

Field	Data	Example	Units
29	JS_WndDirT	267.05	$PSWDA, Jackstaff True wind direction (deg, 1 minute average)
30	JS_WndSpdT	12.75	$PSWDA, Jackstaff True wind speed (m/s, 1 minute average)
31	MM_WndDirR	286.31	$PSWDB, Main Mast Relative wind direction (deg, 1 minute average)
32	MM_WndSpdR	13.58	$PSWDB, Main Mast Relative wind speed (m/s, 1 minute average)
33	MM_WndDirT	251.95	$PSWDB, Main Mast True wind direction (deg, 1 minute average)
34	MM_WndSpdT	13.35	$PSWDB, Main Mast True wind speed (m/s, 1 minute average)
35	SBE_Oxy	6.269	$PSOXA, SBE-43 Oxygen (ml/l, 1 minute average)
36	SBE_Oxy_T	7.652	$PSOXA, SBE-43 Oxygen Temperature(Deg C, 1 minute average)
37	Isus_1	0.083	$PSNTA, Isus Aux 1(Volts, 1 minute average)
38	Isus_2	-6.128	$PSNTA, Isus Aux 2(Volts, 1 minute average)
39	WinchAft	3	Aft A-Frame Winch number
40	TensionAft	-377	Aft A-Frame Winch Wire tension (Pounds, 1 minute average)
41	WireOutAft	8	Aft A-Frame Winch Wire out (Meters, 1 minute average)
42	SpeedAft	0	Aft A-Frame Winch Wire speed (Meters/minute, 1 minute average)
43	WinchSbd	1	Starboard A-Frame Winch number
44	TensionSbd	-156	Starboard A-Frame Winch Wire tension (Pounds, 1 minute average)
45	WireOutSbd	1	Starboard A-Frame Winch Wire out (Meters, 1 minute average)
46	SpeedSbd	0	Starboard A-Frame Winch Wire speed(Meters/minute, 1 minute average)
47	StbdWndSpdT	18.73	RMYoung True Wind Speed, starboard (Knots, 1 minute average)
48	StbdWndDirT	251.2	RMYoung True Wind Direction, starboard (angular distance from 0 (North) clockwise through 360, 1 minute average)
49	OxySat	6.78	Dissolved oxygen (DO) saturation as a funciton of T and S (Weiss)(ml/L, 1 minute average)
50	AOU	0.51	Apparent Oxygen Utilization (AOU)(ml/L,1 minute average)

FILE FORMATS OF DATA COLLECTED UNDERWAY

In the sections below for each data type the directory name is listed, then an example file name, and then 3 lines from that file. This part is followed by a table that lists the data contained in the string.

./SCS_DATA

The following data types are to be found in the SCS_Data directory.

Underway Data

Meteorology Data

R. M. Young Sensors

R.M. Young Air Temperatures

Temperature, humidity, air pressure data in NMEA XDR format from the RM Young meteorological system.
./rmyoung_air
RMYoung-Air_20070414-182437.Raw
04/14/2007,18:24:40.693,$WIXDR,C, -6.62,C,1,H, 89,P,1,C, -8.06,C,1,P, 994.24,B,2,D,-35,M,3hh
04/14/2007,18:24:46.677,$WIXDR,C, -6.49,C,1,H, 89,P,1,C, -7.93,C,1,P, 994.32,B,2,D,-35,M,3hh
04/14/2007,18:24:49.678,$WIXDR,C, -6.49,C,1,H, 89,P,1,C, -7.93,C,1,P, 994.24,B,2,D,-35,M,3hh

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:49.678	hh:mm:ss.sss
3	NMEA header	$WIXDR	ASCI text
4	Data type for field 5	C	Temperature
5	Air Temperature	-6.62	Celsius
6		C	
7		1	
8	Data Type for field 9	H	ASCII character
9	Relative Humidity	89	Percent
10		P	
11		1	
12	Data type for field 13	C	
13	Dew Point Temperature	-8.06	Celsius
14		C	
15		1	
16	Data type for field 17	P	Pressure
17	Barometer	994.24	hPa
18		B	
19		2	
20	Data type for field 20	D	
21	Elevation	-35	Meters
22		M	
23		3hh	

R.M. Young Air Temperatures, Fahrenheit (Derived)

Temperature data from the RM Young wind sensor in Fahrenheit.

Data is derived from data from files in the rmyoung_air directory.
./AIR_TEMP_F
AirTemp-F_20070413-000000.Raw
04/13/2007,00:00:02.074,$DERIV,28.83,-1.76,
04/13/2007,00:00:05.074,$DERIV,28.62,-1.88,
04/13/2007,00:00:08.074,$DERIV,28.62,-1.88,

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/13/2007	mm/dd/year
2	SCS logged Time GMT	00:00:02.074	hh:mm:ss.sss
3	NMEA header	$DERIV	ASCI text
4	Air Temperature	28.83	Fahrenheit
5	Air Temperature	-1.76	Celsius

R.M. Young Wind. Port

Wind speed and direction data in NMEA WMV format from the RM Young weather vane on the port side of the Healy.
./rmyportwind
RMYPortWind_20070414-182437.Raw
04/14/2007,18:24:38.490,$WIMWV,033,R,028.1,N,A*36
04/14/2007,18:24:39.505,$WIMWV,041,R,028.7,N,A*35
04/14/2007,18:24:40.521,$WIMWV,034,R,029.4,N,A*35

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:38.490	hh:mm:ss.sss
3	NMEA header	$WIMWV	ASCII text
4	Wind Direction	033	Degrees
5	R= Relative	R	ASCII character
6	Wind Speed	028.1	Knots
7	N= Knots	N	ASCII character
8	A= Valid Data	A	ASCII character
9	Check sum	*36	ASCII text

R.M. Young Wind, Starboard

Wind speed and direction data in NMEA WMV format from the RM Young weather vane on the starboard side of the Healy.
./rmstbwind
RMYStbdWind_20070414-182437.Raw
04/14/2007,18:24:38.677,$WIMWV,044,R,025.4,N,A*3E
04/14/2007,18:24:39.693,$WIMWV,045,R,025.6,N,A*3D
04/14/2007,18:24:40.724,$WIMWV,042,R,025.2,N,A*3E

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:38.677	hh:mm:ss.sss
3	NMEA header	$WIMWV	ASCII text
4	Wind Direction	044	Degrees
5	R= Relative	R	ASCII character
6	Wind Speed	025.4	Knots
7	N= Knots	N	ASCII character
8	A= Valid Data	A	ASCII character
9	Check sum	*3E	ASCII text

R.M. Young Wind True, Port (Derived)

True wind speed data derived from gyro data and rmyportwind.
./true_wind_port
PortWnd-T_20070415-000000.Raw
04/15/2007,00:00:03.927,$DERIV,18.59,4.57,30.6,12,12.5,343.7,344.2,
04/15/2007,00:00:05.927,$DERIV,19.69,10.28,31.4,16,12.5,344.2,344.2,
04/15/2007,00:00:07.927,$DERIV,19.85,3.73,31.8,12,12.4,344.1,344.2,

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	,00:00:03.927	hh:mm:ss.sss
3	NMEA header	$DERIV	ASCII text
4	Wind Speed derived	18.59	knots
5	Wind Directions derived	4.57	degrees
6	Wind Speed relative	30.6	knots
7	Wind Direction relative	12	direction
8	Speed over ground (pos mv)	12.5	knots
9	Course over ground (pos mv)	343.7	Degrees
10	Heading (pos mv)	344.2	Degrees

R.M. Young Wind True, Starboard (Derived)

True wind speed data derived from gyro data and rmystbdwind.
./true_wind_stbd
StbdWnd-T_20070415-000000.Raw
04/15/2007,00:00:03.396,$DERIV,17.33,3.47,29.4,11,12.5,343.7,344.2,
04/15/2007,00:00:05.396,$DERIV,17.05,15.29,28.5,18,12.5,344.2,344.2,
04/15/2007,00:00:07.396,$DERIV,19.99,13.31,31.4,18,12.4,344.1,344.2,

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:07.396	hh:mm:ss.sss

3	NMEA header	$DERIV	ASCII text
4	Wind Speed derived	19.99	knots
5	Wind Directions derived	13.31	degrees
6	Wind Speed relative	31.4	knots
7	Wind Direction relative	18	direction
8	Speed over ground (pos mv)	12.4	knots
9	Course over ground (pos mv)	344.1	Degrees
10	Heading (pos mv)	344.2	degrees

Dew Point (Derived)

Dew Point derived from rmyoung_air.
./dew_point_f
DewPt-F_20070414-182437.Raw
04/14/2007,18:24:41.099,$DERIV,17.49,-8.06,
04/14/2007,18:24:44.099,$DERIV,17.73,-7.93,
04/14/2007,18:24:47.099,$DERIV,17.73,-7.93,

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:47.099	hh:mm:ss.sss
3	NMEA header	$DERIV	ASCII text
4	Air Temperature	17.73	Fahrenheit
5	Air Temperature	-7.93	Celsius

Jack Staff Meteorological Senors

Weather Sensors on top of the Jack Staff.
./met3a_sen
MET3A-Sen_20080312-000000.Raw
03/12/2008,21:02:17.810,$PSMEA,-6.29,83.89,1018.43,14.17*5C
03/12/2008,21:02:19.810,$PSMEA,-6.28,83.90,1018.45,14.18*5C
03/12/2008,21:02:21.810,$PSMEA,-6.28,83.90,1018.45,14.17*53

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/12/2008	mm/dd/year
2	SCS logged Time GMT	21:02:17.810	hh:mm:ss.sss
3	NMEA header	$PSMEA	ASCII text
4	Air Temperature	-6.29	Celsius
5	Relative Humidity	83.89	%
6	Barometric Pressure	1018.45	milibars
7	Precipitation, total accumulation	14.17	milimetersP
8	Check sum	*5C	ASCII text

* The Precipitation sensor is zeroed at 50 millimeters and starts from 0 millimeters again.

Jack Staff Wind Sensors

Wind Sensors on top of the Jack Staff.
./wind_sen_a
WIND-SEN-A_20080312-000000.Raw
03/12/2008,21:18:00.841,$PSWDA,52.45,13.92,341.17,14.81*62
03/12/2008,21:18:02.856,$PSWDA,53.55,14.15,333.55,15.14*64
03/12/2008,21:18:04.841,$PSWDA,52.27,14.48,337.10,14.35*6F

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/12/2008	mm/dd/year
2	SCS logged Time GMT	21:18:00.841	hh:mm:ss.sss
3	NMEA header	$PSWDA	ASCII text
4	Relative Wind Direction	52.45	degrees
5	Relative Wind Speed	13.92	m/s
6	True Wind Direction	341.17	degrees
7	True Wind Speed	14.81	m/s
8	Check sum	*62	ASCII text

Yard Arm Wind Senors

Wind Sensors on top of the Jack Staff.
/wind_sen_b
WIND-SEN-B_20080312-000000.Raw
03/12/2008,21:49:48.919,$PSWDB,45.64,15.53,325.29,14.45*68
03/12/2008,21:49:50.919,$PSWDB,46.55,15.48,328.82,13.39*63
03/12/2008,21:49:52.919,$PSWDB,46.36,15.48,326.14,14.68*64

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/12/2008	mm/dd/year
2	SCS logged Time GMT	21:49:48.919	hh:mm:ss.sss
3	NMEA header	$PSWDB	ASCII text
4	Relative Wind Direction	45.64	degrees
5	Relative Wind Speed	15.53	m/s
6	True Wind Direction	325.29	degrees
7	True Wind Speed	14.45	m/s
8	Check sum	*68	ASCII text

Solar Radiometers

Photosynthetic Active Radiation (PAR) Sensor

Photosynthetic Active Radiation Microeinstens/m2 sec and volts from the surface PAR sensor on top of HCO.
./suface_par

Surface-PAR_20080312-000000.Raw
03/12/2008,22:02:46.872,$PSSPA,1749.51,1.056*4C
03/12/2008,22:02:48.872,$PSSPA,1755.43,1.060*47
03/12/2008,22:02:50.888,$PSSPA,1755.43,1.060*47

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/12/2008	mm/dd/year
2	SCS logged Time GMT	22:02:46.872	hh:mm:ss.sss
3	NMEA header	$PSSPA	ASCII text
4	Surface PAR	1749.51	MicroEinstiens sec /m*2
5	Surface PAR	1.056	Volts
6	Check sum	*4C	ASCII text

Solar Radiometers (Short and Long Wave), Pyranometer and Pyrgeometer

Solar Radiometers data from the sensors on top of HCO. The short wave radiometer is the Pyranometer and the Long wave radiometer is the Pyrgeometer.
/solar_radiometers
SRM_20080314-000000.Raw
03/14/2008,12:31:43.329,$PSSRA,1.20,0.010,338.30,0.034,276.02,1.192,275.97,1.194*44
03/14/2008,12:31:45.329,$PSSRA,1.20,0.010,338.30,0.034,276.02,1.192,275.97,1.194*44
03/14/2008,12:31:47.328,$PSSRA,1.20,0.010,339.20,0.037,276.02,1.192,275.97,1.194*47

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/14/2008	mm/dd/year
2	SCS logged Time GMT	12:31:43.329	hh:mm:ss.sss
3	NMEA header	$PSSRA	ASCII text
4	Short Wave Radiation	1.20	W/m*2
5	Short Wave Radiation, RAW	0.010	millivolts
6	Long Wave Radiation (LWR)	338.30	W/m*2
7	LWR, RAW	0.034	millivolts
8	LWR, Dome temperature	276.02	Degrees Kelvin
9	LWR, Some temp, RAW	1.192	volts
10	LWR, Body temperature	275.97	Degrees Kelvin
11	LWR, Body temp, RAW	1.194	volts
12	Check sum	*44	ASCII text

SAMOS (Shipboard Automated Meteorological and Oceanographic Systems)

Data formatted to be sent to the U.S. Research Vessel Surface Meteorology Data Assembly Center (DAC).
These data are in files that have only a single value. Every variable sent into SAMOS is in a separate file. The name of the file should tell the user what the variable is.
There are two types of formats used. The bulk of the data has the date, time, a NMEA header for derived

data, the mean data for the minute, the last value used in the minute, the total of all the values for the minute and the number of values used to get the mean. The other is for data that is in degrees. The data for degrees has the date, time, a NMEA header for derived data, the mean data for the minute found using the arc tangent of the sine and cosine of the data, the last data value for the minute, the mean of the sums of the sin of the data, the mean of the sum of the cosines of the data and the number of values used to get the mean.
For calculation of the True wind direction and speed value for SAMOS the method is a less accurate one. The directions are calculated as described above with the means of the sine and cosine of the angles applied to the arctangent for an average heading. The True winds are only a mean of the values entered. In the future (2009???) the direction and speed averages will be calculated using the vectors these data represent.

Example Format for most variables

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/25/2008	mm/dd/year
2	SCS logged Time GMT	00:00:04.710	hh:mm:ss.sss
3	NMEA header	$DERIV	
4	mean value	7.71	
5	Last value used	7.712	
6	Sum of values	215.893	
7	number of values	28	

Example file using the Oxygen data:
SAMOS-OX_20080325-000000.Raw
03/25/2008,00:00:04.710,$DERIV,7.71,7.712,215.893,28,
03/25/2008,00:00:06.132,$DERIV,7.71,7.712,223.605,29,
03/25/2008,00:00:07.475,$DERIV,7.71,7.709,223.605,29,

Example Format for data in Degrees

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.505	hh:mm:ss.sss
3	NMEA header	$DERIV	ASCII text
4	Arctangent of the Sums	79.39	
5	Last value used	93.174	
6	Mean of the Sines	57.4453621646971	
7	Mean of the Cosines	10.7645427712987	
8	number of values	59	

Example file using the Jack Staff True Wind data:
SAMOS-TIB_20080326-000000.Raw
03/26/2008,00:00:04.561,$DERIV,321.84,319.15,36.9644472519094,47.0329478291115,60,
03/26/2008,00:00:06.045,$DERIV,321.72,317.79,36.436429442339,46.173817552869,59,
03/26/2008,00:00:07.092,$DERIV,321.66,317.79,37.1082793162236,46.9145049005139,60,
The data filenames each have a 2 letter data type designator to tell what kind of data is in the file. The

files are named:

SAMOS	The start of the filename for SAMOS data
OX	Data type, here for Oxygen
20080325	Date, year, month and day of the month
000000	Time in hour, minute and seconds in UTC

The above file name would be: SAMOS-OX_20080325-000000.Raw

SAMOS Data Designator Keys

Parameter	Designator Key
Air temperature	AT
Air temperature $PSMEA(2)	AT1
Atm. pressure	BP
Atm. Pressure $PSMEA(4)	BP1
Conductivity $PSTSA(3)	TC
Course over ground	CR
Depth to Surface	BT
Dewpoint temperature	DP
Earth relative wind direction	TIP
Earth relative wind direction $PSWDA(4)	TIB
Earth relative wind direction $PSWDB(4)	TIS1
Earth Relative Wind Direction Stbd	TIS
Earth relative wind speed	TKP
Earth relative wind Speed $PSWDA(5)	TWB
Earth relative wind speed $PSWDB(5)	TWS
Earth Relative Wind Speed Stbd	TKS
Flow through TSG $PSFMA(2)	FI
Heading	GY
Heave	VH
Latitude	LA
Longitude	LO
Longitudinal Water Speed Fore - Aft	SL
Longwave radiation $PSSRA(4)	LW
Longwave radiation $PSSRA(6)	LD
Longwave radiation $PSSRA(8)	LB
Oxygen $PSOXA(2)	OX
Oxygen $PSOXA(4)	OT
Photosynthetically Active Radiation $PSSPA(2)	PA
Pitch	VP

POS-MV Heading	SH
Precipitation $PSMEA(5)	PR
Relative humidity	RH
Relative humidity $PSMEA(3)	RH1
Roll	VR
Salinity $PSTSA(4)	SA
Sea Surface Temp $PSSTA(2)	ST
Ship relative wind direction	WDP
Ship relative wind direction $PSWDA(2)	WDB
Ship relative wind direction $PSWDB(2)	WDS1
Ship Relative Wind Direction Stbd	WDS
Ship relative wind speed	WKP
Ship relative wind speed $PSWDA(3)	WSB
Ship relative wind speed $PSWDB(3)	WSS
Ship Relative Wind Speed Stbd	WKS
Shortwave radiation $PSSRA(2)	SW
Speed over ground	SP
Transverse Water Speed Port to Stbd	SX
TSG Fluorometry $PSFLA(2)	FL1
TSG Fluorometry $PSFLB(2)	FL
TSG internal water temp. $PSTSA(2)	TT
Turbidity $PSFLB(4)	TB

