Scientific Report on Cruise NBP0602
2 February to 22 February 2006
McMurdo Station, Ross Sea, Antarctica to Punta Arenas, Chile

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ABSTRACT

This report discusses the underway geophysical data carried out from McMurdo Base, Antarctica, to Punta Arenas, Chile, between 2 and 22 February 2006 by the *R/VIB Nathaniel B. Palmer* (NBP0602). We collected swath data over more than 8500 km of track. Underway gravity was obtained along all profiles and magnetic data collected at the beginning of the cruise only. Knudsen subbottom echo sounder data were also collected. Detailed multibeam study areas included the region of the fossil Bellingshausen-Pacific-Antarctica triple junction trace on the Antarctic plate north of the Marie Byrd Seamounts, and the trench and inner trench wall – slope region west of the Straits of Magellan (the region near the modern Antarctica-South America-Scotia triple junction). A planned survey of the region near the Eltanin (asteriod) Impact was aborted due to bad weather.

KEYWORDS

NBP0602, Ross Sea, marine geophysics, swath, magnetic, gravity, Bellingshausen triple junction, Marie Byrd Seamounts, Chile Trench, Scotia plate, South America plate, Antarctica plate.

NBP0602 CRUISE SCIENCE PARTICIPANTS

NAME	ROLE	Institution
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Julie Parra	Watchstander; REU participant	California Polytechnic University, Pomona CA
Camilo Rada-Giacaman	Watchstander; Chilean observer	Universidad de Chile, Santiago, Chile

The above members of the science party conducted the geophysical watch during the time of data logging for cruise NBP0602. Paper (carbon) copies of geophysical watch logs were filled out every 15 minutes with relevant data values. Events at other times were noted as needed. An electronic version of the watchstander's log was also maintained. This electronic version was saved as a Microsoft Excel spreadsheet file which is included as an electronic document on the DVD of the cruise data distribution. Paper copies of the watchstander's logs are held by the PI (Stock) and Caltech and the Co-PI (Cande) at UCSD.

OTHER PARTICIPANTS

We were ably assisted by the following personnel of Raytheon Polar Services Corporation: Karl Newyear, Marine Projects Coordinator; Kathleen Gavahan, swath bathymetry; Paul Huckins and Chris Linden, network administrators and IT support; Sheldon Blackman, Electronics Technician; Meghan King, Greg Buikema and Rick Lichtenhan, Marine Technicians. We thank Captain Scott Dunaway, Chief Engineer Johnny Pierce, and the mates and crew of Edison Chouest Offshore for their support during the cruise.

