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-0703

August 17 to September 15, 2007

Barrow, AK to Barrow, AK

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September 20, 2007

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INTRODUCTION

HEALY-0703 was the third in a series of cruises (HEALY-0302 and HEALY-0405) aimed to collect high-resolution seafloor mapping data in areas of the Arctic Ocean which 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 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 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 United Nations 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 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, 120 beam) swath mapping system, was chosen for this task.

PREVIOUS CRUISES:

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 this approach. 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.

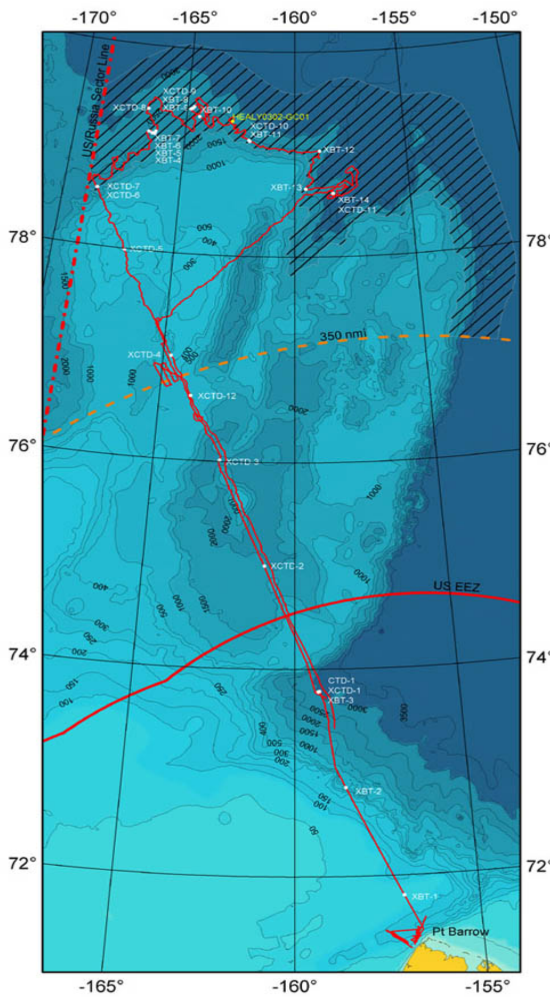


Figure 1. Track of HEALY-0302 September 2003.

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 (Figure 2). 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.

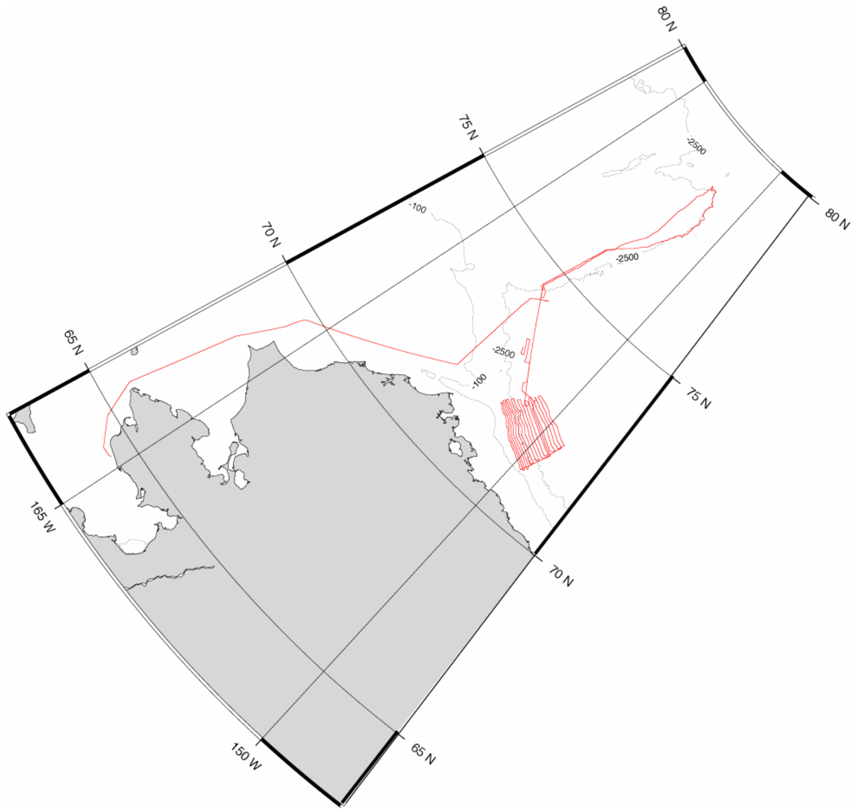


Figure 2. Cruise track for HEALY-0405

HEALY-0703 CRUISE OVERVIEW:

The following section contains a brief overview of the activities of HEALY-0703; a more detailed description of day-to-day activities including numerous figures can be found in the Chief-Scientist Log presented in the next section.

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 3). 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. We encountered 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 relevant to a potential ECS submission.

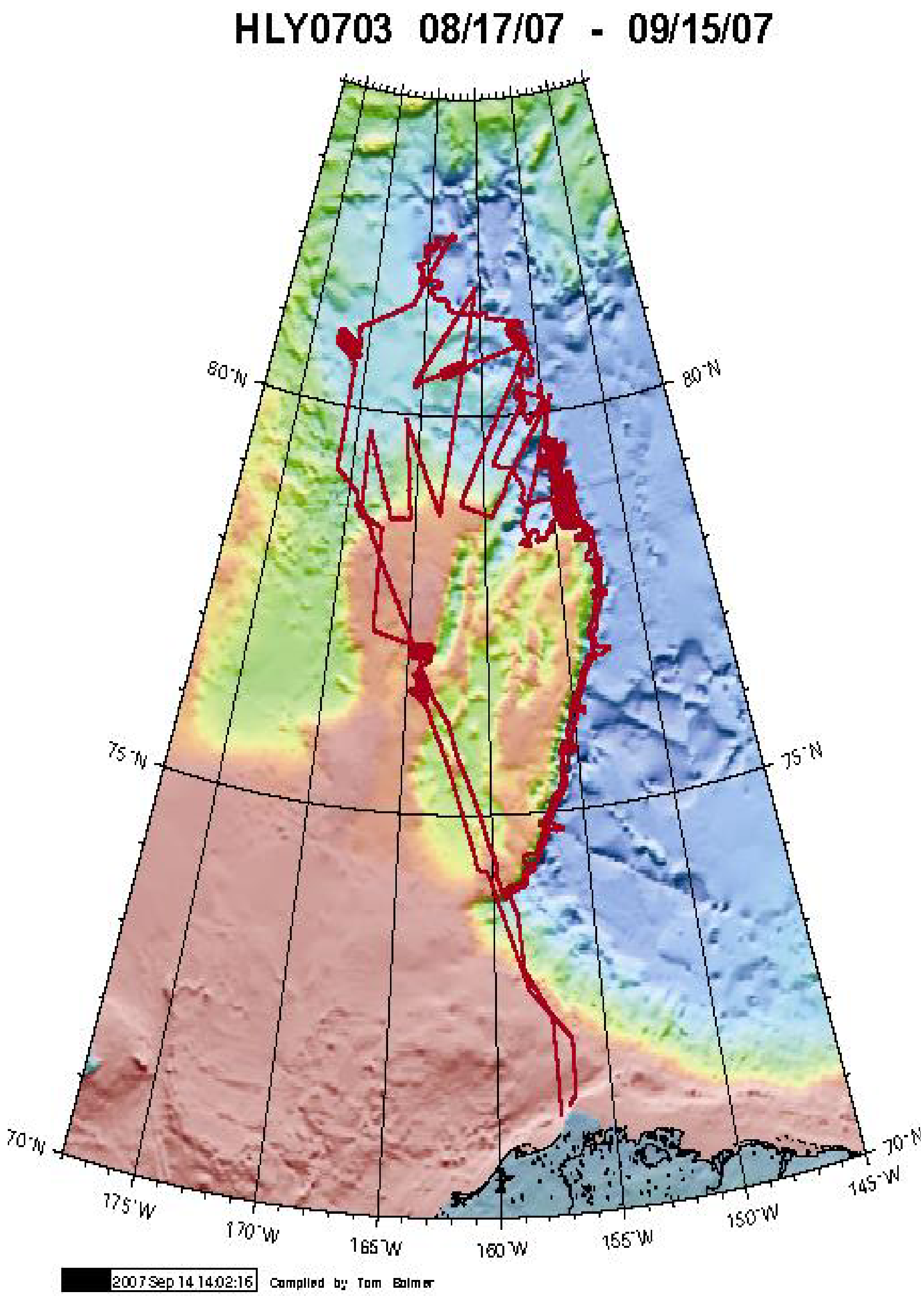
A well-developed foot of the slope was traced down and then back up the eastern side of Northwind Ridge, revealing a very sharp and clear slope/abyssal plain transition with the abyssal plain sediments consistently occurring at a depth of approximately 3820 m. Following this transition to the north allowed 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 0700L on the 15th of Sept with transfer of the science party by helo commencing at approximately 0900L.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80°N
80°N
75°N
75°N
70°N
70°N
175°W
170°W
165°W
160°W
155°W
150°W
145°W
2007 Sep 14 14:02:16
Compiled by Tom Bolmer

Figure 3. Ship-track for HEALY 0703

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Stewart, Jeffrey LCDR	Hamilton, Herbert FS3	Redd, Davion DC2
Alani, Brandon BM2	Harbinsky, Mark ET2	Reed, Jonathan SN
Angelo, James YNC	Harris, Daniel SK1	Rieg, Mark MSTC
Arakaki, Rebecca SK2	Hazelton, Chad FNDC	Rivera-Maldonado, Abner SKC
Bartlett, Charles MST1	Hernandez, Kelvin EM2	Rocklage, Eric MST1
Baxa, Philip ENS	Hoke, Brandon MK2	Rodda, Joel ETC
Beasley, Corey HSCS	Hurtado, Daniell EM1	Rudibaugh, Kenneth MK1
Beckmann, Rachel ENS	Hymes, Glenda FN	Sargent, Richard SNBM
Bender, Zachary ENS	Jacobs, Bryson ENS	Shaffer, Hans EM1
Blas, Paul FN	Jones, Greg MKCS	Smith, Corey MK3
Brogan, John MKC	Juengling, Ryan EM3	Smith, Josh ENS
Brown, Betty MK3	Kidd, Wayne BMC	Sullivan, Timothy BMCS
Buford, Aimee BM2	Kruger, Thomas MST3	Sundeen, Christopher SN
Carr, Michael LTJG	Laisure, Jeremy SK2	Swanson, Shawn ET2
Carter, John FS2	Lambert, Douglas MK1	Thomas, Tasha ENS
Charney, Nicholas BM3	Layman, Rich MST2	Travers, Cynthia ENS
Conroy, William BM3	Liebrecht, Brian ET1	Tyler, Gustavo CWO3
Coombe, Jeffrey MK3	Loftis, Jon MK2	Von Kauffmann, Daniel IT1
Dabe, Jeffrey IT2	Lyons, Sean R CWO2	Wagner, Alexander FN
Daem, Steven ET2	Manangan, Sorjen OSC	Wallingford, Diane MKC
Davidson, Ash BM2	Mandrie, Montarno DC3	Ward, John CWO
Davis, Jonathon ET2	Marsden, George DCC	Whiting, Allan, MK2
Deggans, Linzi FS2	McNally, Terence SK1	Williams, Marquessa FN
Dull, Steven FS3	Meadowcroft, Brian LTJG	Williams, Tony FSCS
Dunning, Lara BM3	Merten, James SN	Worrell, Kenneth EM1
Elliott, Stephen LTJG	Murphy, Nicholas MK2	Wright, Tamekia FS2
Ferland, Thomas FNDC	Myers, Robert MK2	Wright, Tiffany MST2
Fernandez, Chelsey SN	Neuhausen, Jeffrey EMC	Yeckley, Andy BM3
Finley, Nathan EM3	Newton, Elizabeth LTJG	
Galvez, Oscar R. LT	Passalacqua, Joseph ETCM	
Glenzer, William BM1	Pentecost, James DC1	

HEALY 07-03 CHIEF SCIENTIST LOG

All times LOCAL +8 from GMT

17 Aug = JD 229

0800 AST: Healy appears off Barrow. Approx 3 m off the beach. Since no hunting is going on now – can stay close by and helo can take direct route. Establish comms with HEALY on channel 83a and with helo pilot on cell phone. Helo pilot and AMD inspector enroute to Search and Rescue Hangar where staging will take place. Excellent weather for flying and waiting – HEALY calls and says no boat transfer and request that VIPs from Barrow (George Olemaun, Harry Brower and wife, Glenn Sheehan and wife, come out by helo. Science party gathers at Polar Bear Theater in Barrow awaiting clearance of helo for HEALY work. Transfers begin approx 1030 L – continue till approximately 1630L.

1400L: Arrive aboard HEALY – all going well. Brian has already set up computers in Future Lab. Tracy Wahl from NPR has been aboard since first helo. Spent a bit of time talking with her and then back to trying to settle in. Mooring recovery team were first to arrive as mooring recovery will be first operation. By time I arrived on board, they had tested their equipment and were ready to go.

1700L: Underway

1815L: First Captain's meeting. We will need to decide very soon whether we head west or east after we recover the moorings. NIC folks briefed on ice conditions – claim they there is less ice then ever and we should have smooth sailing. If it is really clear, we may think about real overlapping surveys rather than exploratory zig-zag lines. Also reviewed mooring recovery procedures and requested Patch Test and CTD at foot of slope – eta tomorrow 0800.

1900L : In-brief and first science meeting (introductions and logistics)

2020L: Mooring recovery started – acquired and recovered very quickly – Capt agreed to recover second mooring rather than waiting for morning

2300L: Begin recovery of second mooring. Did not acquire it or range on it but sure enough it surfaced.

Decide to head west to Russian boundary line first as ice seems to be thinnest on that side and retreating from west to east.

Setting up Ozi Explorer with new IBCAO in Albers and geographic cords, and Global Mapper with new IBCAO in polar stereographic and geographic. Dale has provided another newly made serial cable with NMEA string and works fine with Ozi Explorer. COM1 requires 9600 baud 1 stop bit no parity. Same settings for Global Mapper do not work – Global Mapper manual says that it requires NMEA-0183 v2.x – will check but I assume that that is not what we are getting.

Set up Fledermaus with new IBCAO data and vessel manager works fine but there is clearly an offset in positions with all other sources. Will investigate further when I have time.

The most fantastic new addition to the HEALY's capabilities is the Map Server (Figure 4) web site created by Steve Roberts. It provides a GIS-like environment with real-time position mapping superimposed on bathymetry, track lines many other layers including ice imagery. Most importantly they have in the background ALL of the previous HEALY data (and some NB Palmer data) that we have not had access to (proprietary). This enables us to ensure that we do not collect duplicate data.

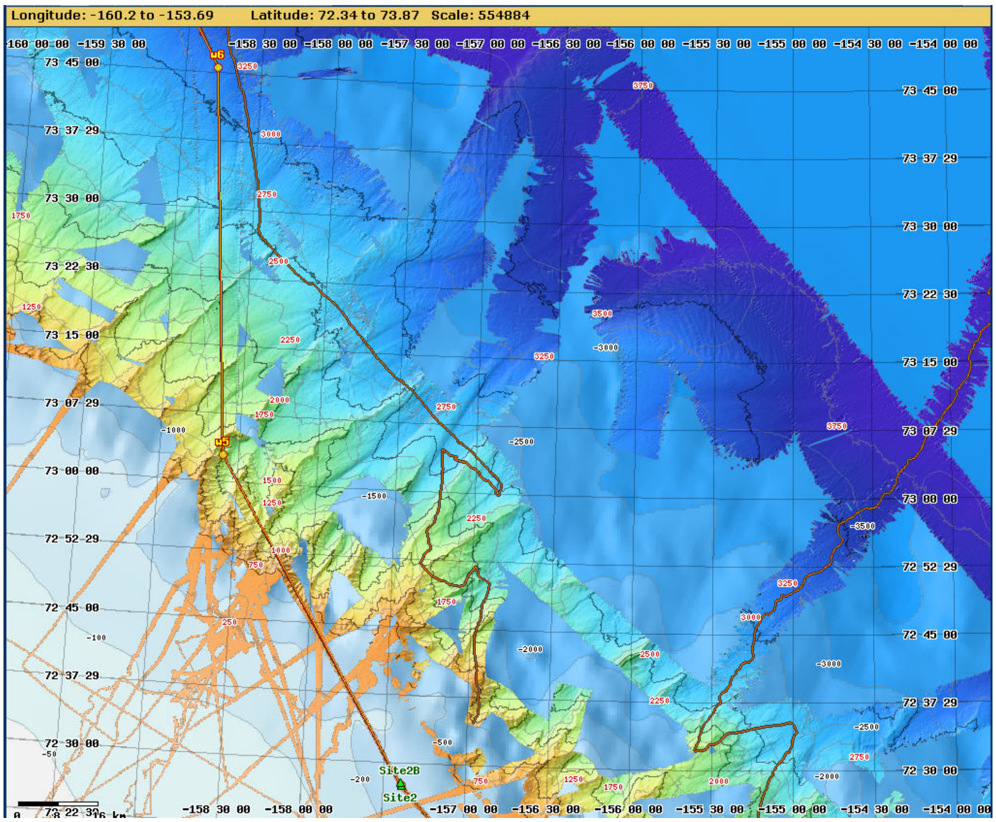


Figure 4. Example of existing data coverage in Map Server

18 August 2007 – JD 230

All systems working well. Training people to stand watches, process data, etc. BRC wrote a data processing guide (Appendix A) and LM wrote brief watchstanders guide (Appendix B). Decided on 8 on, 16 off watch schedule with at least 3 people on watch at a time – Andy and LM will do 12 on – 12 off, as will Luciano and Brian. Colin, Jimmy Olemaun and Mac Funk will float.

0800L: Decide to do patch test in region where we go from deep (about 3200 m) to shallow – will also try to fill small gap in coverage in that region. Have also requested CTD to calibrate XBT at same (deep spot).

Find out that when I discussed Patch Test and CTD for this station, MST's assumed that this was only a patch test. They were unfamiliar with the terminology "patch test" – they call this a roll and pitch bias test. Must be more careful from now on.

Roll bias test went fine. Dale and Brian independently analyzed result and found an offset of -0.07 degrees. Previous setting was -0.03 degrees.

1145L: Take CTD in 3280 m of water – CTD to about 3000m.

1443L: Set up for pitch bias test up and down slope. As we move up slope it is not well-behaved – canyons and slumps. Decide to move west to see if it is better (over HEALY 03-02 line) but it just isn't suitable. Abort and move on (Figure 5).

Plan is to try to parallel HEALY-03-02 (and other) lines building on existing data and attempting offset coverage – WP's 5, 6, 7, and 8.

BBC called for interview – let Stephen Elliot handle it.

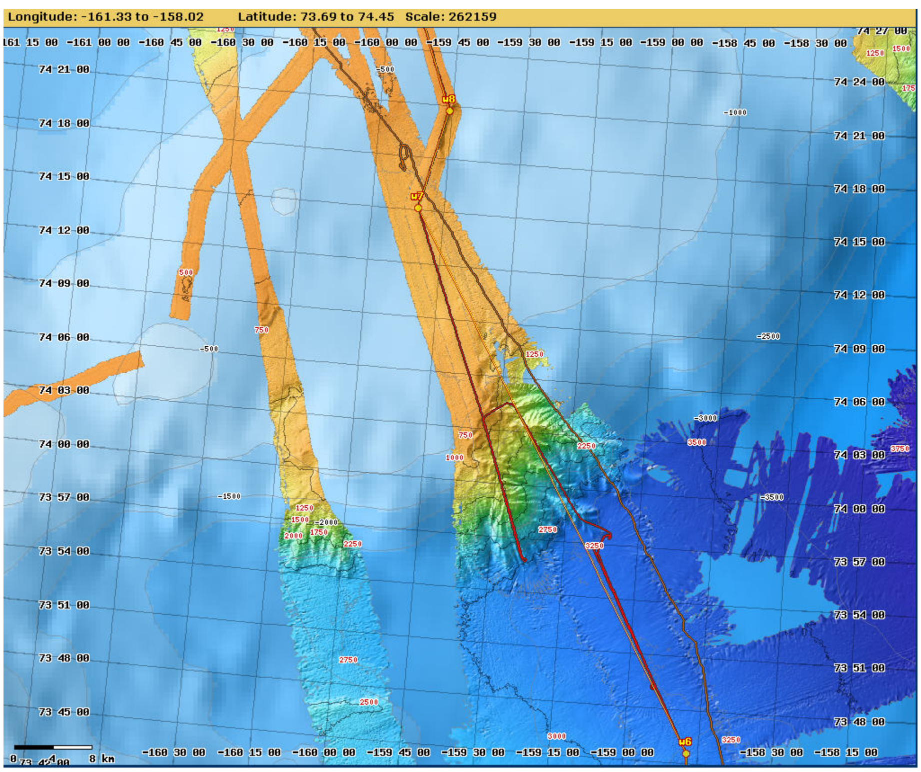


Figure 5. Patch Test area

Continuing underway – making about 15 knots, data reasonable – swathwidth about 7 km in 3200 m of water.

Brian processed first day's data. Luciano extracting reasonable backscatter from system.

2245L: Encountered first ice!! Very thick multi-year ice (about 1-2 m thick) with water on top. Beautiful blue color. Location: 75 03 N 160 45 W – interestingly when we had provide CG with predicted position of vessel each day (last January) we made the assumption that the ice margin would be at 75 N. Surface sound speed dropped quickly in ice (1436 -- below 1440 – had to go to manual input). Decided to take XBT and enter. Slowing to 8 knts then 6 knts then 3 knts (Figure 6).

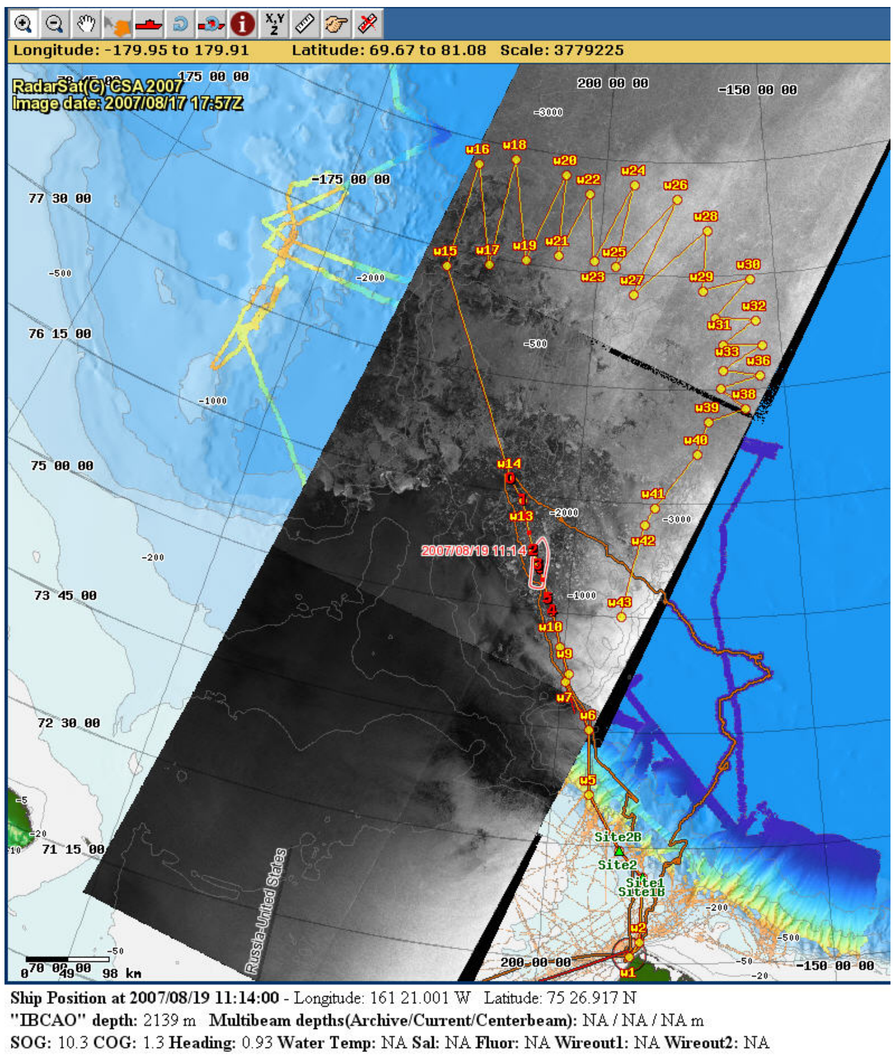


Figure 6. First encounter with ice

19 August 2007 – JD 231

0216L: First back and ram – followed by many 75 23.35N 161 14.06W.

0258L: Opens up

0345L: in ice again – easier going can maintain 8-9 knts

0354L: SB crash

0417L: SB back on line

0700L: Continue to move in and out of very thick (2- 3 m) multiyear ice.

1430L: Ship hove to for memorial service

1516L: Making way following memorial service

2000L: Polar bear sighted 1000 yds on port bow

2100L: LM on watch

2150L: take XBT

20 August 2007 – JD232

A very uneventful long transit over the shallow regions of the NW portion of the plateau. In and out of thick ice – very intermittent data but we are continuing to make good forward progress. Data quality marginal in places.

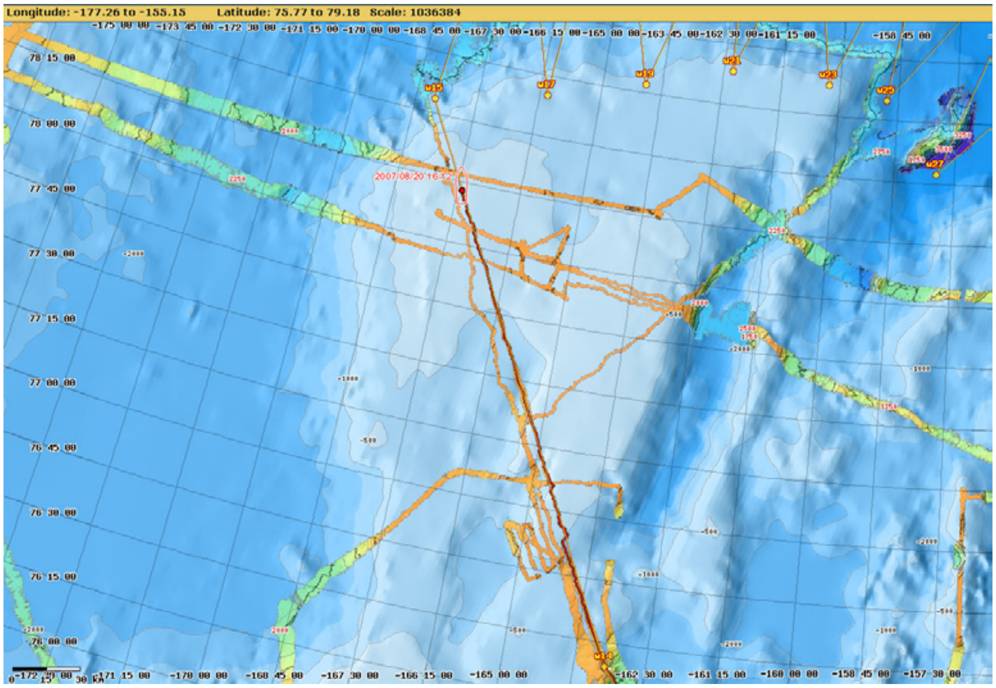


Figure 7. Note two tracklines that run to the west of the Cap well across the boundary line – these are HEALY 0503 and 0602 (Darby/Coakley and Lawver, respectively). We should request these data as they are relevant to the FOS and 2500 m bathy on the western side of the Cap.

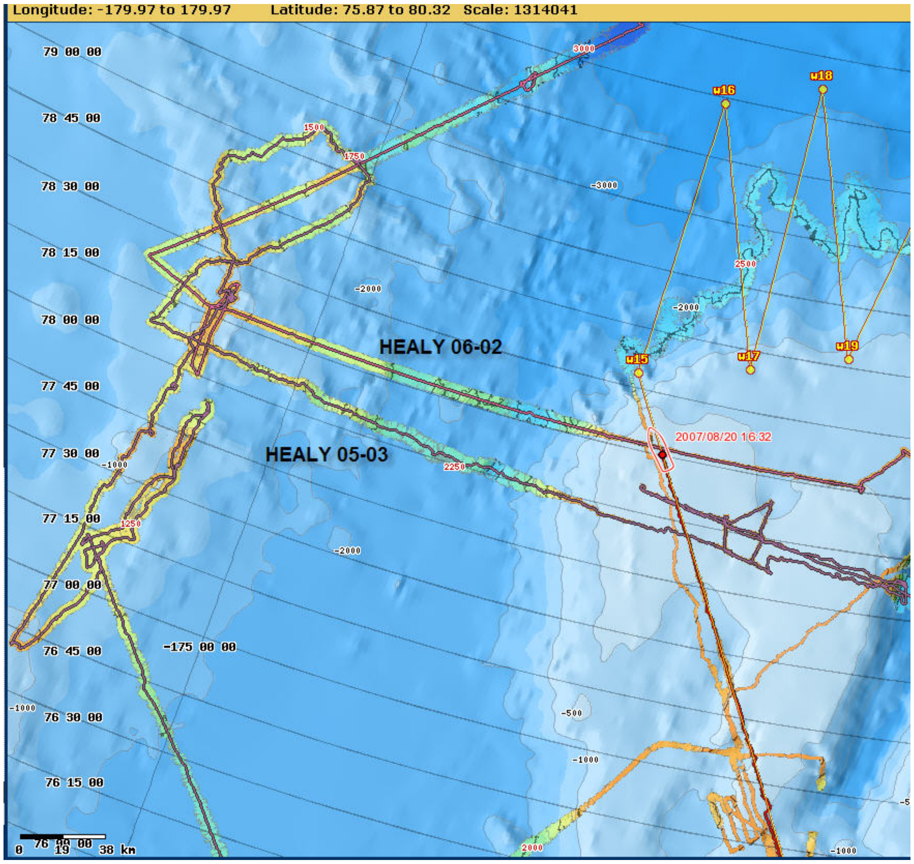


Figure 8. HEALY location 2007/08/20 0832

The plan is to run up to the Russian boundary line and then parallel the line heading north until we are comfortable with the foot of the slope – this is a complex area.