Oceanographic Data

Thermosalinograph / Fluorometer

TSG A

Thermosalinograph data from the A TSG, Seabird SBE45, instruments in the Bio Chem Lab.
/tsg_a
TSG-A_20080313-000000.Raw
03/13/2008,04:46:03.355,$PSTSA,2.565,28.4522,31.526,1456.01*7E
03/13/2008,04:46:05.340,$PSTSA,2.566,28.4529,31.526,1456.02*75
03/13/2008,04:46:07.355,$PSTSA,2.565,28.4519,31.525,1456.01*75

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	04:46:03.355	hh:mm:ss.sss
3	NMEA header	$PSTSA	ASCII text

4	Temperature	2.565	Celsius
5	Conductivity	28.4522	Siemens/meter
6	Salinity	31.526	PSU
7	Sound Velocity	1456.01	Meters per Second (m/s)
8	Check sum	*7E	ASCII text

TSG B

Thermosalinograph data from the B, Seabird SBE21, TSG instruments in the Bio Chem Lab.
NOT Collected on HLY0805
/tsg_b
TSG-B_20080313-000000.Raw
03/13/2008,04:46:03.355,$PSTSB,2.565,28.4522,31.526,1456.01*7E
03/13/2008,04:46:05.340,$PSTSB,2.566,28.4529,31.526,1456.02*75
03/13/2008,04:46:07.355,$PSTSB,2.565,28.4519,31.525,1456.01*75

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	04:46:03.355	hh:mm:ss.sss
3	NMEA header	,$PSTSB	ASCII text
4	Temperature	2.565	Celsius
5	Conductivity	28.4522	Siemens/meter
6	Salinity	31.526	PSU
7	Sound Velocity	1456.01	Meters per Second (m/s)
8	Check sum	*7E	ASCII text

Sea Surface Temperature

Sea surface temperature from the Science sea water intake. This uses a Sdeabird SBE3S Sensor.
/Surface_temp
Sea-Surface_20080313-000000.Raw
03/13/2008,05:46:40.402,$PSSTA,2.039,2945.900*7E
03/13/2008,05:46:42.402,$PSSTA,2.039,2945.900*7E
03/13/2008,05:46:44.402,$PSSTA,2.039,2945.900*7E

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	05:46:40.402	hh:mm:ss.sss
3	NMEA header	$PSSTA	ASCII text
4	Surface temperature (Sea Chest)	2.039	Celsius
5	Temperature, RAW	2945.900	volts
6	Check sum	*7E	ASCII text

Theromsalinograph Flowmeter A

Flow meter A, Flocat C-ES45-B003, data from the A TSG instruments in the Bio/Chem Lab.
/flomet_a
FlowMeter-A_20080314-000000.Raw
03/14/2008,13:44:44.640,$PSFMA,2.51,38.000*44
03/14/2008,13:44:46.624,$PSFMA,2.64,40.000*4D
03/14/2008,13:44:48.624,$PSFMA,2.64,40.000*4D

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/14/2008	mm/dd/year
2	SCS logged Time GMT	13:44:44.640	hh:mm:ss.sss
3	NMEA header	$PSFMA	ASCII text
4	Flow meter	2.51	Liters/minute
5	Flow meter, RAW	38.000	frequency
6	Check sum	*44	ASCII text

Theromsalinograph Flowmeter B

Flowmeter B, Flocat C-ES45-B003, data from the B TSG instruments in the Bio/Chem Lab.
NOT Collected on HLY0805

/flomet_b
TSG-B_20080313-000000.Raw
03/13/2008,02:51:49.277,$PSFMB,2.91,15.000*44
03/13/2008,02:51:51.277,$PSFMB,2.91,15.000*44
03/13/2008,02:51:53.261,$PSFMB,2.91,15.000*44

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	02:51:49	hh:mm:ss.sss
3	NMEA header	$PSFMB	ASCII text
4	Flowmeter	2.91	Liters/minute
5	Flowmeter, RAW	15.000	frequency
6	Check sum	*44	ASCII text

Oxygen Sensor A

Oxygen A, SEABIRD SBE-43, data from the A TSG instruments in the Bio/Chem Lab.
./oxygen_a
OXYGEN-A_20080313-000000.Raw
03/13/2008,05:25:28.371,$PSOXA,7.265,2.922,2.576,2.576*58
03/13/2008,05:25:30.386,$PSOXA,7.265,2.922,2.577,2.577*58
03/13/2008,05:25:32.371,$PSOXA,7.268,2.923,2.576,2.576*54

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year

2	SCS logged Time GMT	05:25:28.371	hh:mm:ss.sss
3	NMEA header	$PSOXA	ASCII text
4	Oxygen	7.265	ml/l
5	Oxygen, RAW	2.922	
6	Oxygen Temperature	2.576	Celsius
7	Oxygen Temperature, Raw	2.576	volts
8	Check sum	*58	ASCII text

Oxygen Sensor B

Oxygen B, Aanderaa Optode 3835, data from the B TSG instruments in the Bio/Chem Lab.
NOT Collected on HLY0805

./oxygen_b
OXYGEN-B_20080313-000000.Raw
03/13/2008,05:25:28.371,$PSOXB,7.265,2.922,2.576,2.576*58
03/13/2008,05:25:30.386,$PSOXB,7.265,2.922,2.577,2.577*58
03/13/2008,05:25:32.371,$PSOXB,7.268,2.923,2.576,2.576*54

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	05:25:28.371	hh:mm:ss.sss
3	NMEA header	$PSOXB	ASCII text
4	Oxygen	7.265	ml/l
5	Oxygen, RAW	2.922	
6	Oxygen Temperature	2.576	Celsius
7	Oxygen Temperature, Raw	2.576	volts
8	Check sum	*58	ASCII text

Fluorometer A

Flurometer A data from the A, Seaoint SCF, TSG instruments in the Bio/Chem Lab.
/fluro_a
Fluro-A_20080313-000000.Raw
03/13/2008,03:19:57.277,$PSFLA,0.330,0.033,0.000, 0.010*49
03/13/2008,03:19:59.277,$PSFLA,0.330,0.033,0.000,0.010*49
03/13/2008,03:20:01.277,$PSFLA,0.360,0.036,0.000,0.010*49

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	03:19:57.277	hh:mm:ss.sss
3	NMEA header	$PSFLA	ASCII text
4	Flurometer	0.330	Ug/l
5	Flrometer, RAW	0.033	volts

6	Turbidity	0.000	NTU
7	Turbidity, RAW	0.010	volts
8	Check sum	*49	ASCII text

Fluorometer B

Flurometer B, Turner SCUFA, data from the B TSG instruments in the Bio/Chem Lab.
NOT Collected on HLY0805

/fluro_b
Fluro-B_20080313-000000.Raw
3/13/2008,03:24:49.293,$PSFLB,0.910,0.091,0.200,0.020*4B
03/13/2008,03:24:51.293,$PSFLB,0.910,0.091,0.200,0.020*4B
03/13/2008,03:24:53.308,$PSFLB,0.910,0.091,0.200,0.020*4B

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	03:24:49.293	hh:mm:ss.sss
3	NMEA header	$PSFLB	ASCII text
4	Flurometer	0.910	Ug/l
5	Flrometer, RAW	0.091	volts
6	Turbidity	0.200	NTU
7	Turbidity, RAW	0.020	volts
8	Check sum	*4B	ASCII text

Transmissometer

Transmissometer TSG instruments in the Bio/Chem Lab.
/trans
Fluro-B_20080313-000000.Raw
3/13/2008,03:24:49.293,$PSFLB,0.910,0.091,0.200,0.020*4B
03/13/2008,03:24:51.293,$PSFLB,0.910,0.091,0.200,0.020*4B
03/13/2008,03:24:53.308,$PSFLB,0.910,0.091,0.200,0.020*4B
THIS IS YET TO BE Offically INSTALLED AND LOGGED

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/13/2008	mm/dd/year
2	SCS logged Time GMT	03:24:49.293	hh:mm:ss.sss
3	NMEA header	$PSFLB	ASCII text
4	Flurometer	0.910	Ug/l
5	Flrometer, RAW	0.091	volts
6	Turbidity	0.200	NTU
7	Turbidity, RAW	0.020	volts
8	Check sum	*4B	ASCII text

ISUS Nitrate Sensor

ISUS Nitrate Sensor, MBARI/Satlatic ISIS V3, TSG instruments in the Bio/Chem Lab. Data is logged every 5 minutes for about 30 seconds. For the times in between this the values in the volts columns are 0.0
NOT Collected on HLY0805

./isus
Isus_20080422-000000.Raw
04/22/2008,00:04:31.275,$PSNTA,-0.308,0.478*75
04/22/2008,00:04:33.275,$PSNTA,-0.308,0.478*75
04/22/2008,00:04:35.275,$PSNTA,-0.308,0.478*75

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/22/2008	mm/dd/year
2	SCS logged Time GMT	00:04:31.275	hh:mm:ss.sss
3	NMEA header	$PSNTA	ASCII text
4	ISUS Aux 1	-0.308	volts
5	ISUS Aux 2	0.478	volts
6	Check sum	*75	ASCII text

ISUS Nitrate Sensor 3V

ISUS Nitrate Sensor 3V, MBARI/Satlantic ISIS V3, instrument in the Bio/Chem Lab. Data is logged every 5 minutes for a few seconds. The data only gets the SCS time stamp at the start of data being sent in that time window. These files are very large. A more complete description of this format is below in a section from the Satlantic Operation Manual's format section. The example of the data below only shows the first 6 columns of data.
NOT Collected on HLY0805

./isus
ISUSV3_20080422-000000.Raw
04/22/2008,00:00:53.167,,4623,9021,....   This is the first line that gets the SCS time stamp
SATNLF0141,2008112,23.928082,-4.82,19.99,407.63,...
SATNLF0141,2008112,23.928759,-4.65,20.32,403.75,...
SATNLF0141,2008112,23.928759,-4.65,20.32,403.75,...
SATNLF0141,2008112,23.929436,-5.05,20.59,405.80,...

FIELD	DATA	Example	UNITS
1	Instrument	SATNLF0141	ASCII text
2	Date (year, day of year)	2008112	yyyyjjj
3	decimal hours, GMT	23.928082	number
4	Nitrate Concentration	-4.82	uMol/L
5	Aux 1	19.99	volts
6	Aux 2	407.63	ASCII text
7 - n	See Appendix	...	...

Science Seawater Pressure Sensor

The sensor is located in the Bio_Chem lab approx. 30' upstream of the TSG.
On HLY0802 this was installed and started logging on 04/19/2008 at 22:06:02.387Z.
./pressure_sen
Seawater-Pressure-Sensor_20080428-000000.Raw
04/28/2008,00:00:03.401,$PSPSA,25.88,2.588*41
04/28/2008,00:00:05.401,$PSPSA,25.86,2.586*41
04/28/2008,00:00:07.401,$PSPSA,25.92,2.592*41

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/28/2008	mm/dd/year
2	SCS logged Time GMT	00:00:03.401	hh:mm:ss.sss
3	NMEA header	$PSPSA	ASCII text
4	Pressure	25.88	PSI
5	Raw Volts	2.588	Volts
6	Check sum	*41	ASCII text

Sonar Data

Seabeam 2112 Center Beam

Center depth data derived from the Seabeam 2112 data on the POSMVNAV computer.
./seabeam_center
Seabeam-Centerbeam_20070414-182437.Raw
04/14/2007,18:24:38.427,$SBCTR,2007,4,14,18:24:35.713,58.119110,-169.839278,70.70,60*00
04/14/2007,18:24:40.177,$SBCTR,2007,4,14,18:24:37.213,58.119152,-169.839367,70.49,61*00
04/14/2007,18:24:40.615,$SBCTR,2007,4,14,18:24:38.734,58.119193,-169.839452,70.92,60*00

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:40.615	hh:mm:ss.sss
3	NMEA header	$SBCTR	ASCII text
4	Seabeam Date	2007,	Year
5	Seabeam Date	4	month
6	Seabeam Date	14	day
7	Seabeam Time	18:24:38.734	hh:mm:ss.sss
8	Latitude	58.119193	Degrees
9	Longitude	-169.839452	Degrees
10	Depth	70.92	meters
11	Number of Beams	60	
12	Check sum	*00	ASCII text

Knudsen

3.5 kHz

Depth data in a proprietary PKEL format received from Knudsen 320 B/R serial output.
./knudsen
Knudsen_20070414-182437.Raw
04/14/2007,18:24:38.099,$PKEL99, ,14042007,182524.248,00192,HF,00.00,0,+008.50, LF,73.24,1,+008.50,1500, , ,58 07.123897N,169 50.315830W,1060*12
04/14/2007,18:24:38.349,$PKEL99, ,14042007,182525.759,00191,HF,00.00,0,+008.50,LF,73.22,1,+008.50,1500,------, ,58 07.127267N,169 50.322883W,0565*1F
04/14/2007,18:24:39.865,$PKEL99, ,14042007,182527.269,00191,HF,00.00,0,+008.50,LF,73.22,1,+008.50,1500, , ,58 07.128948N,169 50.326409W,1078*10

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:39.865	hh:mm:ss.sss
3	NMEA header	$PKEL99	ASCII text
4	Record Number???	------	
5	Knudsen Date	14042007	DDMMYYYY
6	Knudsen Time	182527.269	HHMMSS.sss
7		00191	
8	HF Header (12 kHz)	HF	ASCII text
9	HF Depth to Surface	00.00	Meters *
10	HF Draft	,+008.50	Meters
11	LF Header	LF	ASCII text
12	LF Depth to Surface	73.22	Meters *
13	LF Depth Valid Flag	1	ASCII integer
14	LF Draft	+008.50	Meters
15	Sound Speed	1500	Meters Per Second**
18	Latitude	58 07.128948N	DD MM.MMMMMM***
19	Longitude	169 50.326409W	DDD MM.MMMMMM***
20	Position Latency	1078	
21	Checksum	*10	

* Knudsen depth is currently set for XXXXXXX Meters
** Knudsen default sound speed 1500 meters/sec.
*** Current GPS source is the POS/MV

Winch data

Starboard A-Frame Winch Data

4 samples per second data from the Starboard A Frame winch data output.
./sbd_a_frame
Stbd-A-Frame_20070418-000000.Raw
04/18/2007,06:13:18.281,01, 890, , 36, , -27, ,0000
04/18/2007,06:13:19.250,01, 890, , 35, , -28, ,0000
04/18/2007,06:13:20.235,01, 900, , 35, , -28, ,0000

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/18/2007	mm/dd/year
2	SCS logged Time GMT	06:13:20.235	hh:mm:ss.sss
3	Winch number	01	
4	Wire tension	900	Pounds
5	Wire out	35	Meters
7	Wire speed	-28	Meters/minute

Aft A-Frame Winch Data

1 second data from the Aft A Frame winch data output.
./aft_a_frame
Aft-A-Frame_20070418-000000.Raw
04/18/2007,08:46:45.844,02, -160, , 31, , 58, ,0000
04/18/2007,08:46:46.844,02, -160, , 32, , 60, ,0000
04/18/2007,08:46:47.812,02, -160, , 33, , 60, ,0000

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/18/2007	mm/dd/year
2	SCS logged Time GMT	08:46:47.812	hh:mm:ss.sss
3	Winch number	02	
4	Wire tension	-160	Pounds
5	Wire out	33	Meters
7	Wire speed	60	Meters/minute

Navigational Data

POSMV

The POSMV location on the ship is software shifted to the Master Reference Point (MRP) (See the ship diagram below) from it’s location atop the HCO shack.

POSMV GGA

Position data in NMEA GGA format from the POS/MV.
./posmv_gga
POSMV-GGA_20070415-000000.Raw
04/15/2007,00:00:03.052,$INGGA,000002.737,5830.47054,N,17012.64182,W,2,08,1.0,1.80,M,,,4,0297*07
04/15/2007,00:00:04.052,$INGGA,000003.737,5830.47385,N,17012.64365,W,2,08,1.0,1.76,M,,,5,0297*0A
04/15/2007,00:00:05.052,$INGGA,000004.737,5830.47716,N,17012.64550,W,2,08,1.0,1.71,M,,,6,0297*07

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.052	hh:mm:ss.sss
3	NMEA header	$INGGA	ASCII text
4	GPS time at position GMT	000004.737	hhmmss.sss
5	Latitude	5830.47716	ddmm.mmmmm
6	North (N) or South(S)	N	ASCII character
7	Longitude	17012.64550	dddmm.mmmmm
8	East (E) or West (W)	W	ASCII character
9	GPS Quality: 1 = GPS2=DGPS	2	
10	Number of GPS Satellites Used	08	
11	HDOP (horizontal dilution of precision)	1.0	
12	Antenna height	1.71	meters
13	M for Meters	M	
14	Geoidal Height		meters
15	M for Meters		
16	Differential reference station ID	0297	
17	Checksum	*07	

POSMV Psuedo Noise

Psuedorange error statistics in NMEA GST format from the POS/MV.
./posmv_gst
POSMV-Pseudo-Noise_20070415-000000.Raw
04/15/2007,00:00:02.990,$INGST,000002.737,,0.6,0.4,22.3,0.4,0.6,0.8*63
04/15/2007,00:00:03.990,$INGST,000003.737,,0.6,0.4,22.3,0.4,0.6,0.8*62
04/15/2007,00:00:04.990,$INGST,000004.737,,0.6,0.4,22.3,0.4,0.6,0.8*65

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.052	hh:mm:ss.sss
3	NMEA header	$INGST	ASCII text

4	GPS time at position GMT	000004.737	hhmmss.sss
5			
6	Smjr.smjr	0.6	meters
7	Smnr.smnr	0.4	meters
8	000.0	22.3	
9	l.l	0.4	meters
10	y.y	0.6	meters
11	Standard deviation of altitude (a.a)	0.8	meters
12	Checksum	*65	ACII text

POSMV HDT

Heading data in NMEA HDT format from the POS/MV.
./posmv_hdt
POSMV-HDT_20070415-000000.Raw
04/15/2007,00:00:03.083,$INHDT,344.2,T*24
04/15/2007,00:00:04.083,$INHDT,344.2,T*24
04/15/2007,00:00:05.083,$INHDT,344.2,T*24

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.083	hh:mm:ss.sss
3	NMEA header	$INHDT	ASCII text
4	Heading	344.2	Degrees
5	True(T) or Magnetic(M)	T	ASCII character
6	Checksum	*24	ASCII text

POSMV PASHR

Pitch and Roll data in NMEA PASHR format from the POS/MV.
./posmv_pashr
POSMV-PASHR_20070415-000000.Raw
04/15/2007,00:00:02.912,$PASHR,000002.737,344.17,T,-0.21,0.10,-0.02,0.017,0.017,0.011,2,1*17
04/15/2007,00:00:03.912,$PASHR,000003.737,344.19,T,-0.22,0.10,-0.02,0.017,0.017,0.011,2,1*1B
04/15/2007,00:00:04.912,$PASHR,000004.737,344.20,T,-0.24,0.10,-0.02,0.017,0.017,0.011,2,1*10

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.052	hh:mm:ss.sss
3	NMEA header	$PASHR	ASCII text
4	Time GMT	000004.737	hhmmss.sss
5	Heading	344.20	heading
6	True	T	ASCII character