SUPPORTING AWARDS

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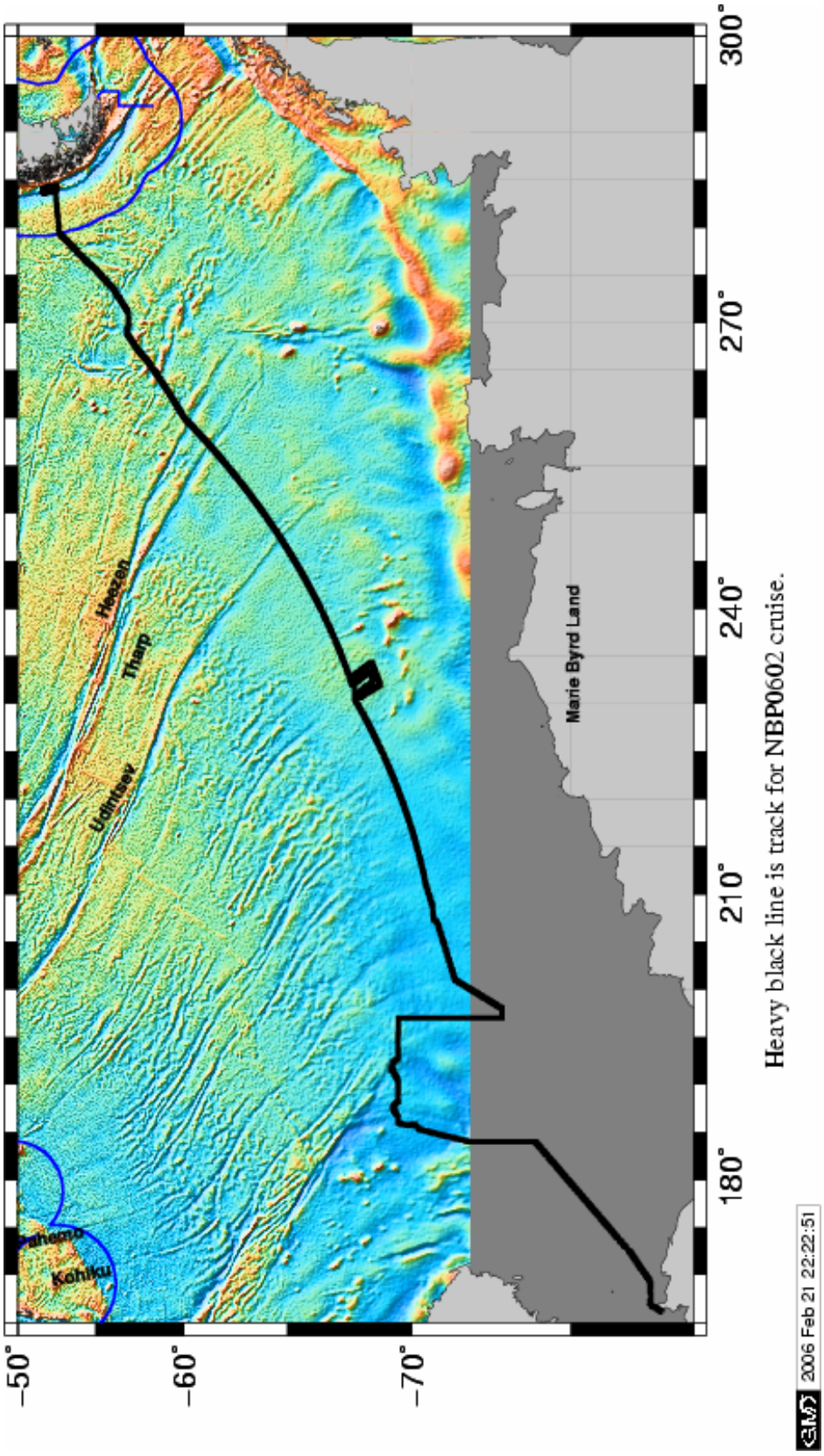
SECTION 1: DAILY ACTIVITY SUMMARY