2150L: XBT taken

Have run up to about 79 44 N (WP16) along boundary line – crossing a high to the west. Turning back to diagonally cross back south to WP 17. Ice is getting thinner and thinner – making 8 – 9 knots – if this keeps up may take a couple of long runs north over hummucky topography on northern end of Cap.

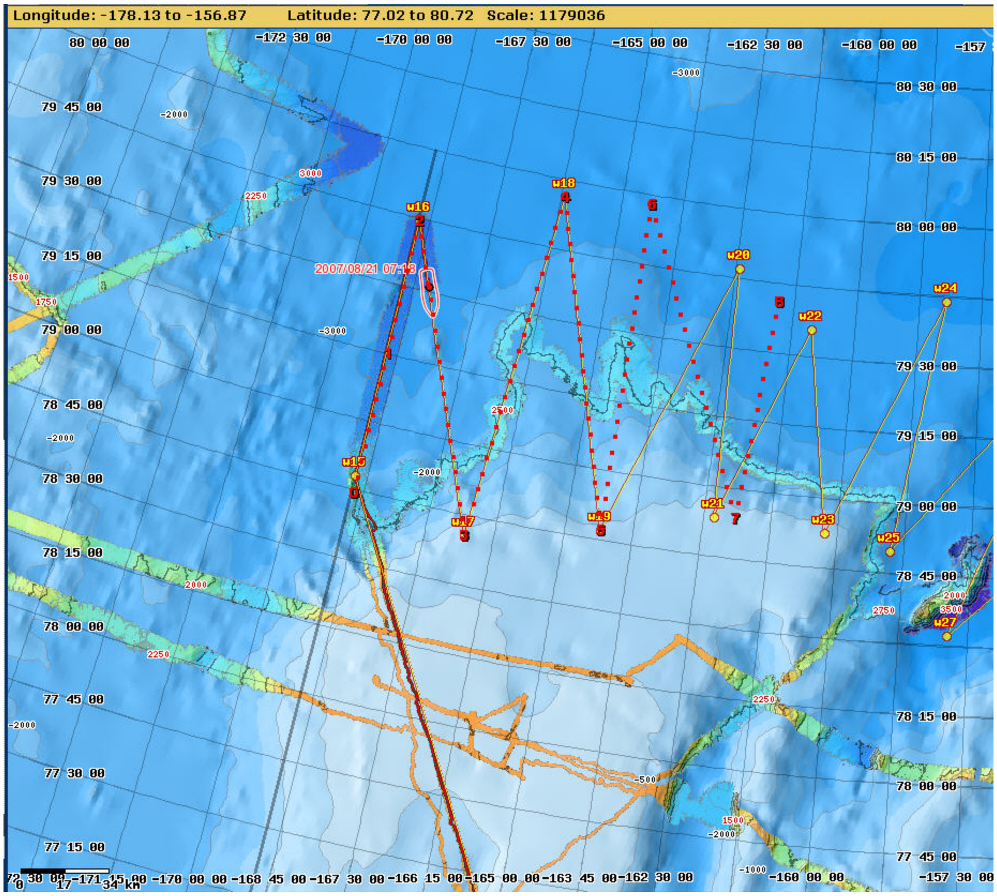


Figure 9. Ships position 2007/08/21 0715L

21 August 2007 – JD 233

Relatively smooth sailing – little ice, good data.

Clear slope break at **0212l (1012Z) –** water depth 3120 m.

Adding extra waypoint so that we don't run directly over HEALY 0302 line when heading back north. From extra waypoint will head directly to waypoint 18.

0600L: Beautiful evidence of slumping at northern edge of cap – shows up in both Knudsen and multibeam.

0645L: At WP 17 -- beginning turn to 17A

0850L: Turning at WP 18

Continuing in mixed ice – sometimes open water sometimes very melted pieces of old multiyear ice. We have no problem maintaining 5-6 knots but have asked the bridge to increase the speed when the water is clear. They are bringing it up to 8-10 knots sometimes, but speed is varying quite a bit.

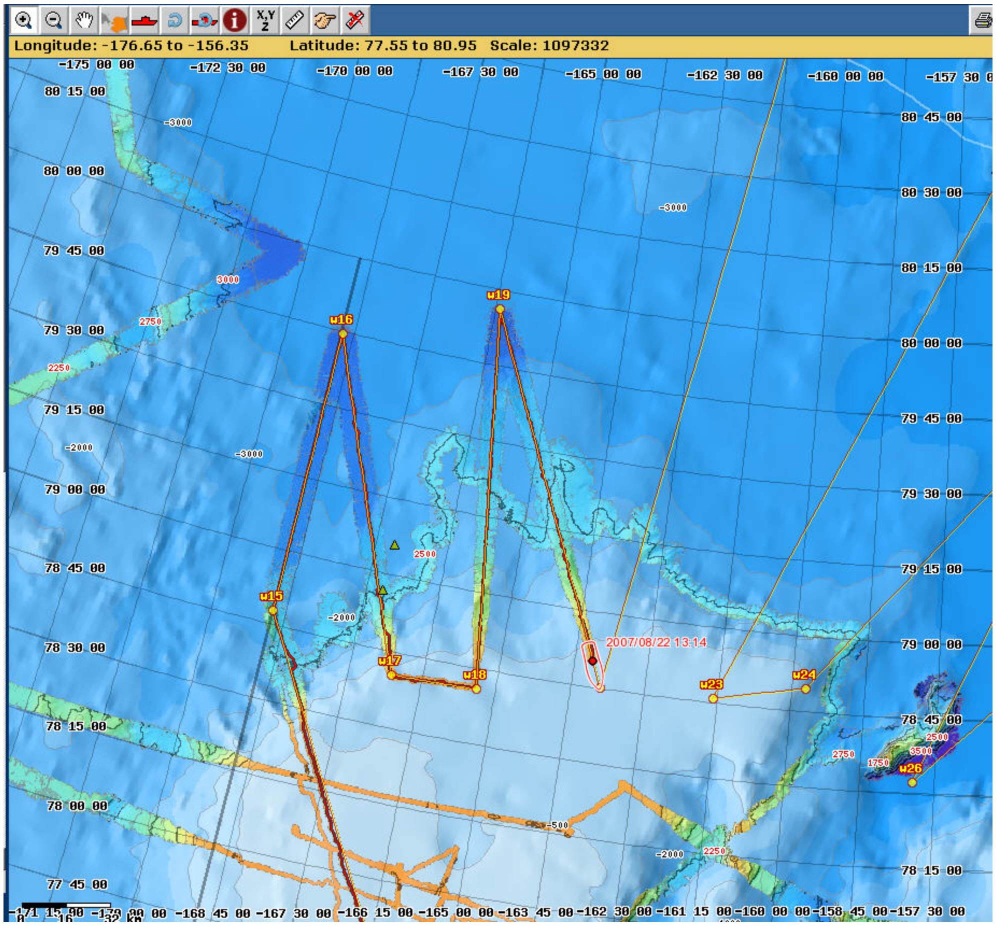


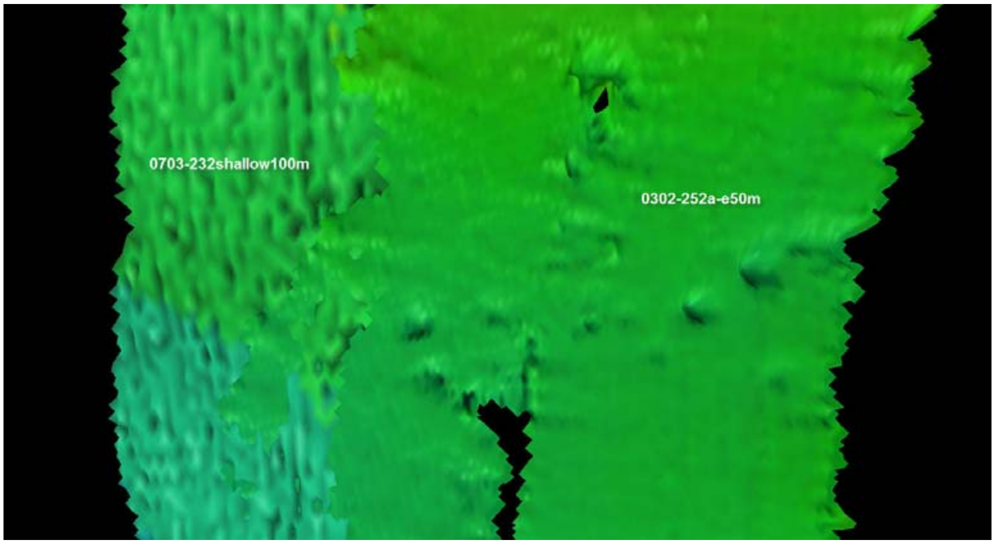
Figure 10. Ship's position at 2007/08/22 1314L

1900L : Have traversed up the cap again and again see a relatively clear break in slope at the tow of the cap. Pockmarks on the shallow portions – beginning the turn to WP 20.

22 August 2007 – JD 234

Now continuing south to WP 21 – conditions same as before alternating times of no ice and patches of broken multiyear ice.

Been looking at our processed data and concerned a about the high-frequency noise – not seeing scours and pockmarks that we see on the raw Seabeam display – compare several places where we have lines next to 0302 lines – not a pretty picture -- and 0302 was gridded at finer resolution. It could be worse ice conditions but I don't believe it – I think there is something going in with the gridding process. Will check with Brian. See example below (Figure 11).



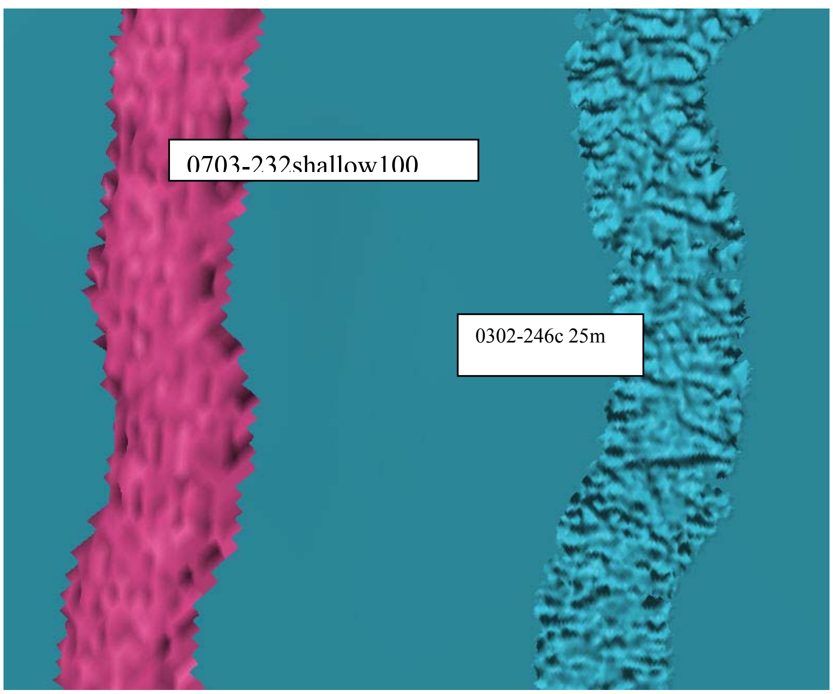


Figure 11. Comparions of 0302 and 0703 data

0600L: At WP 20 – turning for the long run up to WP 21 – if ice conditions allow

0800L: Air temperatures have dropped to about 28 degrees and we are seeing our first ice forming on the decks and on the ocean

0830L: New ice image just in – not a pretty picture – we are sitting just south of the solid pack – and heading right into it on this leg. If it gets too tough we may turn around and start full coverage mapping in open water.

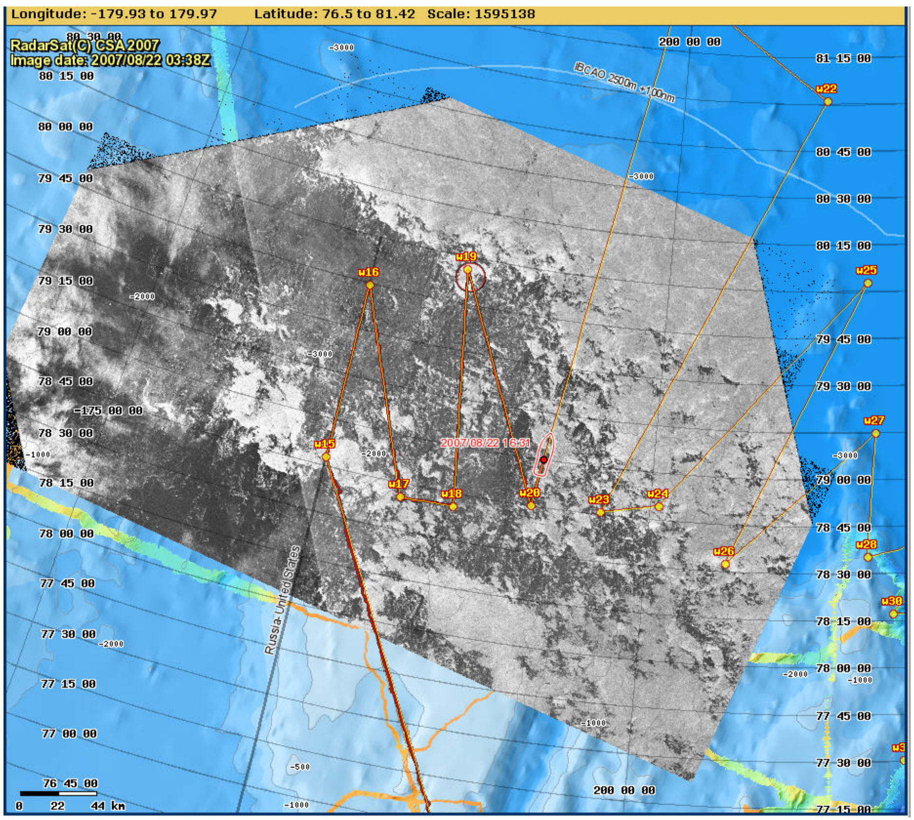


Figure 12. Ship position and ice coverage at 2007/08/22 1613L

0930L: Maneuvering for clear water to drop XBT and XSV

1004L: Launched XBT

1030L: Launched XSV in patchy ice; no completely clear water nearby; lost signal at ~200 m, likely that wire parted – comparison of upper 250 m of XSV to XBT adjusted by Levitas salinity shows good match – will continue to use this approach with XBT's

Beautiful day – sun has finally come out -- skim of new grease ice but still broken large pieces of old multiyear ice. We are settling on a speed of about 6 knots which retains reasonable data and lets us still make some progress. Despite the fact that we are now well within the zone that looked like heavy ice on the radarsat image (see below) – the ice remains exactly as it has been broken blocks of old melting multiyear ice – sometimes denser and sometimes less dense. Steady progress at 6-7 knots is not a problem. We will just keep heading north until the ice stops us or we reach WP 21 (expected tomorrow morning).

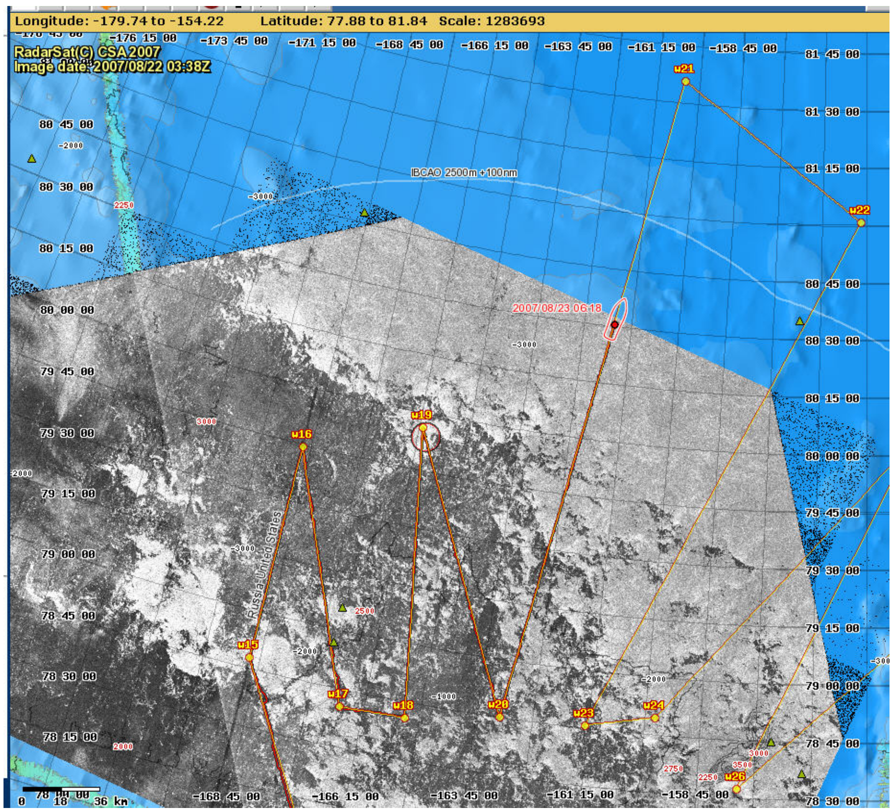


Figure 13. Ships position (and ice coverage at 2007/08/22 2228L

2200L: XBT taken

23 August 2007 – JD 235

Continuing north -- conditions still same – broken chunks of rotten multiyear ice.

0742L (1542Z): Beautiful break in slope at edge of northern-most outer high. Should capture Knudsen record at that point (Figure 14).

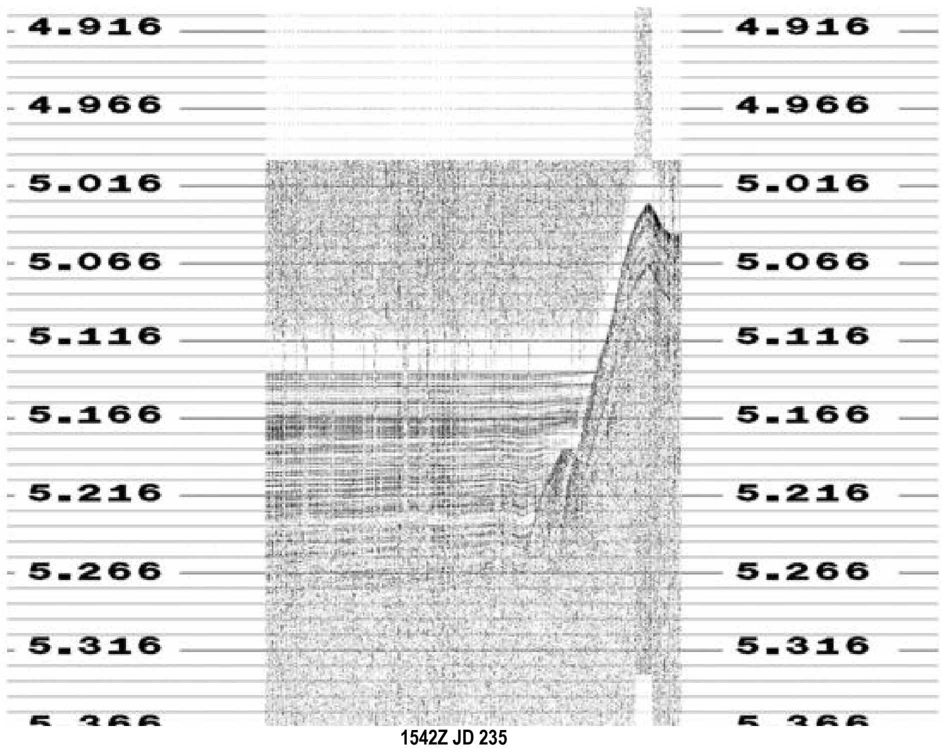


Figure 14. Knudsen record at 0742L -23 August -

0850L: Stopping to change light bulb on bow mast; back on line after about 20 min. Have decided to turn southwest after reaching WP21 (farthest north point) and come back down to the area with relatively shallow bathymetry and run a line that crosses this feature from west to east. From there we will head southwest back to the top of the cap in the vicinity of Healy seamount.

1130L: Reached the farthest north point of our survey 81 36N – ice conditions still same.

1200L: Began searching for suitable ice floe for deployment of ice buoy by National Ice Center team. Slow speed and variable courses.

1320L: HEALY stopped for buoy deployment. Also deployed marine mammal hydrophone off bow.

1430L: Deployment of ice buoy on ice floe completed; making way away from buoy and back to planned track; coming up to 6 kt.

1841L: Backing and ramming in thick ice.

2115L: Ethan is deploying sonobuoy in short sleeves

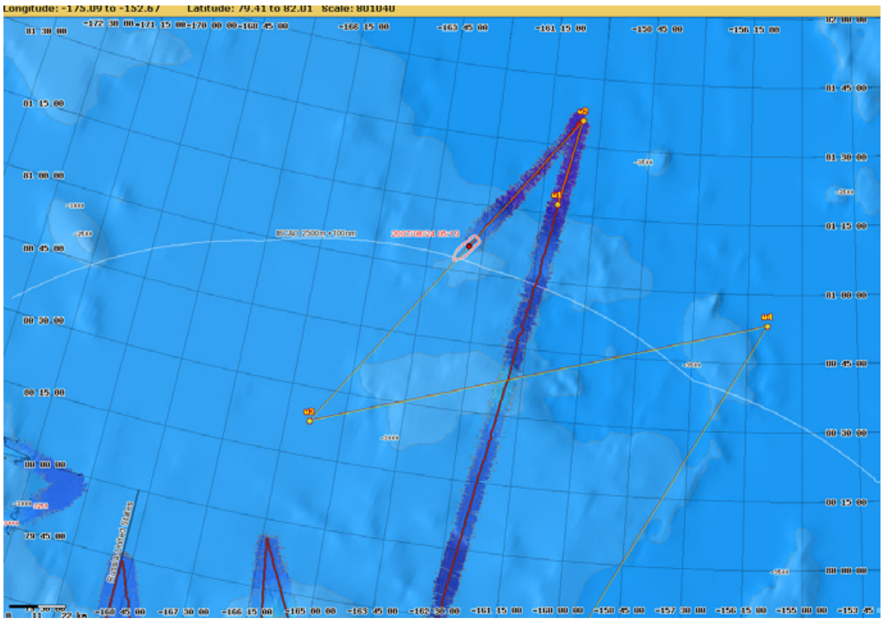


Figure 15. Location of ship at 2007/08/23 2119L

2150L: XBT taken

24 August JD 236

0530L: At WP 22 – beginning turn – all as before.
0855L: Loss of power – slowing for repairs.

Crossing topographic high enroute to WP 23. Depths rising to 2600 m – wondering if feature may come above 2500 m – decide to do two more offset lines and develop the full feature. Nothing above 2500m.

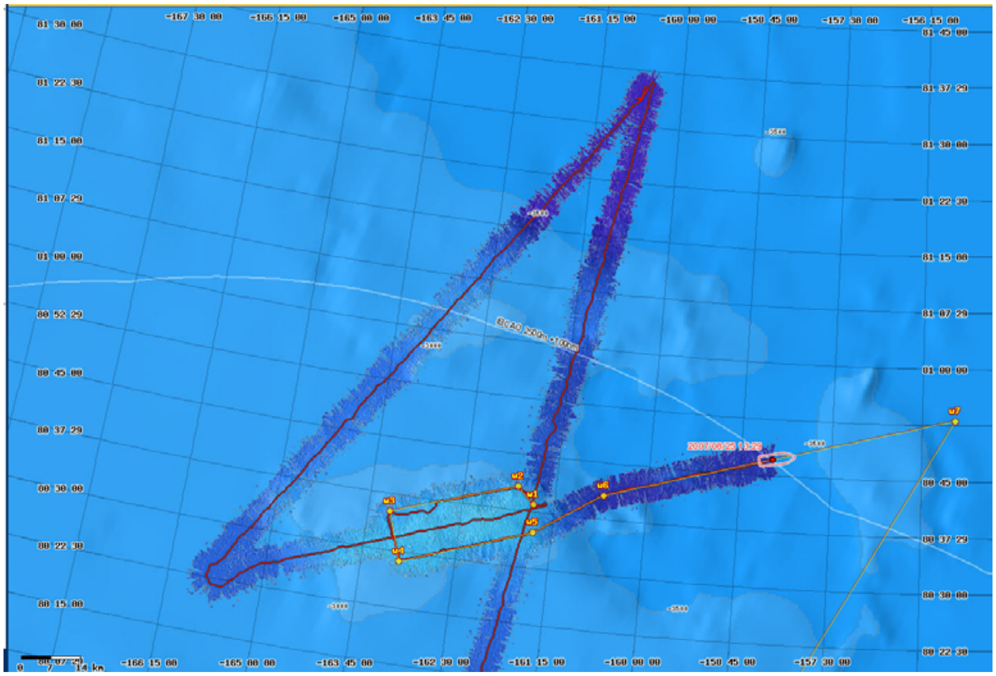


Figure 16. Location of HEALY 2007/08/25 0529L

25 August 07 – JD237

0500L - Wakeup for Bluenose Polywogs – mustering in hanger, calisthenics on the helo deck and then “breakfast”. It will be a cold morning for them.

0600L: Bridge called – putting second engine on line

0620L: As an experiment to try to understand why data has a very different appearance from 0302 to this leg we will go 3 knots for the next two hours and look at data quality. Recovered to 6 kts 0910L to allow for scheduled line file change. Second main on-line to allow breaking at 6 kts in heavier ice.

0900L: Ended experiment – back to 6 knots – Brian will process up and we will see if this makes a difference.

1130L: at WP4 – turning to the southwest

1230L: XBT taken

1900L – 1955: Several more crossings of the sharp break between flat-lying sediments and the topographic high of the blocks at the northern most tip of the cap.

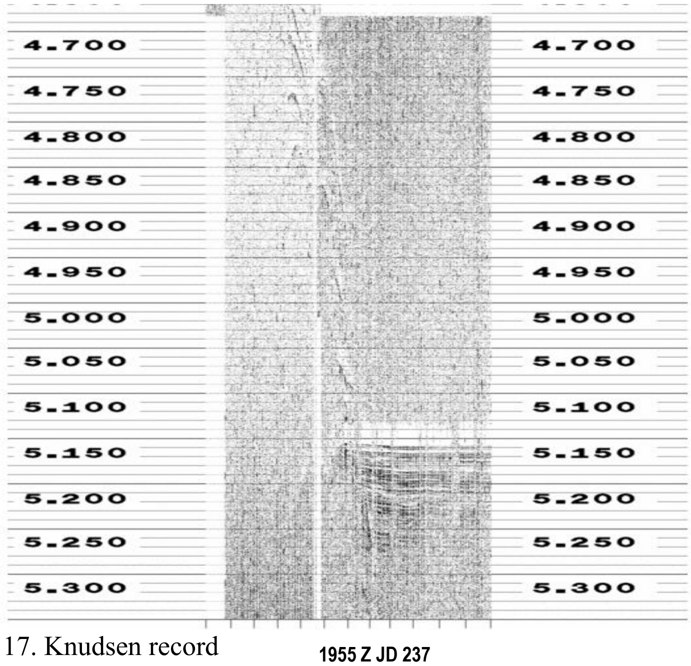


Figure 17. Knudsen record

2150L: XBT taken

2300L: Seal spotted – sonobuoy deployed by Ethan Roth

26 August 2007 JD 238:

0020L: Stopping for ice buoy deployment

0220L: Ice buoy deployed – underway again

1100L: Passed new waypoints to Navigator

1330L: Turned onto eastward leg across plateau

1400L: Passed revised waypoints to Navigator

1500L: Frequent pockmarks on seafloor along track

1600L: Linear artifact along port side of swath

1700L (apprx): Turned north at revised WP 25 along slope of cap to run along spur extending NNW from the main plateau of Chukchi Cap.

Continuing northward along spur – some slump features, have caught the edge of the high and now moving up on the high.