7	Roll	-0.24	Degrees
8	Pitch	0.10	Degrees
9	Heave	-0.02	Degrees
10	Accuracy roll	0.017	Degrees
11	Accuracy pitch	0.017	Degrees
12	Accuracy heading	0.011	Degrees
13	Accuracy of heading 0-no aiding, 1-GPS 2= GPS & GAMS	2	ASCII integer
14	IMU 0= out 1= satisfactory	1	ASCII character
15	Check Sum	*10	ASCI text

POSMV VTG

Course and speed over ground in NMEA VTG format from the POS/MV.
./posmv_vtg
POSMV-VTG_20070415-000000.Raw
04/15/2007,00:00:03.130,$INVTG,343.7,T,,M,12.5,N,23.1,K*75
04/15/2007,00:00:04.130,$INVTG,344.0,T,,M,12.5,N,23.1,K*75
04/15/2007,00:00:05.115,$INVTG,344.2,T,,M,12.5,N,23.1,K*77

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.115	hh:mm:ss.sss
2	NMEA header	$INVTG	ASCII text
3	Heading	344.2	Degrees
4	Degrees true (T)	T	ASCII character
5	Heading		Degrees
6	Degrees magnetic	M	ASCII character
7	Ship Speed	12.5	knots
8	N=Knots	N	ASCII character
9	Ship Speed	23.1	km/hr
10	K=KM per hour	K	ASCII character
11	Check sum	*77	ASCII text

POSMV ZDA

Time and date data in NMEA ZDA format from the POS/MV.
./posm_zda
POSMV-ZDA_20070415-000000.Raw
04/15/2007,00:00:03.162,$INZDA,000003.0016,15,04,2007,,*77
04/15/2007,00:00:04.162,$INZDA,000004.0016,15,04,2007,,*70
04/15/2007,00:00:05.162,$INZDA,000005.0016,15,04,2007,,*71

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.162	hh:mm:ss.sss
2	NMEA header	$INZDA	ASCII text
3	Time UTC	000005.0016	HHMMSS.ssss
4	Day	15	DD
5	Month	04	MM
6	Year	2007	Year
7	??		??
8	??	00	??
9	Checksum	*71	ASCII text

Ashtech GPS

Ashtech Attitude

Attitude in NMEA format from the Ashtech ADU5 GPS receiver.
./ashtech_attiude
Ashtech-Attitude_20070415-000000.Raw
04/15/2007,00:00:03.490,$GPPAT,000003.00,5830.44196,N,17012.62728,W,00030.21,344.3730,000.25,-000.01,0.0015,0.0074,0*42
04/15/2007,00:00:04.490,$GPPAT,000004.00,5830.44527,N,17012.62914,W,00030.23,344.3537,000.20,-000.06,0.0015,0.0071,0*4A
04/15/2007,00:00:05.490,$GPPAT,000005.00,5830.44859,N,17012.63099,W,00030.23,344.3431,000.22,-000.07,0.0014,0.0077,0*41

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.490	hh:mm:ss.sss
3	NMEA header	$GPPAT	ASCII text
4	GPS time at position GMT	000005.00	hhmmss.ss
5	Latitude	5830.44859	ddmm.mmmmm
6	North (N) or South(S)	N	ASCII character
7	Longitude	17012.63099	dddmm.mmmmm
8	East (E) or West (W)	W	ASCII character
9	Altitude	00030.23	Meters
10	Heading	344.3431	Degrees
11	Pitch	000.22	Degrees
12	Roll	-000.07	degrees
13	Attitude phase measurement rms error, MRMS	0.0014	meters

14	Attitude baseline length rms error, BRMS	0.0077	meters
15	Attitude reset flag (0:good attitude, 1:rough estimate or bad attitude)	0	ASCII integer
16	Check sum	*41	ASCII text

Ashtech GGA

Position data in NMEA GGA format from the Ashtech ADU5 GPS receiver.
./ashtech_gga
Ashtech-GGA_20070415-000000.Raw
04/15/2007,00:00:02.333,$GPGGA,000002.00,5830.43864,N,17012.62542,W,1,13,0.7,20.74,M,9.47,M,,*73
04/15/2007,00:00:03.333,$GPGGA,000003.00,5830.44196,N,17012.62728,W,1,13,0.7,20.75,M,9.47,M,,*7E
04/15/2007,00:00:04.333,$GPGGA,000004.00,5830.44527,N,17012.62914,W,1,13,0.7,20.76,M,9.47,M,,*75

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:04.333	hh:mm:ss.sss
3	NMEA header	$GPGGA	ASCII text
4	GPS time at position GMT	000004.00	hhmmss.ss
5	Latitude	5830.44527	ddmm.mmmmm
6	North (N) or South(S)	N	ASCII character
7	Longitude	17012.62914	dddmm.mmmmm
8	East (E) or West (W)	W	ASCII character
9	GPS Quality: 1 = GPS 2=DGPS	1	ASCII integer
10	Number of GPS Satellites Used	13	
11	HDOP (horizontal dilution of precision)	0.7	
12	Antenna height	20.76	meters
13	M for Meters	M	ASCII character
14	Geoidal Height	9.47	meters
15	M for Meters	M	ASCII character
16	Differential reference station ID (no data in sample string)		
17	Checksum	*75	ASCCII text

Ashtech GGL

Position data in NMEA GLL format from the Ashtech ADU5 GPS receiver.
./ashtech_ggl
Ashtech-GLL_20070415-000000.Raw
04/15/2007,00:00:03.271,$GPGLL,5830.44196,N,17012.62728,W,000003.00,A,A*74

04/15/2007,00:00:04.255,$GPGLL,5830.44527,N,17012.62914,W,000004.00,A,A*7C
04/15/2007,00:00:05.255,$GPGLL,5830.44859,N,17012.63099,W,000005.00,A,A*74

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.255	hh:mm:ss.sss
3	NMEA header	$GPGLL	ASCI text
4	Latitude	5830.44859	ddmm.mmmmm
5	North or South	N	ASCII character
6	Longitude	17012.63099	dddmm.mmmmm
7	East or West	W	ASCII character
8	GMT of Position	000005.00	hhmmss.ss
9	Status of data (A=valid)	A	ASCII character
10	???	A	
11	Checksum	*74	ASCII text

Ashtech HDT

Heading data in NMEA HDT format from the Ashtech ADU5 GPS receiver.
./ashtech_hdt
Ashtech-HDT_20070415-000000.Raw
04/15/2007,00:00:03.505,$GPHDT,344.373,T*31
04/15/2007,00:00:04.505,$GPHDT,344.354,T*34
04/15/2007,00:00:05.505,$GPHDT,344.343,T*32

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.505	hh:mm:ss.sss
3	NMEA header	$GPHDT	ASCII text
4	Heading	344.343	Degrees
5	True(T) or Magnetic(M)	T	ASCII character
6	Checksum	*32	ASCII text

PCode

PCode AFT

PCODE AFT GGA
Position data in NMEA GGA format from the Trimble Centurion receiver located in the Computer lab.
./pcode_aft_gga
PCode-AFT-GGA_20070415-000000.Raw
04/15/2007,00:00:03.443,$GPGGA,000002.522,5830.4417,N,17012.6249,W,1,04,1.5,019.8,M,-008.9,M,,*51
04/15/2007,00:00:04.427,$GPGGA,000003.522,5830.4450,N,17012.6267,W,1,04,1.5,019.8,M,-

008.9,M,,*5F
04/15/2007,00:00:05.427,$GPGGA,000004.522,5830.4483,N,17012.6286,W,1,04,1.5,019.8,M,-008.9,M,,*59

FIELD	DATA	Examples	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.427	h:mm:ss.sss
3	NMEA header	$GPGGA	ASCII text
4	GPS time at position GMT	000004.522	hhmmss.ss
5	Latitude	5830.4483	ddmm.mmmm
6	North (N) or South(S)	N	ASCII character
7	Longitude	17012.6286	dddmm.mmmm
8	East (E) or West (W)	W	ASCII character
9	GPS Quality: 1 = GPS 2=DGPS	1	ASCII integer
10	Number of GPS Satellites Used	04	
11	HDOP (horizontal dilution of precision)	1.5	
12	Antenna height	019.8	meters
13	M for Meters	M	ASCII character
14	Geoidal Height	-008.9	meters
15	M for Meters	M	ASCII character
16	Differential reference station ID (no data in sample string)		
17	Checksum	*59	ASCII text

PCode Aft GLL

Position data in NMEA GLL format from the Trimble Centurion receiver located in the Computer lab.
./pcode_aft_gll
Pcode-AFT-GLL_20070415-000000.Raw
04/15/2007,00:00:03.474,$GPGLL,5830.4417,N,17012.6249,W,000002.522,A*25
04/15/2007,00:00:04.474,$GPGLL,5830.4450,N,17012.6267,W,000003.522,A*2
04/15/2007,00:00:05.490,$GPGLL,5830.4483,N,17012.6286,W,000004.522,A*2D

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.490	hh:mm:ss.sss
3	NMEA header	$GPGLL	ASCI text
4	Latitude	5830.4483	ddmm.mmmm
5	North or South	N	ASCII character
6	Longitude	17012.6286	dddmm.mmmm
7	East or West	W	ASCII character
8	GMT of Position	000004.522	hhmmss.sss
9	Status of data (A=valid)	A	ASCII character

10	Checksum	*2D	ASCVII text

PCode AFT VTG

Course and speed over ground in NMEA VTG format from the Trimble Centurion receiver located in the Computer lab.

./pcode_aft_vtg

Pcode-AFT-VTG_20070415-000000.Raw

04/15/2007,00:00:03.537,$GPVTG,343.7,T,331.4,M,012.4,N,023.0,K*4E
04/15/2007,00:00:04.537,$GPVTG,343.6,T,331.3,M,012.5,N,023.1,K*48
04/15/2007,00:00:05.537,$GPVTG,343.6,T,331.3,M,012.4,N,023.0,K*48

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.537	hh:mm:ss.sss
2	NMEA header	$GPVTG	ASCI text
3	Heading	343.6	Degrees
4	Degrees true (T)	T	ASCII character
5	Heading	331.3	Degrees
6	Degrees magnetic	M	ASCII character
7	Ship Speed	012.4	knots
8	N=Knots	N	ASCII character
9	Ship Speed	023.0	km/hr
10	K=KM per hour	K	ASCII character
11	Check sum	*48	ASCII text

PCode AFT ZDA

Time and date data in the NMEA ZDA format. Data retrieved from the Trimble Centurion receiver located in the Computer lab.

./pcode_aft_zda

Pcode-AFT-ZDA_20070415-000000.Raw

04/15/2007,00:00:03.224,$GPZDA,000003.00,15,04,2007,00,00,*4C
04/15/2007,00:00:04.224,$GPZDA,000004.00,15,04,2007,00,00,*4B
04/15/2007,00:00:05.224,$GPZDA,000005.00,15,04,2007,00,00,*4A

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.537	hh:mm:ss.sss
2	NMEA header	$GPZDA	ASCII text
3	Time UTC	000005.00	hhmmss.sss
4	Day	15	DD
5	Month	04	MM
6	Year	2007	Year
7	??	00	??

8	??	00	??
9	Checksum	*4A	ASCII text

PCode Bridge

PCode Bridge GGA

Position data in NMEA GGA format from the Trimble GPS receiver located on the bridge.
./pcode_bridge_gga
PCode-Bridge-GGA_20070415-000000.Raw
04/15/2007,00:00:03.037,$GPGGA,000002.00,5830.469,N,17012.644,W,1,04,2.666,32.15,M,8.930,M,,*4D
04/15/2007,00:00:05.037,$GPGGA,000004.00,5830.476,N,17012.648,W,1,04,2.667,31.82,M,8.930,M,,*45
04/15/2007,00:00:07.052,$GPGGA,000006.00,5830.482,N,17012.651,W,1,04,2.668,31.55,M,8.930,M,,*41

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:07.052	hh:mm:ss.sss
3	NMEA header	$GPGGA	ASCII text
4	GPS time at position GMT	000006.00	hhmmss.ss
5	Latitude	5830.482	ddmm.mmm
6	North (N) or South(S)	N	ASCII character
7	Longitude	17012.651	dddmm.mmm
8	East (E) or West (W)	W	ASCII character
9	GPS Quality: 1 = GPS 2=DGPS	1	ASCII integer
10	Number of GPS Satellites Used	04	
11	HDOP (horizontal dilution of precision)	2.668	
12	Antenna height	31.55	meters
13	M for Meters	M	ASCII character
14	Geoidal Height	8.930	meters
15	M for Meters	M	ASCII character
16	Differential reference station ID (no data in sample string)		
17	Checksum	*41	ASCII text

PCode Bridge GLL

Position data in NMEA GLL format from the Trimble GPS receiver located on the bridge.
./pcode_bridge_gll
Pcode-Bridge-GLL_20070415-000000.Raw
04/15/2007,00:00:03.099,$GPGLL,5830.469,N,17012.644,W,000002.00,A*12
04/15/2007,00:00:05.099,$GPGLL,5830.476,N,17012.648,W,000004.00,A*16
04/15/2007,00:00:07.099,$GPGLL,5830.482,N,17012.651,W,000006.00,A*17

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:07.099	hh:mm:ss.sss
3	NMEA header	$GPGLL	ASCII text
4	Latitude	5830.482	ddmm.mmm
5	North or South	N	ASCII character
6	Longitude	17012.651	dddmm.mmm
7	East or West	W	ASCII character
8	GMT of Position	000006.00	hhmmss.ss
9	Status of data (A=valid)	A	
10	Checksum	*17	ASCII text

PCode Bridge VTG

Course and speed over ground data in NMEA VTG format from the Trimble GPS receiver located on the bridge.
./pcode_bridge_vtg
Pcode-Bridge-VTG_20070415-000000.Raw
04/15/2007,00:00:03.162,$GPVTG,343.9,T,333.8,M,12.46,N,23.08,K*40
04/15/2007,00:00:05.162,$GPVTG,343.8,T,333.8,M,12.49,N,23.12,K*45
04/15/2007,00:00:07.146,$GPVTG,343.9,T,333.8,M,12.48,N,23.11,K*46

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:07.146	hh:mm:ss.sss
2	NMEA header	$GPVTG	ASCII text
3	Heading	343.9	Degrees
4	Degrees true (T)	T	ASCII character
5	Heading	333.8	Degrees
6	Degrees magnetic	M	ASCII character
7	Ship Speed	12.48	knots
8	N=Knots	N	ASCII character
9	Ship Speed	23.11	km/hr
10	K=KM per hour	K	ASCII character
11	Check sum	*46	ASCII text

Glonass

Glonass GGA

Position data in NMEA GGA format from the GLONASS GPS receiver.
./glonass_gga
Glonass-GGA_20070415-000000.Raw

04/15/2007,00:00:02.412,$GPGGA,000002.00,5830.472078,N,17012.636881,W,1,09,0.9,22.999,M,9.46,M,,*49
04/15/2007,00:00:03.396,$GPGGA,000003.00,5830.475412,N,17012.638716,W,1,09,0.9,23.000,M,9.46,M,,*40
04/15/2007,00:00:04.412,$GPGGA,000004.00,5830.478732,N,17012.640527,W,1,09,0.9,22.932,M,9.46,M,,*4D

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:04.412	hh:mm:ss.sss
3	NMEA header	$GPGGA	ASCII text
4	GPS time at position GMT	000004.00	hhmmss.ss
5	Latitude	5830.478732	ddmm.mmmmmm
6	North (N) or South(S)	N	ASCII character
7	Longitude	17012.640527	dddmm.mmmmmm
8	East (E) or West (W)	W	ASCII character
9	GPS Quality: 1 = GPS 2=DGPS	1	ASCII integer
10	Number of GPS Satellites Used	09	
11	HDOP (horizontal dilution of precision)	0.9	
12	Antenna height	22.932	meters
13	M for Meters	M	ASCII character
14	Geoidal Height	9.46	meters
15	M for Meters	M	ASCII character
16	Differential reference station ID (no data in sample string)		
17	Checksum	*4D	ASCII text

Glassnos GLL

Position data in NMEA GLL format from the GLONASS GPS receiver.
./glassnos_gll
Glonass-GLL_20070415-000000.Raw
04/15/2007,00:00:03.240,$GPGLL,5830.475412,N,17012.638716,W,000003.00,A*12
04/15/2007,00:00:04.255,$GPGLL,5830.478732,N,17012.640527,W,000004.00,A*16
04/15/2007,00:00:05.255,$GPGLL,5830.482216,N,17012.642424,W,000005.00,A*11

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.255	hh:mm:ss.sss
3	NMEA header	$GPGLL	ASCII text
4	Latitude	5830.482216	ddmm.mmmmmm
5	North or South	N	ASCII character
6	Longitude	17012.642424	dddmm.mmmmmm
7	East or West	W	ASCII character

8	GMT of Position	000005.00	hhmmss.ss
9	Status of data (A=valid)	A	ASCII character
10	Checksum	*74	ASCII text

Gyro

Gyro Heading

MK27 GYRO
Heading data in NMEA HDT format from the Sperry MK27 gyrocompass.
./gyro_mk27
Gyro-MK27_20080314-000000.Raw
03/14/2008,00:00:01.467,$HEHDT,53.94,T*24
03/14/2008,00:00:01.577,$HEHDT,53.94,T*24
03/14/2008,00:00:01.671,$HEHDT,53.94,T*24

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/14/2008	mm/dd/year
2	SCS logged Time GMT	00:00:01.467	hh:mm:ss.sss
3	NMEA header	$HEHDT	ASCII text
4	Heading	53.94	degrees
5	True (T) or Magnetic (M)	T	ASCII character
6	Check sum	*24	ASCII text

MK39 Gyro

Heading data in NMEA HDT format from the Sperry MK39 gyrocompass.
./gyro_mk39
Gyro-MK39_20080314-000000.Raw
03/14/2008,00:00:01.327,$INHDT,53.70,T*24
03/14/2008,00:00:01.436,$INHDT,53.70,T*24
03/14/2008,00:00:01.530,$INHDT,53.70,T*24

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/14/2008	mm/dd/year
2	SCS logged Time GMT	00:00:01.327	hh:mm:ss.sss
3	NMEA header	$HEHDT	ASCII text
4	Heading	53.70	degrees
5	True (T) or Magnetic (M)	T	ASCII character
6	Check sum	*24	ASCII text

Waypoints

IBS Waypoints

Waypoints from the Healy's Integrated Bridge System (IBS).
./ibs_waypoints
IBS-WayPoints_20070415-000000.Raw
04/15/2007,00:00:03.193,$NVWPL,6152.68,N,17402.58,W,62*51
04/15/2007,00:00:04.193,$NVWPL,6156.58,N,17422.68,W,63*56
04/15/2007,00:00:05.193,$NVWPL,6202.16,N,17439.96,W,64*52

FIELD	DATA	Example	UNITS
1	SCS logged Date		mm/dd/year
2	SCS logged Time GMT	00:00:05.193	hh:mm:ss.sss
3	NMEA header	$NVWPL	ASCII text
4	Latitude	6202.16	ddmm.mm
5	North or South	N	ASCII character
6	Longitude	17439.96	dddmm.mm
7	East or West	W	ASCII character
8	Waypoint number	64	
9	Checksum	*52	ASCII text

SPEED LOG

Sperry Speed Log

Ground/water speed data from the Sperry Speed Log.
./sperry_speedlog
Sperry-Speedlog_20070415-000000.Raw
04/15/2007,00:00:02.755,$VDVBW,12.32,0.85,A,12.43,0.66,A*5A
04/15/2007,00:00:03.271,$VDVBW,12.33,0.80,A,12.44,0.66,A*59
04/15/2007,00:00:03.771,$VDVBW,12.34,0.78,A,12.45,0.68,A*56

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:03.771	hh:mm:ss.sss
2	NMEA header	$VDVBW	ASCII text
3	Fore-aft Water Speed - = astern	12.34	knots
4	Port-Stbd Water Speed - = port	0.78	knots
5	A= Data Valid V=Invalid	A	ASCII character
6	Fore-aft Bottom Speed - = astern	12.45	knots
7	Port-Stbd Bottom Speed - = port	0.68	knots
8	A= Data Valid V=Invalid	A	ASCII character

9	Checksum	*56	ASCII text

Sound Velocimeter

SV2000

Sound Velocity data from the SV2000 sound velocimeter.
./sv2000
Sound-Velocimeter_20080314-000000.Raw
03/14/2008,00:00:24.999, 1470.87
03/14/2008,00:00:55.030, 1470.87
03/14/2008,00:01:25.045, 1470.87

FIELD	DATA	Example	UNITS
1	SCS logged Date	03/14/2008	mm/dd/year
2	SCS logged Time GMT	00:00:24.999	hh:mm:ss.sss
2	NMEA header	1470.87	Meters/sceond

./RAW

The following sections are in the Raw data directory.