GMT Day	Day of Year	Cumulative distance (km) of logged data	Activities and Findings
WEEK 1			
2 Feb	033	163	Departed from the ship channel near Ross Island at about 15:00 GMT. Began transit, swath mapping and Knudsen echo-sounder in ship channel & passed around the N side of Beaufort Island, north of McMurdo base. Start data logging 15:30 GMT.
3 Feb	034	632	Transit NE, swath mapping and echo sounder.
4 Feb	035	1071	Start logging magnetics 0900 GMT. Continue swath mapping and echo sounder. Start logging echo sounder subbottom files. Crossed magnetic chron 33o on the W side of the Emerald Fracture Zones.
5 Feb	036	1526	Multibeam track mostly to E with excursions to N to avoid sea ice. Surveyed over the very SE edge of the Pac-Ant spreading corridor that represents a Miocene to recent leaky transform fault. Magnetometer lost during retrieval 0200 GMT in sea ice.
6 Feb	037	2032	Surveyed along a southbound line; observed ENE-trending abyssal hill fabric on the N half of the line. Crossed the E Emerald and W Emerald fracture zones.
7 Feb	038	2537	Continued track to NE around the ice. Crossed the Kohiku Fracture zone.
8 Feb	039	3037	Continued track to NE to the area of the Bellingshausen-Pacific-Antarctic paleo triple junction. Seafloor flat and sediment covered; very low relief.
WEEK 2			
9 Feb	040	3524	Continued collecting swath map and echo sounder data en route to the Bell-Ant-Pac TJ area. Started the detailed survey.
10 Feb	041	3966	Swathmap survey of the Bell-Ant-Pac triple junction area; lines designed to complement previous swathmap data collected on the NBP9602 cruise.
11 Feb	042	4443	Finished the lines in the Bell-Ant-Pac TJ area, continued out to the NE.
12 Feb	043	4947	Continued transit to the NE. Good swathmap data. A few volcanic peaks and channels visible on the sea floor.
13 Feb	044	5449	Continued to the NE. Very flat bathymetry. Good multibeam data.
14 Feb	045	5947	Crossed the Tharp and Heezen fracture zones. NW-trending abyssal hill fabric visible in the multibeam bathymetry on the N side of each of the FZs, curving into the FZ valley.
15 Feb	046	6411	Entered Eltanin Impact Area. NNE trending abyssal hill fabric visible. Weather was very bad (40 knot winds). Difficulty getting good multibeam data.
WEEK 3			
16-Feb	047	6811	Continued to NE. Heavy seas & high winds. Multibeam data mostly not usable.
17-Feb	048	7284	Continued NE to the Chilean EEZ. Abyssal hill fabric trends NW. Entered Chilean waters at 17:49 UTC, location 279.33395ºE, 52.75078ºS.
18-Feb	049	7715	Started the detailed Chilean EEZ survey with northbound line along the Antarctica-Scotia plate boundary (the trench).
19-Feb	050	8136	Continued swath mapping of the Chilean EEZ study area. Mapped up the slope with a series of N- and S- lines. Weather made it difficult to get good multibeam data on the southbound lines.

GMT Day	Day of Year	Cumulative distance (km) of logged data	Activities and Findings
20-Feb	051	8573	Continued swath mapping of the Chilean EEZ study area. There appear to be some E-W trending linear canyons that may be caused by active normal faults that splay off of the main plate boundary fault and break up the Scotia Plate in the region near the triple junction.
21-Feb	052	8839	Finished swath mapping of the region between the trench and the slope west of the Straits of Magellan. Turned off geophysical/oceanographic data collection at 14:00 GMT. Proceeded eastward towards Punta Arenas through the Straits of Magellan.
22-Feb	053		Arrived at Punta Arenas. No underway surveying. Gravity tie conducted to finalize data set. Cruise data distributions completed.

Figure 1. *Final track of cruise NBP0602 in black. Colored background is satellite gravity data (Sandwell and Smith, 1997). Blue lines are national EEZs.*



SECTION 2: WEEKLY CRUISE REPORTS

Weekly science summary – NBP0602 – Feb. 9, 2006.

Dates covered by this report: Feb. 2 – Feb. 8, 2006.
The GO-071-N science party embarked on Thurs, Feb. 2 after midnight (so it was Feb. 3 New Zealand time). We were transported to the ship by helicopter from McMurdo Base. The ship began sailing immediately after we embarked.

We turned on the Simrad EM 120 multibeam system and the Knudsen 3.5 kHz echo sounder shortly after exiting the ice channel. The magnetometer did not need to be deployed immediately. The gravimeter has been running continually since the last port call at the McMurdo ice pier (on Jan. 31) so our gravity data stream will include data back to that date in the records.

Magnetics When first deployed, the magnetometer was not working properly (it was emitting strings of garbage data). The ET (Sheldon Blackman) worked on it and was able to fix most of the problems. He could communicate with it if it was plugged in to the deck box but not if it was plugged in to the tow cable. Hence it appeared that there was some electronics problem with the tow cable. We decided that we could run it even with the tow cable problem, because we were getting clean data. So, it was deployed on Feb. 3. However on Feb. 4 we ran into some unexpected sea ice, which got heavy enough that it seemed prudent to take the magnetometer out of the water. During the process of retrieving the magnetometer, it was lost (it separated at a joint on the bottle). Since there is no spare magnetometer on board ship, we had no possibility to continue collecting magnetics data.