Have been trying to figure out why 2003 data appears to be less “speckley” than this year’s. We have rerun data sets from 2003 using the current processing path. There is an interesting difference – see figure below:

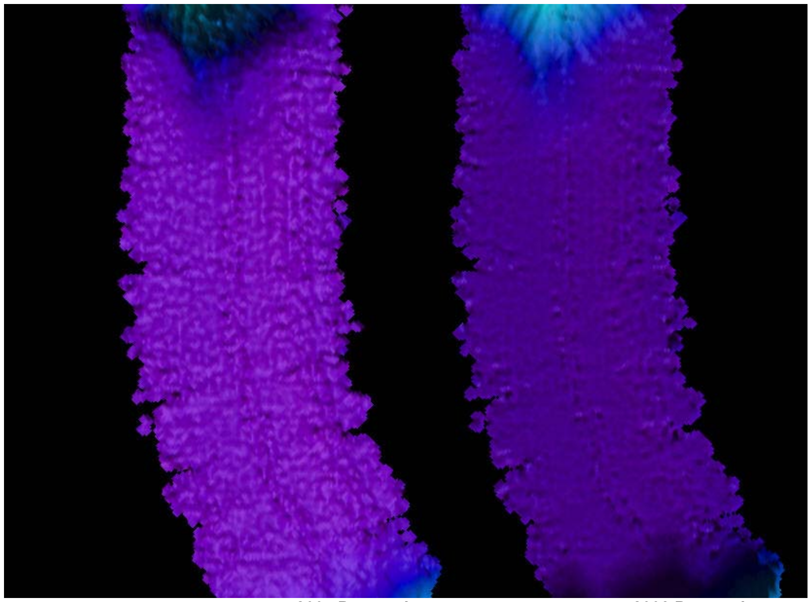


Figure 18. Comparison of 2007 processing and 2003 processing

It turns out that the fundamental difference is the shading and illumination parameters. If we change the shading parameters to:

Shadow Direction: 131 deg
Effective Sun Angle: 7 deg
Ambient: 31.3
Specular: 21.6
Soft Shadow: 47.5
Vertical Scale: 11.3

When these are applied to the same data set displayed above:

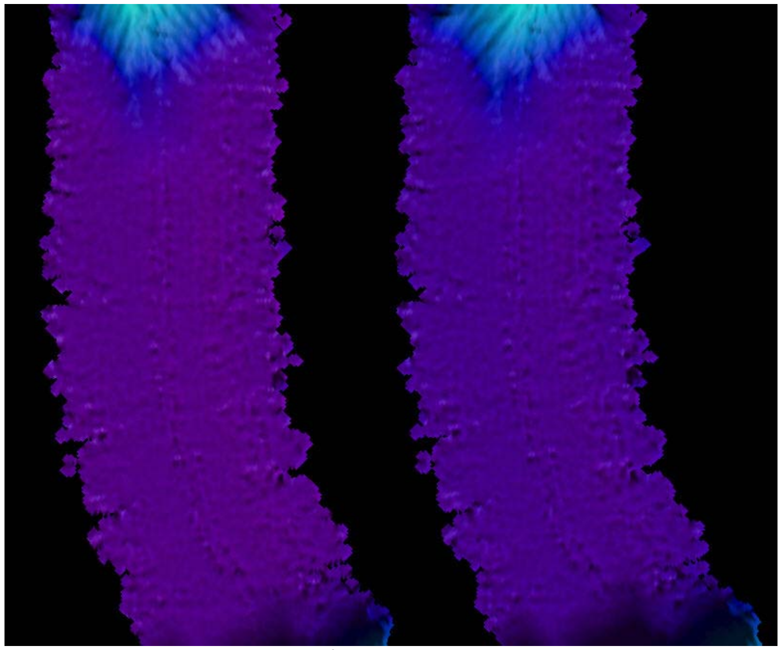


Figure 19. 2007 data with revised shading compared to 2003 data

27 Aug. 2007 – JD 239

1045L: Once again, crossing tip of local high and have beautiful sharp contact with steep gradient (see figure below)

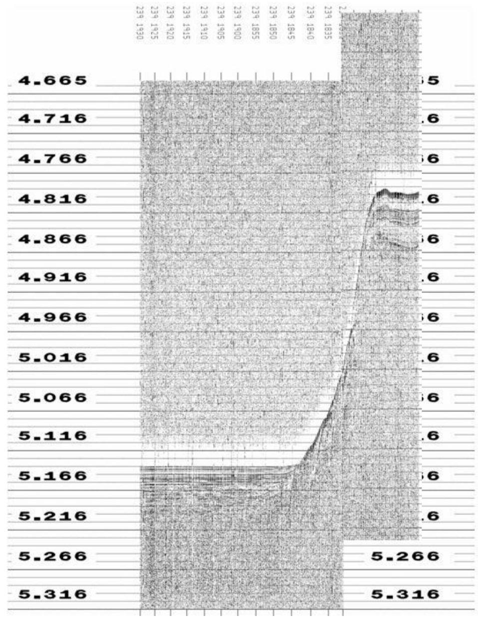


Figure 20. Knudsen record 27 Aug 2007 1045L

1120L: Turned southward at waypoint after dropping off seafloor elevation and reaching abyssal plain. Back onto elevation shortly after turn.

1430L: Began directing conn by marker on seabeam screen, with goal of keeping foot of the slope in the middle of the swath.

1710L: Resumed normal track following as foot of the slope turned eastward. Crossed over bathymetric high.

2030L: Increased Sea Beam pulse duration to 15 msec (from 10) to improve performance in deep water with flat seafloor.

2045L: On very flat seafloor but see a topographic high on the far port beams (east of the track) – this may line up with the series of highs that we will investigate in the next track to the north

2145: Ethan deployed sonobuoy

2235: Ethan deployed another sonobuoy

28 Aug. 2007 -- JD 240

Continuing to run down the very flat seafloor north of Healy Seamount.

0330L: Passing Healy Seamount

0455L: At turning point by Healy Seamount – beginning line to cross traditional FOS on top of Cap

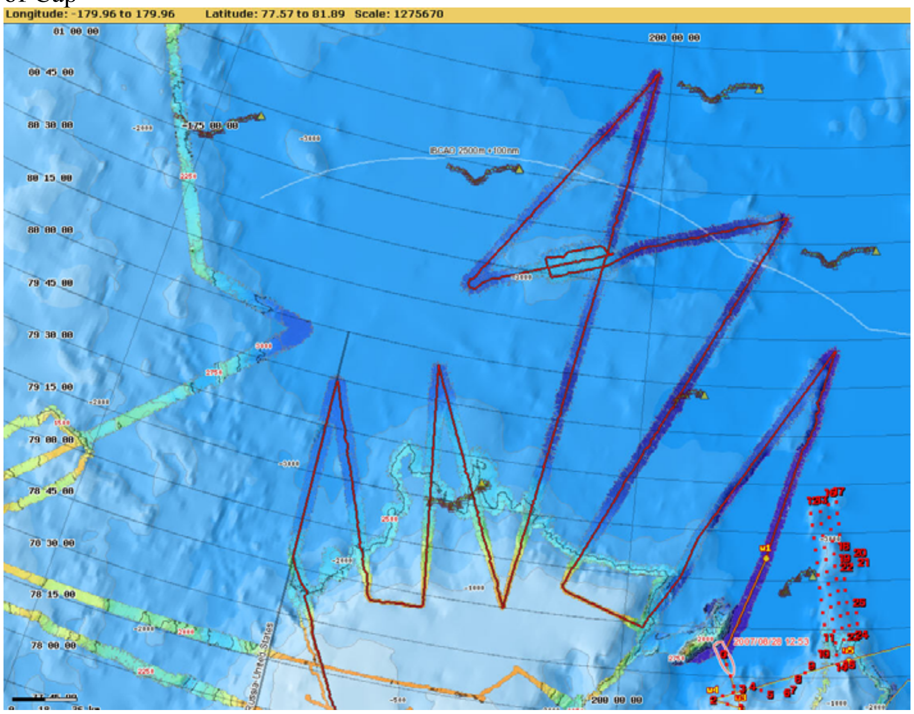


Figure 21. Location of HEALY 2007/08/28 0453L

0745L: Turning to the west to pick up the 2500 m contour. Began steering by contour-following guided by survey watch from computer lab display

1230L: 2500 m isobath is tracking farther offshore than shown in IBCAO

1530L: Lost bottom return for several minutes. Opened gates and increased pulse duration to 15 msec to regain bottom return. Small gap in 2500 m isobath.

2019L: Finished following the 2500 m contour – joined up with HEALY 0405 line. We have put down a series of N-S waypoints that should allow us to establish the continuity of the topographic feature to the east of Healy Seamount - -starting up the feature.

29 August 2007 – JD241

0440L: As we came up the ridge, we crossed two steep highs on to our east but there is no connection to the small feature that we saw to the west. Will turn west to see what is between
.

0640L: Have surveyed the small feature and it is an isolated little peak – very strange – heading back to the original track.
0855L: Back on scheduled track after exploratory excursion.

1100L: Launched XBT; first probe failed at 200 m, stopped ship for 2nd (successful) drop

1105L: Resumed making way, beginning broad turn to pick up southbound track

1200L: On southerly track

1300L: Ship stopped for mechanical problems for apprx 8 min. Data acquisition unaffected

2100L: concerned we may have refraction problem – though we are coming down a ridge - will take XBT – XBT looked good but funky near bottom – will take XSV – XSV looks real good and matches XBT w/ Levitas until funky part – will leave funky part out.

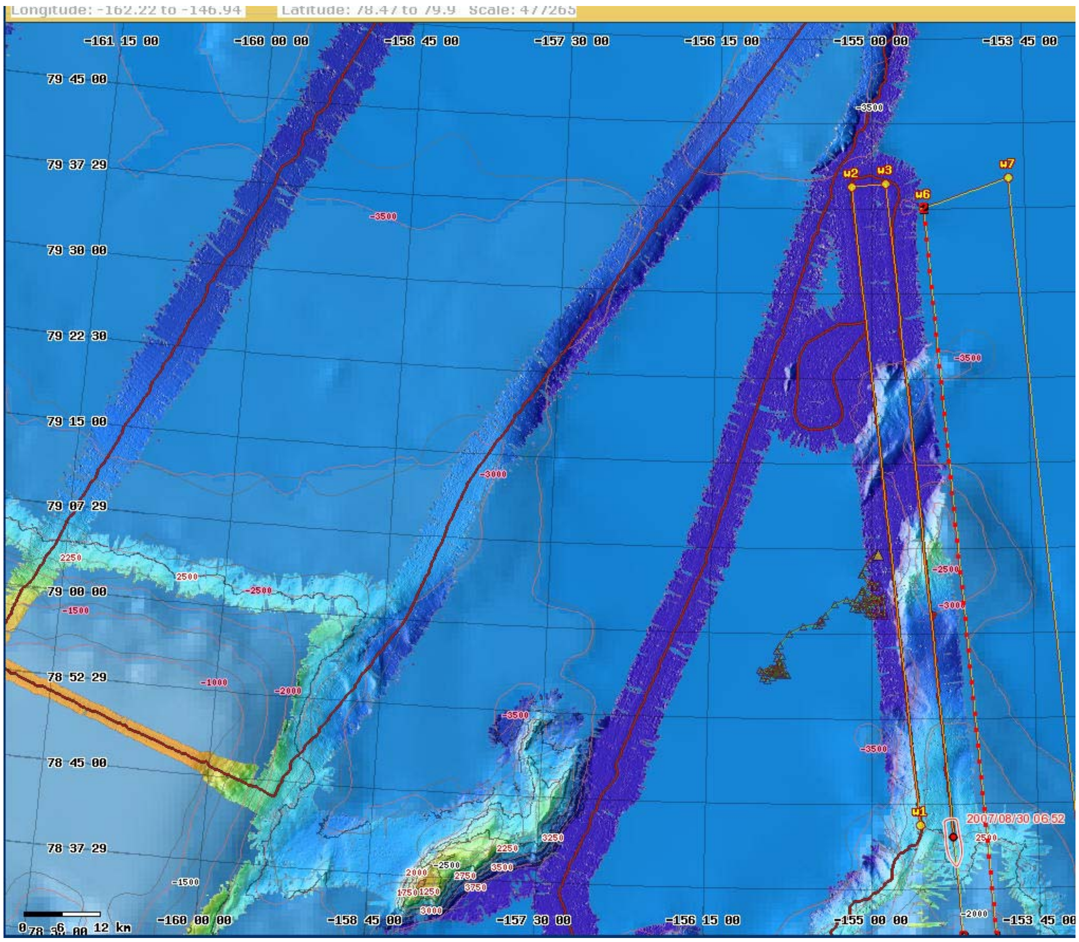


Figure 22. Location of HEALY 2007/08/29 2252L

30 August 2007 – JD 242

0030L: Begin turn to the east

0115L: Begin leg to the north

0525L: Message from Martin Jakobbson on Oden – they are at 86N and 31W – heavy ice.

1200L: Begin leg to the south

1430L: Detected seafloor elevation to the east

1510L: Began loop in cursor steering mode to develop feature. After reaching feature, began parallel line development

1830L: Completed mapping of elongated seafloor feature and began returning to track.

1959L: XBT taken

31 August 2007 – JD 243

Surveying on the south eastern section of "Extension Spur" – we crossed a clear FOS on the top and now looking for the southern boundary. The key to finding the FOS is finding the point on the 3.5 where the flat-lying sediments that abut against the ridge.

0045L: First sunset of the cruise – a long and drawn out experience but beautiful.

0400L: Sunrise

0430L: beginning turn to north

0720L: As we pass WP the ship starts heading in all sorts of strange directions – call up to aloft con several times and they say that the new line is being entered and that they are having trouble with the GPS, etc. etc. I ask to them to just steer a heading (357) but they seem not to be able to do that. (Figure 23).

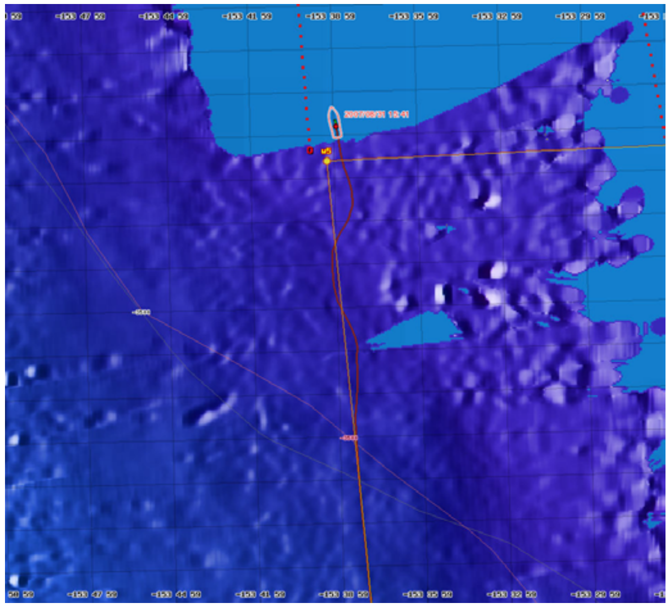


Figure 23. Attempting to drive straight line

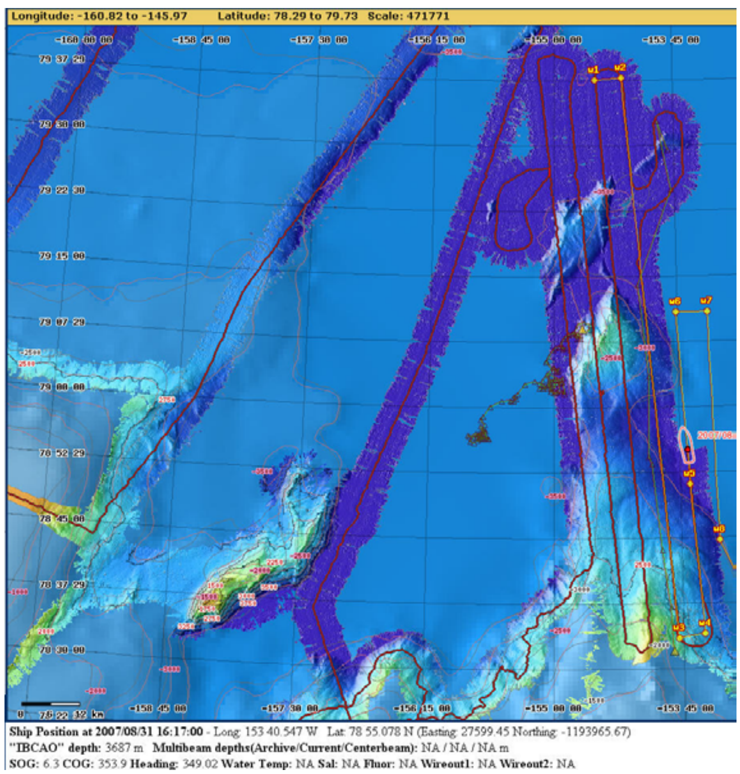


Figure 24. Survey of “Extension Spur”

0735L: Crossing FOS

1125L: Reached northern point of planned track in abyssal depths, began wide turn to come onto southerly line

1420L: Made some adjustments to surface sound speed in SeaBeam to regain bottom return

1430L: Initiated eastward diversion to ensure complete coverage of seafloor elevation and confirm location of foot of the slope

1540L (apprx): Returned to track to south

1800L: Reached base of spur and began following foot of the slope along eastern margin

2034L: Ethan deployed a sonobuoy

2215L: Maneuvering to deeper water for CTD – will take CTD then do a wide turn back and run a cross line onto top of Cap.

2230L: Stopping for CTD

1 Sept. 2007 – JD 244 –

0200L: CTD on deck – XBT taken – getting underway – heading west to get an orthogonal crossing of the FOS then back east to pick up the FOS again and head south.

0850L: Back on track following the FOS south

1130L: Turned to follow north-eastward excursion of the foot of the slope.

1210L: Completed mapping of spur; reversed course to resume southward FOS following.

1800L: Much more open water; increased survey speed to 7 kt. as trial. Data remaining good

1810L: Stopped for possible ice buoy deployment. Bouy deployed on ice by small boat

1950L: Boat back aboard, making way back onto mapping FOS

2 Sept. 2007 - JD 245

0024L: Believe it or not we are backing and ramming – we seem to have found the only ice on this side of the Arctic

Uneventful evening of following the FOS – in region where HEALY0602 line crossed the FOS the morphology is more complex and possibly related to some slumping.

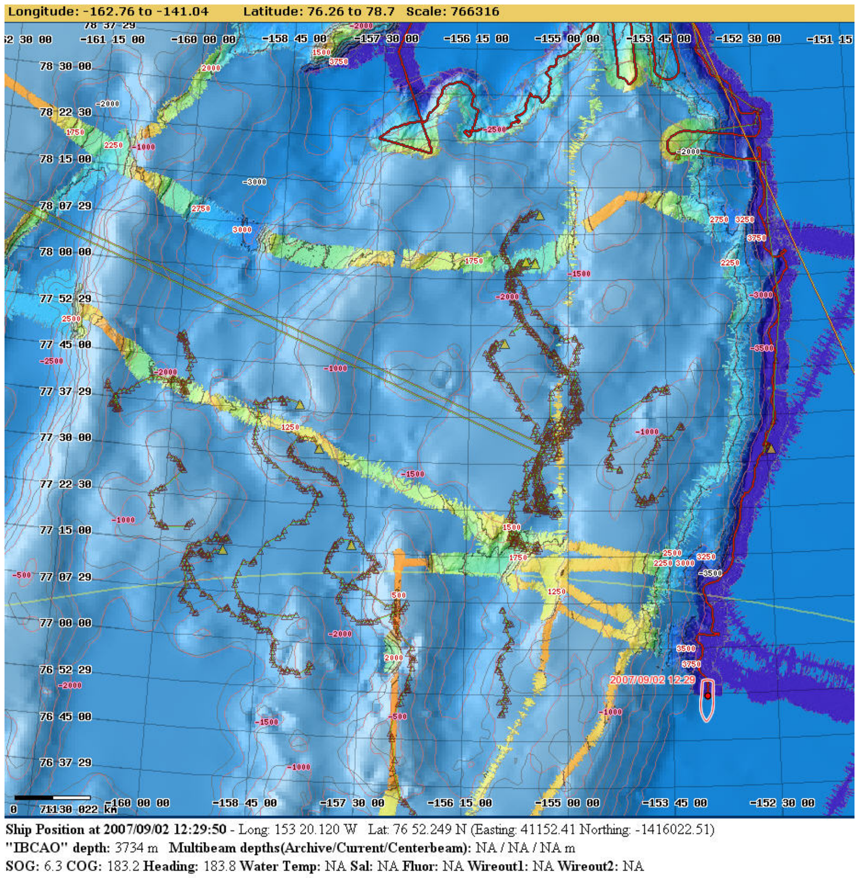


Figure 25: HEALY location 2007/09/02 0429L with ice buoy tracks

0900L: Continuing to follow the FOS; almost completely out of ice; increasing speed incrementally as ice and echo sounder performance permit.

1320L: Surface temperature of water increasing; shifted to automatic transducer sound speed adjustment

1600L: Launched XBT and entered new sound speed profile

1705L: Increased speed to 10 kt

1900L: 2nd engine online, increased speed gradually to 15 kt

3 Sept 2007 – JD 246

0118L: Seas picking up – data starting to look a bit ragged – will try slowing to 10 knots.

0230L: Starting the trek up north

0300L: A quick review of data quality before and after slowing showed little difference – we will bring speed up to 15 knots

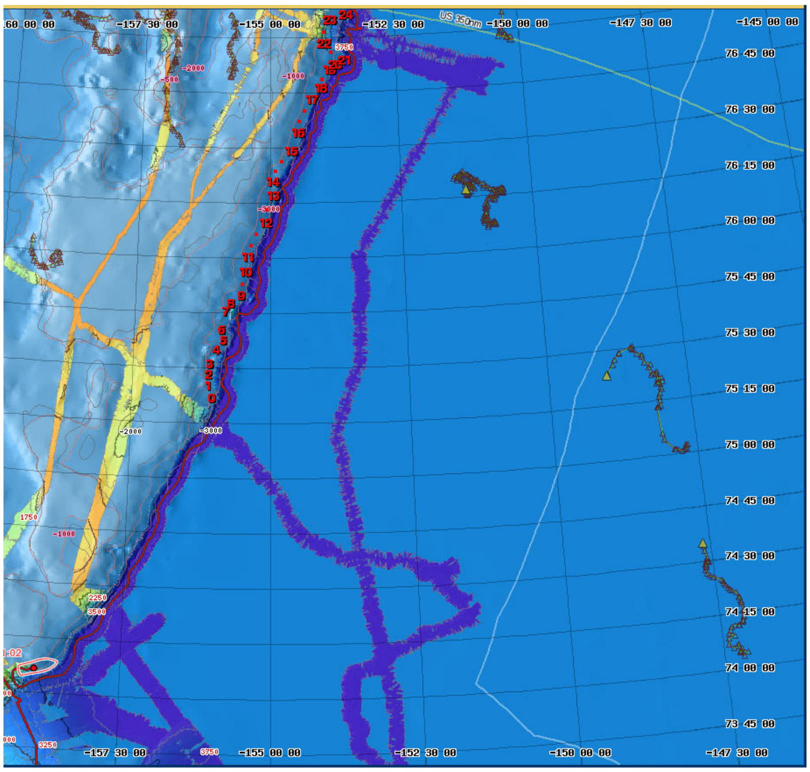


Figure 25 –Running line down and up eastern side of Northwind Ridge

0730L: Starting orthogonal cross line

0915L: Reversed course for inbound orthogonal line

1040L: Began altering course to resume line along slope; track intended to provide overlap with southbound swath; courses specified by survey watch

1400L: Diverted upslope to run a slope-crossing transect

1515L: Turned northward near ice margin to set up upslope transect.

1530L: Slowed briefly for propulsion system check, then resumed speed, turned onto upslope transect line; surface sound speed dropping near the ice

1615L: Completed upslope transect; ship maneuvered for engineering tests and came to SW course to fill in gap in along-slope track

1900L: After diverting to west, began downslope transect across FOS. Surface temperature decreasing as ice edge is getting nearer.

2000L: Slowing as more ice is appearing – though there are open patches beyond

2130L: Heading north again – ice clearing back to 15 knots while we can

4 Sept. 2007 – JD 247

0035L: Beginning turn to connect to cross-track profile

0430L: Back into relatively heavy ice – slowing to 5 knots – and up to 10 knts

0505L: crossing FOS on western leg of E-W line

0545L: Resumed northerly track along slope

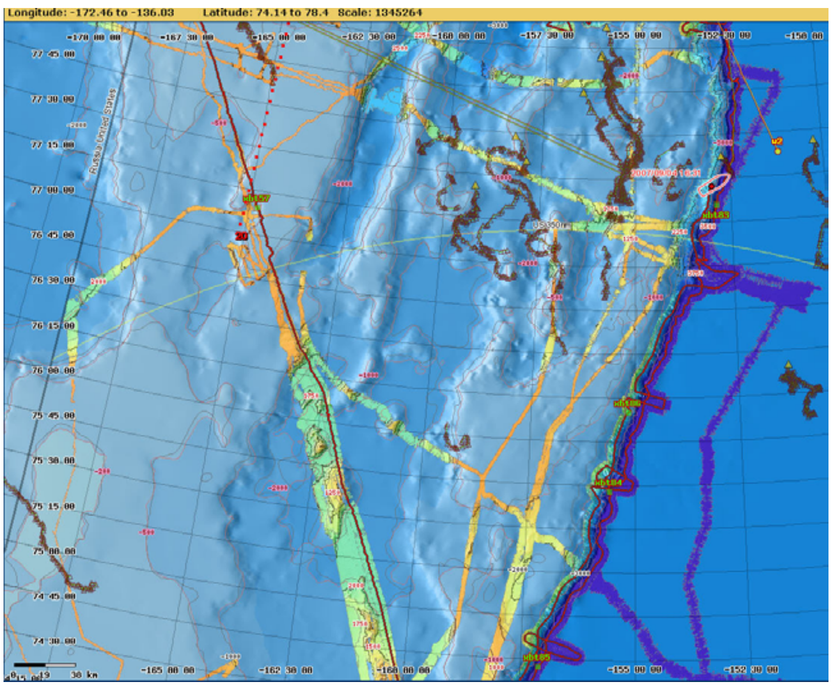


Figure 26. HEALY location 2007/09/04 0831L

1005L: Began E and W slope crossing lines

1630L: Moving upslope to fill in gaps from previous year swaths and close 2500 m isobath where gap exists

1836L: Launched XBT; 2 failures at 6 kt required stopping; 3rd XBT successful; loading new profile

2030L: Completed 2500 m isobath diversion and returned to paralleling FOS swath.

2203L: Ethan deployed a sonobuoy

5 Sept. 2007 – JD 248

Finished the northward leg up the eastern side of the Northwind Ridge – now turning west and then heading north again on the western side of Extension Spur

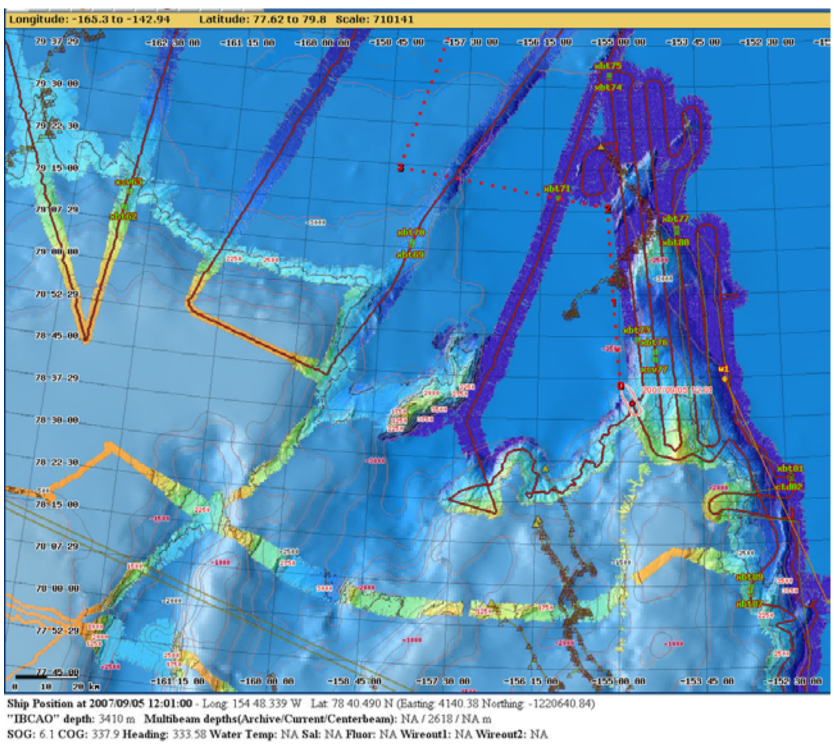


Fig. 27. HEALY location 2007/09/05 0401L

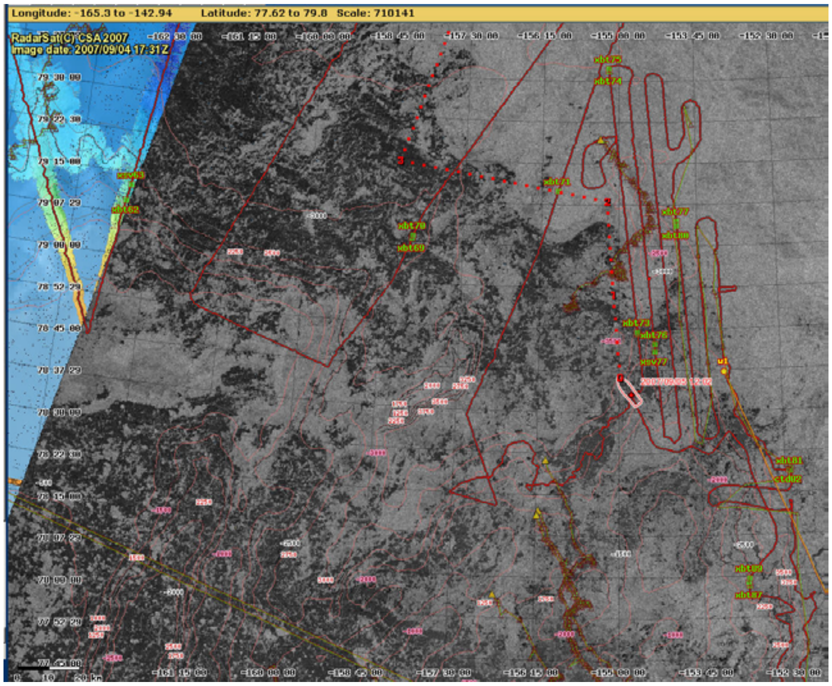


Figure 28. HEALY location 29007/09/05 0432L on ice image

0500L: We have crossed to the west side of Extension Spur – we will enter an XBT that was taken when we were here last (XBT-73)

0600L: Pulse width changed to 20 as we get into deep water

0700L: Heading west across abyssal plain towards HEALY seamount.