75 KHz ADCP data

./adcp75
The shipboard ADCP system measures currents in the depth range from about 30 to 300 m—in good weather. In bad weather or in ice, the range is less, and sometimes no valid measurements are made. ADCP data collection occurs on the Healy for the benefit of the scientists on individual cruises and for the long-term goal of building a climatology of current structure in the Ocean.
The ADCP data set collected during this cruise are placed in the directory ./Raw/adcp75. The archive consists of a single file for each day of data collection. The files are named by the cruise such as HLY0801, a three place number of the sequence in the files, then an extra "_000000", and then an extension for the kind of data in the file. An example of the files for one set is:

FILE NAME	FILE EXTENSION	DEFINITION
HLY0703022_000000	.ENR	Raw Binary ADCP Data
HLY0703022_000000	.ENS	Binary Adcp Data
HLY0703022_000000	.ENX	Binary Ensemble Data
HLY0703022_000000	.STA	short term average
HLY0703022_000000	.LTA	long term average
HLY0703022_000000	.N1R	Raw NMEA ASCII
HLY0703022_000000	.N2R	Raw NMEA ASCII
HLY0703022_000000	.NMS	Averaged Nav Data

150 Khz ADCP data

./adcp150

The shipboard ADCP system measures currents in the depth range from about 30 to 300 m—in good weather. In bad weather or in ice, the range is less, and sometimes no valid measurements are made. ADCP data collection occurs on the Healy for the benefit of the scientists on individual cruises and for the long-term goal of building a climatology of current structure in the Ocean.
The ADCP data set collected during this cruise are placed in the directory ./Raw/adcp150. The archive consists of a single file for each day of data collection. The files are named by the cruise such as HLY0801, a three place number of the sequence in the files, then an extra "_000000", and then an extension for the kind of data in the file. An example of the files for one set is:

FILE NAME	FILE EXTENSION	DEFINITION
HLY0703022_000000	.ENR	Raw Binary ADCP Data
HLY0703022_000000	.ENS	Binary Adcp Data
HLY0703022_000000	.ENX	Binary Ensemble Data
HLY0703022_000000	.STA	short term average
HLY0703022_000000	.LTA	long term average
HLY0703022_000000	.N1R	Raw NMEA ASCII
HLY0703022_000000	.N2R	Raw NMEA ASCII
HLY0703022_000000	.NMS	Averaged Nav Data

KNUDSEN 320B/R

The Knudsen 320B/R depth sounder can record depth in both 3.5 and 12 kHz mode. The Healy records the 3 - 6kHz data (Sub Bottom Profile) underway. This data is saved in all of the formats that the Knudsen can record data in. These files are in both ASCII and BINARY format (see the table below). This data is also saved as depth in Datalog/Knudsen.
./knudsenraw

FILENAME	FORMAT	DEFINITION
2007_102_0005_004.keb	Binary	Knudsen Playback File
2007_102_0005_008.kea	Ascii	Log of depth, settings and environmental data
2007_102_0005_HF_001.sgy	Binary	SEG-Y extended Seismic format

CTD

Data for the each CTD cast are contained here. These files are in SeaBird software's format. Each cast is in a separately numbered subdirectory.
./ctd

FILENAME	FORMAT	DEFINITION
021.BL	ASCII	Bottle firing information

021.CON	ASCII	The configuration file for the cast
021.HDR	ASCII	Header information for the cast
021.btl	ASCII	Averaged Bottle firing information
021.cnv	ASCII	The data
021.dat	Binary	The data
021.jpg	Binary	Plotted JPEG image of the cast
021.ros	ASCII	Data from when bottles fire
021avg.cnv	ASCII	Meaned 1 meter down cast of the data

Expendable Bathythermograph (XBT)

The file names use the probe type and the sequence number of the XBT or Expendable Sound Velocimeter (XSV in the series used for the cruise.
For HLY0802 No XBTs were taken.
./xbt

FILENAME	EXTENSION	DEFINITION	PROGRAM REQUIRED to read the file
T5_00014.rdf	.RDF	Raw Data Format	Sippican Software
T5_00014.edf	.EDF	Exportable Data Format	Any text/spreadsheet

LDS_DATA

The Lamont Data Logging System (LDS) outputs it's file to LDS_Data. Below are directories in which data is written to.

Navigation

Navigation data are logged in the format they come from the device with a data source stamp and a time stamp added to them in several directories in LDS_Data. These data strings are in NMEA (National Marine Electronics Association) format. You will need a copy of NMEA 183, Standard for Interfacing Marine Electronics Devices, Version 2.3, March 1, 1998, to help you understand the data formats used. These data are also in the SCS_Data directories that are described above in formats that are explained. The web-site http:/www.gpsinformation.org/dale/nmea.htm might help you understand these formats. Example files will be shown below but no formats will be given.

ADU5 (Ashtech GPS)

Data from the Ashtech GPS is written here as it is from the GPS receiver.
./adu5
HLY0801-adu5.y2008d082
adu5 2008:082:00:00:00.1772 $GPGLL,6222.52645,N,16922.29346,W,000000.00,A,A*7B
adu5 2008:082:00:00:00.2942
$GPGGA,000000.00,6222.52645,N,16922.29346,W,1,11,0.8,18.49,M,7.53,M,,*73
adu5 2008:082:00:00:00.3542 $GPVTG,165.20,T,154.20,M,002.86,N,005.29,K,A*23

adu5 2008:082:00:00:00.4152
$GPPAT,000000.00,6222.52645,N,16922.29346,W,00026.02,150.5834,000.30,001.12,0.0015,0.0093,0*62
adu5 2008:082:00:00:00.4241 $GPHDT,150.583,T*3F
adu5 2008:082:00:00:01.1731 $GPGLL,6222.52568,N,16922.29301,W,000001.00,A,A*75
adu5 2008:082:00:00:01.2901
$GPGGA,000001.00,6222.52568,N,16922.29301,W,1,11,0.8,18.50,M,7.53,M,,*75
adu5 2008:082:00:00:01.2920 $GPVTG,164.37,T,153.37,M,002.96,N,005.47,K,A*2C
adu5 2008:082:00:00:01.4110
$GPPAT,000001.00,6222.52568,N,16922.29301,W,00026.03,150.7601,000.28,001.23,0.0017,0.0118,0*6C
adu5 2008:082:00:00:01.4200 $GPHDT,150.760,T*30

Trimble AGGPS

Navigation data from the AGGPS receiver is written here as it is from the GPS receiver.
./aggps
HLY0801-aggps.y2008d082
aggps 2008:082:00:00:00.2252
$GPGGA,000000.00,6222.525857,N,16922.290938,W,2,07,1.2,21.02,M,8.08,M,5.0,0297*54
aggps 2008:082:00:00:00.2832 $GPGLL,6222.525857,N,16922.290938,W,000000.00,A,D*75
aggps 2008:082:00:00:00.3412 $GPVTG,165.5,T,,,002.89,N,005.35,K,D*42
aggps 2008:082:00:00:00.3992
$GPGSV,2,1,07,31,23,093,44,32,25,079,45,23,22,190,46,20,66,229,50*78
aggps 2008:082:00:00:00.4572 $GPGSV,2,2,07,11,51,173,50,14,20,043,42,17,41,279,50,,,,*46
aggps 2008:082:00:00:00.5172 $GPGSA,A,3,31,32,23,20,11,14,17,,,,,,2.6,1.2,2.3*37
aggps 2008:082:00:00:00.5752 $GPZDA,000000.10,22,03,2008,00,00*6E
aggps 2008:082:00:00:00.6332
$GPRMC,000000,A,6222.525857,N,16922.290938,W,002.89,165.5,220308,13.9,E,D*03
aggps 2008:082:00:00:00.6631 $GPGST,000000.00,0.4,1.1,0.9,52.2,1.0,1.0,2.7*6A
aggps 2008:082:00:00:01.2320
$GPGGA,000001.00,6222.525073,N,16922.290454,W,2,07,1.2,20.94,M,8.08,M,3.6,0297*52
aggps 2008:082:00:00:01.2902 $GPGLL,6222.525073,N,16922.290454,W,000001.00,A,D*7D

POSMV Attitude

The Attitude data from the POSMV is written here.
./posatt
HLY0801-posatt.y2008d082

posatt	2008:082:00:00:00.0082	:06000C	-0004F	0105	0013
posatt	2008:082:00:00:00.1082	:010007	-0003F	0105	0013
posatt	2008:082:00:00:00.2082	:0A0007	-0003F	0105	0013
posatt	2008:082:00:00:00.3082	:01000C	-0004F	0105	0013
posatt	2008:082:00:00:00.4082	:09011E	-0003F	0105	0013
posatt	2008:082:00:00:00.5081	:0A000C	-0003F	0105	0013
posatt	2008:082:00:00:00.6081	:04011E	-0003F	0105	0013

POSMV GPS

The data from the POSMV GPS is written here.
./posnav
HLY0801-posnav.y2008d082
posnav 2008:082:00:00:00.0502 $INZDA,000000.0043,22,03,2008,,*78
posnav 2008:082:00:00:00.1922 $PASHR,000000.069,150.36,T,1.05,0.13,-0.03,0.019,0.019,0.011,2,1*35
posnav 2008:082:00:00:00.1923 $PRDID,0.13,1.05,150.36*7E
posnav 2008:082:00:00:00.2502 $INGST,000000.069,,0.7,0.5,18.0,0.7,0.5,1.1*6F
posnav 2008:082:00:00:00.3112 $INGGA,000000.069,6222.50218,N,16922.26144,W,2,09,0.9,-2.73,M,,,4,0297*23
posnav 2008:082:00:00:00.3642 $INHDT,150.4,T*25
posnav 2008:082:00:00:00.3643 $INVTG,169.7,T,,M,3.0,N,5.5,K*7A
posnav 2008:082:00:00:01.0501 $INZDA,000001.0043,22,03,2008,,*79
posnav 2008:082:00:00:01.1920 $PASHR,000001.069,150.53,T,1.04,0.13,-0.03,0.019,0.019,0.011,2,1*36

POSMV Navigation for the SeaBeam

The SeaBeam only needs specific navigation data. So the POSMV data is reformatted SeaBeam and sent to the SeaBeam for use by it.
./posreform2sb
HLY0801-posreform2sb.y2008d082
posreform2sb 2008:082:00:00:00.366 $NVVBW,3.0,0.1,A,3.0,0.1,A*5B
posreform2sb 2008:082:00:00:00.366 $NVHDT,150.36,T*0B
posreform2sb 2008:082:00:00:00.366 $NVGLL,6222.5022,N,16922.2614,W,000000.07,A*10
posreform2sb 2008:082:00:00:01.366 $NVVBW,3.1,0.1,A,3.1,0.1,A*5B
posreform2sb 2008:082:00:00:01.366 $NVHDT,150.53,T*08
posreform2sb 2008:082:00:00:01.366 $NVGLL,6222.5014,N,16922.2611,W,000001.07,A*11
posreform2sb 2008:082:00:00:02.368 $NVVBW,3.2,0.1,A,3.2,0.1,A*5B

Automatic Identification System (AIS) messages

Automatic Identification System (AIS) messages as encapsulated VDM sentences. The bit-by-bit descriptions of the contents of these messages are documented in tables contained in the ITU-R M.1371 international standard for AIS.
./ais
HLY0805-ais.y2008d247
ais 2008:247:23:58:55.5902 !AIVDM,1,1,,B,34eQ;R3Oi3Dk3Q0dpKVSoC3d00u0,0*40
ais 2008:247:23:59:02.0952 !AIVDM,1,1,,B,34eQ;R3Oi6Dk3jPdpKS3k3400000,0*19
ais 2008:247:23:59:02.6691 !AIVDM,1,1,,B,34Qle<001=Dd4WndsdttQ:040000,0*7B
ais 2008:247:23:59:08.3642 !AIVDM,1,1,,B,14eQ;R3019Dk454dpKPCf34<00Sa,0*4F
ais 2008:247:23:59:09.4160 !AIVDM,1,1,,B,34Qle<0Oi=Dd4JndseELPb2@00uA,0*52

SeaBeam Data

SeaBeam Center Beam Data

The data from the SeaBeam's center beam is stripped out of the data file and used for displays around the ship. This data is also available as described above.
./sbctr
HLY0801-sbctr.y2008d082

sbctr	2008:082:00:00:03.8623	$SBCTR,2008,3,22,00:00:01.222,62.375023,-169.371017,33.82,43*00
sbctr	2008:082:00:00:05.3697	$SBCTR,2008,3,22,00:00:02.742,62.375000,-169.371010,33.92,51*00
sbctr	2008:082:00:00:07.7156	$SBCTR,2008,3,22,00:00:04.252,62.374975,-169.371002,36.19,40*00
sbctr	2008:082:00:00:08.1426	$SBCTR,2008,3,22,00:00:05.762,62.374957,-169.370990,33.32,40*00
sbctr	2008:082:00:00:09.8221	$SBCTR,2008,3,22,00:00:07.272,62.374932,-169.370985,31.89,46*00
sbctr	2008:082:00:00:11.6578	$SBCTR,2008,3,22,00:00:08.992,62.374903,-169.370970,32.48,42*00
sbctr	2008:082:00:00:13.5820	$SBCTR,2008,3,22,00:00:10.502,62.374870,-169.370955,34.15,48*00
sbctr	2008:082:00:00:16.1493	$SBCTR,2008,3,22,00:00:13.522,62.374817,-169.370927,34.30,45*00
sbctr	2008:082:00:00:17.6985	$SBCTR,2008,3,22,00:00:15.032,62.374790,-169.370912,33.82,43*00
sbctr	2008:082:00:00:19.5798	$SBCTR,2008,3,22,00:00:16.552,62.374760,-169.370890,33.47,55*00

Speed of Sound in the Surface Water for SeaBeam

The SeaBeam needs the Speed of Sound at the surface. This is calculated from the Sea Chest intake water temperature and the TSG Salinity. The water temperature and Salinity are also in this file.
./sbsv
HLY0801-sbsv.y2008d082

sbsv	2008:082:00:00:00.4142	1439.5,	-1.72,	0033.7,0
sbsv	2008:082:00:00:02.4138	1439.5,	-1.72,	0033.7,0
sbsv	2008:082:00:00:04.4146	1439.5,	-1.72,	0033.7,0
sbsv	2008:082:00:00:06.4222	1439.5,	-1.73,	0033.7,0
sbsv	2008:082:00:00:08.3860	1439.5,	-1.73,	0033.7,0
sbsv	2008:082:00:00:10.4126	1439.5,	-1.73,	0033.7,0
sbsv	2008:082:00:00:12.4142	1439.5,	-1.73,	0033.7,0
sbsv	2008:082:00:00:14.4140	1439.5,	-1.73,	0033.7,0
sbsv	2008:082:00:00:16.3947	1439.5,	-1.73,	0033.7,0
sbsv	2008:082:00:00:18.3864	1439.5,	-1.73,	0033.7,0

Raw SeaBeam Files

The Raw SeaBeam data files are here. These are in the SeaBeam 2112 format. To use these files you will need a tool such as the MB-System Software package that can be found at LDEO. The files are named using the year, day of year and time.
./seabeam
sb20080812300.mb41
sb20080820000.mb41
sb20080820100.mb41
sb20080820200.mb41

sb20080820300.mb41
sb20080820400.mb41
sb20080820500.mb41
sb20080820600.mb41
sb20080820700.mb41
sb20080820800.mb41
sb20080820900.mb41

Gyroscope data

There are 2 Sperry Gyroscopes running the MK27 and the MK30 on the ship. These contain heading of the ship.

MK27 Sperry Gyroscope

./mk27
0801-mk27.y2008d082

mk27	2008:082:00:00:0.0556	$HEHDT,150.94,T*16
mk27	2008:082:00:00:0.1452	$HEHDT,150.95,T*17
mk27	2008:082:00:00:0.1876	$HEROT,7.07,A*1B
mk27	2008:082:00:00:0.3013	$HEXDR,A,150.95,D,HDG,A,-0.97,D,ROLL,A,-0.24,D,PITCH*48
mk27	2008:082:00:00:0.3432	$HEHDT,150.97,T*15
mk27	2008:082:00:00:0.3855	$HEHDT,150.98,T*1A
mk27	2008:082:00:00:0.4516	$HEHDT,151.00,T*1A
mk27	2008:082:00:00:0.5452	$HEHDT,151.02,T*18
mk27	2008:082:00:00:0.6495	$HEHDT,151.03,T*19
mk27	2008:082:00:00:0.6936	$HEROT,8.06,A*15
mk27	2008:082:00:00:0.7453	$HEHDT,151.05,T*1F

MK30 Sperry Gyroscope

./mk30
HLY0801-mk30.y2008d082

mk30	2008:082:00:00:00.0159	$INHDT,150.68,T*1F
mk30	2008:082:00:00:00.0666	$INROT,9,A*36
mk30	2008:082:00:00:00.1142	$INHDT,150.69,T*1E
mk30	2008:082:00:00:00.1602	$INROT,9,A*36
mk30	2008:082:00:00:00.2205	$INHDT,150.71,T*17
mk30	2008:082:00:00:00.2646	$INROT,9,A*36
mk30	2008:082:00:00:00.3142	$INHDT,150.72,T*14
mk30	2008:082:00:00:00.3623	$INROT,10,A*0E
mk30	2008:082:00:00:00.4186	$INHDT,150.74,T*12
mk30	2008:082:00:00:00.4633	$INROT,10,A*0E
mk30	2008:082:00:00:00.5142	$INHDT,150.76,T*10
mk30	2008:082:00:00:00.5725	$INROT,10,A*0E

mk30 2008:082:00:00:00.6166 $INHDT,150.77,T*11

All SIO TSG and MET Data

All of the data from the SIO TSG and Meteorological Sensors are sent in one serial line. All of these data have different NMEA strings and formats. These are listed above. This is a single file for all these data. This data is also in the SCS data sections above. The format for this file can be seen in the file Healy_MET_Mar_1_2008.txt.