Bathymetry: Depth values from both the Simrad EM 120 and the Knudsen have been generally good. Our science party (7 people) has been doing the ping editing. Kathleen Gavahan of RPSC has been doing the quality checks on the ping editing and processing the daily multibeam data files.

Gravity: The gravity tie was performed on Jan. 31 at McMurdo Base, where there is a reference gravity base station. Gravity data are reasonably good so far, with no unexpected events. There are some spikes in the processed gravity for some of the days, and we need to study this to determine what is causing them.

XBTs: XBTs have been launched once per day.

Major scientific results: We recorded magnetic anomaly 33o east of Iselin Bank before we lost the magnetometer. It lines up well with the 33o previously recorded in this region on other Palmer cruises. We crossed over the following fracture zones: East Emerald, West Emerald, Kohiku, Pahemo, Erebus, Endeavor. Some of these had strong signatures in bathymetry and/or gravity.

Other issues: RPSC and ECO personnel have been very helpful in all respects. Our science party is impressed with all of the help they have provided to us, in support of our science. Seas have been very calm so that there has not been much problem with seasickness. We have been averaging speeds over 10 knots on the cruise so far.

MAJOR CONCERNS:

The ship needs to have several functional magnetometers. There was no spare magnetometer on board, which means we will be doing nearly the entire cruise unable to collect any magnetics data. We have modified the intended cruise track to concentrate on survey areas where the scientific questions can be addressed with gravity and multibeam data.

Weekly science summary – NBP0602 – Feb. 16, 2006.

Dates covered by this report: Feb. 9 – Feb. 15, 2006.

During this week we continued on our eastbound track through several target areas on the seafloor: the region of the former Bellingshausen-Antarctica –Pacific triple junction, and the NW side of the Eltanin meteor impact site. The weather was calm and we got good multibeam data until Feb. 15 when we had more wind and waves that adversely affected the quality of the data.

Magnetics: no data are being collected due to the earlier loss of the magnetometer.

Bathymetry: We were able to collect good multibeam data up through Feb. 14th. On Feb. 15th the multibeam data quality dropped a great deal due to bad weather. We found that the Knudsen 3.5 kHz echo sounder has been running with a non-standard value of sound speed in water (1452 m/s instead of 1500). This was apparently set by techs on a previous cruise and never fixed. We are leaving the value set at 1452 for the rest of this cruise so as not to introduce a DC shift into the values in our data set. However, it should be set back to 1500 for future cruises.

Gravity: A minor error was found in how the gravitational offset (result of the gravity tie) was being incorporated into the data processing. This was corrected, and Paul Huckins reprocessed the gravity data from the start of our cruise, so it is now all correct and consistent. This will require reprocessing of the gravity data from the two previous cruises as well. Probably it will only make a difference of a few milligals in the data.
The spikes we mentioned seeing in the data continue to appear. They correspond to course changes or speed changes and are a result of how the Eotvos correction is being calculated and applied to the raw data.

XBTs: XBTs were launched once per day and recently more often due to somewhat rapid changes in the sea surface temperature.

TSG: the Thermosalinograph was giving erratic salinity readings with drifting and jumps in the salinity data. Since these salinity data are crucial for interpreting the sound speed in water (and thus for processing the multibeam bathymetry), it was necessary to swap out the unit and replace it with a spare unit.