0945L: Encountered FOS at base of Healy Seamount and began following to the north

1440L: Reached intersection with FOS point on earlier track and changed course to westward

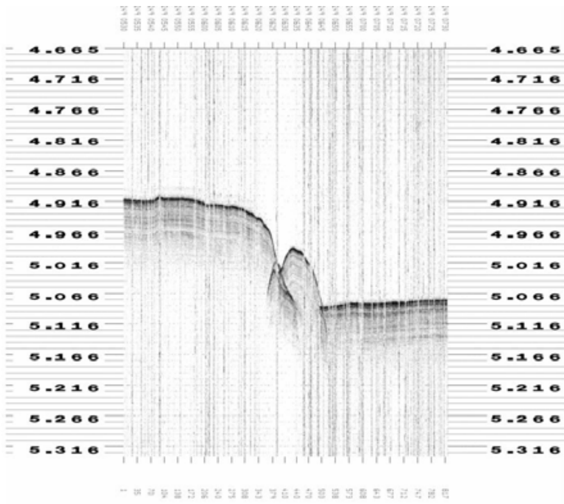
1730L: Turned north; no indication of bathymetric high shown on IBCAO

1830L: XBT and new sound speed profile

2100L: Information came to light—

a. setting receiver gain at 40 reduces swath width; setting at 39 is ok????
b. switching from 'auto' to 'manual' reduces swath from 121 max to 99 max beams

2235L: We are crossing a small channel and then an approximately 50-100 m step to flat-lying stratified sediments – look like "abyssal plain" stuff but not as flat-lying – they undulate more– depth is at about 3760 m – not obvious on bathy but very clear on the Knudsen (Figure 29):



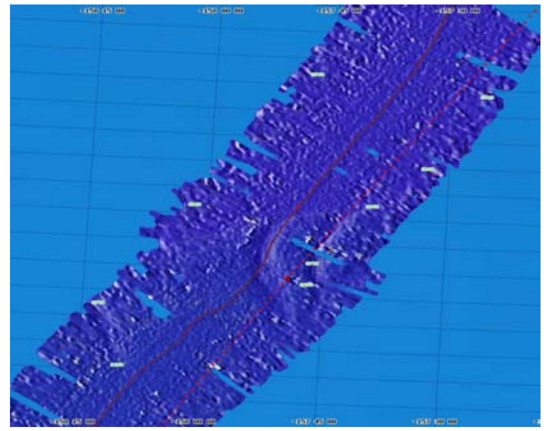
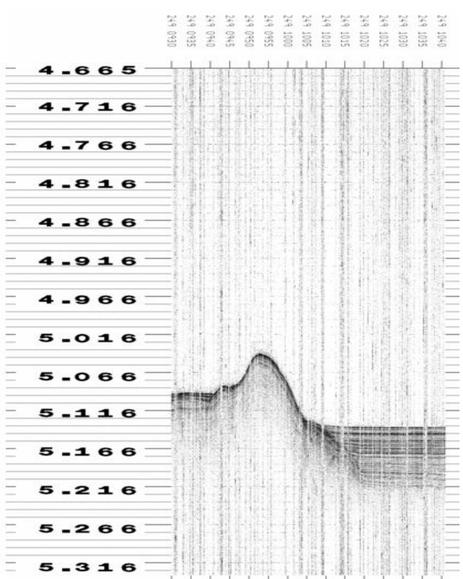


Figure 29 – Knudsen and Seabeam record crossing small channel

6 September 2007 – JD 249

Continuing north – Knudsen record is showing more structure and undulations – definitely not character of “AB” sediments.

0245L: Another high on the transit north – on Knudsen –



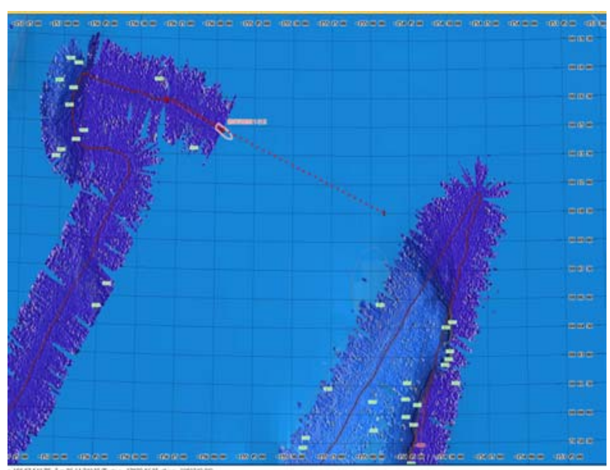


Figure 30. Knudsen record at transition to AB

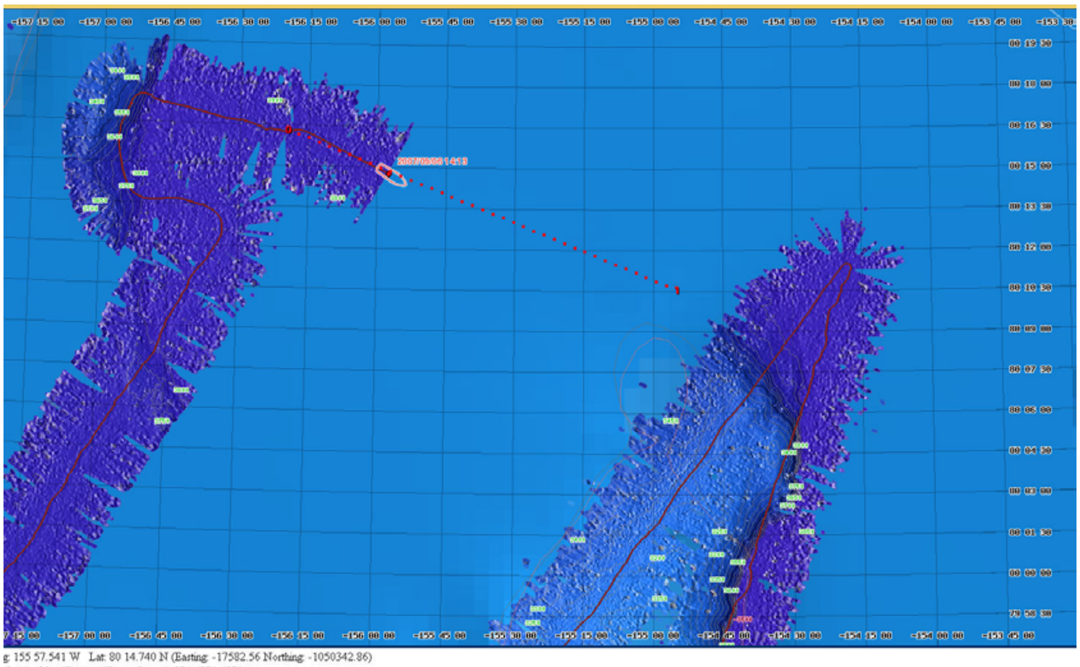


Figure 31.Looking for connection between features.

0300L: We are going to start following this feature

0410L: Backing and ramming

0430L: The relief on the topographic step we were following increased rapidly to the NW – this appears to be the boundary with truly flat-lying AB sediments. We can see it to the west – but it is not clear what happens to the east and how the very sharp transition that we mapped at the north end of the promontory to the east transitions into the feature we have just crossed. We have decided to double back and try to follow this transition now before we get too far north and west. Sharp right turn (Figure 31).

0900L: Developing an apparent northwestward projection on the large spur projecting from the N end of the Northwind Ridge. Heavier ice is sometimes requiring stopping, backing and ramming. Slow going

1430L: Completed development of spur and began tracking sharp bathymetric change line to the south. Fairly heavy ice continues.

1845L: New XBT

1905L: Altered course to 331 to leave the foot of the slope and travel westward toward an intersection with topographic step mentioned at 0430L.

2000L: Encountered gradual slope transition as depth gradually decreased and sub bottom profile revealed rising feature (Figure 32).

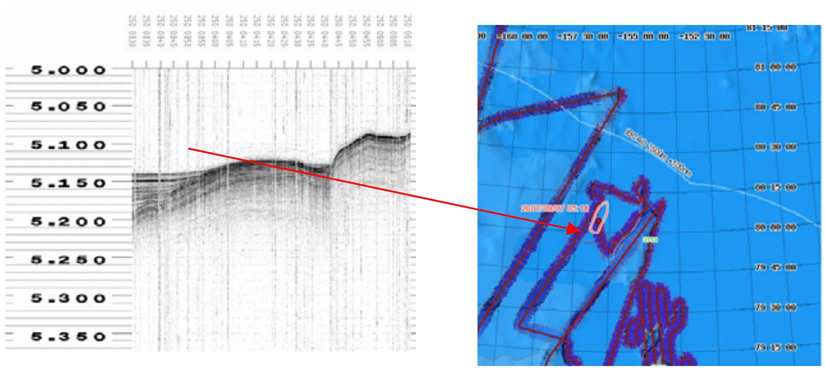


Figure 32. Knudsen record 2007/09/06 2118L

07 September 2007 – JD 250

0000L: Have finished up the loop and now back to the topographic feature on the western side of the embayment. The transition between topographically high areas and the flat-lying "AB" sediments (consistently at about 3820m depth) is quite different here – instead of a sharp topographic transition there is a much more subtle one with a series of small horst and graben steps – probably covered with Cretaceous sediments. We will now trace the topo/sediment transition to the NW.

0205L: Critical system failure alert on SB system – Tom pressed OK and we continued on.

0400L: Backing and ramming for about 15 minutes

0500L: Absolutely spectacular sunrise!!!!!

Figure 33. Sunrise 07 Sept 0500L

0515L: lots more backing and ramming – I have asked for 2^{nd} engine

0530L: second engine put on line

0545L: Bridge reports engine problems we have stopped – hopefully will be resolved soon.

0900L: Following the slope/plain transition, which is quite distinct in this area

1100L: Problems with the ship's propulsion system. Mostly dead in the water for analysis and repair

1500L: Resumed making way, asked for best speed as we pass through already-mapped area. Continuing propulsion system problems are periodically stopping ship

1625L: Passing out of previously mapped area, and following transition to the north and west; progress again interrupted by propulsion system casualty. Ship stopped for 10 minutes

1730L: Maintaining speed even though data are sometimes dropping out; will hold speed 5.5 – 6.0 as long as we can continue to map the transition.

1800L: Backing and ramming

1845L: Reduced max speed to 5.5 kt to reduce noise in data

0600 – 2000L: We have made slow progress to the NW following the FoS to our west. Much backing and ramming and numerous engine problems "cycle-converter" problems. At about 1930L – the flat-lying AP like sediments transitioned into a complex hummicky topography and began shoaling. We continued north and west but it appears we are in a small embayment and have now turned back east to regain the "AP" like sediments .

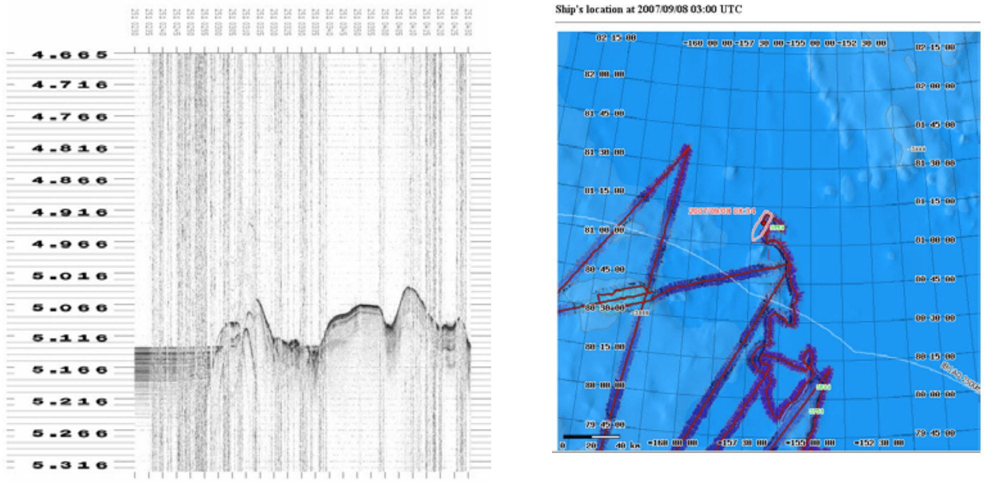


Figure 34. transition from flat-lying sediment to hummocky topography

2130L: Finally found flat-lying seds again at about 2130L – see figure below

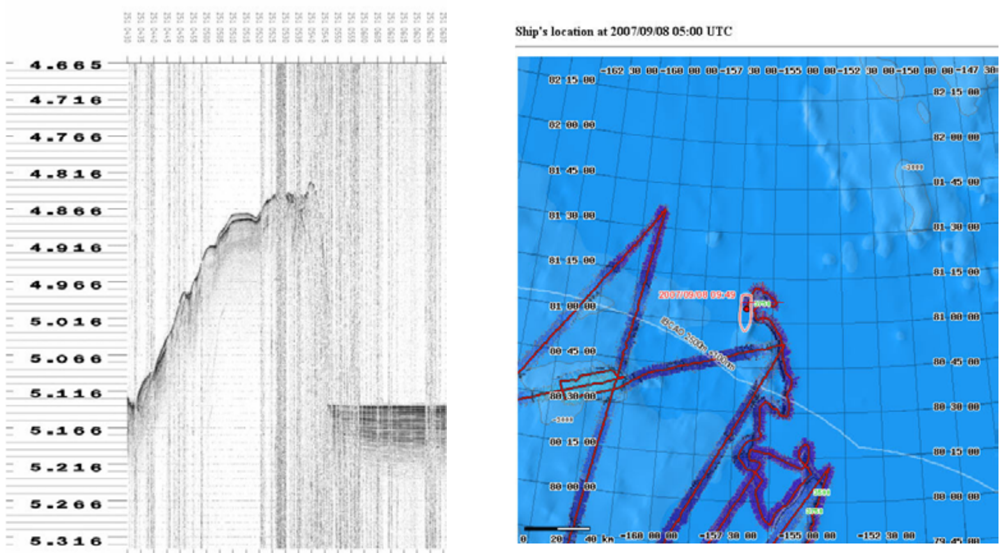


Figure 35. Transition from hummocky topography to flat-lying sediments

Followed the flat-lying sediments around to the NW – outlining a small promontory. We will know follow this around and then explore the topo high indicated to the SW on the IBCAO chart. This is because Hunkins Seamount which was reported to shoal to 2150m (Hall, 1990 – DNAG Chapter 19) be at 156W and 81N was not there (3813m on our multibeam and nothing in site). We see the indication of high to the SW

8 Sept. 2007 – JD 251

0030L: Flat-lying sediments continue back to south – finally cross topo-step out of them at 0030L

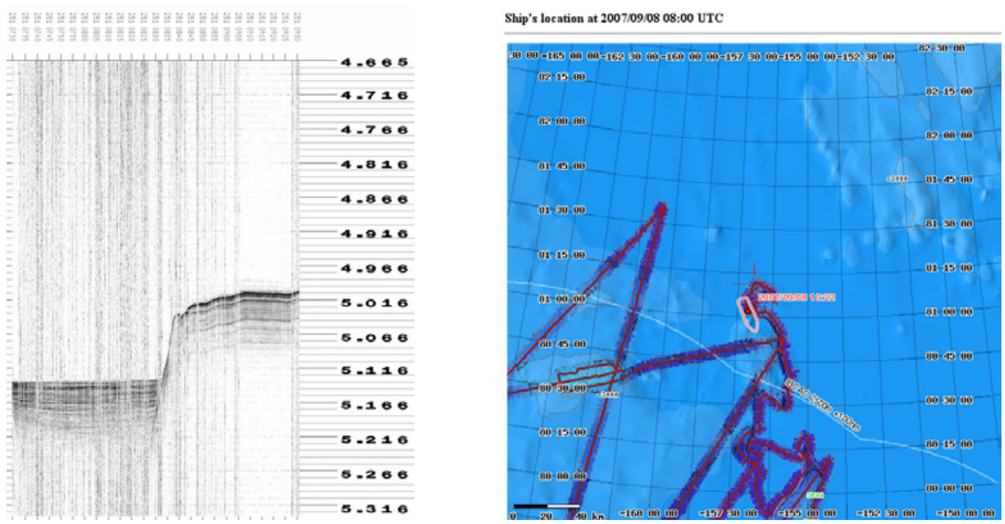


Figure 36. HEALY location at 2007/09/08 0000L

0110L: dropped two cycle converters – port shaft out

0130L: up again

0300L: Heading southeast trying to find shoal point of feature indicated on IBCAO chart.

0345L: -- feature shoaling – at 2900 m now….

0415L: -- stopping again for engine work -- resetting cyclo-converter many times and keeps tripping – Bridge will wake EO and Capt.

Calculating back from arrival at HARP buoy site at 1930 on the 14th (per Mr. Elliot), we will need to break off far north survey work at about 2330 on the 9th. This is based on a 30 hour steam from far north to Pockmark Area – (~300 miles at avg of 10 knots – figuring half ice /

half not). Depart Pockmark Area at 2330 on the 13th from the Pockmark area for 1930 arrival on the 14th at HARP buoy site (~300 miles at 15 knots).

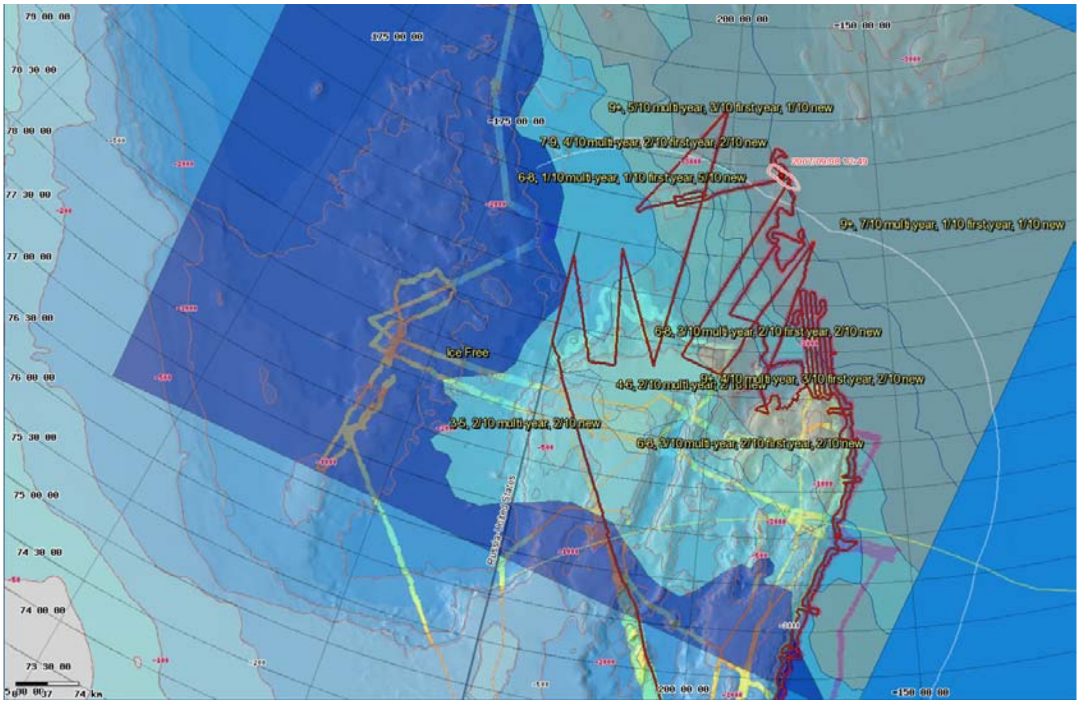


Figure 37.HEALY location 2007/09/08 0449L

0450L: Getting started again – still some problems on port shaft but forging ahead.

0600L: Stopped again due to "sequencing of engines"

0610L: Underway again – maybe – not really

0645L: Really underway now – will move north parallel to last track then pick up FoS at north western corner surveyed area.

1215L: Passed over sharp bathymetric transition to abyssal depths; began turn to begin tracking transition toward W.

1245L: Stopped for 25 minutes for ship's engineering work, then resumed westward track

1530L: Stopped for 35 minutes for ship's engineering work, then resumed westward track

1700L: Morale night on Healy; Science Party prepares and serves pizza, risotto, ratatouille, fried polenta, penne pasta, and bread pudding with caramel sauce. Polar bear smells the food and approaches on the starboard side

1810L: Slope to plain transition line turns northward with HEALY in pursuit

1830L: XBT 94 successfully launched and recorded

1940L: Stopped with cyclo-converter problem

2000L: Underway again

2300L: Following the FoS? to the east

9 Sept. 2007 – JD 252:

0030L: Engines stopped – cyclo-trip

0053L: Back on line and underway

0100L: Hot water leaking on the fantail – steam rising – potable hot water secured.

Continuing to follow FoS? to north and west.

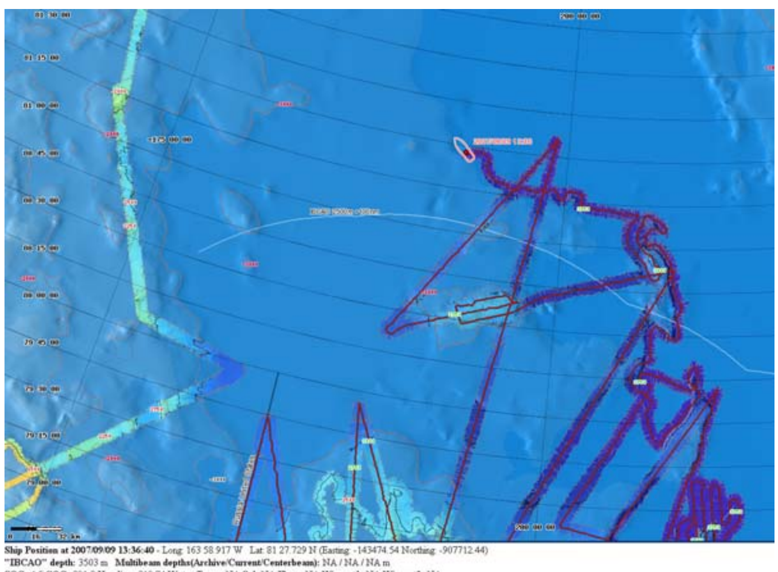


Figure 38. HEALY location at 2007/08/09 0536L

0820L: Still following FoS? but it has now turned east and south. Lots more open water as we have moved north and west. Easily surveying at 6 knts.

0930L: 25-minute stop for ship's propulsion system problem

1310L: Entered relatively open water and increased speed to 8 kt

1320L: FoS? turning north

2300L: Brian Van Pay has been winding back and forth following a very complicated slope/plain transition

2310L: Seabeam stopped pinging – Steve looking at the problem
Have asked bridge to go to dead slow – rebooting…… NOW NO CHANCE OF DALE DANCING NAKED ON THE FANTAIL (to everyone's relief) – Tape was 77% full.

2325L: Back in business – pinging again --

10 Sept. 2007 - JD 253

0010L: Stopping for cyclo-converter problem\

0129L: Underway again

0330L: Still following the slope/AP boundary – its really oscillating with a number of small promontories and embayments – will continue this till 6AM – and then head back.

0425L: CC-1 tripped – ALL STOP

0445L: Underway

0500L: CC tripped again – both shafts out all stop.

0515L: Underway at 3 knts

0600L: That's it – we are going to break off the survey and start heading south west to a small topo feature on the IBCAO chart. Maximum North position:

82 17.31 162.43.08

Have created a single color map for the Chukchi data –
CHUKCHI.cmap and CHUKCHI2.cmap

CHUKCHI.cmap is a depth dependent cmap that has a major color change (blue to purple) at 3819 m – this is fine except in the far north where noise in the AP data jumps back and forth above and below 3820. Therefore created CHUKCHI2.cmap with change at 3811 m.

Shading parameters are:
Sun Direction = 131
Sun Angle = just less than ¼ down the bar
Ambient=47.4
Specular=21.6
Soft Shadow= 68.1
Vertical=10.0

0915L: Passed by reported position of ice buoy, but buoy was not sighted. We did see a large polar bear, though.

0920L: Ship stopped for 15 minutes; propulsion system problems

1035L: Another stop for cyclo problems

1200L: More propulsion problems

1430L: Slowed from 9 kt to 6 kt while crossing plain to slope transition area

1515L: Resumed higher speed at conn discretion ~9 kt

1540L: Diverted slightly to the south of track to reach open water;

1600L: Heading to WP on single shoal contour (3000m) on IBCAO –

2200L: Crossed area but nothing on multibeam to indicate a topographic high

2300L: Continuing on to larger feature that shows 2500 m contour – steaming at 6 – 11 knots depending on presence or absence of ice.

11 Sept. 2007 JD-254

0100L: Approaching the larger feature – will run a line up (NW and then back SE) – and deploy an ice buoy at the western most point of the survey)

0200L: Slowing to deploy ice buoy

Saw polar bear drift by on lone small piece of ice in totally open water…. very very sad.

0215L: Ice buoy deployed – underway again

0500L: Finishing up last line of seamount survey – spectacular turn by Mr. Elliot

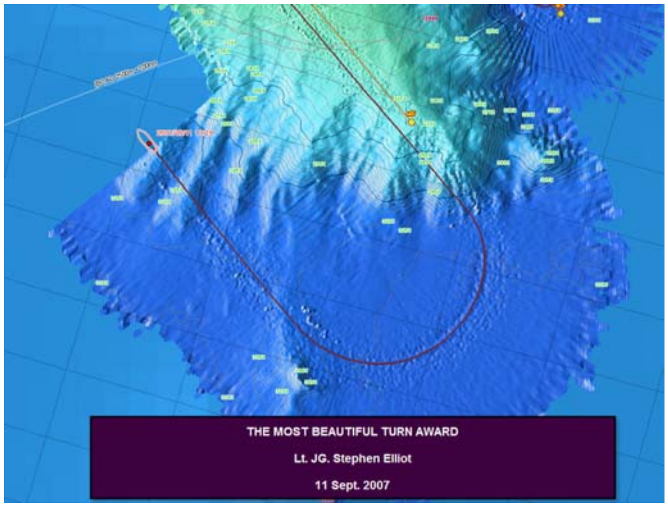


Figure 39. Example of beautiful turn.

Increasing speed to 15 knots (finally!!)

0510L: Slowing because of high-vibration alarm on one of the engines.

0545L: Coming back up to speed – hopefully

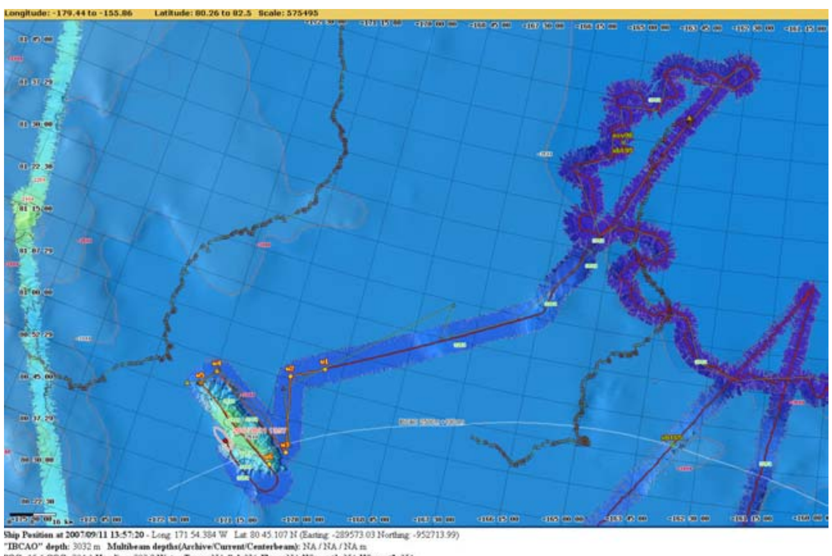


Figure 40. Survey of small seamount 11 Sept. 07 – 0600L

0800L: Finished up beautiful survey of seamount – now heading over small one south of it enroute to pockmark area.

1356L: Crossed 2500 m contour; ship began vibrating; stopped engines to reset cyclo; resumed making way, changing course to 128 toward next waypoint

1650L: Changed course to 180 to develop W side of bathymetric feature; speed varying with varying amounts of ice

1745L: Track excursion due to communication failure between bridge and survey, altered course to SE to continue filling in west side of feature and move onto main plateau

12 Sept. 2007 – JD 255

Continuing south towards pock mark area – lots of beautiful ice scours.

0055L: Steve switched to external surface sound velocity input – sound speed 1435 m/sec

0138L: Change in the nature of the subbottom – from clearly disrupted (iceberg scour) to undisturbed and stratified sediment – happened at 575m water depth.

0500L: Starting POCKMARK survey – beautiful ice scours but not pockmarks yet **-**

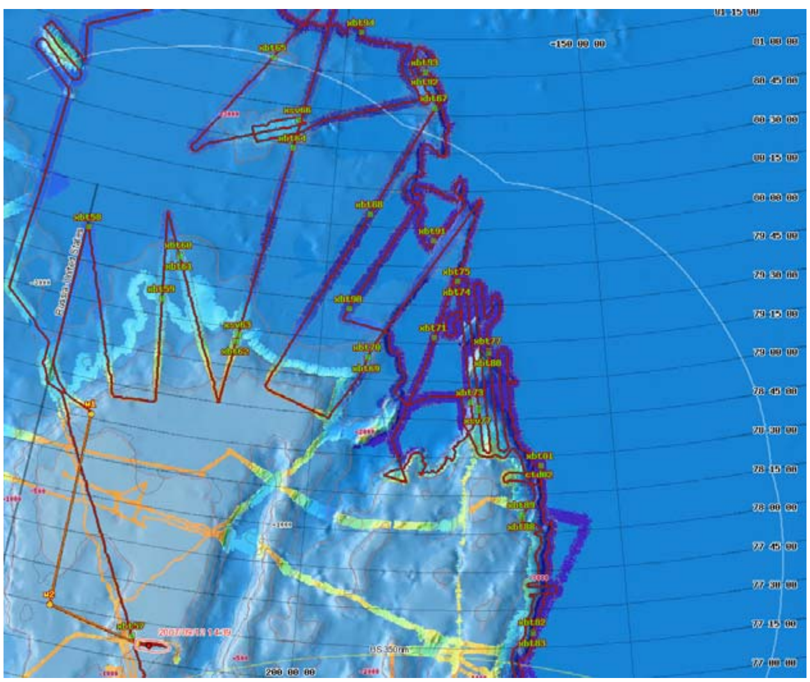


Figure 41. HEALY location 2007/09/12 0639L

1000L: Extended eastward line to overlap with existing N-S track and map large groove along slope break

1030L: Mega pockmark with excellent sub-bottom expression

Running lines back and forth ……

2200L: Rosh Hashana celebrated by a small group in the mess hall –

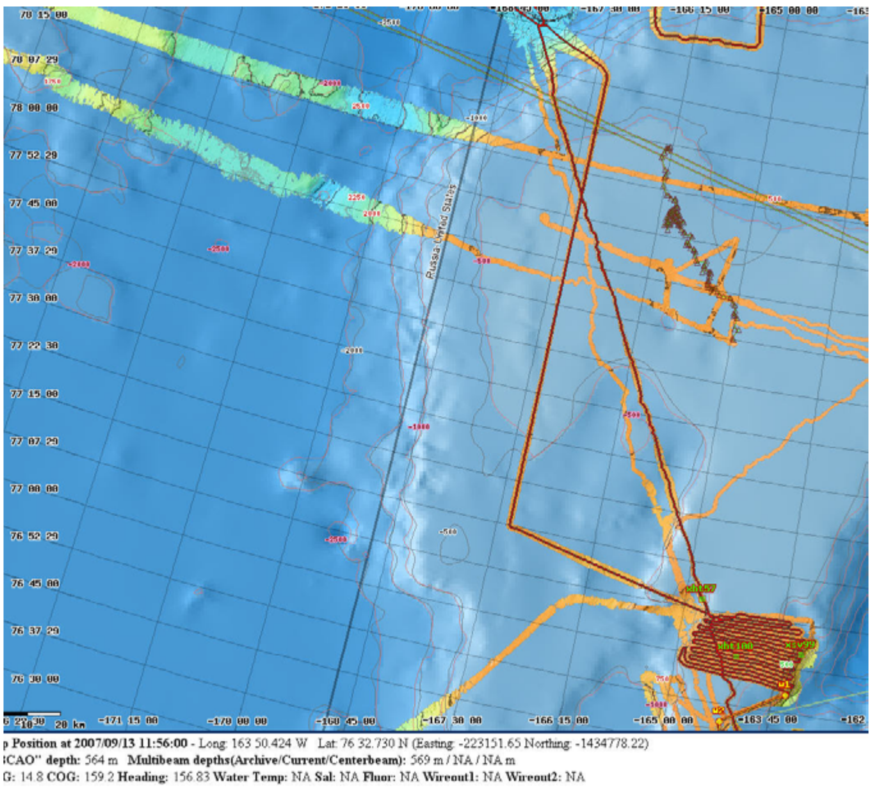


Figure 42. Scour survey 12 Sept 2007

13 Sept. 2007 – JD 256

0100L: Running our last line in the scour area. The scour area ranges from about 450m depth on the west to about 500 m on the east – both sides are bounded by relatively steep dropoffs – to 800 m on the west and at least 1500 m on the east. We have seen a series of very fine closely spaced iceberg scours in the nw quadrant of the area – these are remarkably uniform and parallel – oriented NW-SE (313). To the east they blend into much larger and deeper scours that change orientation in a curvilinear fashion – swinging to closer to 300 – though with discordant behavior in some of the scours. South of these are what appear to be a series of barchan dune-like structures – with lee slope on western side. Knudsen over dunes makes them look more erosional then depositional – stranger and stranger (Figures 43 and 44).