./tsg_met
HLY0801-tsg_met.y2008d082
tsg_met 2008:082:00:00:00.3272 $PSSRA,501.80,4.190,349.54,0.257,261.02,1.951,261.51,1.922*4E
tsg_met 2008:082:00:00:00.3275 $PSSPA,1665.98,1.006*43
tsg_met 2008:082:00:00:00.3542 $PSMEA,-11.56,87.90,1022.45,0.03*51
tsg_met 2008:082:00:00:00.3543 $PSWDA,240.50,11.88,243.30,11.08*5C
tsg_met 2008:082:00:00:00.3872 $PSWDB,234.33,10.31,233.57,11.74*57
tsg_met 2008:082:00:00:00.4142 $PSSTA,-1.721,2708.200*52
tsg_met 2008:082:00:00:00.4143 $PSTSA,-1.274,27.0231,33.728,1441.48*5C
tsg_met 2008:082:00:00:00.4432 $PSTSB,,,,*46
tsg_met 2008:082:00:00:00.4432 $PSOXA,7.350,2.768,-1.274,-1.274*5F
tsg_met 2008:082:00:00:00.4433 $PSOXB,,,,*56
tsg_met 2008:082:00:00:00.4732 $PSFLA,0.300,0.030,0.000,0.013*4A
tsg_met 2008:082:00:00:00.5012 $PSFLB,1.150,0.115,0.430,0.043*4B
tsg_met 2008:082:00:00:00.5013 $PSNTA,0.000,0.000*58
tsg_met 2008:082:00:00:00.5311 $PSFMA,3.04,46.000*4C
tsg_met 2008:082:00:00:00.5313 $PSFMB,3.30,17.000*4C
tsg_met 2008:082:00:00:00.5371 $GPZDA,000000.00,22,03,2008,00,00*6F

Gravity

Two Gravimeters are being recorded from the IC no-Gyro room.

BGM221

./bgm221
HLY0801-bgm221.y2008d082
bgm221 2008:082:00:00:00.5731 04:025278 00
bgm221 2008:082:00:00:01.5661 04:025279 00
bgm221 2008:082:00:00:02.5661 04:025279 00

FIELD	DATA	Example	UNITS
1	Data Stream Name	bgm221	ASCII text
2	LDS logged Time GMT	2008:082:00:00:00.5731	yyyy:jjj:hh:mm:ss.sss
3	measurement period in quarters of a second	04	quarters of a second
4	“counts” proportional to observed gravity	025278	counts

5	status flags	00	0 = OK

BGM222

./bgm222
HLY0801-bgm222.y2008d082
bgm222 2008:082:00:00:00.4962 04:025332 00
bgm222 2008:082:00:00:01.5071 04:025333 00
bgm222 2008:082:00:00:02.4960 04:025332 00

FIELD	DATA	Example	UNITS
1	Data Stream Name	bgm222	ASCII text
2	LDS logged Time GMT	2008:082:00:00:00.4962	yyyy:jjj:hh:mm:ss.sss
3	measurement period in quarters of a second	04	quarters of a second
4	“counts” proportional to observed gravity	025332	counts
5	status flags	00	0 = OK

Events in Running LDS

The files here are logs of LDS start and stops of different data loggers.
./events
Some examples files here are:
HLY0801-ev-adcp_nav.y2008d073
HLY0801-ev-adcp_nav.y2008d081
HLY0801-ev-adcp_rph.y2008d073
HLY0801-ev-adcp_rph.y2008d081
HLY0801-ev-adu5.y2008d073
HLY0801-ev-aggps.y2008d073
HLY0801-ev-bgm221.y2008d073
HLY0801-ev-bgm222.y2008d073
This file HLY0801-ev-posreform2sb.y2008d073 contains:
posreform2sb 2008:073:20:22:50.0857 LOGGER_STARTUP N/A starting up...
posreform2sb 2008:073:20:22:50.0857 OTHER N/A succeeded in locking in memory

UNDERWAY SENSORS AND CALCULATIONS

HLY0805 - Shipboard Sensors

Sensor	Description	Serial #	Last Calibration Date	Status
Meteorology & Radiometers				
Port Anemometer	RM Young 09101	L001	02/06/07	Collected
Stbd Anemometer	RM Young 09101	L003	03/07/07	Collected

Barometer	RM Young 612011	BP01643	02/22/08	Collected
Air Temp/Rel. Hum.	RM Young 41382V	13352	02/22/08	Collected
Helo shack PAR	BSI QSR-2200	20270	01/09/07	Collected
Shortwave Radiation	Eppley labs - PSP	35032F3	08/01/07	Collected
Longwave Radiation	Eppley labs PIR	34955F3	08/17/07	Collected
Barometer	Paroscientific MET3A	101757	06/27/07	Collected
Bow Temperature	Paroscientific MET3A	101757	06/27/07	Collected
Precipitation	Paroscientific MET3A	101757	06/27/07	Collected
Relative Humidity	Paroscientific MET3A	101757	06/27/07	Collected
Jack Staff Ultrasonic Anemometer	RM Young 85004	00703	09/20/07	Collected
Yard Arm Stb Ultrasonic Anemometer	RM Young 85004	00704	09/20/07	Collected
Underway Ocean				
TSG A	SeaBird SBE45	0215	08/01/07	Collected
TSG B	SeaBird SBE45	3107	01/16/08	Not Collected
Remote Sea Temp	SeaBird SBE3S	4063	12/13/07	Collected
Fluorometer B	Turner SCUFA	0600	12/15/07	Collected
Fluorometer A	Seapoint SCF	SCF2957	12/15/07	Collected
Oxygen Sensor A	SeaBird SBE-43	1307	09/28/07	Collected
Oxygen Sensor B	Aanderaa Optode 3835	719	11/21/07	Collected
Nitrate Sensor	MBARI ISUS v3	141	10/11/07	Collected
Flowmeter A	Flocat C-ES45-B003	09061005	01/07/08	Collected
Flowmeter B	Flocat C-ES45-B003	02030692	01/07/08	Collected
AC-S Spectral Attenuation and Absorption Meter	Wetlabs	053	01/01/08	Collected
Sonars				
Knudsen- subbottom	320 B/R	K2K-00-0013	N/A	Collected
ADCP 150 kHz	Broad Band (BB150)	80	N/A	Not Collected
ADCP 75 kHz	Ocean Surveyor	172	N/A	Collected
Multibeam	Seabeam 2112	?	N/A	Collected
Speed log	Sperry	?	N/A	Collected some
Navigation				
P-Code GPS (aft)	Trimble Centurion	0220035469	N/A	Collected
Attitude GPS	Ashtech ADU5	AD520033513	N/A	Collected
DGPS	Trimble AGGPS-AG132	0224016199	N/A	Collected

POSMV	Model- MV V4	2306	N/A	Collected
P-Code GPS (fwd)	Rockwell	?	N/A	Collected
Glonass	?	?	N/A	Collected
GYRO 1	Sperry MK39 PN 03956-1982416-2	340	?	Collected
GYRO 2	Sperry MK27A 4800880-1	025	N/A	Collected

HLY0805 - CTD Sensors

Sensor	Comments	Serial #	Last service/ Calibration Date	Status
CTD fish	SBE 911plus	639	01/18/08	
Pressure Sensor #1	Digiquartz with TC	83012	01/18/08	Collected
Temperature #1	SBE3- Primary	2855	01/21/08	Collected
Temperature #2	SBE3- Secondary	2796	01/27/08	Collected
Conductivity #1	SBE4- Primary	2568	01/18/08	Collected
Conductivity #2	SBE4- Secondary	2561	01/18/08	Collected
Pump	SBE5 Primary	3115	01/08	NA
Pump	SBE5 Secondary	3112	01/08	NA
Deck Unit	SBE 11-Plus V2	0417	12/07	NA
Altimeter	PSA916	843	01/08	Collected
Oxygen	SBE43	458	12/12/07	Collected
Fluorometer	Chelsea-Aquatrack3	088234	03/07	Collected
Transmisometer	Wetlabs	CST-390DR	01/08	Collected
PAR	Bioshperical QSP2300	70115	01/07	Collected
Carousel	SBE32- 12 place	347	01/08	NA

HLY0805 Sensor Calculations

The coefficients for temperature, conductivity, fluorometer and turbidity sensors can be found in the calibrations sheets below in the Appendix.

Calculating Temperature – ITS-90

T = decimal equivalent of bytes 1-4
Temperature Frequency: $f = T/19 + 2100$
Temperature = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Calculating Conductivity – ITS-90

C = decimal equivalent of bytes 5-8
Conductivity Frequency f = sqrt(C*2100+6250000)
Conductivity = $(g + hf^2 + if^3 + jf^4)/[10(1 + \delta t + \varepsilon p)]$ (siemens/meter)
t = temperature (°C); p = pressure (decibars); δ = Ctcor; ε = CPcor

Calculating Fluorometry Voltage

f = decimal equivalent of bytes 15-17
Fluorometry Voltage = f/819

Calculating Transmittance

V_{dark} = 0.058 V
V_{ref} = 4.765 V
t = decimal equivalent of bytes 18 – 20
Transmissometer Voltage (V_{signal}) = t/819
% Transmittance = $(V_{signal} - V_{dark}) / (V_{ref} - V_{dark})$

Calculating PAR for surface PAR

raw data = mV
calibration scale = 6.08 V/(μEinstiens/cm^{2}sec)
offset (V_{dark}) = 0.3 mV
(*raw* mV - V_{dark})/scale x 10^4 cm^2/m^2 x 10^{-3} V/mV= μEinstiens/m^{2}sec
or
(*data* mV – 0.3 mV) x 1.65 (μEinstiens/m^{2}sec)/mV = μEinstiens/m^{2}sec

Calculating Pyrgeometer Values

V = Eppley PIR Thermopile voltage
S = Sensitivity (Calibration factor from Eppley Cal sheet)
S = 3.32
J = Stefan-Boltzmann Constant
J = 5.6697e-8
B = [absorption constant (for Eppley Black paint formula) 0.985 / dome glass IR transmission 0.5]
B= 3.5 for Stock Eppley PIR
Tb = Eppley Body Temperature in degrees Kelvin
Td = Eppley Dome Temperature in degrees Kelvin
Tb and Td calculated as follows:
T = 1/ (a + ln(Vo/Irt)*(b + c*(ln(Vo/Irt)**2)));
Irt = (Vref-Vin)/R1
On Healy R1 = 82500 Vref = 5.0
a= 0.0010295 b= 0.0002391 c = 1.568e-7

W/M2 = V/S + (J * Tb^4) + (B*J*(Tb^4 - Td^4))

CALIBRATIONS

The following pages are replicas of current calibration sheets for the sensors used during this cruise.

Meteorology & Radiometers

R.M. Young Wind Bird, Starboard

Serial # L001

R. M. Young Wind bird Calibration Results
Model # 09101, S/N L003 (Starboard Windbird)

As per Young Meteorological Instruments
Wind System Calibration Manual

Date: 07 Mar 07 Technician: ET1 Berringer / ETC Rodda

Wind speed torque: Passed

Maximum toque = 2.4 gm/cm
Test results:

CW	0.7
CCW	0.7

Wind direction torque: Passed

Maximum toque = 30 gm/cm

Test results:

CW	20 gm/cm
CCW	22 gm/cm

Wind speed signal:

Maximum % error = 1%

Test results: Passed

Actual RPM	Actual Wind Speed	Measured	% Error
200	1.90	1.9	0.21
500	4.76	4.8	0.84
1200	11.42	11.4	0.21
3600	34.27	34.3	0.08
5000	47.60	47.6	0.00

Note; Wind speed in knots = 0.00952 * shaft RPM

Wind direction signal:

Maximum error = +/- 2 degrees

Test results: Failed – off by 1 degree

Actual	Meaured	Error
0	358	-2
30	27	3
60	58	2
90	88	2
120	118	2
150	149	1
180	178	2
210	207	3
240	238	2
270	268	2
300	297	3
330	327	3

R.M. Young Wind Bird Port

Serial # L001

R. M. Young Wind bird Calibration Results
Model # 09101, S/N L001 (Port Windbird)

As per Young Meteorological Instruments
Wind System Calibration Manual

Date: 06 Feb 07 Technician: ET3 Daem / ET2 Davis

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Wind speed torque: Passed

Maximum toque =2.40 gm/cm

Test results:

CW	.2 gm/cm
CCW	.2 gm/cm

Wind direction torque: Passed

Maximum toque = 30 gm/cm

Test results:

CW	10gm/cm
CCW	10gm/cm

Wind speed signal: Passed

Maximum % error = 1%

Test results:

Actual RPM	Actual Wind Speed	Measured	% Error
200	1.90	1.9	0.21
500	4.76	4.8	0.84
1200	11.42	11.4	0.21
3600	34.27	34.3	0.08
5000	47.60	47.6	0.00

Note; Wind speed in knots = 0.00952 * shaft RPM

Wind direction signal: Passed

Maximum error = +/- 2 degrees

Test results:

Actual	Meaured	Error
0	359	-1
30	29	1
60	59	1
90	90	0
120	120	0
150	150	0
180	180	0
210	210	0
240	240	0
270	269	1
300	298	2
330	330	0

Barometer

Serial # BP01643

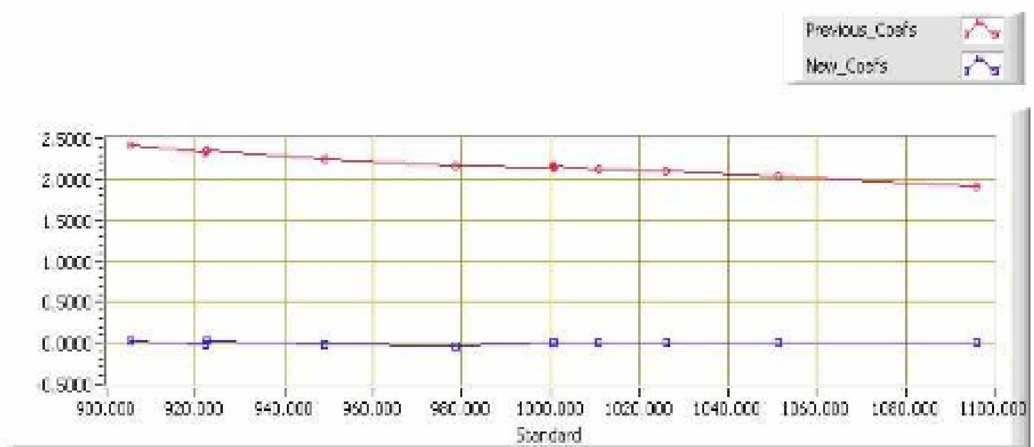
Baro Pres Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: BP01643
CALIBRATION DATE: 22-Feb-08
SENSOR ID: BPR80
Mfg: RM Young   Model: 612011
Previous Cal Date: 01-Jan-00
Calibration Tech: CM
CALIBRATION AT 25.0 DegC

A= 5.98528E+1
B= 8.02635E+2

Calibration Standard: Mfg: Paroscientific   Model: 765-16B   s/n: 101778
Polynomial Order = 1
Xcalc = A*X+B

SENSOR VOLTS	STANDARD DATA	SENSOR New_Coefs	SPRT-INST Prev_Coefs	SPRT-INST New_Coefs
4.901	1095.960	1095.953	1.920	0.007
4.151	1051.090	1051.086	2.028	0.004
3.731	1025.970	1025.963	2.092	0.007
3.475	1010.640	1010.645	2.118	-0.005
3.306	1000.490	1000.479	2.159	0.011
3.314	1000.990	1000.986	2.151	0.004
2.939	978.480	978.517	2.165	-0.037
2.445	948.980	949.001	2.254	-0.021
2.004	922.570	922.555	2.355	0.015
1.998	922.190	922.205	2.326	-0.015
1.713	905.210	905.180	2.413	0.030



Air Temperture

Serial # 13352

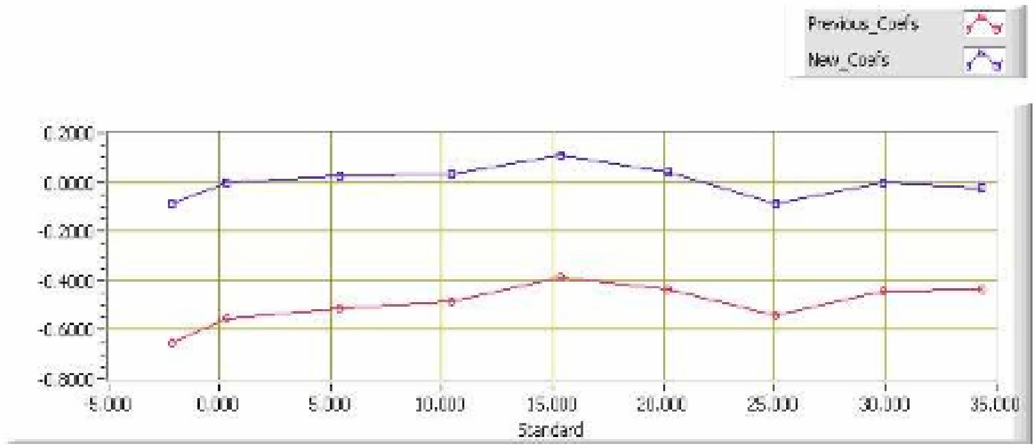
Air Temperature Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 13352
CALIBRATION DATE: 22-Feb-08
SENSOR ID: HRH17
Mfg: RM Young Model: 41382V
Previous Cal Date: 01-Jan-2000
Calibration Tech: CM

A= 1.01413E+2
B= -5.07642E+1

Calibration Standard: Mfg: Seabird Model: SBE35 s/n: 0006
Polynomial Order = 1
Xcalc = A*X+B

SENSOR	STANDARD DATA	SENSOR New_Coefs	SPRT-INST Prev_Coefs	SPRT-INST New_Coefs
0.480	-2.122	-2.035	-0.652	-0.087
0.504	0.337	0.338	-0.557	-0.001
0.554	5.421	5.398	-0.513	0.023
0.603	10.448	10.418	-0.485	0.030
0.651	15.345	15.235	-0.386	0.110
0.699	20.190	20.154	-0.439	0.036
0.748	25.029	25.113	-0.539	-0.084
0.796	29.914	29.920	-0.442	-0.006
0.840	34.361	34.382	-0.439	-0.021