Major scientific results: We surveyed the region of the former Bellingshausen-Antarctica boundary, to complement the swath bathymetry obtained in this area on the NBP9602 cruise. We had calm weather so the multibeam data were excellent. We could see clear abyssal hill fabric corresponding to Pac-Bell and Pac-Ant spreading. The most prominent abyssal hill fabric was located in the sector of Bell-Pac spreading near the triple junction, which is consistent with the earlier magnetic anomaly interpretation of this region as having been formed at the slowest spreading rate. In the region of the crust corresponding to Bell-Ant motion, this abyssal hill fabric was lacking. There is one rather large channel on the seafloor in this region (at > 4 km water depth), possibly caused by mass flow deposits from one or

more of the large seamounts in the vicinity.

We recorded excellent multibeam and gravity data on crossings of the Tharp and Heezen fracture zones, and could see well-developed abyssal hill fabric on the NE (younger) side, and the change in depth of the seafloor in both locations.

We had also planned to do a few survey lines in the region of the Eltanin Impact area (where a meteorite hit the ocean floor 2 million years ago). However, when we got to this region, we were having very rough seas, so we were only able to do a small part of the study lines we had planned. We had difficulty getting good multibeam data due to the weather.

Other issues: RPSC and ECO personnel have been very helpful in all respects. Our science party is impressed with all of the help that these groups have provided to us, in support of our science.

MAJOR CONCERNS:

The situation with the TSG (thermosalinograph), the spares, and their calibration dates needs to be examined in order to avoid difficulties on future cruises. It would be useful to have more recently calibrated spares on board. We are using the last viable one right now, and apparently its calibration will expire shortly after our cruise is over.

Weekly and final science summary – NBP0602 – Feb. 23, 2006.

Dates covered by this report: Feb. 16 – Feb. 22, 2006.

During this week we continued on our eastbound track, through the middle of the Eltanin meteor impact site, and over to our detailed survey area in the Chilean EEZ west of the Straits of Magellan. The weather was quite rough on Feb. 16 but calmed down throughout the week, allowing us to get very good data within our Chilean survey area.
We stopped logging at 14:00 GMT on Feb. 21 and turned towards Punta Arenas. We entered the Straits of Magellan later that day under clear, sunny skies. We arrived in Punta Arenas on Feb. 22.

Magnetics: no data were collected due to the earlier loss of the magnetometer.

Bathymetry: As the weather improved, we were able to collect progressively better multibeam data during the course of the week. We spent the last 3 days doing the detailed multibeam survey in the Chilean EEZ, which imaged the Antarctica-Scotia boundary (subduction zone) and the details of the morphology of the upper plate. After data collection was finished, we found a problem with the time stamps recorded in the Knudsen *.keb files. All the data had time stamps that were approximately 20 minutes ahead of the correct GMT time. This behavior was corrected by running the time synchronization in the Knudsen data acquisition software (which probably needs to be done at the start of every cruise).

Gravity: The gravimeter experienced some jumps and spikes in rough seas, due to the inner frame banging against the external frame. These were edited out of the data, but this behavior was a cause for concern. However, the gravity tie done in Punta Arenas late on 2/22 indicated a minor, small amount of drift during our cruise (2 mgal), within the normal range of what would be expected. Therefore this behavior does not appear to have been detrimental to our data set.

XBTs: XBTs were launched daily during the data collection, except for Feb. 21 when we were in the same detailed survey area (Chilean EEZ) and there had been no significant change in surface water temperature or salinity.

TSG: The TSG functioned well, except for Feb. 18th, when a leak in a pipe in the cargo hold (in the uncontaminated seawater system) caused the TSG to be down for approximately 6 hours at the end of the day.

DATA REPORTS: The RPSC support staff worked very efficiently and finished the data reports and data sets for distribution by the end of the day on Feb. 22nd.