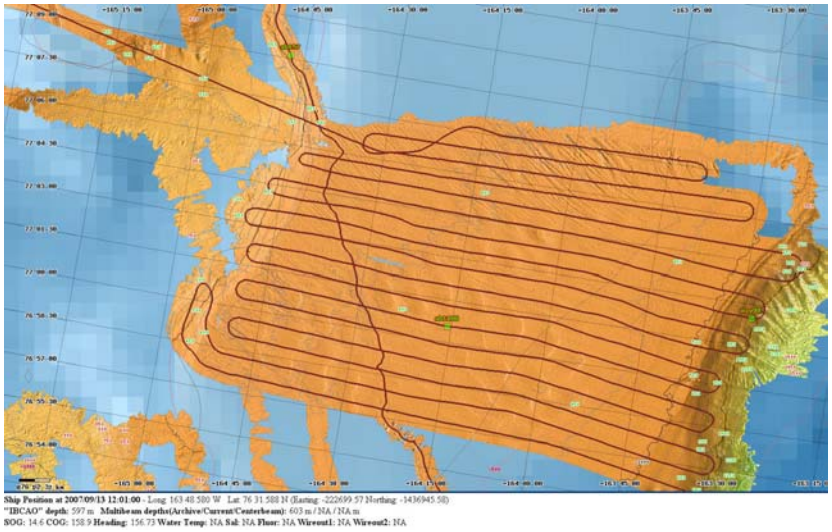


Figure 43 – overview of ice scour survey – note dune-like features to south

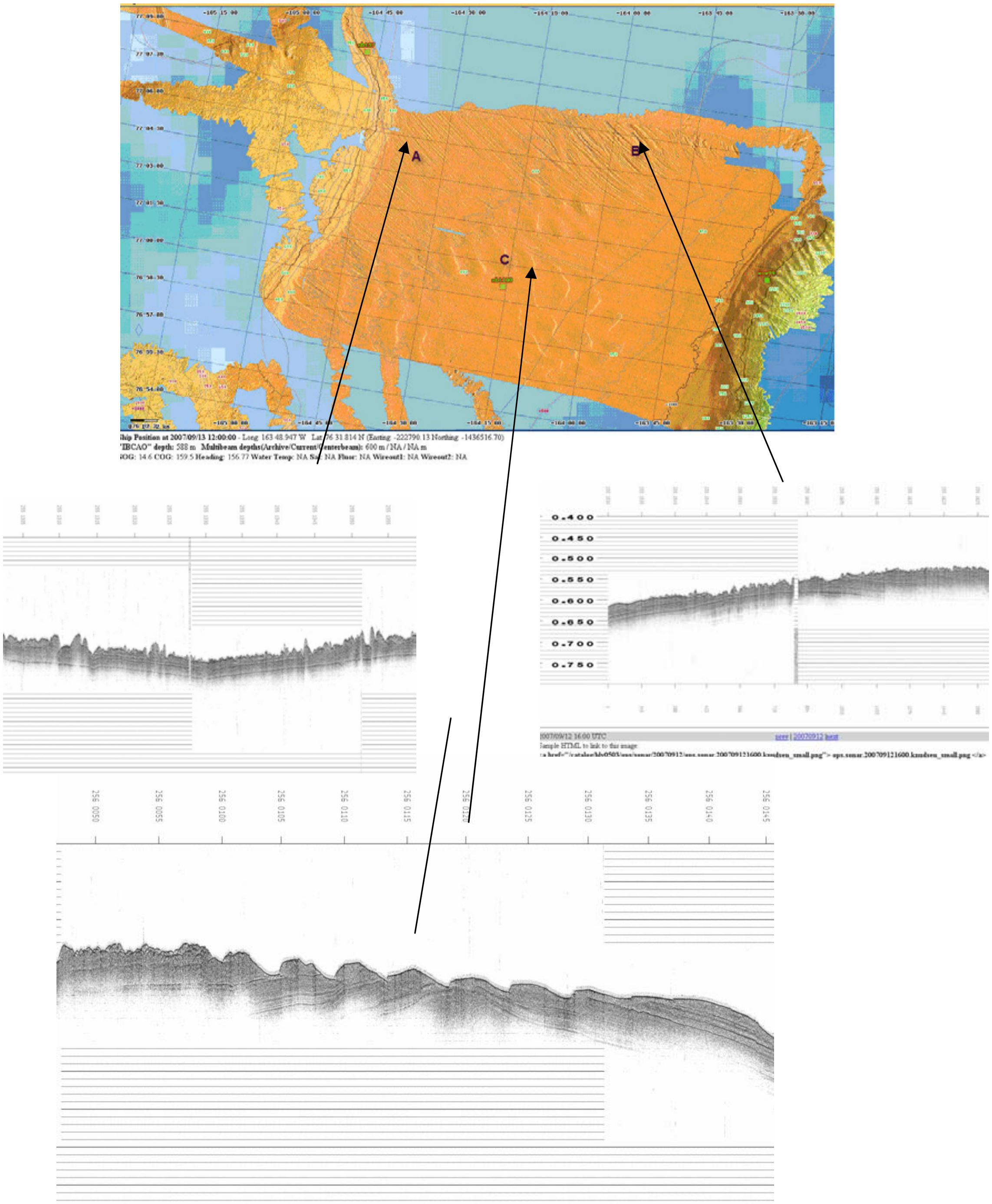


Figure 44. Knudsen records from different areas in scour field. Area C – in above image – dune-like features – note anticlinal-like bedding and truncation of reflectors – look more erosional than depositonal

0130L: Heading to pockmark area –

0250L: Crossing over giant groove in bottom – lines up perfectly with other data –400 m wide and about 30 m deep – Kelly doesn't think its ice related but it sure looks like it and we are now crossing its termination – amazing (Figure 45).

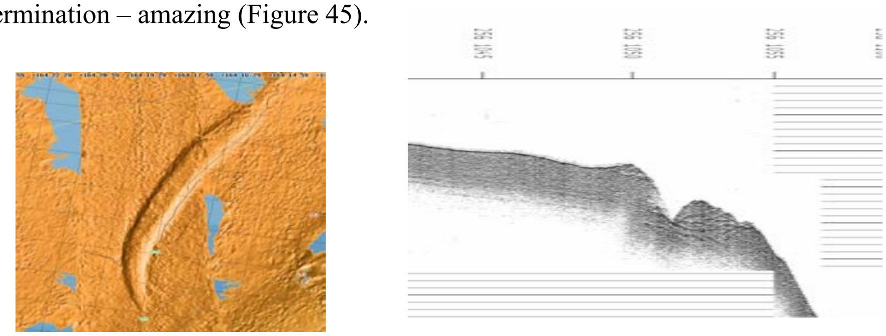


Figure 45. Mega-groove – bathy and Knudsen record

0315L: Our first pockmark – hopefully just the beginning.

0330L: A beautiful recent fault on the Knudsen that lines up with the pockmark trend – on the second pass this is part of a spectacular, perfectly circular set of pockmarks (Figure 46).

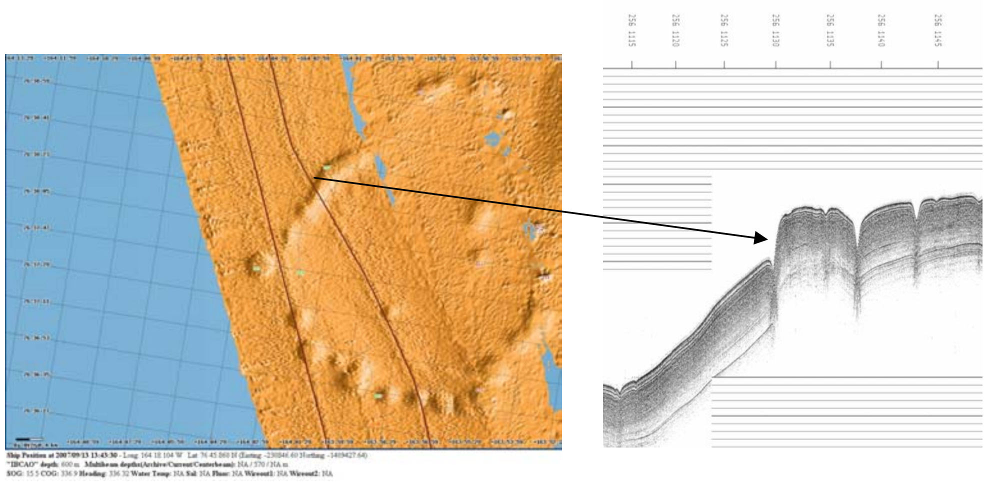


Figure 46. Pockmark ring

0430L: Seas really picking up – noticeable large period roll – some degradation of the data.

0545L: Seas getting worse – -- winds 44 knots -- many dropouts as them to slow to 12 knots. – Made remarkable difference in data quality

0800L: coming around for line on cse 335 – now rolling +/- 3 – 4 degrees – causing many center beam dropouts – wind coming from 115R – 30 knots

0810L: change transmit power to full

1000L: Continuing N – S lines in pockmark survey area. Running with 100% overlap due to large amount of lost beams.

1415L: Lost both echo sounder returns when ship slowed to ~4 kt in drills. Depths returned at about 7.5 kt. Turned around to re-run portion of line.

1600L: Data very sparse on upwind line, especially on starboard side

1740L: Came about for NNW leg, but ship rolling too much; altered course to 295; will change survey plan to 305—125 headings

1830L: Passed mega pockmark; ~100 m depression, ~700 m across

1832L: Launched XBT

1900L: More mega pockmarks, and a knoll about same diameter as mega pockmarks

2330L: Continued surveying in the pockmark area – weather still rough – definition of skootch and scoche- one skoothes a scoche –scoothing is a verb and scoche is a noun –

40 knot winds – slowing to 12 knots but data quality still poor

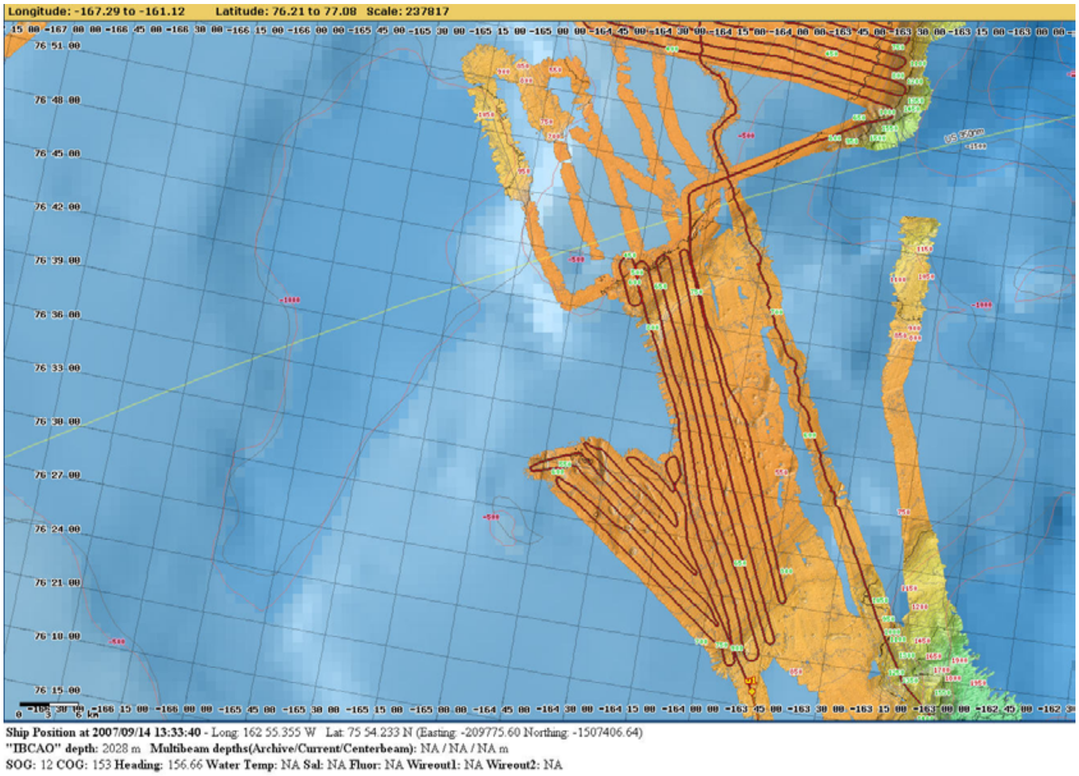


Figure 47. Overview of scour and pockmark surveys

14 Sept. 2007 – JD 257

0130L: Turning south – final turn – heading toward Barrow -- both seas and winds still high – wind ~ 40 knots – seas 10-12 feet

1215L: Running uneventfully along track in southerly direction; lots of beam dropouts, especially on starboard side, which is leeward side. Wind speed ~35kt.

2130L: Arriving at HARP 1 Site – maneuvering for drop –

2223L: Drop at 328 m water depth -- position: 72 47.8868 158 23.7121

2230L: Drop XBT

2240L: Sonobuoy dropped

Underway to HARP2 drop site.

15 Sept. 2007 – JD 258

0100L: On site for 2nd HARP deployment – maneuvering

0125L: Drop HARP2 – 236 m water **--** Position: 72 27.6021N 157 23.6096W

0134L: Take XBT and drop sonobuoy

0150L: Underway to Barrow – eta 0700L

XBT COUNT: 34 T-5's 7 XSV's left on board in refer by main lab.

RECOVERY AND DEPLOYMENT OF HARP BUOYS
Ethan Roth

On September 25, 2006, two High-Frequency Acoustic Recording Packages (HARPs) were deployed in the Chukchi Sea, due north of Point Barrow, Alaska (coordinates given in the end). Each passive acoustic instrument consists of a two-channel hydrophone positioned 10 meters above the seafloor. By sampling at 32 kHz and implementing pre-amplifying and pre-whitening techniques with anti-aliasing filters, this infers that sound within a 15 Hz to 16 kHz frequency bandwidth will be monitored autonomously and continuously within the Barrow region for approximately one full year. This is made possible by a data-logging system with low-power consumption (using alkaline batteries) and approximately 2 Terabytes of hard drive capacity.

On August 17, 2007, both HARPs were successfully recovered aboard the USCG Healy by initially transmitting coded sonar pings that acoustically released the anchor weights. Once sighted at the surface, a small rhib boat was launched to the HARP positions and towed the packages up to the starboard side of the Healy, where a crane could then transfer the HARPs onto the fantail deck.

The instrument due north of Pt. Barrow stored data up until February 2007; the northernmost instrument contained data up until June 2007. Both hydrophones were still sampling subsequent to retrieval, so upon further investigation, it appeared the lack of data collection was due to a power and current draw issue in the datalogger. Due to the environmental conditions and longevity of the deployment, the hard drives required additional current draw that wasn't sufficiently provided by the batteries because the cold temperatures (~ -2° C) drained the voltage levels too low. I was not able to anticipate when this would occur since it was the first deployment of its kind.

It's still unclear to me why one HARP performed better than the other, except that it appears one instrument landed in an ice scour which potentially could have thermally insulated the batteries to some small degree. Aside from that, there could have been manufacturing flaws in either the batteries or hard drives, but there didn't appear to be any from inspection. Since the redeployments must make do with the same equipment, my plan is to set a ½ duty cycle; meaning that for every 14 minute interval, the HARP will record data for 7 minutes and then turn off for 7 minutes. This should allow for a full year of data collection, and the probability of data gaps is considered to be statistically minimal.

The quality of the data appears good. There were a couple issues with the pre-amplifier circuit in one of the hydrophones; a tank was produced as a result of added gain that in turn fed some system noise into the data being recorded. These high-frequency spikes can be dealt with using filters and interpolation during post-processing. I replaced this board with a new and improved design, so I should hopefully see better performance from that hydrophone in the next deployment.

While underway, there was an interest in conducting vertical sound speed profiles, obtaining biological recordings, and sampling ambient noise in various locations along the ship's track. Ice conditions permitting, a contingent of expendable 57D sonobuoys were deployed, and transmitted acoustic data real-time through FM radio signals to an omni-directional antenna positioned on the Healy. In addition, a two-channel (high/low freq.) drop hydrophone array was deployed on a few occasions when the Healy was stationary for a long enough period.

Based on multi-beam sonar data collected by the Healy in recent years (proving the IBCAO charts misjudged the location of the shelf slope), it appears one HARP was dropped in the corner of a contour that slopes down into the shelf, producing an "amphitheater" effect in terms of what direction sound propagation was received from. Thus, I have chosen to move this instrument to a site further north where it will be deployed to a sufficiently safe depth and positioned on a relatively flat contour that will receive propagation in all directions. The other instrument will remain in the same site as last year's deployment in order to keep a consistent time series at a specific location.

-- Redeployment Ops --

The primary scientific objective of this project is to establish and characterize a baseline measurement for ambient noise in the Arctic, while examining the variability and distinct characteristics that are inherent in seasonality shifts. A contention is that during winter months when the majority of the Arctic Ocean is covered with sea ice, there will be minimal noise contributions from environmental/metrological variables and man-made sources. Ambient noise data should be relatively quiet, providing the groundwork to later explore changes in acoustic propagation – especially within an environment experiencing a declining trend in sea ice concentration. During the spring and summer months, ambient noise can be characterized by sea ice fracturing and cracking, moving ice masses colliding, the marginal ice zone, and weathering effects caused primarily by wind. This data can also serve as a comparison to shifting sea ice concentrations in future studies. Once most of the sea ice has melted, it will be important to examine the increase in noise levels (dB) and variability in sound speed from winter months, and determine what sources or characteristics can be attributed to this seasonal fluctuation. Besides the thinning or scattering of sea ice altering underwater propagation, other possible contributions to these increases are seismic surveys, oil drilling, and shipping.

A secondary objective for this dataset is to also monitor marine mammals transiting or feeding in the near-shore and coastal regions. Possible mammals include bowhead whales, beluga whales, gray whales, ringed seals, bearded seals, and walrus. Aside from the whales, the seals and walrus are dependent on hauling out on the ice pack, which constantly shifts as a function of where the ice edge is prevalent. This has been visually observed during both years of field work now. The ice edge may play a significant role in determining where whales and these other mammals are able to forage for food, though these are simply preliminary assumptions based on past literature.

The broader impact of this ambient noise data will be for comparison purposes regarding future deployments of acoustic instrumentation. Presently, our lab plans on refurbishing the two HARPS in the Barrow region for at least the next few years. The subsequent data will be evaluated against ambient noise data collected in the Arctic during the same time period, primarily due to the time-variant impact of climate change and sea ice declination. It has been established that the unprecedented warming at high latitudes is the primary cause of sea ice thinning or disappearance, which indirectly determines the underwater propagation characteristics of sound. Comparing future data to the baseline ambient noise measurements collected in the past year may shed light on the causes and sources associated with the augmentation of ocean noise and the anthropogenic effects on marine mammal behavior.

HARP Sites:

Recovery Locations
Site 1: 72° 10.569 N, 156° 33.176 W, 230 m depth
Site 2: 72° 27.523 N, 157° 23.364 W, 246 m depth

Redeployment Locations

Site 1: 72 47.8868 N 158 23.7121 W 328m depth
Site 2: 72 27.6021N 157 23.6096W 236m depth

DEPLOYMENT OF ICE BUOYS

MEMORANDUM FOR THE RECORD - Draft

FROM: Pablo Clemente-Colón, Chief Scientist
National Ice Center - NOAA

SUBJECT: Trip Report – *Healy* HLY0703
Barrow, AK, September 17-16, 2007

HIGHLIGHTS

- NIC provided a sea ice analyst and sea ice observers during the cruise
- NIC provided remote sensing data collection, analysis pre- and during cruise
- IANP buoys were deployed during cruise

TEXT

The primary mission of the 3rd USCGC *Healy* cruise of 2007 (HLY0703) was to collect bathymetric data using the *Healy's* multibeam mapper that can be used in by the U.S. to define future limits of extended continental shelf under the United Nations Convention on the Law of the Sea (UNCLOS). The cruise departed from Barrow, AK on 17 October, 2007 and returned their on 16 September. The cruise leaders were Larry Mayer, HLY0703 Chief Scientist, from the Center for Coastal and Ocean Mapping/Joint Hydrographic Center at the University of New Hampshire (UNH) and Andy Armstrong, Co-Chief Scientist, from NOAA/NOS. The cruise was funded by NOAA and UNH. The mission entailed continuing mapping on the Chukchi Sea with the multibeam sonar as well as a 3.5 kHz subbottom profiler. Previous mapping missions of the Chukchi Sea and Beaufort Sea have taken place in 2003 and 2004. Additionally, a secondary objective was the recovery, refurbishing and redeployment of two Scripps Institute of Oceanography (SIO) High Frequency Acoustic Recording Packages (HARPS) in the Beaufort Sea.

Four members of the National Ice Center (NIC) participated in the HLY0703 cruise. This included AG1 Lewis S. Park, a sea ice analyst under the USCG crew, and Sean Helfrich, Bryan Wagonseller, and the Pablo Clemente-Colón as part of the science crew. The NIC personnel provided routine sea ice analysis and characterization as well as deploying ice beacons at locations of opportunity for the International Arctic Buoy Programme (IABP). The NIC provided pre-cruise analyses of sea ice conditions in the Chukchi Plateau to guide in the selection of the initial cruise track. NIC personnel aboard the *Healy* organized a 24/7 sea ice research observing program for the validation of remote sensing techniques and operational NIA analysis. Sea ice and meteorological observations were recorded on an hourly basis following a predetermined methodology. Photographs of broken ice and the surrounding ice field were also taken each hour. NIC personnel on land and aboard worked to secure access to required imagery for tactical support and to provide near-real time analysis and daily tailored sea ice support during icebreaking operations. A daily sea ice brief was given by AG1 Park to the *Healy*'s Commanding Officer, CAPT Lindstrom. A more detailed sea ice observers' report is attached. Additionally, several NIC seminar presentations were provided during the cruise, including Arctic Sea Ice Recent Reduction and Present Conditions by Clemente-Colón, Sea Ice Production and The Snow and Ice Mapping System by Helfrich, and The NOAA Corps by Wagonseller.

During the cruise, we were able to see first hand the melting of significant multiyear ice (MYI) floes in an area over 500 nm away from Barrow that last year was part of an ice pack extending significantly closer to the Siberian and Alaskan coasts. In fact, just prior to the cruise and as part of a NASA/JPL-lead team, we have documented a recent record loss of MYI or perennial sea ice and proposed that this year's summer extent minimum would be a record one based on that loss. According to both QuikSCAT data and the NIC sea ice analyses, we indeed surpassed the 2005 sea ice minimum extent record by over 500,000 sq-km during the cruise. The latest satellite observations of sea ice indicate unusually ice-free and nearly-opened conditions in both the Northern Sea Route (NSR) and the Northwest Passage (NWP) although significant choke points are still present. In fact, the rapid reduction of sea ice extent observed this year has already slow down and we are now seeing evidence of persisting new ice and overall refreezing conditions in the last part of the cruise.

The cruise provided an opportunity for the deployment of several METOCEN ice beacons to add-on to the IABP network. Four successful deployments were undertaken, three on ice floes and one in the open ocean. Two of the ice floe deployments were conducted by putting personnel on the ice via a basket the third one using a boat. Ice holes were drill on each case and the buoys inserted. The CS participated in all these deployments. The fourth buoy deployment was done via a crane by lowering a buoy directly into open water just outside the marginal ice zone as the *Healy* left the ice-covered region on its way back to Barrow an at the westernmost point of the cruise. This particular deployment is expected to provide an indication of survivability of these beacons as the ocean freezes up again and it is incorporated into the ice pack. Although one of the buoys deployed on an ice floe unfortunately ceased working several days after deployment, all three others are reporting properly.

During the cruise, response was provided by Clemente-Colón to a number of critical action items and activities in spite of limited email and internet connectivity. These included response to a request for support from the USCG on a major oil spill off the southwestern coast of Puerto Rico, input to a NOAA action item to support the meeting of VADM Lautenbacher and ADM Allen, inputs on action items and information requests relating Arctic sea ice changes from NAVO, OPNAV, and SeaPower magazine, the NY Times, NSIDC and several other consultations on Canada, Russia, and China planned activities in the region.

Sadly, while at sea, we were informed of the death of Hon. Duane H. Laible, U.S. Arctic Research Commision (USARC) Commissioner. We contacted the Commision's Chair, Hon. Mead Treadwell, to convey our sympathy and were invited to meet with him on our way back through Anchorage.

ACTION ITEMS

- Organize in-situ observations, remote sensing data, and NIC analyses into a database for further analysis and assessment of NIC products.
- Call a meeting of shore and onboard participants to Identify lessons learned on NIC sea ice support to the *Healy*.
- Closely track the status of the ice beacon deployed in open water during the freezing season

Attachment: NIC Sea Ice Observers' Report

References:

Rapid reduction of Arctic perennial sea ice by S. V. Nghiem, I. G. Rigor, D. K. Perovich, P. Clemente-Colón, J. W. Weatherly, and G. Neumann, *Geophys. Res. Lett.*, in press.

UNH HLY0703 Cruise - http://ccom.unh.edu/index.php?p=31|34|35&page=outreach/projects/healy0703/h0703_home.php#blog

HLY0703 CRUISE SYSTEM SUMMARY

Instrument Lab
Lamont-Doherty Earth Observatory of Columbia University
61 Route 9W
Palisades, NY 10964

Subject:	HLY0703 Science cruise system status summary
Project:	Healy Science Support
Created:	September 13, 2007
Updated:	September 14, 2007
Engineer:	Dale Chayes <dale@ldeo.columbia.edu>
Doc No.:	
Revision:	-

The following is a quick summary of the status of Healy science systems during HLY0703.

- **Science Ice Machine**

Not used on this leg

- **Photosynthetically Active Radiation (PAR) sensor**

A PAR sensor was added this spring. No problems were experienced during this leg.

- **DCP (150khz)**

The RDI VM150 ADCP has not been operational all season. The cable was damaged by the shipyard in February and after several attempts, the manufacturer has finally managed to produce a new cable that was ready to ship from San Diego a few weeks ago.

- **ADCP (75khz)**

Has been running during this leg. No significant evaluation of data quality has been performed.

- **Aft P-Code (Trimble Centurion)**

The cyrpto keys for this receiver were expired at the beginning of this leg. New keys were loaded at 1651Z on August 27. No unusual performance has been observed.

- **Ashtech 3DGPS (ADU5)**

Operated normally during this leg. There were a few data dropouts as noted in elog.

- **CCTV**

The CCTV station was removed from the Chief Scientist cabin prior to the start of this leg.
There were a problem with the CCTV controller on the Watch Standers' Workstation related to the address switch on the bottom which caused the unit to cycle through the cameras independent of any control from the keyboard.
There were some occasional issues with the video from some cameras.

- **Science Conference Lounge Audio Visual**

There were problems with the XGA/audio interface at the forward end of the central table. A temporary fix was implemented by the ETs.

- **Ship's entertainment TV system**

In general worked well.
There is no DVD player in for the TV in the Science Conference lounge

- **Ship's entertainment video system**

The quality of the data display on the ship's cable TV plant is barely readable on at least some of the smaller monitors. Perhaps a few less fields would allow larger characters and improve readability.

- **CTD**

Two CTD-only (no rosette, no water bottles) stations were taken successfully by the MSTs. File transfer and data processing was done manually by science support personnel to verify sound speed profiles.

- **DI/RO Pure Water Systems**

The system was secured during this leg.

- **Fluorometer**

Data was collected but not evaluated or used for science.

- **Forward P-Code (Rockwell Collins)**

No known problems.

- **General Purpose Science Workstations**

There were intermittent and annoying issues w/ domain name resolution early in the cruise. Most personnel brought their own laptops.

- **Coring Equipment**

No coring was done on this leg.

- **Gyro Compasses**

No known problems.

- **Sperry MK27F gyrocompas**

A Sperry MK27F gyro was installed temporarily for this cruise in preparation for the planned upgrade. Data was logged starting on August 26, 2007 at 0322Z.

- **Integrated Bridge System**

the IBS/VMS was reasonably reliable on this leg

- **Multibeam Router (he-gate)**

The multibeam network data logging and routing is has been moved into 'posmvnav' and has been working well. The old computer has been repurposed.

- **(Science) Navigation Computer (posmvnav)**

No particular problems.

- **POS/MV**

Reliable and stable. The POS is reporting the position of the ship's master reference point (in IC gyro.) This is very close to the center of the SB2112 arrays.

- **Science Data Network (general)**

There were some problems with DNS resolution early in the cruise.

- **Science Hoist/A-Frames/Capstans & Cranes**

Operational.