Relative Humidity

PAR

Serial # 20270

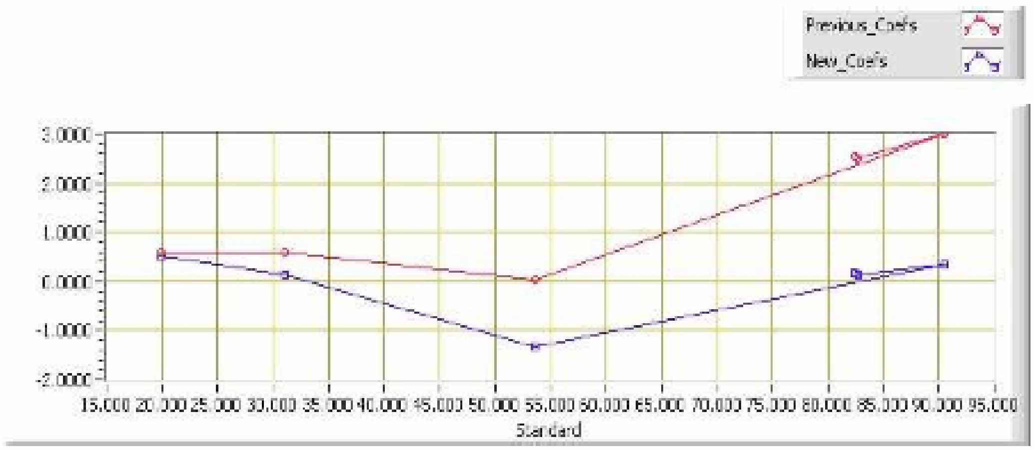
HUMIDITY Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 13352
CALIBRATION DATE: 24-Feb-08
SENSOR ID: HRH17
Mfg: RM Young   Model: 41382V
Previous Cal Date: 01-Jan-2000
Calibration Tech: CM

A= 1.04836E+2
B= -6.79727E-1

Calibration Standard: Mfg: GE Sensing   Model: Humilab   s/n: 0240507
Polynomial Order = 1
Xcalc = A*X+B

SENSOR	STANDARD DATA	SENSOR New_Coefs	SPRT-INST Prev_Coefs	SPRT-INST New_Coefs
0.791	82.450	82.266	2.539	0.184
0.794	82.710	82.560	2.516	0.150
0.866	90.460	90.108	2.994	0.352
0.530	53.570	54.904	0.020	-1.334
0.301	31.000	30.876	0.599	0.124
0.192	19.920	19.396	0.579	0.524



QSR240R 05/24/95

Shortwave Radiation Pyranometer

Serial # 35032F3

THE EPPLEY LABORATORY, INC.

12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
Telephone: 401-847-1020 Fax: 401-847-1031
Email: info@eppleylab.com Internet: www.eppleylab.com

EPLAB
Scientific Instruments
for Precision Measurements
Since 1917

STANDARDIZATION OF EPPLEY PRECISION SPECTRAL PYRANOMETER Model PSP

Serial Number: 35032F3

Resistance: 724 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This radiometer has been compared with Standard Precision Spectral Pyranometer, Serial Number 21231F3 in Eppley's Integrating Hemisphere under radiation intensities of approximately 700 watts meter^{-2} (roughly one half a solar conatant).

As a result of a series of comparisons, it has been found to have a sensitivity of:

8.35 x 10^{-6} volts/watts meter^{-2}

The calculation of this constant is based on the fact that the relationship between radiation intensity and emf is rectilinear to intensities of 1400 watts meter^{-2}. This radiometer is linear to within ± 0.5% up to this intensity.

The calibration of this instrument is traceable to standard self-calibrating cavity pyrheliometers in terms of the Systems Internationale des Unites (SI units), which participated in the Tenth International Pyrheliometric Comparisons (IPC X) at Davos, Switzerland in September-October 2005.

Eppley recommends a minimum calibration cycle of five (5) years but encourages annual calibrations for highest measurement accuracy. Unless otherwise stated in the remarks section below or on the Sales Order, the results are "AS FOUND / AS LEFT".

Useful conversion facts: 1 cal cm^{-2} min^{-1} = 697.3 watts meter^{-2}
1 BTU/ft^{2}-hr^{-1} = 3.153 watts meter^{-2}

Shipped to:
UCSD/SIO
La Jolla, CA

S.O. Number: 61245
Date: August 1, 2007

Date of Test: July 5, 2007

In Charge of Test: R.T. Freeman

Reviewed by: Thomas D Kirk

Remarks:

Longwave Radiation Pyrgeometer

Serial # 34955F3

THE EPPLEY LABORATORY, INC.
12 Sheffield Ave., P.O. Box 419, Newport, RI 02840 USA
Telephone: 401-847-1020 Fax: 401-847-1031
Email: info@eppleylab.com Internet: www.eppleylab.com

EPLAB
Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION INFRARED RADIOMETER Model PIR

Serial Number: 34955F3

Resistance: 708 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This pyrgeometer has been compared against Eppley's Blackbody Calibration System under radiation intensities of approximately 200 watts meter^{-2} and an average ambient temperature of 25°C as measured by Standard Omega Temperature Probe, RTD#1.

As a result of a series of comparisons, it has been found to have a sensitivity of:

3.32 x 10^{-6} volts/watts meter^{-2}

The calculation of this constant is based on the fact that the relationship between radiation intensity and emf is rectilinear to intensities of 700 watts meter^{-2}. This radiometer is linear to within ±1.0% up to this intensity.

The calibration of this instrument is traceable to the International Practical Temperature Scale (IPTS) through a precision low-temperature blackbody.

Eppley recommends a minimum calibration cycle of five (5) years but encourages annual calibrations for highest measurement accuracy. Unless otherwise stated in the remarks section below or on the Sales Order, the results are "AS FOUND / AS LEFT".

Shipped to:
UCSD/SIO
La Jolla, CA

S.O. Number: 61272
Date: August 17, 2007

Date of Test: May 31, 2007

In Charge of Test:

Reviewed by:

Remarks:

Jack Staff MET Station

Serial # 101757

Paroscientific, Inc.
Pressure Instrument Configuration

SN: 101757 Part Number: 1539-004 Model: MET3A Port:

Calibration Date: 27-Jun-07 Report No: 7238 Technician: WMR

Pressure Range: 500 to 1100 hPa Temperature Range: -50 to -60

Customer: Scripps Inst. of Oceanography
Address : 8825 Biological Grade
La Jolla, CA 92037 USA

Report Date: 27-Jun-07
Sales Order: 24387
S/R Number :

Configuration

BL:	0	PT:	N
BR:	9600	QD:	-
DD:	-	QO:	-
DL:	-	SL:	-
DM:	-	SN:	101757
DO:	-	ST:	-
DP:	-	SU:	-
ID:	01	TI:	-
IM:	-	TR:	00952
LL:	-	TU:	-
LH:	-	UF:	1.000000
MC:	Y	UL:	-
MD:	0	UM:	-
MN:	-	UN:	3
OP:	-	US:	-
PF:	-	VR:	M1.02
PI:	-	ZI:	-
PL:	-	ZS:	-
PO:	-	ZL:	-
PR:	00238	ZV:	-
PS:	-		

Calibration Coefficients

U0:	5.766908	µsec
Y1:	-4015.975	deg C / µsec
Y2:	-17065.37	deg C / µsec²
Y3:	-140256.4	deg C / µsec³
C1:	94.87589	psi
C2:	3.545282	psi / µsec
C3:	-114.9551	psi / µsec²
D1:	0.0345157	
D2:	0.0000000	
T1:	28.00064	µsec
T2:	0.837535	µsec / µsec
T3:	16.78157	µsec / µsec²
T4:	-150.7085	µsec / µsec³
T5:	-129.729	µsec / µsec⁴
TC:	0.6782145	
PA:	0.0000000	
PM:	1.0000000	

Met3/3A Coefficients

E1:	-0.551136	E2:	0.84
F1:	-264.3591	F2:	3.152
G1:	12.56743	G2:	0.00216
H1:	RHT694	H2:	0.0036
K1:	01842	K2:	0.00511
M1:	1	M2:	1
Z1:	0	Z2:	0

Paroscientific, Inc.
4500 148th Ave. N.E. Redmond, WA 98052
Phone: (425)883-8700 Fax: (425)867-5407
Web:http://www.paroscientific.com
Email: support@paroscientific.com

Prepared by

PARO TEST 17

Digiquartz® Technology

Page 1 of 1

Paroscientific, Inc.
4500 148th Avenue N. E.
Redmond, WA 98052-5194
Telephone: (425) 883-8700
Facsimile: (425) 867-5407
Email:salessupport@paroscientific.com
Internet:http://www.paroscientific.com

CERTIFICATE OF CALIBRATION

TRANSDUCER MODEL: MET3A

SERIAL NUMBER: 101757

The Paroscientific transducer(s) identified above has been calibrated and tested with one or more of the following primary pressure and temperature standards. All have traceability to the National Institute of Standards and Technology.

Bell and Howell Primary Pressure Standard

Pneumatic Absolute or Gauge Dead Weight Tester Part Number: 6-201-0001, S/N 4034 and S/N 1014

___ Piston/Cylinder: 6-001-0002, P2-919/C2-1523,
Weight Set 1: 6-002-0002
Range: 1.5 to 50 psi [10 to 345 kPa]
Accuracy: 0.010 percent of reading

✓ Piston/Cylinder: 6-001-0002, P2-652/C2-1378,
Weight Set 2: 6-002-0002
Range: 1.5 to 50 psi [10 to 345 kPa]
Accuracy: 0.010 percent of reading

___ Piston/Cylinder: 6-001-0001, P1-949/C1-922 ,
Weight Set 2: 6-002-0002
Range: 0.3 to 5 psi [2 to 34 kPa]
Accuracy: 0.015 percent of reading

DH Primary Pressure Standard

Pneumatic Absolute or Gauge Dead Weight Tester Part Number: PG7601 S/N 161

___ Piston/Cylinder: S/N 305, Mass Set: S/N 2052
Range: 0.7 to 50 psi [5 to 345 kPa] absolute mode, 0.29 to 50 psi [2 to 345 kPa] gauge mode
Accuracy: 0.002 percent of reading

DH Primary Pressure Standard

Pneumatic Gauge Dead Weight Tester, Model 5203, S/N 5557

___ Piston/Cylinder: S/N 4845, Mass Sets: S/N 2032, S/N 3293
Range: 20 to 1,600 psi [0.14 to 11 MPa]
Accuracy: 0.005 percent of reading

DH Primary Pressure Standard

Oil Operated Gauge Dead Weight Tester, Model 5306, S/N 3505

___ Piston/Cylinder: S/N 3375, Mass Set: S/N 2032
Range: 40 to 20,000 psi [0.3 to 138 MPa]
Accuracy: 0.01 percent of reading above 200 psi [1.4 MPa]
or 0.02 psi [0.14 kPa] at lower pressure

___ Piston/Cylinder: S/N 3511, Mass Set: S/N 2032
Range: 145 to 72,500 psi [1 to 500 MPa]
Accuracy: 0.02 percent of reading above 725 psi [5 MPa]
or 0.145 psi [1 kPa] at lower pressure

Hart Scientific Precision Thermometer (MET3A only)

✓ Black Stack model 1560 S/N 97568, PRT Scanner model 2562 S/N A34523, Temperature Probe Model A1959:
S/Ns 4424A-02, 4424A-04, 4424A-05, 4424A-06 and 5177C-02.
Range: -50° to 60° C.
Accuracy: .015°C.

PARO TEST 17

Tested By: [signature] DATE 6-27-07

Digiquartz® Pressure Instrumentation
Document No. 8145-001, Rev. M 4/18/07

Underway Ocean Flow through Sensors

Seabird ThermoSalinograph

Serial # 0215

Temperature

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0215
CALIBRATION DATE: 01-Aug-07

SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

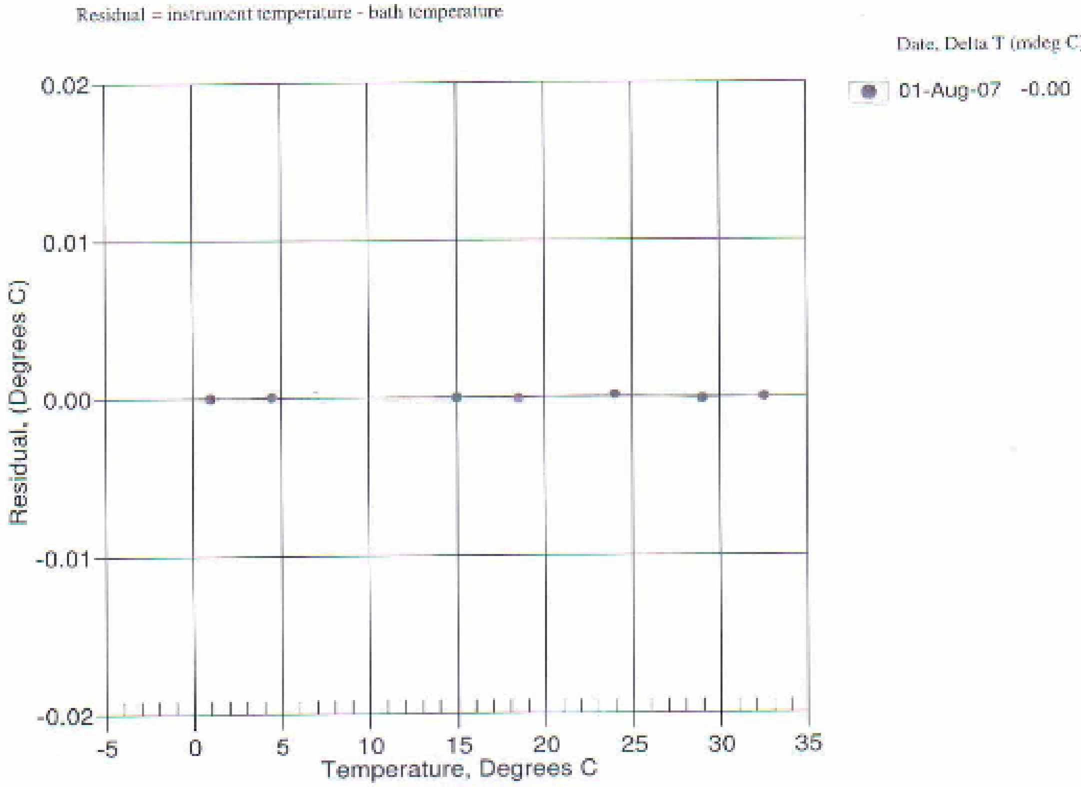
ITS-90 COEFFICIENTS

a0 = -1.277283e-006
a1 = 2.800988e-004
a2 = -2.767325e-006
a3 = 1.635307e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	657810.8	0.9999	-0.0001
4.5000	562392.5	4.5000	0.0000
15.0000	358334.1	14.9999	-0.0000
18.5001	310251.4	18.5000	-0.0001
24.0000	248855.2	24.0001	0.0002
29.0001	204884.7	29.0000	-0.0001
32.4999	179404.2	32.5000	0.0000

Temperature ITS-90 = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



Conductivity

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0215
CALIBRATION DATE: 01-Aug-07

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.817728e-001
h = 1.408375e-001
i = -1.671624e-004
j = 3.431539e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 2.4202e-005

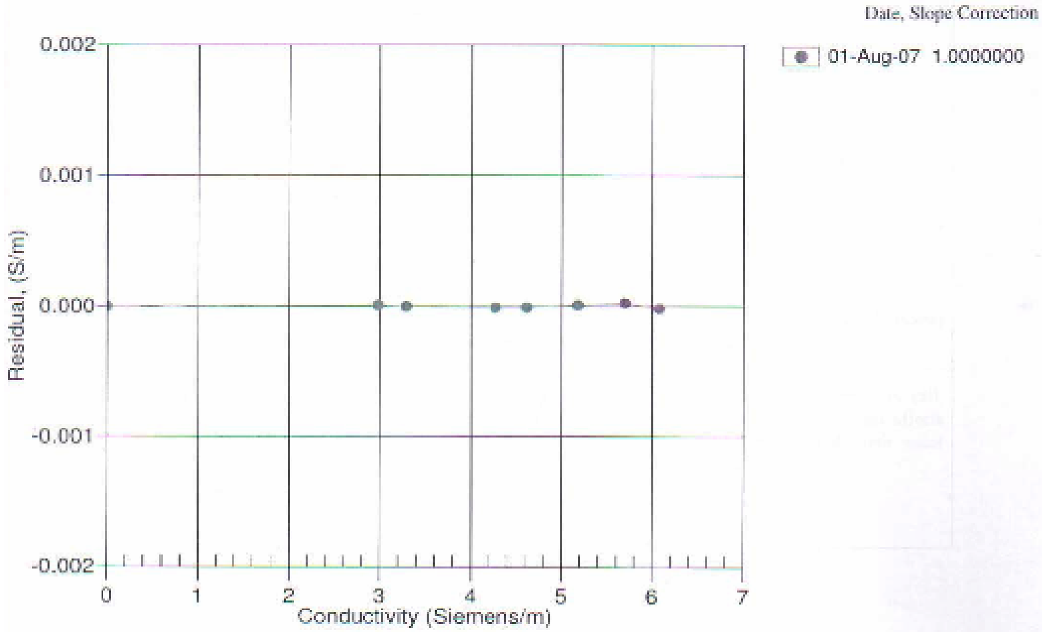
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2641.45	0.00000	0.00000
1.0000	34.8934	2.98132	5303.53	2.98133	0.00001
4.5000	34.8731	3.28955	5504.48	3.28955	-0.00000
15.0000	34.8297	4.27308	6101.73	4.27307	-0.00001
18.5001	34.8207	4.61890	6297.94	4.61889	-0.00001
24.0000	34.8111	5.17793	6602.44	5.17794	0.00001
29.0001	34.8062	5.70086	6874.67	5.70088	0.00002
32.4999	34.8046	6.07417	7062.34	6.07415	-0.00002

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Remote Sea Temperature (Sea Chest)

Serial # 4063

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4063
CALIBRATION DATE: 13-Dec-07

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS
g = 4.29921671e-003
h = 6.36406488e-004
i = 2.06912541e-005
j = 1.52019386e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS
a = 3.68121265e-003
b = 5.99688417e-004
c = 1.61521904e-005
d = 1.52164480e-006
f0 = 2721.791