Major scientific results:

We transited through the area of the Eltanin asteroid impact without collecting much useful multibeam data due to the extremely rough weather. We skipped the detailed survey lines we had planned to do there, because the sea state was so rough that the data would have been useless. We proceeded to the Chilean EEZ and did a detailed multibeam grid of the trench and the inner trench wall (depths from 4100 meters up to about 100 meters) within the latitude limits that were specified by the Chilean government in the permissions document. This region contains 3 tectonic plates: Antarctica plate (oceanic, subducting), South America plate (continental, overriding) and Scotia plate (continental, also overriding). Our objective in surveying this region was to try to map the triple junction and the nearby plate boundaries, since no detailed study has been done of this area. The inferred South America –Scotia boundary is a left-lateral strike-slip fault that passes through the Straits of Magellan. Our data do not clearly show this fault in our study area, although it may be controlling some NW-trending canyons at the NW limit of our survey. However, the more prominent canyons on the slope are E-W trending and NE-trending (inferred to be controlled by faults that are acting to break up the tip of the Scotia plate above the trench). The inner wall of the trench shows a fairly sinuous boundary in the north, with steep slopes close to the trench, and a more linear morphology in the south. We stopped data logging outside the Straits of Magellan in accordance with the research plan specified in our permissions request to the Chilean government.

Other issues: RPSC and ECO personnel have been very helpful in all respects. The cruise was very successful in terms of scientific data collection, and we are very grateful for all their support and for the efficiency with which the final data sets were prepared.

EQUIPMENT CONCERNS:
It might be useful to check with Lacoste-Romberg (the manufacturer of the gravimeter) to determine whether the behavior of the gravimeter in rough seas is normal, or if something should be done to minimize it banging against the external frame from which it is being supported.

SECTION 3: MULTIBEAM SURVEYS

Multibeam swath data were collected from 02 February 2006 (GMT) through 21 February 2006 (GMT). The raw multibeam data were logged in approximately one hour-long files in the Kongsberg-Simrad EM120 raw format that includes all navigation and ship motion data. The MB-System software package[1] (version 5.0.7) was used onboard for editing and processing of the raw data. The science party members ping edited to remove bad data points from these files. The details of data processing and archiving are described in a separate Multibeam Data Report for the cruise.

We ran the system continuously during this cruise. However, there were a few instances of useless data due to bad weather and excessive ship motions. Data collection at "full" speed, generally > 10 kts, worked well if there were not too many high winds. If we got bad data the beam width would need to be narrowed to 30˚ so that the multibeam system could then re-find the bottom and the beams could then be brought back out to 56 or 60˚. The maximum angle is 75º but we normally never got returns from the outer beams at this setting, so generally we used something smaller – 65º or less. We shot XBTs (normally T-5s but some XSVs, Fast Deep, and T-7) once per day in order to constrain the sound velocity profile used to process the multibeam data. The list of XBT measurements is included in a table in the final cruise Multibeam data report.

Our cruise had several locations as multibeam targets. These included: the region of the Bellingshausen-Antarctica-Pacific triple junction (a fossil triple junction) on the Antarctica plate near the Marie Byrd Seamounts; the region of the Eltanin Impact site; and the trench and slope west of the Straits of Magellan to search for active structures of the Scotia-South America plate boundary where it projects westward from the straits of Magellan.

3.1 Bellingshausen-Antarctica-Pacific triple junction

This part of the Antarctica plate had been surveyed with magnetics, seismics, and gravity on cruise NBP9208, and with magnetics, seismic, gravity, and SeaBeam swath bathymetry on cruise NBP9602. The magnetic anomaly data seen on the previous cruises suggested that there had been a former plate boundary here, because magnetic isochrons 31-27 have different trends east and west of this area, and had different spacings (with a faster half-spreading rate west of this area and a slower half-spreading rate east of this area). Previous interpretations of this region suggested that the region to the west was always part of the Antarctica plate, whereas the region to the east had formerly been part of the Bellingshausen plate before that Bellingshausen plate became attached to Antarctica (Heinemann et al., 1999).