- **Science Uncontaminated Seawater System**

Upon departure from Barrow, the system was still operating in the low-latency configuration that was employed on the transit up from Barrow. In this mode, only pump #3 is used and the centrifugal ice separator is bypassed. It was switched to the normal three-pump mode for operating in ice after leaving Barrow but before getting into serious ice.

The SCS logging of the flow meter has been unreliable due to some confusion in the proper configuration of the end of line sequence in the data stream. This results in SCS recording a large fraction of zeros in the data even though the flow has been very stable.

- **Science Reefer/Freezer/Climate Control Chambers**

Not used except for storage of XBT and XSV probes on this leg.

- **SCS Logging System**

Operational and stable except for the TSG flow data. The high percentage of zeros in the as-logged data coupled with the simple averaging algorithm employed to create the SAMOS Flow data lead to the SAMOS data under-reporting the actual flow.

- **SDN Time Servers**

Operational and stable

- **SeaBeam 2112 Multibeam Sonar**

Operated as expected with only a few reboots. The very mild weather conditions(except for the last two days of the leg) coupled with the light ice coverage led to very high quality data.

- **Sippican Mk21 XBT System**

Operational. A number of XBT and a few XSV probes were launched successfully

- **Sperry Speed Log (SRD-500)**

The SRD-500 was retracted prior to entering the ice and lowered after leaving the ice. No SRD-500 data was logged for most of the cruise. Data collection started at 09/11/2007,23:23:03.30.

- **Sub-Bottom Profiler (Knudsen)**

The Knudsen worked well and was stable.

- **Sea Space Weather Decision System (WDS, aka Terascan)**

The data quality was “okay”

The Air Force changed their policy on encrypting DMSP data so that the satellites now transmit in the clear when within view from Fairbanks, AK. This resulted in making DMSP data useless to us since the passes of interest change from encrypted to unencrypted over our area of operation.

The ship does not currently have the crypto hardware and key necessary to decode data from the F12 satellite.

- **TSGs**

The TSG in the Biochem lab has been used for the entire cruise. The back-up location in the aft hose real room was not used.

- **Weather Station**

The RM-Young weather station has been mostly operational. There were a couple of periods when the ETs took parts of the system off line for various reasons. The relative humidity sensor was not working for the first part of the leg and the values reported later seem suspect. It is hard to measure relative humidity in sub-freezing temperatures.
There were several days when one or both windbirds were frozen up with rime ice and did not produce useable data. It appeared at times that the starboard bird was more likely to ice up.
It appears that there was a problem starting on September 12 where there was a very strong correlation between ship's heading and true wind direction.

- **Winches/Wires/Displays**

The 0.322 winch was used for a couple of CTD stations.

- **Elog**

Used extensively.
A special log was established for the science party watch standers.

- **Gravimeter**

No gravity meter was aboard in 2007.

- **SV2000 (velocimeter in the ADCP 150 well)**

Not used on this leg because the well was dry and the VM150 was not used.

- **Map-2 Server**

There was a problem with the web server on this machine being relocated without updated the log file rotation configuration. This was fixed.
We should think about some automatic monitoring of disk space.

- **Map-3 server**
- **Map-4 server**

Mapserver and our support websever were running on this machine with no problems. Map-4 was installed at the beginning of the 2007. It is has dual 64 bit dual core processors and is twice as fast as map-3 processing multibeam data and handling mapserver tasks.

- **WebCameras**

The AloftCon web camera worked well.
The power supply to the Fantail web cam was disconnected and no data was logged for most of the cruise.
The Board of Lies web camera was not used.

- **Watchstander Workstation**

WSWS was extensively used on this leg.
At the beginning of the year a Mac Mini (core2 Duo) and 20" Cinema display was added. The POSMV control program and a LabView real-time display were run on this screen.

- **QC plots**

Operational

- **Iridium email system**

The email system based on the General Dynamics Reachbacks worked well, but intermittently. There were periods when very few of the radios would connect.
Debugging showed that the #2 radio was having trouble. This has not yet been resolved.

- **End of cruise data archive**

LDEO has taken over producing the end of cruise data distribution archive media (on DVDs.) Substantial improvements in consistency have been achieved.

- **Cruise metadata**

Substantial effort has been put into improving the quality and quantity of metadata this year.

- **Experimental, upgrade and development efforts:**

Added a remote data logger (written in Perl) running on a laptop on the bridge to capture (and broadcast) the data from the Sperry MK27F gyrocompass on the bridge. These UDP datagrams were logged by LDS on the posmvnav computer in the Computer lab.
Wrote a LabView display for the WSWS that incorporates data from various navigation and attitude sources, the TSG and SeaBeam. Work continues on adding data from additional sources. Iterated feedback from the science party into updated capabilities.
A large number of improvements were made to the mapserver including:

. With the addition of the new server (map-4) we can now update once per minute,
a. Automatic update of the position of ice tracking buoys to the mapserver.
b. Contouring for real-time multibeam data,
c. A depth profile tool using jpgrah,
d. Envisat images,
e. Identification of individual multibeam data files using shape files.
f. XBT location plot
g. Access to real-time position via a PostgreSQL relational database that is populated in real-time,
h. Improvements to the Knudsen sub-bottom plots

Added a Knudsen layer

DATA SYNOPSIS

August 17 – September 15, 2007
Point Barrow to Point Barrow

Chief Scientist- Larry Mayer
Healy Captain- Captain Tedrick R. Lindstrom

Prepared by: **Tom Bolmer, David Forcucci, David Hassilev, & Steve Roberts**

Underway Sensors and Calibrations

HLY0703 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 5106	L003	03/07/07	Collected
Barometer	RM Young 61201	BP01643	03/07/07	Collected
Air Temp/Rel. Hum.	RM Young 41382VC	109652	03/07/07	Collected
Helo shack PAR	BSI QSR-2200	20270	01/09/07	Collected
Underway Ocean				
TSG	SeaBird SBE21	1864	01/23/07	Collected
Remote Sea Temp	SeaBird SBE3S	4063	01/24/07	Collected
Fluorometer	Turner SCUFA	0584	01/22/07	Collected
Sonars				
Knudsen- subbottom	320 B/R	K2K-00-0013	N/A	Collected
ADCP 150 kHz	Broad Band (150)	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, start 09/11/07 23:23
Navigation				
P-Code GPS (aft)	Trimble Centurion	0220035469	N/A	Collected
Attitude GPS	Ashtech ADU5	AD520033513	N/A	Collected
DGPS	Trimble AG132	0224016199	N/A	Collected
POSMV	V4	2306	N/A	Collected
P-Code GPS (fwd)	?	?	N/A	Collected
Glonass	?	?	N/A	Collected
GYRO 1	Sperry MK25	?	N/A	Collected
GYRO 2	Sperry MK25	?	N/A	Collected

HLY0703- CTD Sensors

Sensor	Comments	Serial #	Last service/ Calibration Date	Status
CTD fish	SBE 911plus	639		Collected
Pressure Sensor #1	Digiquartz with TC	83009	05-Dec-06	Collected
Temperature #1	SBE3- Primary	2796	25-Jan-07	Collected

Sensor	Comments	Serial #	Last service/ Calibration Date	Status
Temperature #2	SBE3- Secondary	2855	24-Jan-07	Collected
Conductivity #1	SBE4- Primary	2561	19-Jan-07	Collected
Conductivity #2	SBE4- Secondary	2568	19-Jan-07	Collected
Pump	SBE5 Primary	3112	27-Jan-07	
Pump	SBE5 Secondary	3114	27-Jan-07	
Deck Unit	SBE 11-Plus V2	0416	?	
Altimeter	PSA916	843	27-Jan-07	Collected

Distribution Contents

Introduction to Data

The Healy data acquisition systems continuously log data from the instruments used during the cruise. This document describes:

- The structure and organization of the data on the distribution media.
- The format and contents of the data strings.
- Formulas for calculating values.
- Information about the specific instruments in use during the cruise.
- A log of acquisition problems and events during the cruise that may affect the data.
- Scanned calibration sheets for the instruments in use during the cruise.

The data is distributed on a series of DVD-ROMs (DVD-R) written in ISO9660 level-4 format. It is readable by virtually every computing platform.

IMPORTANT*: Read the section, "Acquisition Problems and Events," for important information that may affect the processing of this data.*

There are two logging system on the Healy. The ship (ESU) runs the SCS logging system and the LDEO support group runs the LDS logging system. This provides some redundancy in logging. The main purpose of LDS is to support the sonars and it's output is saved in Raw/pos_mv.

The Scientific Computer System (SCS) is a data acquisition, and display system designed for Oceanographic, Atmospheric, and Fisheries research applications. It acquires sensor data from shipboard oceanographic, atmospheric, and fisheries sensors and provides this information to scientists in real time via text and graphic displays, while simultaneously logging the data to disk for later analysis. SCS also performs quality checks by monitoring I/O, providing delta/range checks and plotting data after acquisition.

The LDEO Data System is somewhat distant relative of the logging code that has grown through more than a decade of use at LDEO. It is a significant revision of the current (2004) code used on the R/V Ewing (the Ewing Data System) and is architecturally much different. Because of this, LDS is still growing and at the moment (2007) this is the only operational implementation.

Data

Data are received via RS-232 serial 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 ay of the year
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.
The delimiters that separate fields in the raw data files are commas. Care should be taken when reprocessing the data that the field's separations are clearly understood.

Distribution DVD Contents at a Glance

Most data files are gzipped before they are written to the DVD to save space on the DVD.

There are two types/styles of DVDs created for the data for the cruise
The first DVD in the data set contains a summary of all of the data, descriptions and smaller data sets. It has a 1 minute averaged file of all the data collected under way. It also has ASCII files of many of the sensors from which data are collected. These sensors are ones that do not create huge amounts of data. There is also a directory called Meta_Data, which has descriptions of the data and the formats used. This DVD is created at the end of the cruise.
The second and subsequent DVDs contain data from sensors that create large amounts of data. These DVDs are created during the cruise as the data collected covers enough disk space to fill a DVD. By making these DVDs during the cruise, the time to create the full data set at the end of the cruise is shortened. Some data sets in this category cover several DVDs. Are must be taken to be sure all of the data of a certain type are recovered when you down load data form these DVDs to your own computers.
Appendix "Example list of the DVD directories" below for an example of the layout of each of the DVDs created.
The DVD will be name for the cruise and the number of the DVD in the series created for the cruise. So, the second DVD for HLY0703 will be named ***HLY07031Vol2***. The root directory on the DVD will be ***media-vol2***. This naming convention will let your copy all of the DVDs to a directory and keep each DVD unique but in a named sequence for accessing.

In the main directory is a file that lists all of the files on the DVD. This file is called:

media-volxx.md5: This file is a master list of every file on the DVD the file's checksum. The x is the DVD volume number.

Directories on the first DVD:

1_Minute_Averaged_Data: This directory contains all of the under way data averaged over a 1 minute window in time.
Datalog*:* This directory contains serial data collected by the SCS version 3.3b data collection system in different directories. Directory names are labeled by the instrument name and string type of the data collected. A description of the data contained in this directory is below.
Raw: This directory contains raw data as recorded by individual instruments and put into different directories. Directory names are labeled by the instrument name and string type of the data collected. A description of the data contained in this directory is below.
Meta_data: This directory contains documents useful in the post analysis of the data on this DVD media set. The data type are separated into different directories by type. A description of these directories is below.

1_Minute_Averaged_Data:

HLY0703_distance.csv.gz - Distance along track from port.
HLY0703_Averaged.csv.gz - All the Under way data averaged for 1 minute.
Shapefile - All of the 1 minute under way data averaged at 1 minute spacing in an ESRI GIS Shapefile.

Datalog:

/aft_a_frame - Wire tension, wire out, and wire speed for the Aft A frame sheaves.
/air_temp_f - Temperature data from the RM Young wind sensor in Fahrenheit. Data is derived from data from files in the rmyoung_air directory
/ashtech_attitude - Attitude 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 derived from air temp
/glonass_gga - Position data in NMEA GGA format from the GLONASS GPS receiver.
/glonass_gll - Position data in NMEA GLL format from the GLONASS GPS receiver.
/gyro - Heading data in NMEA HDT format from the Sperry gyrocompass
/ibs_waypoints - Waypoints from the Healy's Integrated Bridge System
/knudsen - Depth data in a proprietary PKEL format received from Knudsen 320 B/R serial output

/par- Photosynthetic Active Radiation volts from the surface par sensor
/par_derived - Photosynthetic Active Radiation, Microeinstens/m2 sec from surface par sensor
/pcode_aft_gga - Position data in NMEA GGA format from the Trimble Centurion receiver located in the Computer lab
/pcode_aft_gll - Position data in NMEA GLL format from the Trimble Centurion receiver located in the Computer lab
/pcode_aft_vtg - Course and speed over ground in NMEA VTG format from the Trimble Centurion receiver located in the Computer lab
/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_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
/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.
/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
/sperry_speedlogvbw - ground/water speed data from the Sperry Speed Log
/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_aft - Thermosalinograph and fluoromter data from the instruments in the Aft Fuel Hose room
/tsg_flow - Flow meter data just upstream of the TSG and Fluorometer
/tsg_fwd -Thermosalinograph and fluorometer data from the instruments in the Bio/Chem Lab
/winch_data - Line out and speed data from the winch system
/EventData – SCS 1 minute data. Data nearest the minute.
/EventData/samos_data – Meterology data files for SAMOS.

Meta_data:

Files describing data formats, Calibrations of Instruments, the Data DVD descriptions and some other track, instrument and other reports are in this directory.

/elog - Contains the technician's narrative of important events, which occurred both to the network and to individual sensors.

/Bridge_Logs – Bridge logs kept by the bridge

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.

./Systems_Calibration_Data – Calaibration files for Sensors

/CTD_Sensors – CTD calibration files

/Underway_Sensors – Under way Sensor Calibration files

/Met_Sensors – Meteorological Calibration files

/Ocean_sensors – TSG Sensor Calibration files

/HLY0703_Sensors_files – Figures for HLY0703_Sensors.htm

Science Event log as logged by the bridge.

Station log of only where the science stations were.

Raw:

/ctd - CTD data in directories by Cast number.

/pos_mv - POS/MV and other navigation data. LDS logged data.

/tsg_fwd - Thermosalinograph/Fluorometer data from instruments in the Bio/Chem Lab in their raw format.

/tsg_aft - Thermosalinograph/Fluorometer data from instruments in the aft fuel hose room in their raw format. NOT collected on HLY0703.

/xbt - Expendable Bathythermograph data.

ice_observations:

Directories of the Ice Observations taken for each day August 17 to September 15.

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 a ½ hour before the file name and a ½ hour after the hour the file is named for.

First DVD Contents by directory:

Datalog:	posmv_gst	**Raw:**

ashtech_gll ashtech_gga ashtech_attitude ashtech_hdt glonass_gga glonass_gll gyro pcode_bridge_gga pcode_bridge_gll pcode_bridge_vtg rmyportwind pcode_aft_gga pcode_aft_gll pcode_aft_zda pcode_aft_vtg rmyoung_air rmystbdwind sperry_speedlog winch_data seabeam_center knudsen	posmv_gga posmv_hdt posmv_vtg posmv_zda posmv_pashr ibs_waypoints tsg_aft tsg_fwd sv2000 par air_temp_f dew_point_f true_wind_port true_wind_stbd par_derived aft_a_frame sbd_a_frame EventData EventData/Samos_data	pos_mv pos_mv/events tsg_fwd ctd xbt **Meta_Data:** elog Bridge_Logs Systems_Calibration_Data CTD_Sensors Underway_Sensors Underway_Sensors/MET_Sensors Underway_Sensors/Ocean_sensors HLY0703_Sensors_files Track **Ice_observatons:** **knudsen_hourly_plots:** 20070817 ops.sonar.200708171800.knudsen.png ops.sonar.200708171800.knudsen_small.png ops.sonar.200708171900.knudsen.png Ops.sonar.200708171900.knudsen_small.png

Directories on the second and subsequent DVDs:

Raw: This directory contains raw data as recorded by individual instruments and put into different directories. Directory names are labeled by the instrument name and string type of the data collected. Then DVDs contain as much data for a given time interval that can fit on the DVD. Then a new DVD is started. A description of the data contained in this directory is below.
Images: This directory contains three directories of images from both the web cameras on board and Satelitte data received during the cruise.
AloftConCam: This directory contains picture files separated by directories named by Day of YearDay (YYYYJJJ). The files are rolled over at midnight GMT. Some directories are empty as the DVDs are created. The picture files are in JPEG format.
FantailCam: This directory contains picture files separated by directories named by Day of YearDay (YYYYJJJ). The files are rolled over at midnight GMT. The base folder contains different files as well.
Satellite_Images: This directory contains images from Satellites collected over the cruise. They are in dire3ctories named for their content and further broken into directories named by YearMonthDay (YYYYMMDD).

Raw:

/adcp75 - 75 KHz ADCP data
/adcp150 - 150 Khz ADCP data. NOT Collected on HLY0703.
/knudsenraw - Knudsen 320B/R data
/seabeam - Seabeam 2112 data in the raw format.

Images:

Contains directories of Terascan, aloftconn and fantail cameras.

/AloftConCam - Contains picture files separated by folders named by Day of Year (YYYYJJJ) taken from a web camera in Aloft Con. The picture files are in JPEG format.

/FantailCam - Contains picture files separated by folders named by Day of Year (YYYYJJJ) taken from a web camera in Aft Con. The files are in JPEG format.

/Satellite_Image - Contains satellite imagery in jpeg format. Folder names are labeled as instrument name and string type of data collected
/dmsp - dmsp folders labeled by Year, Month, Day
/hrpt - hrpt folders labeled by Year, Month, Day

Second DVD Contents by directory:

An example list of subdirectories and files here may be different from the actual DVD.

Images:

Images/AloftConnCam
./2007229
2007-229-1640.jpeg
2007-229-1645.jpeg
……
./2007230
2007-230-0000.jpeg
2007-230-0005.jpeg
……
./2007235
……
Images/FantailCam
./2007229
2007-229-164001.jpeg
2007-229-164501.jpeg
……
2007230
2007-230-000001.jpeg
2007-230-000501.jpeg
…..
2007231
……
Images/Satellite_Images
Images/Satellite_Images/dmsp
./20070815
200708150053.f-12.4km_ir.jpeg
200708150053.f-12.4km_vis.jpeg
200708150234.f-12.4km_ir.jpeg
…...
/20070816
200708160039.f-12.4km_ir.jpeg
200708160039.f-12.4km_vis.jpeg
…..
./200700817
…..
Images/Satellite_Images/hrpt
./20070815
200708150005.noaa-17.1km_ir_ch5.jpeg
200708150005.noaa-17.1km_vis_ch1.jpeg
200708150005.noaa-17.1km_vis_ch2.jpeg
…..
./hrpt/20070816
200708160055.noaa-18.1km_ir_ch5.jpeg
200708160055.noaa-18.1km_vis_ch1.jpeg
200708160055.noaa-18.1km_vis_ch2.jpeg
…..
./20070817
…..

Raw:

Raw/adcp75
HL0703035_000000.ENR.gz
HL0703035_000000.ENS.gz
HL0703035_000000.ENX.gz
HL0703035_000000.N1R.gz
HL0703035_000000.N2R.gz
HL0703035_000000.NMS.gz
HL0703035_000000.STA.gz
HL0703035_000000.VMO.gz
…..
Raw/knudsenraw
2007_229_1847_000.kea.gz
/2007_229_1847_000.keb.gz
2007_229_1847_LF_000.sgy.gz
…..
Raw/seabeam
sb20072291600.mb41.gz
sb20072291700.mb41.gz
…..

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.

HLY0703_one_minute.data

24945,2007/04/28 04:33,-169.866590,56.651784,11.4,21.7,20.9,82.3,1.998,2.847,32.12,1.668,2.416, 0.403,0.557,0.279,22,02,-200,26,0,01,-130,-5,0,-1.55,70,-6.33,1003.60,3.91,72.2,4.56,87.4, 532722.519

24946,2007/04/28 04:34,-169.864457,56.654721,11.4,22.0,21.1 81.8,1.980,2.845,32.11,1.648,2.352, 0.392,0.554,0.277,22,02,-200,26,0,01,-140,-5,0,-1.60,70,-6.33,1003.60,4.53,62.7,4.91,79.9, 519890.107

24947,2007/04/28 04:35,-169.862317,56.657645,11.4,22.0,20.8,81.0,1.971,2.844,32.11,1.649,2.261, 0.377,0.550,0.275,22,02,-200,26,0,01,-140,-5,0,-1.59,70,-6.40,1003.60,4.12,56.7,4.48,71.5, 514033.101

Field	DATA	Example	UNITS
01	ID	24950	samplecount
02	date	2007/04/28 04:38	date&timeUTC (year/month/dayhour:minute)
03	lon	-169.855928	POSMVLongitude (decimaldegrees)
04	lat	56.666416	POSMVLatitude (decimaldegrees)
05	sog	11.4	POSMVSpeedOverGround (Knots,1minuteaverage)
06	cog	22.0	POSMVCourseOverGround (angulardistancefrom0 (North) clockwisethrough360,1minuteaverage)
07	heading	20.7	POSMVshipheading (angulardistancefrom0 (North) clockwisethrough360,1minuteaverage)
08	depth	80.3	Seabeamcenterbeamdepth (meters,1minuteaverage)
09	TSGF_InTemp	1.968	SBE21internaltemperature (Celsius,1minuteaverage)
10	TSGF_Cond	2.843	Conductivity (Siemens/meter,1minuteaverage)
11	TSGF_Sal	32.10	Salinity (PSU,1minuteaverage)
12	TSGF_SST	1.612	RemoteTemperature,SeaChestintake (Celsius,1minuteaverage)
13	SCUFA_CHL	2.111	SCUFAFluorometer (Ug/l,1minuteaverage)
14	SCUFA_Fl_V	0.352	SCUFAFluorometer (Volts,1minuteaverage)*

Field	DATA	Example	UNITS
15	SCUFA_Turb	0.540	SCUFATurbidity (NTU,1minuteaverage)
16	Turb_Volts	0.270	SCUFATurbidity (Volts,1minuteaverage)**
17	tsg_flow	22	FlowmeterfeedingTSGandFLUOR (Liters/minute)
18	WinchAft	02	AftA-FrameWinchnumber
19	TensionAft	-200	AftA-FrameWinchWiretension (Pounds)
20	WireOutAft	26	AftA-FrameWinchWireout(Meters)
21	SpeedAft	0	AftA-FrameWinchWirespeed (Meters/minute)
22	WinchSbd	01	StarboardA-FrameWinchnumber
23	TensionSbd	-120	StarboardA-FrameWinchWiretension (Pounds)
24	WireOutSbd	-11	StarboardA-FrameWinchWireout (Meters)
25	SpeedSbd	0	StarboardA-FrameWinchWirespeed (Meters/minute)
26	RMYTemp	-1.70	RMYoungAirTemperature (Celsuis,1minuteaverage)
27	RMYHumidity	69	RMYoungRelativeHumidity (Precent,1minuteaverage)
28	RMYDewPt	-6.58	RMYoungDewPointTemperature (Celcius,1minuteaverage)
29	RMYBaro	1003.55	RMYoungBarometer (hPa,1minuteaverage)
30	PortWndSpdT	4.57	RMYoungWindSpeed,port (Knots,1minuteaverage)
31	PortWndDirT	62.7	RMYoungWindDirection,port (angulardistancefrom0 (North) clockwisethrough360,1minuteaverage)
32	StbdWndSpdT	4.83	RMYoungWindSpeed,starboard (Knots,1minuteaverage)
33	StbdWndDirT	81.5	RMYoungWindDirection,starboard (angulardistancefrom0 (North) clockwisethrough360,1minuteaverage)
34	PARderived	505144.287	DerivedsurfacePAR (Microeinstens/m2sec,1minuteaverage)

File Formats of Data Collected on HLY0703

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.

./Datalog

The following data types are to be found in the DataLog directory of the DVD.

Under way 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	ASCII text
4	Data type for field 5	C	Temperature
5	Air Temperature	-6.49	Celsius
8	Data Type for field 9	H	
9	Relative Humidity	89	Percent
12	Data type for field 13	C	
13	Dew Point Temperature	-7.93	Celcius
16	Data type for field 17	P	Pressure
17	Barometer	994.24	hPa
20	Data type for field 20	D	
21	Elevation	-35	Meters

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	04/14/2007	mm/dd/year
2	SCS logged Time GMT	18:24:49.678	hh:mm:ss.sss
3	NMEA header	$DERIV	ASCII 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	18:24:40.521	hh:mm:ss.sss
3	NMEA header	$WIMWV	ASCI text
4	Wind Direction	034	Degrees
5	R= Relative	R	
6	Wind Speed	029.4	Knots
7	N= Knots	N	
8	A= Valid Data	A	
9	Check sum	*35	

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	18:24:40.724	hh:mm:ss.sss
3	NMEA header	$WIMWV	ASCII text
4	Wind Direction	042	Degrees
5	R= Relative	R	
6	Wind Speed	025.2	Knots
7	N= Knots	N	
8	A= Valid Data	A	
9	Check sum	*3E	

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 2	SCS logged Date SCS logged Time GMT	04/15/2007 00:00:07.927	mm/dd/year hh:mm:ss.sss
3	NMEA header	$DERIV	ASCII text
4	Wind Speed derived	19.85	knots
5	Wind Directions derived	3.73	degrees
6	Wind Speed relative	31.8	knots
7	Wind Direction relative	12	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

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

Comment:

Photosynthetic Active Radiation (PAR) Sensor

PAR

Photosynthetic Active Radiation volts from the surface par sensor.
./par
PAR_20070415-000000.Raw
04/15/2007,00:00:03.068,+01126.24
04/15/2007,00:00:04.068,+01133.28
04/15/2007,00:00:05.068,+01140.96

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	PAR	+01140.96	mVolts

PAR (Derived)

Photosynthetic Active Radiation, Microeinstens/m2 sec from surface par sensor.
./Par_derived
PAR-derived_20070415-000000.Raw
04/15/2007,00:00:03.146,$DERIV,1865353.0198,1126.24,
04/15/2007,00:00:09.146,$DERIV,1909343.4448,1152.8,
04/15/2007,00:00:15.146,$DERIV,1881518.176,1136,

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.193	hh:mm:ss.sss
3	NMEA header	$DERIV	ASCII text
4	Derived surface PAR	1881518.176	MicroEinstiens/m2 sec
5	PAR volts	1136	mVolts

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. One if for data that is in degrees and the other for the rest of the data. 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. The rest 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.