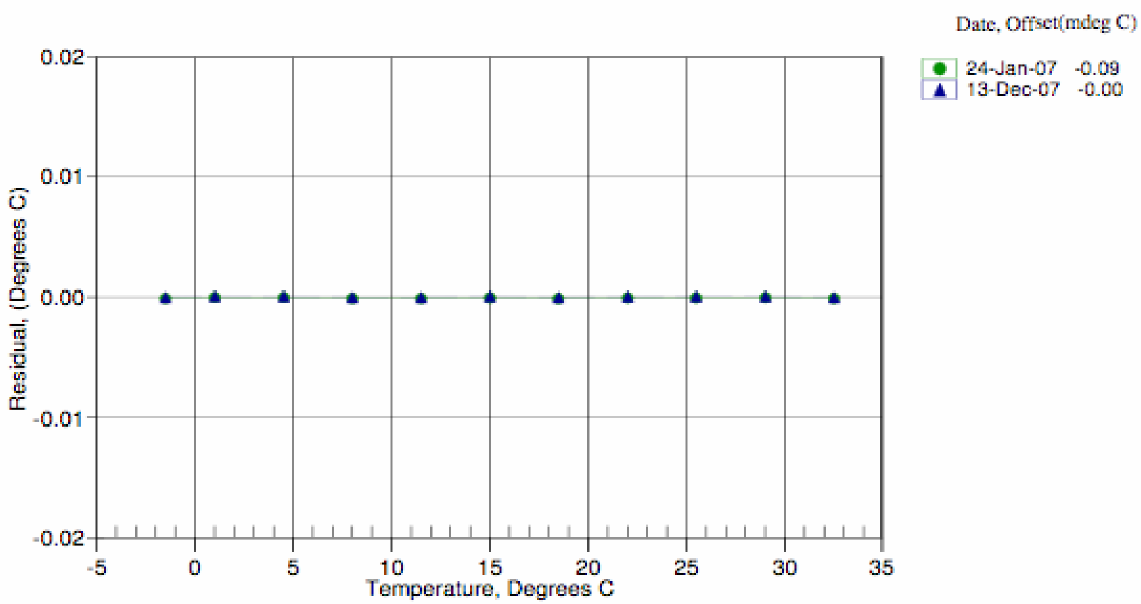
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2721.791	-1.5000	-0.00002
1.0000	2878.781	1.0000	0.00003
4.5000	3109.455	4.5000	0.00002
8.0000	3353.176	8.0000	-0.00001
11.5000	3610.316	11.5000	-0.00001
15.0000	3881.236	15.0000	0.00002
18.5000	4166.278	18.5000	-0.00004
22.0000	4465.803	22.0000	0.00000
25.5000	4780.134	25.5000	0.00003
29.0000	5109.596	29.0000	0.00002
32.5000	5454.501	32.5000	-0.00002

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



Oxygen Sensor A

Serial # 1307

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 1307
CALIBRATION DATE: 28-Sep-07p

SBE 43 OXYGEN CALIBRATION DATA

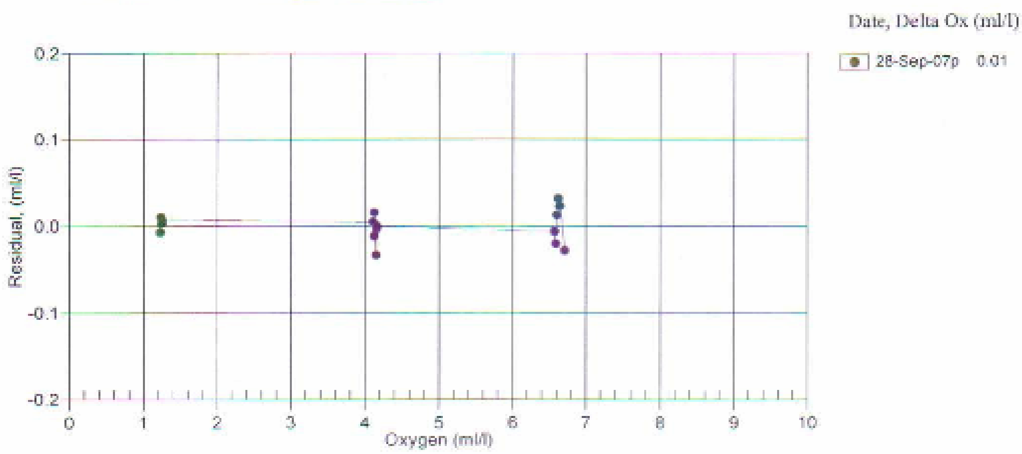
COEFFICIENTS

Soc = 0.3834
Boc = 0.0000
Voffset = -0.4781

TCor = 0.0025
PCor = 1.350e-04

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.22	2.00	0.00	0.805	1.22	-0.01
1.24	12.00	0.01	0.898	1.25	0.01
1.24	20.00	0.01	0.966	1.25	0.01
1.24	26.00	0.01	1.016	1.25	0.00
1.25	6.00	0.00	0.848	1.25	0.00
1.25	30.00	0.01	1.057	1.26	0.01
4.11	20.00	0.01	2.086	4.11	0.00
4.13	26.00	0.01	2.254	4.11	-0.01
4.13	12.00	0.01	1.870	4.14	0.02
4.15	2.00	0.00	1.583	4.11	-0.03
4.15	30.00	0.01	2.382	4.15	-0.00
4.15	6.00	0.00	1.705	4.15	-0.00
6.57	30.00	0.01	3.491	6.57	-0.01
6.58	26.00	0.01	3.311	6.56	-0.02
6.60	20.00	0.01	3.061	6.61	0.01
6.62	12.00	0.01	2.712	6.65	0.03
6.64	6.00	0.00	2.447	6.67	0.02
6.71	2.00	0.00	2.273	6.68	-0.03

oxygen (ml/l) = (Soc * (V + Voffset)) * exp(Tcor * T) * Oxsat(T,S) * exp(Pcor * P)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU]
Oxsat(T,S) = oxygen saturation [ml/l], P = pressure [dbar]
Residual = instrument oxygen - bath oxygen



CTD Sensors

Pressure Sensor

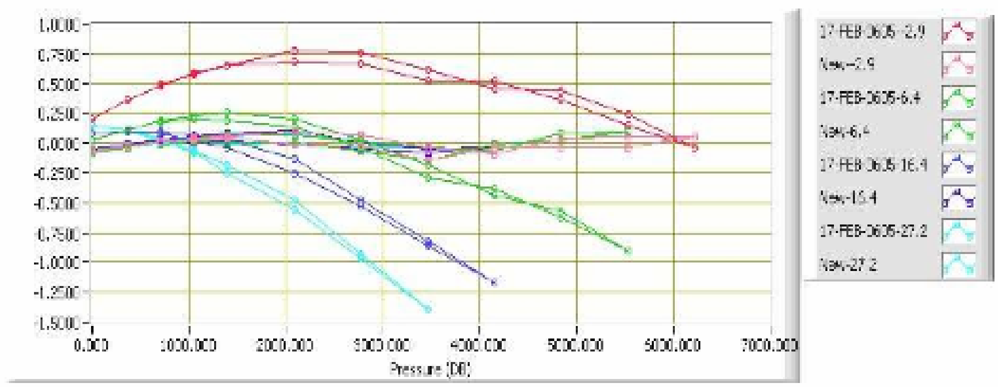
Serial # 83012

Pressure Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 639
CALIBRATION DATE: 18-JAN-2008
Mfg: Seabird Model: SBE9P CTD Prs s/n: 83012

C1= -3.841449E+4
C2= 4.630485E-1
C3= 1.014581E-2
D1= 3.051116E-2
D2= 0.000000E+0
T1= 3.019016E+1
T2= -1.746821E-4
T3= 4.517296E-6
T4= -9.087207E-9
T5= 0.000000E+0
AD590M= 1.27551E-2
AD590B= -9.09133E+0
Slope = 1.0
Offset = 0.0

Calibration Standard: Mfg: Ruska Model: 2400 s/n: 34336
t0=t1+t2*td+t3*td*td+t4*td*td*td
w = 1-t0*t0*f*f
Pressure = (0.6894759*((c1+c2*td+c3*td*td)*w*(1-(d1+d2*td)*w)-14.7)



Temperature #1

Serial # 2855

Temperature Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 2855
CALIBRATION DATE: 21-JAN-2008
Mfg: Seabird   Model: SBE3Plus
Previous Cal Date: 24-Jan-07
Calibration Tech: CM

g= 4.35951439E-3
h= 6.45648951E-4
i= 2.38075037E-5
j= 2.35385504E-6
f0 = 1000.0
Slope = 1.0
Offset = 0.0

Calibration Standard: Mfg: ASL   Model: F18   s/n: 245-5149
Temperature ITS-90 = $1/\{g+h[\ln(f0/f)]+i[\ln^2(f0/f)]+j[\ln^3(f0/f)]\} - 273.15$ (°C)

SBE3 Freq	SPRT	SBE3 New_Coefs	SPRT-SBE3 Prev_Coefs	SPRT-SBE3 New_Coefs
5479.6760	28.1875	28.1875	0.00140	0.00002
5798.0010	31.2142	31.2142	0.00189	-0.00002
5174.8630	25.1737	25.1737	0.00101	0.00002
4839.0220	21.7073	21.7073	0.00066	-0.00000
4563.9390	18.7410	18.7410	0.00045	-0.00003
4313.5900	15.9306	15.9306	0.00036	-0.00000
4062.6960	12.9964	12.9964	0.00029	0.00002
3819.2680	10.0242	10.0242	0.00019	-0.00001
3580.6660	6.9771	6.9771	0.00011	-0.00001
3359.2520	4.0167	4.0167	0.00007	0.00004
3216.0510	2.0264	2.0264	-0.00010	-0.00004
3143.3570	0.9916	0.9916	-0.00010	0.00002
3042.0950	-0.4792	-0.4792	-0.00018	0.00003
3003.6410	-1.0471	-1.0471	-0.00029	-0.00003
2934.0140	-2.0888	-2.0888	-0.00036	-0.00001

Temperature #2

Serial # 2796

Temperature Calibration Report
STS/ODF Calibration Facility

SENSOR SERIAL NUMBER: 2796
CALIBRATION DATE: 21-JAN-2008
Mfg: Seabird Model: SBE3Plus
Previous Cal Date: 27-Jan-07
Calibration Tech: CM

g= 4.30545772E-3
h= 6.41541965E-4
i= 2.26535491E-5
j= 2.15838215E-6
f0 = 1000.0
Slope = 1.0
Offset = 0.0

Calibration Standard: Mfg: ASL Model: F18 s/n: 245-5149
Temperature ITS-90 = 1/{g+h[ln(f0/f)]+i[ln2(f0/f)]+j[ln3(f0/f)]} - 273.15 (°C)

SBE3 Freq	SPRT	SBE3 New_Coefs	SPRT-SBE3 Prev_Coefs	SPRT-SBE3 New_Coefs
5034.9080	28.1869	28.1869	0.00129	-0.00001
5327.3120	31.2134	31.2134	0.00145	0.00001
4754.9570	25.1736	25.1736	0.00117	-0.00003
4446.4900	21.7075	21.7075	0.00113	0.00003
4193.8400	18.7414	18.7414	0.00105	0.00000
3963.9100	15.9311	15.9311	0.00097	-0.00004
3733.4680	12.9969	12.9969	0.00098	0.00001
3509.8970	10.0249	10.0248	0.00098	0.00005
3290.7460	6.9777	6.9777	0.00087	-0.00002
3087.3980	4.0175	4.0175	0.00082	-0.00001
2955.8690	2.0273	2.0273	0.00077	-0.00001
2889.1220	0.9928	0.9928	0.00074	-0.00001
2796.0920	-0.4783	-0.4783	0.00068	-0.00002
2760.7580	-1.0463	-1.0463	0.00070	0.00001
2696.7970	-2.0881	-2.0881	0.00067	0.00003

Temperature #3

Serial # 0011

SBE35 V 2.0a SERIAL NO. 0011 25 Jun 2008

number of measurement cycles to average = 8

number of data points stored in memory = 0

bottle confirm interface = SBE 911plus

SBE35 V 2.0a SERIAL NO. 0011

29-mar-08

A0 = 5.030840630e-03

A1 = -1.387153030e-03

A2 = 2.040326840e-04

A3 = -1.129031550e-05

A4 = 2.392311380e-07

SLOPE = 1.000000

OFFSET = 0.000000

Conductivity #1

Serial # 2568

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email seabird@seabird.com

SENSOR SERIAL NUMBER: 2568
CALIBRATION DATE: 18-Jan-08

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS
g = -1.03670721e-001
h = 1.49463602e+000
i = 3.18405740e-00[illegible]
j = 6.15237692e-005
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS
a = [illegible].84930[illegible]e-00[illegible]
b = 1.48492005e+000
c = -1.03867351e-001
d = 8.28372675e-005
m = 3.5
CPcor = -9.5700e-008 (nominal)

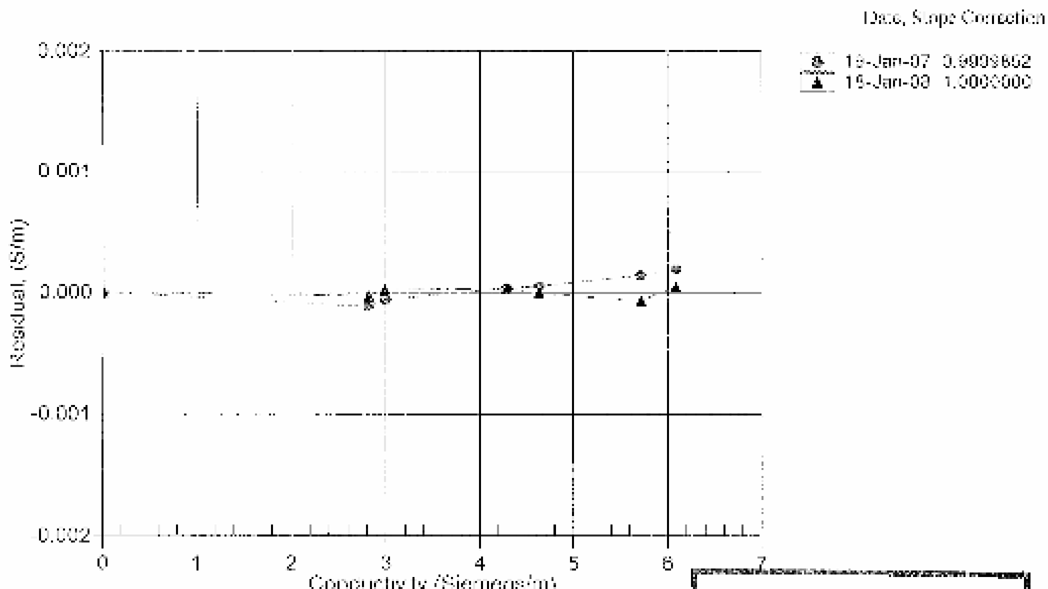
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.64369	0.00000	0.00000
-1.0000	34.3237	2.81315	5.08747	2.81312	-0.00003
1.0000	34.3240	2.96606	5.19962	2.96608	0.00002
15.0000	34.3342	4.28454	5.97907	4.28458	0.00004
18.5000	34.3335	4.67219	6.17084	4.67217	-0.00002
29.0000	34.3293	5.71874	6.72469	5.71867	-0.00007
32.5000	34.3198	6.09199	6.91477	6.09204	0.00005

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \epsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \epsilon p)]$ Siemens/meter

t = temperature[°C]; p = pressure[decibars]; δ = CTcor; ϵ = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE
CALIBRATION

Conductivity # 2

Serial # 2561

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 2561
CALIBRATION DATE: 18-Jan-08

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS
g = -1.0[illegible]e+001
h = 1.0[illegible]e+000
i = -1.0[illegible]e-003
j = [illegible]e-004
CPcor = -9.[illegible]e-008 (nominal)
CTcor = [illegible]e-006 (nominal)

ABCDM COEFFICIENTS
a = [illegible]e-005
b = 1.[illegible]e+000
c = -1.[illegible]e+001
d = -[illegible]e-005
m = [illegible]
CPcor = -[illegible]e-008 (nominal)

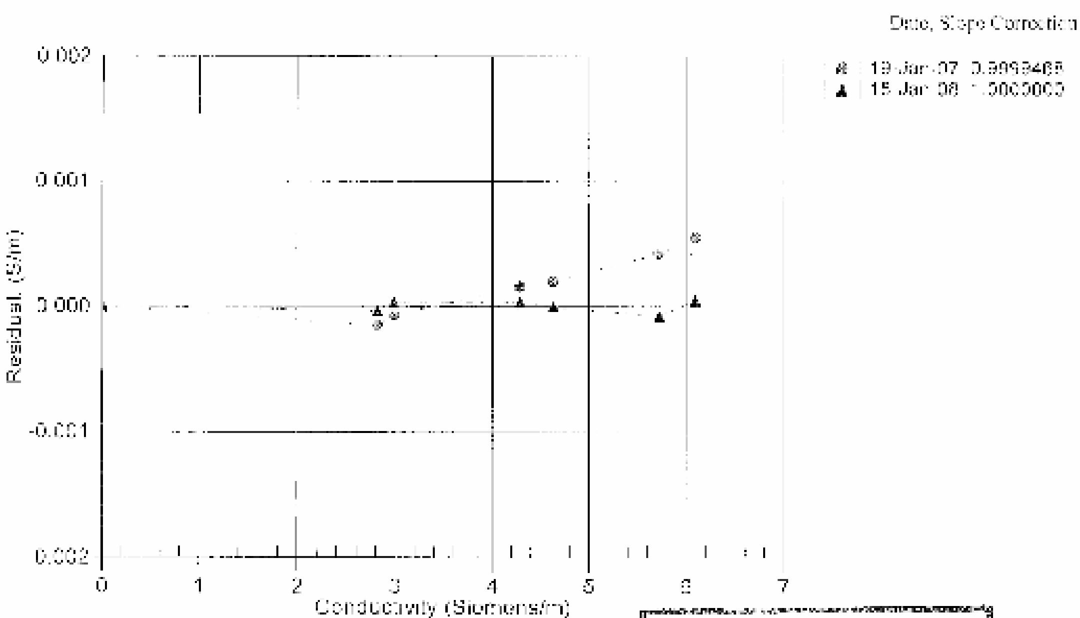
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	[illegible]	0.00000	0.00000
-1.0000	3[illegible]	2.[illegible]	[illegible]	[illegible]	-0.0000[illegible]
1.0000	[illegible]	[illegible]96	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	4.28454	[illegible]	4.28450	[illegible]
[illegible]	[illegible]	4.63228	[illegible]	4.63228	-0.00000
29.0000	34.9295	[illegible]	[illegible]	[illegible]	0.00007
32.[illegible]	34.919[illegible]	6.[illegible]	[illegible]	6.[illegible]	[illegible]

Conductivity = (g + hf² + if³ + jf⁴) / 10(1 + δt + εp) Siemens/meter

Conductivity = (af^m + bf² + c + dt) / [10(1 + εp)] Siemens/meter

t = temperature[°C]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE CALIBRATION

Oxygen

Serial # 0458

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0458
CALIBRATION DATE: 12-Dec-07p