We surveyed this region with additional multibeam data on cruise NBP0602 in order

[1] The MB-System4.6 software package was used for all multibeam data handling. This package was developed at Lamont-Doherty Earth Observatory. This system is designed to manipulate, process, list and display many kinds of multibeam bathymetry, amplitude, and sidescan data. To obtain more information about the MB-System programs or to obtain a copy of the current distribution, contact the authors David W. Caress (caress@mbari.org) and Dale N. Chayes (dale@lamont.Ideo.columbia.edu).

to complement the sparse existing multibeam lines that had been collected on cruise NBP9602, ten years previously. Our objective was to get a look at the seafloor morphology and identify boundaries between the different crustal provinces at the fossil triple junction in this region. We used the world gravity grid (Sandwell and Smith, 1997) as background information for choosing the track lines in such a way as to avoid large seamounts that might obscure the seafloor bathymetry.

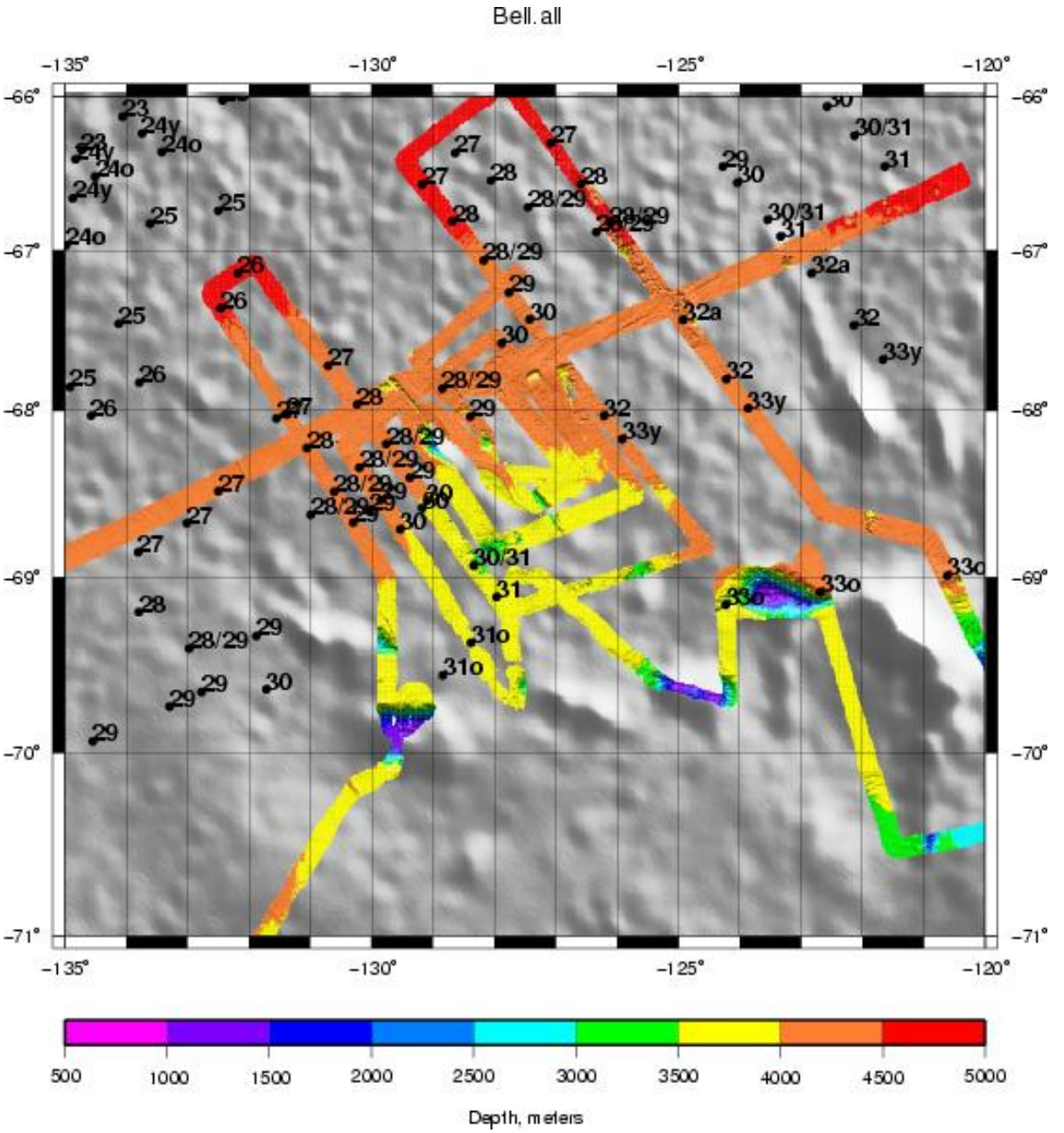


Figure 2. Gray scale satellite gravity as a background for the area of the Bellingshausen-Pacific-Antarctica triple junction. Black dots are previously identified magnetic anomalies using the timescale of Cande and Kent (1995).. Colors are water depths along gridded multibeam swaths from NBP0602 and NBP9602, shaded with false illumination in order to show the abyssal hill fabric. Note the presence of some large seamounts which can be seen in the gravity data and have water depths < 3000 meters.

The swath bathymetry reveals clear NE-trending abyssal hill fabric over the seafloor to the east (Bellingshausen plate side), for chrons 27 to 32. The most prominent abyssal hill fabric

is seen along our track at 127ºW, 67.7ºS, consistent with previous interpretations suggesting that the slowest rate of Bellingshausen-Pacific spreading took place here. The area that would have accommodated motion between Bellingshausen and Antarctica lacks this seafloor spreading fabric but has a hint of N-trending abyssal hill fabric, consistent with possible divergence between these two plates in this vicinity, prior to chron 27 time.

There is also a sinuous channel that can be seen in the western part of the study area, adjacent to some large seamounts.

Additional analysis of these data will be conducted after the cruise.

3.2 Eltanin Impact area