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	mean value	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	

Format for other variables

FIELD	DATA	Example	UNITS
1	SCS logged Date	06/04/2007	mm/dd/year
2	SCS logged Time GMT	00:00:04.732	hh:mm:ss.sss
3	NMEA header	$DERIV	
4	mean value	2.55	
5	Last value used	2.71	
6	Sum of values	51.08	
7	number of values	20	

./Datalog/samos_data
SAMOS-AIRTEMP_20070604-000000.Raw
06/04/2007,00:00:04.732,$DERIV,2.55,2.71,51.08,20,
06/04/2007,00:00:05.732,$DERIV,2.55,2.71,51.08,20,

06/04/2007,00:00:06.732,$DERIV,2.56,2.58,53.66,21,

SAMOS-BARO_20070604-000000.Raw
06/04/2007,00:00:04.888,$DERIV,1009.89,1009.85,20197.79,20,
06/04/2007,00:00:05.888,$DERIV,1009.89,1009.85,20197.79,20,
06/04/2007,00:00:06.888,$DERIV,1009.88,1009.77,21207.56,21,

SAMOS-COG_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,256,266.2,15360,60,
06/04/2007,00:00:05.763,$DERIV,256.35,269,15380.9,60,
06/04/2007,00:00:06.763,$DERIV,256.73,268.7,15403.9,60,

SAMOS-Depth_20070604-000000.Raw
06/04/2007,00:00:04.732,$DERIV,48.35,47.73,1547.29,32,
06/04/2007,00:00:05.732,$DERIV,48.35,48.23,1547.09,32,
06/04/2007,00:00:06.732,$DERIV,48.35,48.23,1547.09,32,

SAMOS-DewPt_20070604-000000.Raw
06/04/2007,00:00:04.763,$DERIV,-0.19,-0.07,-3.71,20,
06/04/2007,00:00:05.763,$DERIV,-0.19,-0.07,-3.71,20,
06/04/2007,00:00:06.763,$DERIV,-0.19,-0.24,-3.95,21,

SAMOS-FLOW_20070604-000000.Raw
06/04/2007,00:00:04.888,$DERIV,19.73,19,1184,60,
06/04/2007,00:00:05.888,$DERIV,19.72,19,1183,60,
06/04/2007,00:00:06.888,$DERIV,19.72,20,1203,61,

SAMOS-GYRO_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,79.39,93.174,57.4453621646971,10.7645427712987,
59,
06/04/2007,00:00:05.747,$DERIV,79.62,93.657,58.4433259328868,10.7007594084164,
60,
06/04/2007,00:00:06.763,$DERIV,80.3,94.163,57.6017409411294,9.84189063347194,5
9,

SAMOS-HDT_20070604-000000.Raw
06/04/2007,00:00:04.951,$DERIV,75.66,89.6,57.5759234493574,14.7194505202793,60,
06/04/2007,00:00:05.951,$DERIV,76.11,90.1,57.6865055529794,14.2606072648547,60,
06/04/2007,00:00:06.951,$DERIV,76.57,90.6,57.7938649038928,13.799257940049,60,

SAMOS-Humidity_20070604-000000.Raw
06/04/2007,00:00:04.951,$DERIV,82.05,82,1641,20,
06/04/2007,00:00:05.951,$DERIV,82.05,82,1641,20,
06/04/2007,00:00:06.951,$DERIV,82.05,82,1723,21,

SAMOS-LAT_20070604-000000.Raw

06/04/2007,00:00:04.732,$DERIV,65.59509,65.5950468333333,3935.70535966667,60,
06/04/2007,00:00:05.732,$DERIV,65.59509,65.5950465,3935.70524833333,60,
06/04/2007,00:00:06.732,$DERIV,65.59509,65.5950463333333,3935.70513966667,60,

SAMOS-LON_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,-168.94876,-168.949358166667,-10136.9255943333,60,
06/04/2007,00:00:05.763,$DERIV,-168.94878,-168.9493785,-10136.9267596667,60,
06/04/2007,00:00:06.763,$DERIV,-168.9488,-168.949398666667,-10136.9279298333,60,

SAMOS-PAR_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,1971523.4717,1938228.7238,120262931.7745,61,
06/04/2007,00:00:05.763,$DERIV,1969668.4538,1956778.903,120149775.6813,61,
06/04/2007,00:00:06.763,$DERIV,1967657.0409,1947238.8109,120027079.496,61,

SAMOS-Remote-SSTemp_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,1.644,1.601,16.439,10,
06/04/2007,00:00:05.763,$DERIV,1.644,1.601,16.439,10,
06/04/2007,00:00:06.763,$DERIV,1.632,1.603,16.324,10,

SAMOS-SLFA_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,-2.79,-2.61,-170.34,61,
06/04/2007,00:00:05.747,$DERIV,-2.79,-2.6,-170.01,61,
06/04/2007,00:00:06.763,$DERIV,-2.78,-2.62,-166.88,60,

SAMOS-SOG_20070604-000000.Raw
06/04/2007,00:00:04.763,$DERIV,1.79,1.8,107.3,60,
06/04/2007,00:00:05.763,$DERIV,1.79,1.8,107.6,60,
06/04/2007,00:00:06.763,$DERIV,1.8,1.8,107.9,60,

SAMOS-SPPS_20070604-000000.Raw
06/04/2007,00:00:04.763,$DERIV,0.76,0.97,46.5,61,
06/04/2007,00:00:05.763,$DERIV,0.77,0.93,46.94,61,
06/04/2007,00:00:06.763,$DERIV,0.78,0.87,47,60,

SAMOS-TSG-Conductivity_20070604-000000.Raw
06/04/2007,00:00:04.888,$DERIV,2.939,2.938,29.389,10,
06/04/2007,00:00:05.888,$DERIV,2.939,2.938,29.389,10,
06/04/2007,00:00:06.888,$DERIV,2.939,2.938,29.387,10,

SAMOS-TSG-Flourometer_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,11.794,12,117.941,10,
06/04/2007,00:00:05.763,$DERIV,11.794,12,117.941,10,
06/04/2007,00:00:06.763,$DERIV,11.824,11.905,118.242,10,

SAMOS-TSG-Salinity_20070604-000000.Raw
06/04/2007,00:00:04.888,$DERIV,32.64,32.64,326.35,10,
06/04/2007,00:00:05.888,$DERIV,32.64,32.64,326.35,10,
06/04/2007,00:00:06.888,$DERIV,32.63,32.63,326.34,10,

SAMOS-TSG-Temp_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,2.604,2.59,26.039,10,
06/04/2007,00:00:05.763,$DERIV,2.604,2.59,26.039,10,
06/04/2007,00:00:06.763,$DERIV,2.601,2.588,26.011,10,

SAMOS-TSG-Turbidity_20070604-000000.Raw
06/04/2007,00:00:04.951,$DERIV,1.572,1.57,15.721,10,
06/04/2007,00:00:05.951,$DERIV,1.572,1.57,15.721,10,
06/04/2007,00:00:06.951,$DERIV,1.573,1.573,15.726,10,

SAMOS-WDPR_20070604-000000.Raw
06/04/2007,00:00:04.888,$DERIV,189.3,177,11547,61,
06/04/2007,00:00:05.888,$DERIV,188.9,176,11523,61,
06/04/2007,00:00:06.888,$DERIV,188.48,176,11497,61,

SAMOS-WDPT_20070604-000000.Raw
06/04/2007,00:00:04.732,$DERIV,9.22,9.6,553.11,60,
06/04/2007,00:00:05.732,$DERIV,9.21,9.2,552.73,60,
06/04/2007,00:00:06.732,$DERIV,9.21,9,561.73,61,

SAMOS-WDSR_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,205.9,185,12354,60,
06/04/2007,00:00:05.763,$DERIV,205.53,197,12332,60,
06/04/2007,00:00:06.763,$DERIV,204.88,179,12293,60,

SAMOS-WDST_20070604-000000.Raw
06/04/2007,00:00:04.951,$DERIV,286.06,279,17163.86,60,
06/04/2007,00:00:05.951,$DERIV,286.24,296.75,17460.61,61,
06/04/2007,00:00:06.951,$DERIV,285.97,270.11,17444.32,61,

SAMOS-WSPR_20070604-000000.Raw
06/04/2007,00:00:04.763,$DERIV,10.96,11,668.8,61,
06/04/2007,00:00:05.763,$DERIV,10.96,10.8,668.6,61,
06/04/2007,00:00:06.763,$DERIV,10.96,10.8,668.6,61,

SAMOS-WSPT_20070604-000000.Raw
06/04/2007,00:00:04.888,$DERIV,9.21,9.2,552.73,60,
06/04/2007,00:00:05.888,$DERIV,9.21,9,561.73,61,
06/04/2007,00:00:06.888,$DERIV,9.2,9,561.36,61,

SAMOS-WSSR_20070604-000000.Raw

06/04/2007,00:00:04.763,$DERIV,10.79,5.2,647.3,60,
06/04/2007,00:00:05.763,$DERIV,10.68,5,640.7,60,
06/04/2007,00:00:06.763,$DERIV,10.57,5,634.3,60,

SAMOS-WSST_20070604-000000.Raw
06/04/2007,00:00:04.747,$DERIV,9.36,4.87,561.73,60,
06/04/2007,00:00:05.763,$DERIV,9.24,3.43,554.32,60,
06/04/2007,00:00:06.763,$DERIV,9.14,3.34,557.66,61,

Oceanographic Data

Thermosalinograph / Fluorometer

AFT Theromsalinograph / Fluorometer

Thermosalinograph and Fluoromter data from the instruments in the Aft Fuel Hose room.
./tsg_aft
TSGAFT_20070414-182437.Raw
NO DATA Collected on HLY0703

Forward Theromsalinograph Flowmeter

Flowmeter data from the instruments in the Bio/Chem Lab

./tfg_flow.
TSGF-FlowMeter_20070415-000000.Raw
04/15/2007,00:00:02.974, 11.
04/15/2007,00:00:09.255, 11.
04/15/2007,00:00:15.537, 11.

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:15.537	hh:mm:ss.sss
3	Flowmeter feeding TSG and FLUOR	11.	Liters/minute

Forward Thermosalinograph / Fluorometer

Thermosalinograph and Fluorometer data from instruments in the Bio Chem Lab. Also, see the appendix section "SBE 21 SEACAT Thermosalinograph Data Output Formats".

./tsg_fwd

TSGFWD_20070415-000000.Raw

04/15/2007,00:00:04.255, 25269 -0.838 2.577 31.56 -1.457
1437.661 3.321 0.664 4.617 4.617
04/15/2007,00:00:10.287, 25270 -0.850 2.577 31.57 -1.458
1437.672 3.474 0.695 5.000 5.000
04/15/2007,00:00:16.255, 25271 -0.848 2.577 31.56 -1.458
1437.664 3.339 0.668 4.927 4.927

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:16.255	hh:mm:ss.sss
3	Scan number	25271	Integer count
4	SBE 21 internal temperature	-0.848	Celsius
5	Conductivity	2.577	Siemens/meter
6	Salinity	31.56	PSU
7	RemoteTemperature (Sea Chest intake)	-1.458	Celsius
8	Sound Velocity	1437.664	Meters per Second (m/s)
9	Fluorometer (SCUFA)	3.339	Ug/l
10	Fluorometer (SCUFA)	0.668	Volts
11	Turbidity (SCUFA)	4.927	NTU
12	Turbidity (SCUFA)	4.927	Volts

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	
4-6	Seabeam Date	2007,4,14	Year,month,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	

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	KEL Proprietary Data String
4	Record Number???	------	Not used
5	Knudsen Date	14042007	DDMMYYYY
6	Knudsen Time	182527.269	HHMMSS.sss
7		00191	
8	HF Header (12 kHz)	HF	ASCI 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 Meters
**	Knudsen default sound speed	***	Current GPS source is the POS/MV

Winch data

Winches were not used on HLY0703 for data collection. The Metocean IABP ice tracking buoys and HARP moorings used the 3/8” winch.

Starboard A-Frame Winch Data

1 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.
./[illegible]
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 device is located above the Helo Control Shack. The results are corrected to the Master Reference Point (MRP) for the ship. See the Instrument Locations on the Healy section in the Appendix.

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 3	SCS logged Time GMT NMEA header	00:00:05.052 $INGGA	hh:mm:ss.sss
4	GPS time at position GMT	000004.737	hhmmss.sss
5	Latitude	5830.47716	ddmm.mmmmm
6	North (N) or South(S)	N	
7	Longitude	17012.64550	dddmm.mmmmm
8	East (E) or West (W)	W	
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 16	M for Meters 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 3	SCS logged Time GMT NMEA header	00:00:05.052 $INGST	hh:mm:ss.sss ASCI textI
4	GPS time at position GMT	000004.737	hhmmss.sss
5	blank		
6	Smjr.smjr	0.6	Meters
7	Smnr.smnr	0.4	eters
8	000.0	22.3	Degrees from True North
9 10	l.l y.y	0.4 0.6	Meters Meters
11	Standard deviation of altitude (a.a)	0.8	Meters
12	Checksum	*65	

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	

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	ASCI text
4	Time GMT	000004.737	hhmmss.sss
5	Heading	344.20	heading
6	True	T	ASCII character
7 8	Roll Pitch	-0.24 0.10	Degrees 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	ASCI integer text
14	IMU 0= out 1= satisfactory	1	
15	Check Sum	*10	

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	ASCI text
3	Heading	344.2	Degrees
4	Degrees true (T)	T	ASCII character
5	Heading		Degrees
6	Degrees magnetic	M	
7	Ship Speed	12.5	knots
8	N=Knots	N	
9	Ship Speed	23.1	km/hr
10	K=KM per hour	K	
11	Check sum	*77	

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	ASCI 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	

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	
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	
16	Check sum	*41	

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	ASCIItext
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 = GPS2=DGPS	1	
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	
14	Geoidal Height	9.47	meters
15	M for Meters	M	
16	Differential reference station ID (no data in sample string)		
17	Checksum	*75	

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	ASCII 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	
10	???	A	
11	Checksum	*74	

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	ASCI character
6	Checksum	*32	

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	ASXCII character
7	Longitude	17012.6286	dddmm.mmmm
8	East (E) or West (W)	W	ASCII character
9	GPS Quality: 1 = GPS2=DGPS	1	
10	Number of GPS Satellites Used	04	
11	HDOP (horizontal dilution of precision)	1.5	
12 13	Antenna height M for Meters	019.8 M	meters
14	Geoidal Height	-008.9	meters
15	M for Meters	M	
16 17	Differential reference station ID (no data in sample string) Checksum	 *59	

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 tgext
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	

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	ASCII 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	

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	

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 = GPS2=DGPS	1	
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	

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	ASCII character
10	Checksum	*17	

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	

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 = GPS2=DGPS	1	
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	

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	

Gyro

Gyro Heading

Heading data in NMEA HDT format from the Sperry gyrocompass.
./gyro
Gyro_20070415-000000.Raw
04/15/2007,00:00:01.912,$HEHDT,346.647,T*2B
04/15/2007,00:00:03.912,$HEHDT,346.713,T*2B
04/15/2007,00:00:05.927,$HEHDT,346.735,T*2F

FIELD	DATA	Example	UNITS
1	SCS logged Date	04/15/2007	mm/dd/year
2	SCS logged Time GMT	00:00:05.927	hh:mm:ss.sss
3	NMEA header	$HEHDT	ASCII text
4	Heading	346.735	degrees
5	True (T) or Magnetic (M)	T	ASCII character
6	Check sum	*2F	

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	04/15/2007	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	

Speed Log

Sperry Sped Log

Ground/water speed data from the Sperry Speed Log. Recording for HLY0703 started on 09/11/07 23:23 once out of the ice.

./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 3	NMEA header Fore-aft Water Speed - = astern	$VDVBW 12.34	ASCII text 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 9	A= Data Valid V=Invalid Checksum	A *56	ASCII character

Sound Velocimeter

SV2000

Sound Velocity data from the SV2000 sound velocimeter.

./sv2000

Sound-Velocimeter_20070415-000000.Raw

NO DATA

./Raw

The following section are in the Raw data directory on the DVD.

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 HLY0703, a three place number of the sequence in the files, then an extra "_000000", and then an extent 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

There was no adcp 150 run during HLY0703
./adcp150

KNUDSEN 320B/R

The Knudsen 320B/R depth sounder can record depths in 3.5 and 12 kHz. The Healy records the 3.5 kHz data (Sub Bottom Profile) under way. This data is saved in all of the formats that the Knudsen can record data in Datalog/Kudsen. And Raw/knudsenraw These files are in both ASCII and BINARY format (see the table below).

./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

POSMV

The files saved in the directory pos_mv are from the posmvnav computer and from various navigation devices related to the system. The files use the naming convention of the name of the cruise, the device and the year and Day of Year day. An example for the ADU5 GPS receiver on day 105 in 2007 would be: HLY0703-adu5.y2007d105. The files are ASCII

./pos_mv

HLY0703-adu5.y2007d244– "Ashtech" GPS
HLY0703-aggps.y2007d244– Differential GPS
HLY0703-ftsgauss.y2007d244– TSG ASCII data
HLY0703-ftsgaussraw.y2007d244– Raw TSG in HEX with a time stamp
HLY0703-mk27f.y2007d244 – MK27 Gyro
HLY0703-par.y2007d244– Raw PAR sensor data
HLY0703-posatt.y2007d244– POSNV Attitude data
HLY0703-posnav.y2007d244– POSMV Nav data
HLY0703-posreform2sb.y2007d244– Reformatted POSMV for Seabeam
HLY0703-sbsv.y2007d244– Surface Sound Velocity

POSMV Events

The events directory in the pos_mv directory has event files from various system showing start and stop times and various events in the recording and setup history of the device.

/pos_mv/events

Seabeam

The raw Seabeam 2112 binary files are in this directory. The naming convention uses the year, month, Day of Year day, and the start hour and minute in it. For year 2007 on day 110 starting at 11:12 the name would be sb20071101112.mb41. mb41 is for the Seabeam 2112. These data can best be accessed and used by using the MB-System software.

./Seabeam

sb20071091600.mb41

Thermosalinograph

Thermosalinograph AFT

Not used for HLY0703.

./tsg_aft

Thermosalinograph Forward

The Forward Thermosalinograph data is written here. There are 2 files for each time period. The files use the name of the cruise and a sequence number in the recording for the cruise. See the SeaBird software Seacat for further processing.

./tsg_fwd

HLY07TSGFwd0702-2.CON
HLY07TSGFwd0702-2.hex

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

Not all of the above files were created for HLY0703

Expandable Bathythermograph (XBT)

The file names use the probe type and the sequence number of the XBT in the series used for the cruise.
./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

./Images

Aloft Con Camera

This directory contains picture files, from the Aloft Con forward view, separated into sub-directories named by Day of Year (YYYYJJJ). The picture files are in JPEG format taken every 5 minutes. The file names have the year, Day of Year and time in them.
/AloftConCam
2007-106-2255.jpeg
2007-106-2300.jpeg
2007-106-2305.jpeg
Fan Tail Camera

This directory contains picture files, from the Fan Tail view from Aft Con, separated into sub-directories named by Day of Year (YYYYJJJ). The picture files are in JPEG format taken every 1 minute. The file names have the year, Day of Year and time in them.
/FantailCam
2007-115-221501.jpeg
2007-115-222001.jpeg
2007-115-222501.jpeg

Satellite Images

/Satellite_Image
This directory contains satellite imagery of two types in jpeg format. Each type of data is separated into sub-directories by Year, Month and Day (YYYYMMDD).

/hrpt

This is data a High-Resolution Picture Transmission (HRPT) from the Chinese FengYun-1 (FY-1) Meteorological Satellite. The files are in Jpeg format named using Year, Month, Day, Hour and Minute. There are several types of images for each time frame.
200704210752.noaa-14.1km_ir_ch5.jpeg
200704210752.noaa-14.1km_vis_ch1.jpeg
200704210752.noaa-14.1km_vis_ch2.jpeg

/dmsp

This data is from the Defense Meteorological Satellite Program (DMSP). The files are in Jpeg format named using Year, Month, Day, Hour and Minute. There are several types of images for each time frame.
200704210101.f-12.1km_vis.jpeg
200704210101.f-12.4km_ir.jpeg
200704210101.f-12.4km_vis.jpeg

APPENDIX:

Acquisition Problems and Events

This table summarizes problems with acquisition noted during this cruise including instrument failures, data acquisition system failures and any other factor affecting this data set. Times are reported in GMT. You should look for more complete details for these events in the ELOG accounts.

Date	*Time (UTC)*	*Event*
08/17/07	16:57	Start LDS for HLY0703
08/17/07	16:58	SeaBeam back to Survey mode
08/17/07	18:12	SCS start acquiring HLY0703 data
08/17/07	18:13	Start Knudsen 3.5 for HLY0703
08/17/07	18:14	Speed log has been lifted from the water for the duration of HLY0703
08/17/07	18:14	Start ADCP75 for HLY0703
08/17/07	18:36	Start TSG data acquisition for HLY0703
08/17/07	21:17	Weather sensors not in use removed translator code.
08/17/07	22:15	Secure Knudsen for test of transponder interrogator.
08/17/07	23:05	Secured SeaBeam briefly for test of transponder interrogator.
08/17/07	23:09	Knudsen wired to transponder and returned to LF (3.5).
08/18/07	01:34	New Weather sensor showed no change in Humidity until surge suppressor bypassed. Will leave it this way for awhile.
08/18/07	02:52	New SVP from XBT 53 entered at 02:10.
08/18/07	04:31	Knudsen shutdown to use transponder for interrogation of buoy.
08/18/07	04:32	SeaBeam to Idle for Mooring recovery.
08/18/07	04:54	SeaBeam to Survey, mooring at surface.
08/18/07	04:59	Knudsen back in LF (3.5) pinging mode.
08/18/07	05:24	start LDS and Seabeam sync'ing to Snap1.
08/18/07	07:06	Knudsen shutdown to use transponder for interrogation of buoy at second site.
08/18/07	07:23	SeaBeam to Idle for Mooring recovery.
08/18/07	07:47	SeaBeam to Survey, mooring at surface.
08/18/07	07:50	Knudsen back in LF (3.5) pinging mode.
08/18/07	08:43	New SVP from XBT 54.
08/18/07	15:27	Create new ELOG account for the watchstanders.
08/18/07	19:56	Seabeam Roll Bias changed from -.03 to 0.07 after patch test.
08/18/07	20:43	New SVP from XBT 56.

Date	*Time (UTC)*	*Event*
08/19/07	12:05	Seabeam crashed.
08/19/07	12:16	Seabeam back in Survey mode with Tape #2 in.
08/19/07	20:22	TSG from seawater pump #3 to 3 pump arrangement (normal ice arrangement).
08/19/07	20:29	TSG spiked at 21 C.
08/20/07	08:46	New SVP from XBT 57.
08/20/07	17:16	Internet off the ship degraded very badly.
08/20/07	21:34	Gyro up and running with NMEA ready for SDN logging.
08/20/07	22:33	Gyro being worked on again.
08/20/07	23:03	Adjust Temp offset 1 degree lower. Humidity adjusted down 2%.
08/20/07	23:22	The Temp and Humidity offsets have been adjusted. Very confusing entries.
08/21/07	07:35	New SVP from XBT 58.
08/21/07	17:42	Gyro back up after adjustments.
08/21/07	21:18	Serial leads for POS/MV and Centurion GPS provided for Mayer laptop.
08/21/07	21:24	Sonobuoy antenna installed on HCO roof for sonobuoys used for marine mammal recording.
08/22/07	04:50	noaa-12 removed from Terascan tables.
08/22/07	07:32	New SVP from XBT 61.
08/22/07	18:53	New SVP from XBT 62 and XSV 63.
08/23/07	08:12	New SVP from XBT 64.
08/24/07	08:14	New SVP from XBT 65.
08/24/07	23:03	New SVP from XBT 66.
08/25/07	21:31	New SVP from XBT 67.
08/26/07	06:10	New logger in LDS for mk27f gyro.
08/26/07	08:30	New SVP from XBT 68.
08/26/07	10:56	New MK27F gyro installed for cruise to test. Not an operational data set.
08/27/07	16:51	Fresh keymat entered into aft and bridge P-Codes.
08/27/07	23:06	RM Young Translator to go off line at 1500 Local.
08/28/07	00:50	ELOG now uses 24 clock.
08/28/07	05:53	ADU-5 locked, just reset.
08/28/07	08:12	New SVP from XBT 71.
08/28/07	22:57	RM Young Translator down for an hour. Back online at 1600 Local.

Date	***Time (UTC)***	***Event***
08/29/07	07:35	New SVP from XBT 73.
08/29/07	19:12	New SVP from XBT 75.
08/29/07	19:32	Note Wind sensors have been plotting weird since 1600Z 8/28. Iced up.
08/30/07	05:45	XSV 2 launched.
08/30/07	06:19	New SVP from XBT 77 and the XSV.
08/31/07	06:30	New SVP from XBT 80.
09/01/07	10:56	New SVP from CTD 02.
09/01/07	10:56	Launched XBT T7 0081 at about 09:56.
09/02/07	06:51	New SVP using CTD 02 and XBT T7 00083.
09/03/07	00:29	New SVP using CTD 02 and XBT T7 00084.
09/03/07	06:23	New SVP using CTD 02 and XBT T7 00085.
09/04/07	00:22	Reuse SVP using CTD 02 and XBT T7 00084.
09/04/07	02:53	New SVP using CTD 02 and XBT T7 00086.
09/04/07	10:45	Note strange TSG Fluorometer step at 0400Z 9/4.
09/04/07	13:47	Reuse SVP using CTD 02 and XBT T7 00083.
09/05/07	04:51	New SVP from XBT T7 00089.
09/06/07	02:57	New SVP from XBT T7 00090.
09/07/07	04:31	New SVP using XBT T7 00091.
09/08/07	00:25	ADU-5 reset at 00:14.
09/08/07	02:55	New SVP using XBT T7 00093.
09/09/07	02:55	New SVP using XBT T7 00094.
09/10/07	03:23	New SVP using XBT T7 00095.
09/10/07	07:05	Seabeam stopped pinging.
09/10/07	07:28	Ship back in motion after reboot of Seabeam.
09/11/07	02:52	New SVP using XBT T7 00097.
09/11/07	23:23	Start recording Sperry sped log, out of the ice.
09/12/07	03:21	New SVP using XBT T7 00098.
09/12/07	13:13	Wind bird “True” plots start tracking the heading, very off.
09/12/07	20:59	New SVP using XSV S2 00099.
09/14/07	03:21	New SVP using XBT T7 00101.
09/14/07	09:02	Wind birds look bad. Starting 13:30 on 9/12/7 true looks off.
09/15/07	02:53	New SVP using XBT T7 00102.

Date	***Time (UTC)***	***Event***
09/15/07	09:17	ADU5 froze, reset.

Calibrations

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

Turner SCUFA Fluorometer

serial # 0584 page 1- APP. NOTE NO. 63- www.seabird.com

SCUFA(TM) TEST LOG

USE PEN ONLY

Reference TD130059 Scufa (TM) Test Procedure

Electrical test

	2000-006	2000-007	2000-008	2000-005	2000-010	Range
S/N:		0584				
Date:		01/22/07				
Initial:		HB				
P/N	2000-006	2000-007	2000-008	2000-005	2000-010	Range
Vin		12.50				12.5V
Power		12.15				12.2+/-0.2V
"+5.5V"		5.30				5.5+0-0.3V
"3.3V"		3.29				3.3V +/-0.1V
Vcc		3.28				3.3V +/-0.1V
Va+		4.98				5+/-0.1V
Va-		5.13				"-5 +/- 0.2V"
U19, offset		-1.5				<15 mV
U29, offset	N/A	0.3		N/A		<15 mV
Signal offset		8.5				<+/-50
Turb. Offset	N/A	28		N/A		<+/-50
Current cons. Power ON		40				<60 mA
Over-V threshold		15.3				15-15.5 V
Signal offset noise		4.8 (10 ripple).				<20 mV p-p
Turb. Offset noise	N/A	10		N/A		<20 mV p-p
Temp. Readout check		17.98/18.51				Ambient +/- 1° C

Unit Configuration. Table #1

Turbidity	No.	Yes.	Yes.	No.
Temp. Compensation	Yes.	Yes.	Yes.	No.
Internal Data Logger	Yes.	Yes.	Yes.	No

Calibration

	Blank %	Range	Standard %	Range
CHL	0.018 (.20)	0-0.03	2.67	2.2-4.5
TRB	0.015	0-0.03	41.9	43-70
RWT		0-0.09		7.0-15.0
TRB		0-0.05		20.5-70.0
PC		0-0.03		0.5-1.2
TRB				
FLU		0-0.05		2.0-10.0
TRB		0-0.05		1.0-6.0

Internal Data Logger Test IDL: ON or OFF (Circle one)

IDL Tested OK: ☐

Analog output calibration

Analog Out 1	610 mV	(1)
Analog Out 2	2.4 V	(1)

Pressure test & Burn In 821.3

	ST #12	ST #15	ST #20	ST #23	
Date:	1/22/07				
Initial:	HB				
Pressure PSI	1000	1000	1000	1000	
Pre test weight	820.7	820.8			
After test weight	821.1				
Difference					<0.5 gram

1) NOTES: Analog out:
1) Rhod and TRB : 2.5 +/-0.1
2) CHL: 0.625 +/- 0.05V
3) FLU: 0.250 +/- 0.05V
4) Others: Consult Product Development

TD130060 Revision N Page 1 of 2

serial # 0584 Page 2

SCUFA(TM) TEST LOG
USE PEN ONLY

Burn In Test

Start		Finish	
Date:	01/22	Date:	01/24
Time:	1500	Time:	820
Initial:	WM	Initial:	WM

Check / configuration test

Configuration	2000-006	2000-007	2000-008	2000-005 2000-010	
Date:		01/24			
Time:		830			
Initial:		WM			
Fluorescence (Black Rod)		0006			
Turbidity (Black Rod)	N/A	0.010		N/A	
Fluorescence (Solid Std)		(9.12)			
Tubidity (Solid Std)	N/A	(94.95)		N/A	
Sig. Pre-amp. Out		(-6)			<+/-50
Turb. Pre-amp. Out	N/A	(-1)		N/A	<+/-50
Analog Out 1		(557)			(1)
Analog Out 2		(2.28)			(1)
IDL	ON	ON	ON	OFF	
Temp. Comp.	ON	ON	ON	OFF	
Temp. Readout check		265 / 195			Ambient +/- 1°C BE

FINAL INSTRUMENT CONFIGURATION (FOR CUSTOM ORDERS ONLY)
Refer to 2000-010 Configuration Instructions (TD130063)

Shop Order #:	IDL	Temp Comp	Turbidity	Date:
2000-~~010~~ 07	ON	ON	ON	Initial(1): W Initial (2)

TD1300(Page 3 of 2

SCUFA TEST STATUS

INIT. HB

1. S/N 0584 MODEL # 2000-007 S/O # 5356.
2. S/N ____ MODEL # ____ S/O # ____
3. S/N ____ MODEL # ____ S/O # ____
4. S/N ____ MODEL # ____ S/O # ____
5. S/N ____ MODEL # ____ S/O # ____

BURN-IN:
DATE IN 1/22/07 TIME 1500
DATE OUT 1/24/07 TIME 0830

WEIGHT: ☑ (TEST LOG)

POST BURN-IN: ☑ (TEST LOG)

LABEL: ☐

BOX: ☐

820.8

COMMENTS:

TD130117
Rev. A

Seabird SBE21 Thermosalinograph Calibration

Serial number 1864 Conductivity Calibration

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: 1864
CALIBRATION DATE: 17-Feb-07

SBE21 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -4.01848022e+000
h =  4.78130246e-001
i =  1.73756277e-003
j = -5.35324252e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  5.51772628e-002
b =  4.20577678e-001
c = -4.01119247e+000
d = -1.84582181e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

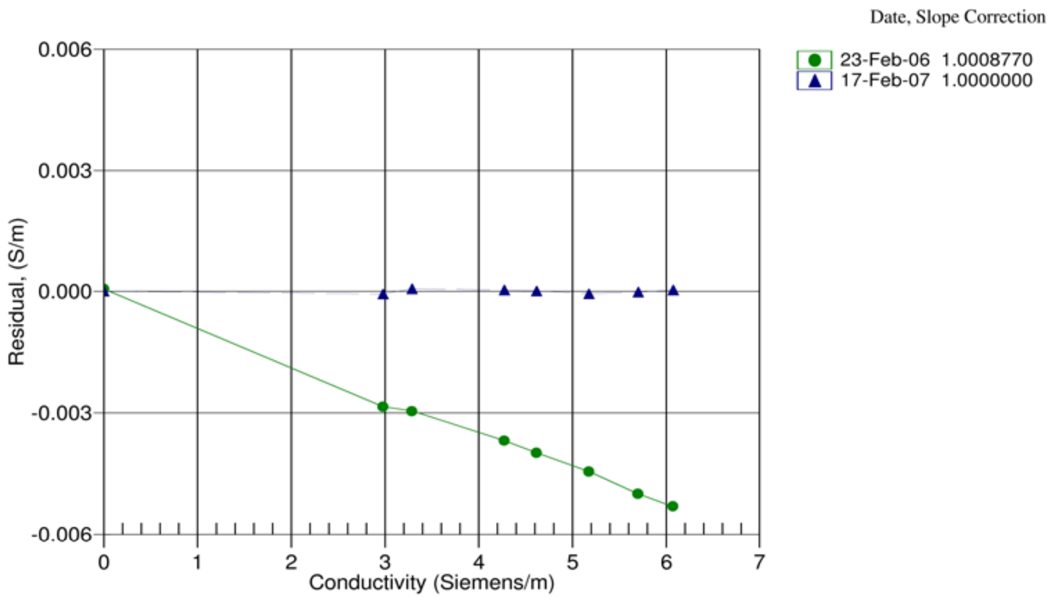
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88532	0.00000	0.00000
1.0000	34.8699	2.98011	8.31725	2.98005	-0.00006
4.4999	34.8506	3.28763	8.68467	3.28769	0.00006
15.0000	34.8098	4.27090	9.76567	4.27093	0.00003
18.4999	34.8013	4.61658	10.11804	4.61660	0.00001
23.9999	34.7923	5.17544	10.66287	5.17538	-0.00006
29.0000	34.7872	5.69809	11.14827	5.69807	-0.00002
32.5000	34.7840	6.07099	11.48204	6.07103	0.00003

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

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

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

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



Serial number 1864 Temperature Calibration

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: 1864
CALIBRATION DATE: 17-Feb-07

SBE21 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS
g = 4.22123757e-003
h = 6.00091050e-004
i = 2.92943927e-006
j = -2.15310298e-006
f0 = 1000.0

ITS-68 COEFFICIENTS
a = 3.64763550e-003
b = 5.88588087e-004
c = 9.17857335e-006
d = -2.15270275e-006
f0 = 2621.105

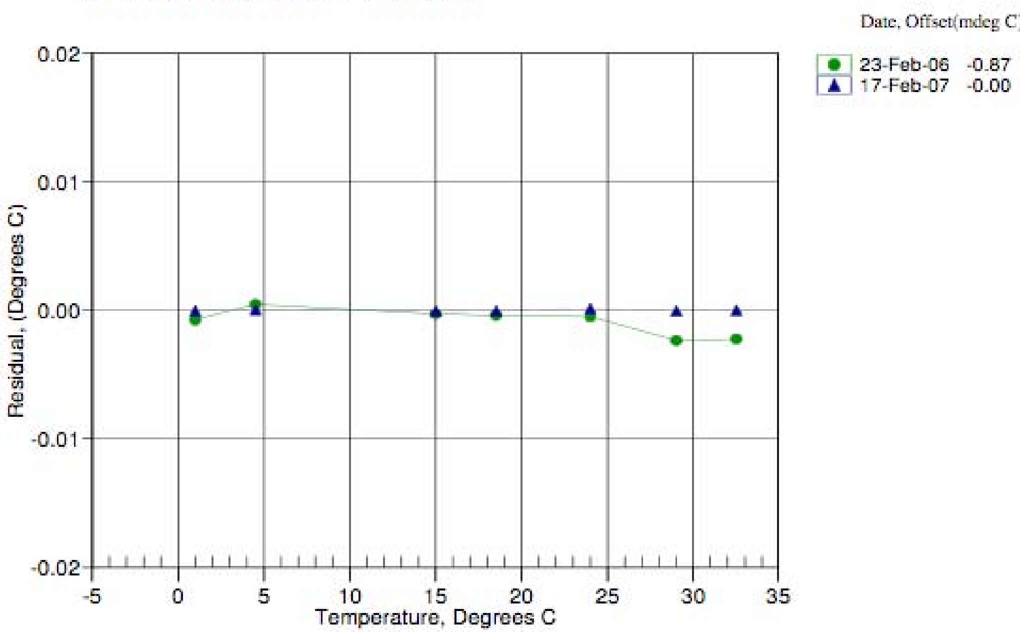
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2621.105	1.0000	-0.00004
4.4999	2834.409	4.5000	0.00008
15.0000	3547.678	14.9999	-0.00007
18.4999	3811.076	18.4999	-0.00003
23.9999	4252.251	24.0000	0.00011
29.0000	4683.211	29.0000	-0.00005
32.5000	5002.409	32.5000	-0.00000

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 ITS-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



MET Sensors

PAR

Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	1/9/2007
Model Number	QSR-2200
Serial Number	20270
Operator	TPC
Standard Lamp	F-863
Probe Excitation Voltage Range:	6 to 18 VDC(+)
Output Polarity:	Positive

Probe Conditions at Calibration(in air):

Calibration Voltage:	6	VDC(+)
Probe Current:	4.0	mA

Probe Output Voltage:

Probe Illuminated	95.87	mV
Probe Dark	1.32	mV
Probe Net Response	94.55	mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

9.43E+15 quanta/cm²sec
0.01566 uE/cm^{2}sec

Calibration Factor:
(To calculate irradiance, divide the net voltage reading in Volts by this value.)