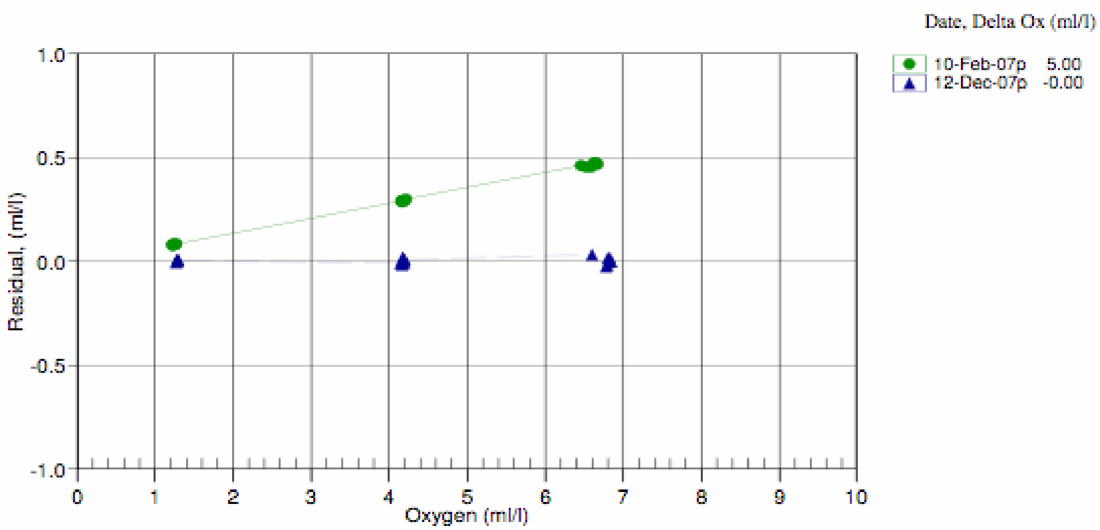
SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS
Soc = 0.4060
Boc = 0.0000
Voffset = -0.4927

TCor = 0.0006
PCor = 1.350e-04

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.27	20.00	0.01	0.979	1.27	-0.01
1.28	26.00	0.01	1.037	1.27	-0.01
1.28	12.00	0.01	0.909	1.28	0.00
1.28	2.00	0.00	0.820	1.28	0.00
1.29	6.00	0.00	0.858	1.29	0.01
1.29	30.00	0.01	1.085	1.29	0.00
4.15	26.00	0.01	2.265	4.13	-0.01
4.16	20.00	0.01	2.083	4.15	-0.02
4.17	12.00	0.01	1.847	4.17	0.00
4.18	30.00	0.01	2.419	4.19	0.02
4.19	2.00	0.00	1.556	4.18	-0.01
4.19	6.00	0.00	1.677	4.20	0.01
6.59	30.00	0.01	3.535	6.62	0.03
6.78	20.00	0.01	3.082	6.75	-0.03
6.79	26.00	0.01	3.397	6.77	-0.02
6.80	12.00	0.01	2.706	6.81	0.01
6.82	6.00	0.00	2.420	6.83	0.01
6.84	2.00	0.00	2.234	6.84	-0.00

oxygen (ml/l) = (Soc * (V + Voffset)) * exp(Tcor * T) * Oxsat(T,S) * exp(Pcor * P)
V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU]
Oxsat(T,S) = oxygen saturation [ml/l], P = pressure [dbar], Residual = instrument oxygen - bath oxygen



Fluorometer

Serial # 088234

CERTIFICATE OF CALIBRATION

All test equipment and standards used are of known accuracy and are traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Chelsea
Technologies
Group

55 Central Avenue
West Molesey
Surrey KT8 2QZ
United Kingdom
Tel: +44 (0)20 8481 9000
Fax: +44 (0)20 8941 9319
sales@chelsea.co.uk
www.chelsea.co.uk

Date of issue	06 March 2007
Description	Mk III Aquatracka (Chlorophyll-a)
Serial Number	088234
Part No	3598C

REPORT

The fluorimeter was exposed to various concentrations of Chlorophyll-a dissolved in acetone in addition to pure water and pure acetone. The following formula was derived from the readings to relate instrument output to chlorophyll-a concentration.

$$\text{Conc.} = (0.00779 \times 10^{\text{Output}}) - 0.0211$$

Where -

Conc. = fluorophor concentration in µg/l
Output = Aquatracka output in volts

The above formula can be used in the range 0 - 100 microgrammes per litre to an uncertainty of 0.02 microgrammes per litre plus 5% of value.

Notes

The above formula has been derived using Chlorophyll-a dissolved in acetone. No guarantee is given as to the performance of the instrument to biologically active chlorophyll in sea-water.

The zero offset has been determined in the laboratory using purified water from a reverse osmosis/ion exchange column. It is possible that purer water may be found in clean deep ocean conditions. Under these conditions, the offset shown in the above formula should be replaced by the antilogarithm of the Aquatracka output in the purest water found, multiplied by the scale factor.

Serial number 88234 Page 1 of 2

Group Companies

Chelsea Technologies Ltd
Chelsea Instruments Ltd
Chelsea Environmental Ltd
Marine Acoustics Ltd

Transmisometer

Serial # CST-390DR

PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

(541) 929-565
Fax (541) 929-527
www.wetlabs.co

C-Star Calibration

Date	February 27, 2007	Customer	US Coast Guard	Work order	004
Job #	0012004	S/N#	CST-390DR	Pathlength	25 cm

	Analog meter
V_d	0.058 V
V_{air}	4.788 V
V_{ref}	4.707 V

Temperature of calibration water	18.8 °C
Ambient temperature during calibration	23.4 °C

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln(Tr)$

V_d Meter output with the beam blocked. This is the offset.
V_{air} Meter output in air with a clear beam path.
V_{ref} Meter output with clean water in the path.
Temperature of calibration water: temperature of clean water used to obtain V_{ref}.
Ambient temperature: meter temperature in air during the calibration.
V_{sig} Measured signal output of meter.

cstarwkbkf1.xls   Revision F   1/17/05

PAR

Serial # 70115

Calibration Date: 01/09/07   Job No.: 18511
Model Number: QSP2300
Serial Number: 70115
Operator: TPC
Standard Lamp: F-863(9/30/05)
Operating Voltage Range: 6 to 15 VDC (+)

Note: The QSP-2300 output is a voltage that is proportional to the log of the incident irradiance.
To calculate irradiance, use this formula:

Irradiance = Calibration factor * (10^Light Signal Voltage - 10^Dark Voltage)

Dry Calibration Factor:	3.22E+12	quanta/cm²·sec per volt	5.34E-06	μEinsteins/cm²·sec per volt
Wet Calibration Factor:	5.42E+12	quanta/cm²·sec per volt	9.00E-06	μEinsteins/cm²·sec per volt

Sensor Test Data and Results[2)]

Sensor Supply Current (Dark):	3.5	mA		
Supply Voltage:	6	Volts		
Lamp Integrated PAR Irradiance:	9.43E+15	quanta/cm²·sec	0.01566	μEinsteins/cm²sec
SC3 Immersion Coefficient:	0.594			

Nominal Filter OD	Expected Transmission	Calibrated Trans.	Sensor Voltage	Expected Voltage	Voltage % Error	Measured Trans.	Transmission Error (%)	Test Irrad. (quanta/cm²·sec)
No Filter	100%	100.00%	3.467	3.467	0%	100.00%	0.0	9.43E+15
0.3	50%	35.10%	3.007	3.024	-1%	34.60%	4.2	3.27E+15
0.5	32%	27.60%	2.897	2.906	0%	26.87%	2.7	2.54E+15
1	10%	9.27%	2.478	2.434	2%	10.22%	-9.3	9.66E+14
2	1%	1.11%	1.608	1.512	6%	1.35%	-17.7	1.30E+14
3	0.10%	0.05%	0.500	0.194	61%	0.07%	-27.4	1.02E+13

Dark Before:	0.003	Volts
Light - No Filter Hldr.:	3.467	Volts
Dark After - NFH:	0.003	Volts
Average Dark	0.00274	Volts

Notes:
1. Annual calibration is recommended.
2) This section is for internal use and for more advanced analysis.

MBARI-ISUS V3 DATA FILE FORMAT

From Satlantic Document SAT-DN-425 pages D-5 and D-6

Field Name	Format	Description
INSTRUMENT	AS 10	The frame header or synchronization string starts with "SAT" for a Satlantic instrument, followed by three characters identifying the frame type. The last four characters are the instrument serial number.
DATE	AS 7 BS 4	The date field denotes the date at the time of the sample, using the year and Julian day. The format is YYYYDDD.
TIME	AF 9 BD 8	The time field gives the GMT/UTC time of the sample in decimal hours of the day.
NTR_CONC	AF 4..7 BF 4	The Nitrate concentration as calculated by the ISUS is reported in ?Mol/L; in ASCII frames to 2 decimal places.
AUX1	AF 4..7 BF 4	First auxiliary fitting result of the ISUS is reported.
AUX2	AF 4..7 BF 4	Second auxiliary fitting result of the ISUS is reported.
AUX3	AF 4..7 BF 4	Third auxiliary fitting result of the ISUS is reported.
RMS ERROR	AF 8..10 BF 4	The Root Mean Square Error of the ISUS' concentration calculation is given, in ASCII frames to 6 decimal places.
The above fields are present in all frames, the following fields only in full frames.		
T_INT	AF 5 BF 4	The temperature inside the ISUS housing is given in degrees Celsius; in ASCII frames to 2 decimal places.
T_SPEC	AF 5 BF 4	The temperature of the spectrometer is given in degrees Celsius; in ASCII frames to 2 decimal places.
T_LAMP	AF 5 BF 4	The temperature of the lamp is given in degrees Celsius; in ASCII frames to 2 decimal places.
LAMP_TIME	AI 1..6 BU 4	The lamp on-time of the current data acquisition in seconds.
HUMIDITY	AF 4..5 BF 4	The humidity inside the instrument, given in percent. Increasing values of humidity indicate a slow leak.
VOLT_12	AF 5 BF 4	The voltage of the lamp power supply.
VOLT_5	AF 5 BF 4	The voltage of the internal analog power supply.
VOLT_MAIN	AF 5 BF 4	The voltage of the main internal supply.
REF AVG	AF 7 BF 4	The average Reference Channel measurement during the sample time, in ASCII mode to 2 decimal places.
REF STD	AF 6 BF 4	The variance of the Reference Channel measurements, in ASCII mode to 2 decimal places.

SW DARK	AF 8 BF 4	An AF formatted field representing the Sea-Water Dark calculation (to 2 decimal places), in spectrometer counts.
SPEC AVG	AF 8 BF 4	An AF formatted field representing the average value of all spectrometer channels, to 2 decimal places.
CHANNEL(?1)	AI 3..5 BU 2	The counts of the first channel (wavelength ?1) of the spectrometer.
…	…	…
CHANNEL(?n)	AI 3..5 BU 2	The counts of the n-th channel (wavelength ?n) of the spectrometer.
…	…	…
CHANNEL(?256)	AI 3..5 BU 2	The counts of the last (256-th) channel (wavelength ?256) of the spectrometer.
CHECK SUM	AI 1..3 BU 1	A check sum validates frames. Satlantic's software rejects invalid frames.
TERMINATOR	AS 2 AS 2	This field marks the end of the frame by a carriage return/line feed pair (0Dhex and 0Ahex).

Depending on the frame type, the sizes of the frames (for ASCII frames including the delimiters) are:

ASCII Concentration Frame 73 bytes (maximum)
ASCII Full Frame 1694 bytes (maximum)
Binary Full Frame 605 bytes (fixed)

For a flash disk size of 256 MB, this translates to approximately 4,500,000 ASCII Concentration frames, 155,000 ASCII Full frames, or 440,000 Binary Full frames. With an acquisition rate of one frame per second, an acquisition period of 52 days (ASCII Concentration frame), 43.5 hours (ASCII Full frame) or 122 hours (Binary Full frame) can be stored on the flash disk. Larger disk sizes are available upon request.

The instrument is normally configured to periodically generate dark spectra to correct for thermal noise. This is achieved by closing an on-board shutter over the UV light source before sampling. To distinguish between *Light* and *Dark* frames, the instrument uses different frame headers. This allows any telemetry acquisition system to distinguish between sensor readings taken with the shutter opened and closed.

The different frames are distinguished by their header string: following the three letter 'SAT' identifier is a three letter frame identifier: The first letter is for ISUS frames always a 'N', indicating that the ISUS is an **N**itrate measuring instrument. The second letter indicates the shutter state of that frame ('L' for **L**ight frame, 'D' for **D**ark frame) and the third letter indicates the frame type ('C' for ASCII **C**oncentration Frame, 'F' for ASCII **F**ull Frame, and 'B' for **B**inary Full Frame).

Frame Header	Explanation of frame header
SATNLC	SATlantic Nitrate Light Concentration frame
SATNDC	SATlantic Nitrate Dark Concentration frame
SATNLF	SATlantic Nitrate Light Full ASCII frame
SATNDF	SATlantic Nitrate Dark Full ASCII frame
SATNLB	SATlantic Nitrate Light full Binary frame
SATNDB	SATlantic Nitrate Dark full Binary frame

Instrument Locations on the Healy

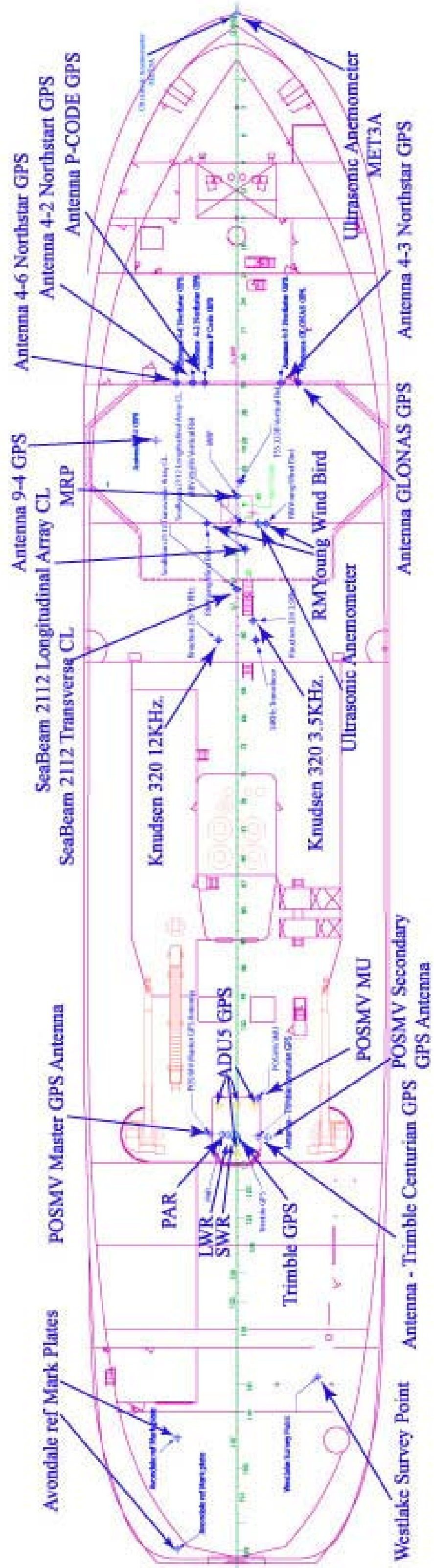


Figure 88. Layout plot of instrument locations.

Consolidated Survey Data						
	Elements of:					
		Avondale Survey				
		Westlake Survey				
		Lamont Survey				
	All Measurements in *Meters* relative to MRP unless otherwise stated					
	X = fore & aft with + foreward					
	Y = port & starboard with + to starboard					
	Z= vertical with + upwards					
				X	Y	Z
Item	***Survey***	***Description***		***North***	***East***	***Elevation***
1	Avondale	**MRP**	See discussion Westlake Final Report	34.30	0.00	9.15
2	Westlake	**MRP**	by Definition	0.00	0.00	0.00
3	Westlake	**Seabeam 2112**				
		Transverse Array	Centerline	-7.679	0.030	9.242
		Longitudinal Array	Centerline	-4.386	0.711	9.238
4	Westlake	**Transducers**				
		Starboard - Forward to Aft				
		Transducer -	Bathy 2000 3.5 kHz	-10.252	1.362	9.243
		Transducer -	Bathy 1500 34 kHz *	-11.866	1.559	9.245
		Transducer -	Doppler Speed Log	-12.168	0.414	9.245
		Transducer -	Spare Transducer Well	-13.081	1.449	9.237
5	Westlake	**Port - Forward to Aft**				
		Transducer -	VM 150	-9.726	-1.395	9.230
		Transducer -	Ocean Surveyor 75 kHz	-10.819	-1.290	9.230
		Transducer -	Bathy 2000 12 kHz	-11.859	-1.492	9.234
		Transducer -	Spare Transducer Well	-13.078	-1.394	9.235
6	Westlake	Gyros				
		Starboard Gyro	Centerline	4.741	0.207	-19.604

		Port Gyro	Centerline	4.746	-0.207	-19.609
7	Westlake	**Antennas**				
		REF DWG TBD	Antenna 9-4 * - GPS Antenna (4.1.5)	4.587	-6.622	-24.000
			Antenna 4-6 * - Northstar GPS (4.1.1)	9.374	-4.970	-23.406
			Antenna 4-2 * - Northstar (4.1.2)	9.362	-3.617	-23.451
			P CODE GPS Antenna *	9.368	-2.645	-23.609
			Antenna 4-3 * - Northstar (4.1.4)	9.355	3.638	-23.363
			GLONAS GPS Antenna *	9.379	5.066	-23.515
			Antenna base (4A)	-53.872	-0.011	-22.025
			Antenna base (4B)	-49.758	0.038	-22.010
			Antenna base (4C)	-49.785	1.629	-22.020
			Antenna base (4D)	-49.771	-1.546	-22.008
			Trimble Centurion**	-52.726	-1.717	-21.113
			Time Server **	-52.671	1.838	-21.115
8	Westlake	**Vertical Ref**				
			MRV-M-MV -			
			Measured at Top of mounting bracket			
			Center (mid-point) - calculated	-2.100	0.291	-0.775
			TSS 333B - Marine Motion Sensor -			
			scribe atop mounting plate			
			Center of TSS 333B	1.210	0.329	-0.013
9	LDEO	**POS/MV**				
		From	**TO**	**X**	**Y**	**Z**
		IMU	Port Antenna (Master)	-2.9719	-3.9140	-5.5310
		MRP	IMU	-49.5710	1.7110	-16.7990

		MRP	Transmit array	-4.3860	0.7110	9.2380
		MRP	Port Antenna (Master)	-52.5429	-2.2030	-22.3300
10	Westlake Raw	**Fan Tail**				
			Aft/Port	-86.737	-4.906	-3.617
			Forward/Port	-77.600	-4.881	-3.589
			Forward/Starboard	-72.590	6.676	-3.653