Dry: 1.00E-17 V/(quanta/cm²sec)
6.04E+00 V/(uE/cm^{2}sec)

Notes:

1. Annual calibration is recommended.
2. Calibration is performed using a Standard of Spectral Irradiance traceable to the National Institute of Standards and Technology (NIST).
3. The collector should be cleaned frequently with alcohol.
4. Calibration was performed with customer cable, when available.

QSR240R 05/24/95

R.M. Young Wind Bird, Starboard

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

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

`

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

CTD Sensors

Pressure Sensor

Serial number 83009

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: 0635
CALIBRATION DATE: 17-Feb-06

SBE9plus PRESSURE CALIBRATION DATA
10000 psia S/N 83009

DIGIQUARTZ COEFFICIENTS:

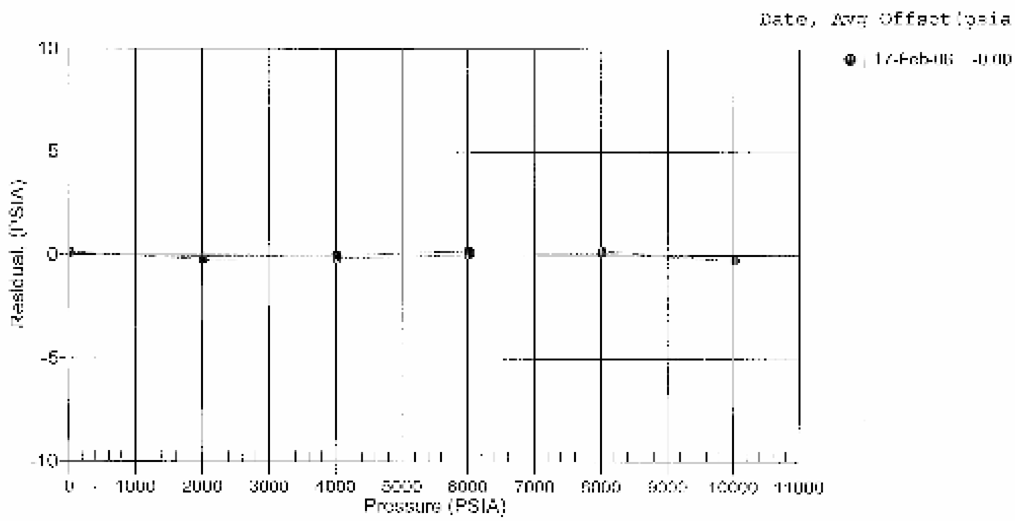
```
C1 =    -4.139335e+004
C2 =     2.566132e-001
C3 =     1.130910e-002
D1 =     3.246900e-002
D2 =     0.000000e+000
T1 =     3.014179e+001
T2 =    -1.666733e-004
T3 =     3.283910e-006
T4 =     5.609600e-009
T5 =     0.000000e+000
```

AD590M, AD590B, SLOPE AND OFFSET:

```
AD590M =    1.27959e-002
AD590B =   -9.20650e+000
Slope  =    0.99973
Offset =   -0.1180  (dbars)
```

PRESSURE (PSIA)	INST OUTPUT(Hz)	INST TEMP(C)	INST OUTPUT (PSIA)	CORRECTED INST OUTPUT (PSIA)	RESIDUAL (PSIA)
14.874	33184.75	18.5	15.199	15.028	0.154
2015.345	33977.61	18.6	2015.884	2015.167	0.218
4015.640	34750.05	18.6	4016.732	4015.470	-0.170
6015.956	35503.45	18.6	6017.775	6015.965	0.010
8016.232	36238.88	18.7	8018.685	8016.229	0.397
10017.075	36957.55	18.8	10019.721	10016.821	-0.254
8016.130	36238.91	18.8	8018.732	8016.478	0.328
6015.765	35503.46	18.9	6017.798	6015.989	0.224
4015.438	34750.05	18.9	4016.686	4015.424	-0.014
2015.230	33977.61	18.9	2015.832	2015.[illegible]	-0.065
14.874	33184.73	19.0	15.095	14.922	0.048

Residual = corrected instrument pressure - reference pressure



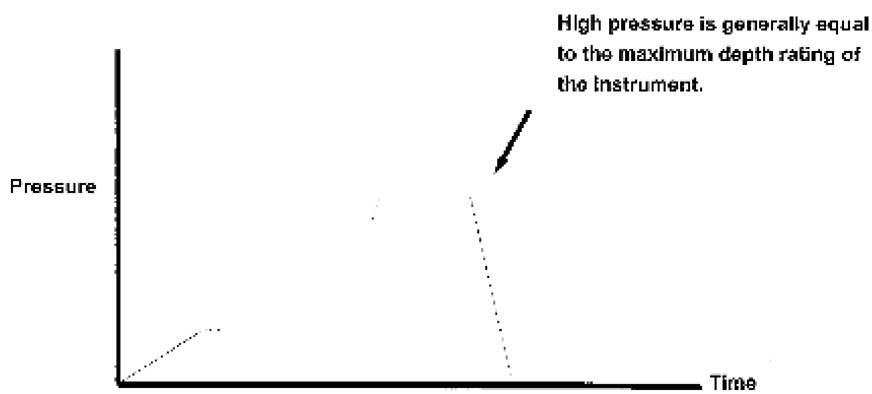
SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Pressure Test Certificate

Customer	US Coast Guard
Job Number	38094A
Date	4/8/2005
Technician	RV
Serial Number	09P24152-0636
Low Pressure (PSI)	50 PSI
Time (Minutes)	15 Minutes
High Pressure (PSI)	40690 PSI
Time (Minutes)	30 Minutes
Pass	☑
Fail	☐

Comments

Replaced corroded connectors JT6 & JB 3. Replaced corroded housing with a new housing. Replaced the main piston "O"-Rings.



Typical Test Profile

Temperature

Serial number 2796

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: 2796
CALIBRATION DATE: 25-Jan-07

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS
g = 4.30533824e-003
h = 6.41250038e-004
i = 2.24347558e-005
j = 2.10307875e-006
f0 = 1000.0

ITS-68 COEFFICIENTS
a = 3.68121221e-003
b = 6.02664195e-004
c = 1.61194865e-005
d = 2.10461316e-006
f0 = 2732.812

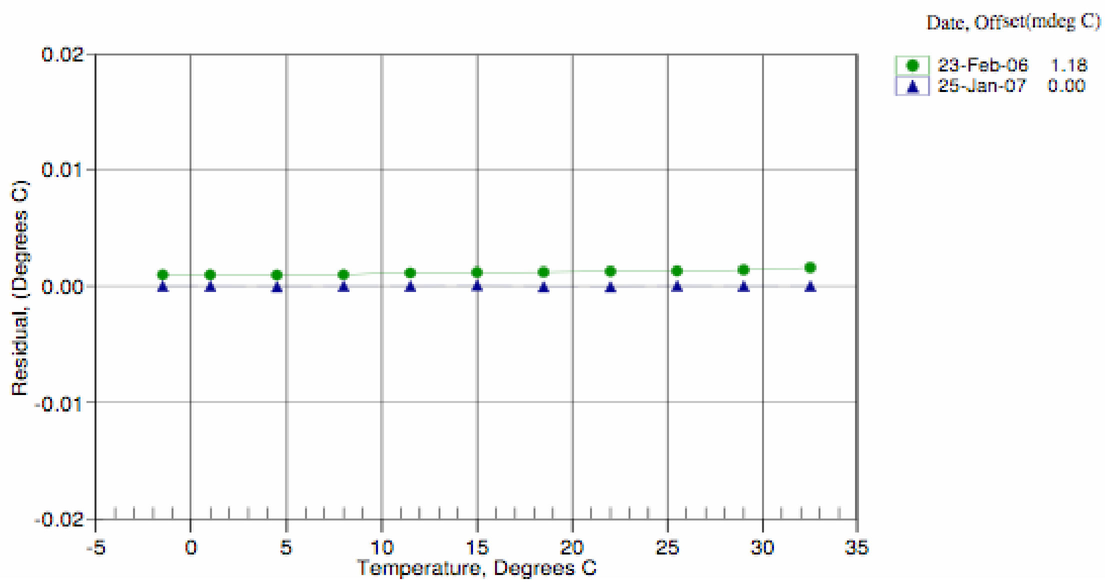
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2732.812	-1.5000	0.00001
1.0000	2889.630	1.0000	-0.00000
4.5000	3119.964	4.5000	-0.00003
8.0000	3363.211	8.0000	0.00001
11.5000	3619.711	11.5000	-0.00000
15.0000	3889.809	15.0001	0.00006
18.5000	4173.815	18.5000	-0.00003
22.0000	4472.063	22.0000	-0.00004
25.5000	4784.858	25.5000	0.00002
29.0000	5112.480	29.0000	0.00000
32.5000	5455.220	32.5000	0.00000

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 ITS-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



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

Temperature Calibration Report

Customer:	Scripps Institute of Oceanography		
Job Number:	45311	Date of Report:	1/25/2007
Model Number	SBE 03Plus	Serial Number:	03P2796

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/25/2007 **Drift since last cal:** -.00129 **Degrees Celsius/year**

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: **Drift since Last cal:** **Degrees Celsius/year**

Comments:

Serial number 2855

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: 2855
CALIBRATION DATE: 24-Jan-07

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS
g = 4.35902595e-003
h = 6.44583673e-004
i = 2.30284780e-005
j = 2.16171614e-006
f0 = 1000.0

ITS-68 COEFFICIENTS
a = 3.68121254e-003
b = 6.02244199e-004
c = 1.59895410e-005
d = 2.16324750e-006
f0 = 2973.201

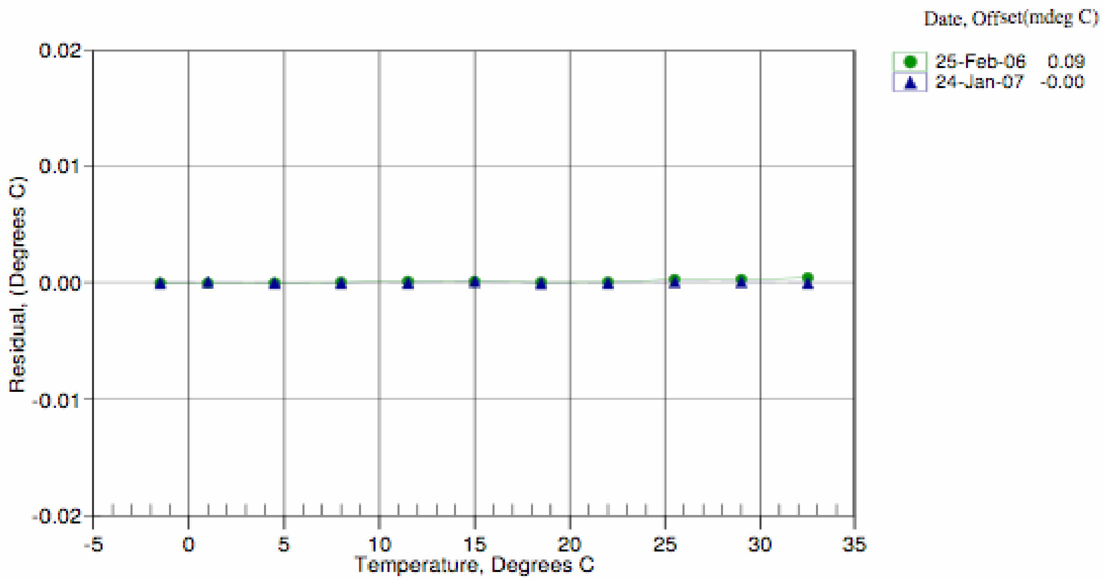
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2973.201	-1.5000	-0.00002
1.0000	3143.938	1.0000	0.00003
4.5000	3394.713	4.5000	-0.00002
8.0000	3659.551	8.0000	-0.00001
11.5000	3938.823	11.5000	-0.00001
15.0000	4232.902	15.0001	0.00007
18.5000	4542.116	18.4999	-0.00006
22.0000	4866.839	22.0000	-0.00004
25.5000	5207.392	25.5000	0.00003
29.0000	5564.082	29.0000	0.00004
32.5000	5937.209	32.5000	-0.00003

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 ITS-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



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

Temperature Calibration Report

Customer:	Scripps Institute of Oceanography		
Job Number:	45311	**Date of Report:**	1/24/2007
Model Number	SBE 03Plus	**Serial Number:**	03P2855

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ **Performed** ☐ **Not Performed**

Date: 1/24/2007 **Drift since last cal:** -.00010 **Degrees Celsius/year**

Comments:

'CALIBRATION AFTER REPAIR' ☐ **Performed** ☑ **Not Performed**

Date: **Drift since Last cal:** **Degrees Celsius/year**

Comments:

Conductivity

Serial number 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: 19-Jan-07

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

GHIJ COEFFICIENTS
g = -1.05303049e+001
h = 1.63286142e+000
i = -1.49837749e-003
j = 2.28126607e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS
a = 9.22287007e-006
b = 1.62950160e+000
c = -1.05247800e+001
d = -8.64269819e-005
m = 5.1
CPcor = -9.5700e-008 (nominal)

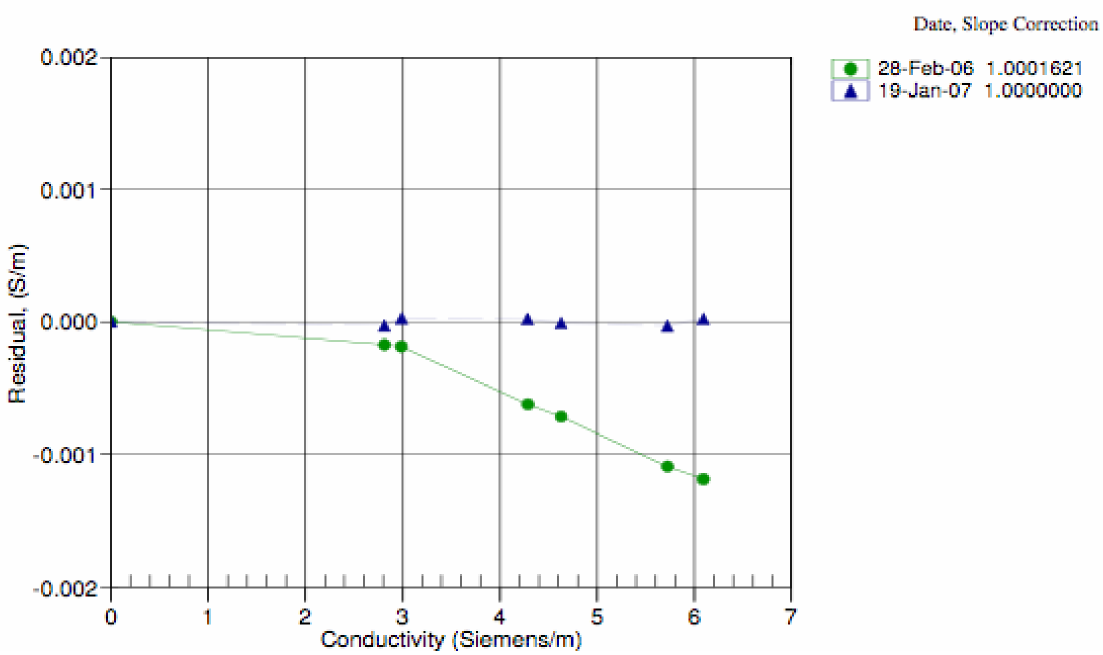
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.54130	0.00000	0.00000
-1.0001	34.9205	2.81218	4.86811	2.81215	-0.00003
1.0536	34.9202	2.98865	4.97793	2.98868	0.00003
14.9999	34.9203	4.28301	5.71862	4.28303	0.00002
18.4999	34.9199	4.63062	5.90158	4.63061	-0.00001
28.9999	34.9176	5.71703	6.43966	5.71700	-0.00003
32.4999	34.9094	6.09037	6.61438	6.09039	0.00002

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



SBE
SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Scripps Institute of Oceanography		
Job Number:	45311	Date of Report:	1/19/2007
Model Number	SBE 04C	Serial Number:	042561

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ✓ **Performed** ☐ **Not Performed**

Date: 1/19/2007 **Drift since last cal:** +.00050 **PSU/month***

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ **Performed** ✓ **Not Performed**

Date: **Drift since Last cal:** **PSU/month***

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

Serial number 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: 19-Jan-07

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

GHIJ COEFFICIENTS
g = -1.03894748e+001
h = 1.48578631e+000
i = 1.14839882e-004
j = 7.56773393e-005
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS
a = 1.65291846e-004
b = 1.48568382e+000
c = -1.03889299e+001
d = -8.25016954e-005
m = 3.7
CPcor = -9.5700e-008 (nominal)

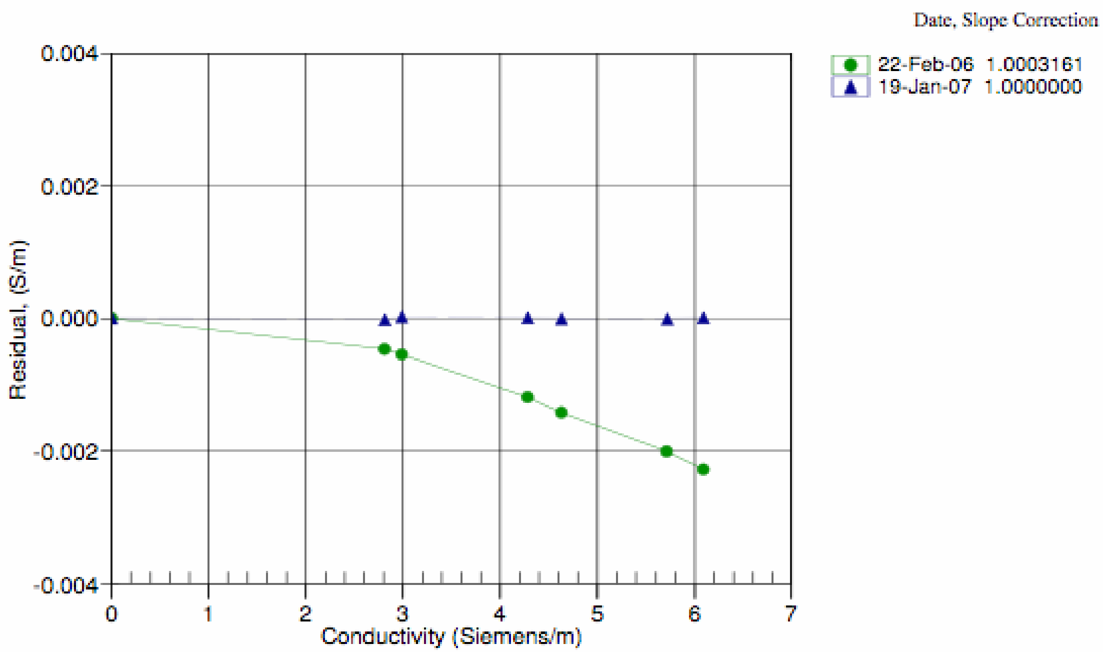
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.64361	0.00000	0.00000
-1.0001	34.9205	2.81218	5.08678	2.81216	-0.00002
1.0536	34.9202	2.98865	5.20188	2.98868	0.00002
14.9999	34.9203	4.28301	5.97821	4.28302	0.00001
18.4999	34.9199	4.63062	6.16997	4.63061	-0.00001
28.9999	34.9176	5.71703	6.73394	5.71702	-0.00001
32.4999	34.9094	6.09037	6.91706	6.09038	0.00001

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

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

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

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



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Job Number:	45311	**Date of Report:**	1/19/2007
Model Number	SBE 04C	**Serial Number:**	042568

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'AS RECEIVED CALIBRATION' ☑ **Performed** ☐ **Not Performed**

Date: 1/19/2007 **Drift since last cal:** +.00090 **PSU/month***

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ **Performed** ☑ **Not Performed**

Date: **Drift since Last cal:** **PSU/month***

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

Instrument Locations on the Healy

Layout plot of instrument locations

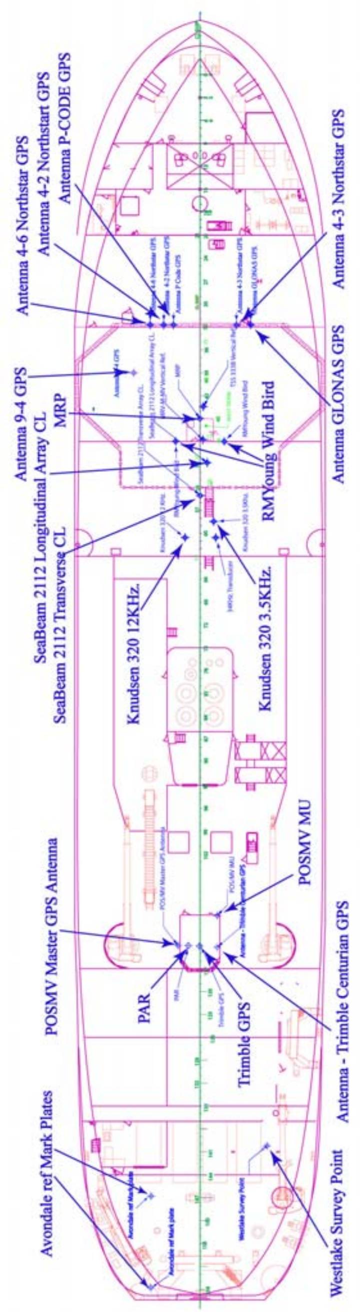

Table of Survey measurements

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

HLY0703 Media Index

The times here are close but not exact. Different files open and close at different times. Use this table to guide you but look at the data itself to be sure how the data is included from one DVD to the next.

File Name	Dates	Start time	End time
Media Vol 1	17 August – 15 September 07	16:00	17:00
Media Vol 2	17 August – 27 August 07	16:00	01:00
Media Vol 3	27 August – 07 September 07	00:00	01:00
Media Vol 4	07 September - 15 September 07	00:00	16:00

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.

APPENDIX A: Data Processing Watchstander Checklist

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

1. 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.
2. 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.
3. 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.
4. 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`.
5. 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`.
6. 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

1. 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.
2. Apply the `zerotide.tid` file to all lines just converted (a tide file is required, even if it's identically zero meters).
3. 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.
4. 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).
5. 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.
6. 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!**
7. 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.
8. 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:

1. Select all of the lines in the sub-product, and export as projected ASCII data points:
    a. File→Export…, use 'HIPS to ASCII'
    b. 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.
    c. Select 'Easting', 'Northing', 'Depth' as the active attributes for output.
    d. Use UPS projection with '75NORTH' as the zone.
    e. CARIS/HIPS will add an extra '.txt' on the end of the filename that you need to remove after the export is complete.
2. Open AvgGrid, and create DTM/GEO products
    a. File→Add File to Grid…, select the appropriate file
    b. Click 'Configure' and set the 'Value to Grid' modified to 'Invert' (to give positive up depths from HIPS default of positive down).
    c. Select an approximate resolution in meters, and click 'Scan Data'.
    d. 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.
    e. 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.
    f. 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.
3. Open DMagic, and create SD objects:
    a. Open the `E:\Healy0703\StaticProducts\2007-DDD` directory [File→OpenProject…].
    b. Select the appropriate DTM file and click '>>' to make it active.
    c. Click 'CMap Librarian' and then select the 'colorsinterp' colormap.
    d. Click 'Surface Shader' and shade the object with the default setting; save the shade file using the default name.
    e. Click 'Assemble Fledermaus Objects' and select the appropriate DTM if required; click 'Build Object' and save with the default name.
4. 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.
5. Select all of the lines in the sub-product, and export as GSF files:
    a. File→Export…, use 'HIPS to GSF'
    b. 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:

1. Export all of the sounding data from the current day as ASCII soundings:
    a. Choose File→Export…, use 'HIPS to ASCII'.
    b. Save file in `E:\Healy0703\ArchiveData\2007-DDD` as `2007_DDD_depth.txt`.

   c. Select ‘Longitude (DD)’, ‘Latitude (DD)’, ‘Easting’, ‘Northing’ and ‘Depth’ as the active output attributes (in that order).
   d. Use UPS projection with ‘75NORTH’ as the zone.
2. Open AvgGrid and make ‘whole day’ projected and geographic objects:
   a. File→Add File to Grid…, select the appropriate file
   b. Click ‘Configure’ and set the ‘Value to Grid’ to the fifth column; select ‘Invert’ to ensure positive up depths.
   c. Select an approximate geographic resolution from Table I; click ‘Scan Data’.
   d. 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.
   e. 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.
   f. 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`.
   g. Click ‘Configure’ again and select columns 3 and 4 as X and Y respectively (you are selecting the projected coordinates for griding).
   h. 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.
   i. 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.
   j. Save the DTM/GEO in `E:\Healy0703\StaticProducts\2007-DDD` as `2007_DDD_ps_RRm.{dtm,geo}` where `RR` is the resolution in meters.
3. 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).
4. Inspect the Fledermaus objects you’ve just created to ensure that they’re stable; rinse and repeat process if required.
5. Extract the navigation for the MBES data into the format required for the GIS database. Open a CygWIN window, and do:
   a. `cd /cygdrive/e/Healy0703/ArchiveData/2007-DDD`
   b. `nav_to_shape.pl 2007-DDD.gen *.gsf`
   c. `posgga_to_shape.pl 2007-DDD_posmv_gga_navigation.gen Z:/Datalog/posmv_gga/POSMV-GGA_2007MMDD-000000.Raw`

Comment: (brc) For the record only; don’t do this yourself, I’ll take care of it each day.

6. 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:
   a. `cd /cygdrive/e/Healy0703/Waypoints`
   b. `ozirte_to_x.pl HEALY0703_ASRUN.rte`

Comment: (brc) As for the construction of navigation files at the end of each day (#8 above), don’t do this yourself; I’ll take care of it as required.

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

APPENDIX B: HEALY 07-03 Watch Standing Notes

Responsibilities of the Watch:

1- Monitor status of SeaBeam system
2- Monitor status of Knudsen subbottom profiling system
3- Monitor status of the ADCP
4- Monitor status of navigation
5- Monitor status of thermosalinographs
6- Help with deployment of CTD, xCTD or xBT when needed
7- Maintain the digital log book
8- Wake the next watch as arranged ensuring that there is enough time for overlap with the next watch for the full transfer of information
9- 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 HEALY0703. 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).

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 (Tom, 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 (Tom, 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

SVP errors or Nav errors – also indicted by strange position or speed values in **System State Window.**

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. **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

Bottom Profile Window: -- this 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 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 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.

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.

Subbottom Profiling System (monitor located to left of the HEALY xserve monitor –Knudsen) – check that the system is properly tracking the bottom – someone will have to show you how to recognize this – check with MST and if he/she can't resolve it page LDEO rep

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.