This region of the SE Pacific ocean, centered on approximately 90º W, 57º S, was hit by an asteroid approximately 2.1 million years ago. Some of the area has been surveyed by multibeam, and numerous cores have been taken in the region (Gersonde et al., 1997), but no actual impact crater has been found. About half of the whole impact area still has not been surveyed. We planned to follow a track in this region to obtain additional multibeam data to complement the surveys that had been done by Gersonde et al. (1997). Unfortunately the weather did not cooperate. We had 40 knot winds that day, which meant that the multibeam data was very poor quality, and the only heading at which we could get reasonable swath bathymetry was an azimuth of about 100º. Therefore we have only one decent multibeam track line in this region. We did not do the entire line we had planned because, given the winds and sea state, there would have been no useful multibeam data. The Knudsen subbottom echo-sounder did not give good data due to the sea state, so we were unable to see any disruption of the bedding in the sediments near the surface even though it might have been there.

3.3 Chilean EEZ Survey

We received permission from the Chilean government to survey between 51º40’ S and 52º45’ S. This is a collaboration with Dr. Emilio Vera of the Universidad de Chile in Santiago. Our major objective was to image any offshore continuation of the NW-striking strike-slip fault that passes through the Straits of Magellan and controls its geometry. This fault is the actual left-lateral plate boundary fault between the Scotia plate (on the SW) and the South America plate (on the NE). We would have liked to image where this fault intersects the trench, but this may happen slightly north of the northern limit of our survey area. A secondary objective in this region was to image the “trench” and the inner trench wall to look at the contact between the Antarctica plate and the overriding plate(s).

We surveyed this area with North-South tracks starting on the SW side and progressing to the NE side of the map region. Because the weather was rough at the start of the survey, there were some gaps in the data. We went back at the end of the survey to fill in these areas of missing coverage.

Two XBTs were run in this study area in order to obtain sound velocity profiles. However,

when the data were processed, some discontinuities were visible at the edges of the swaths.

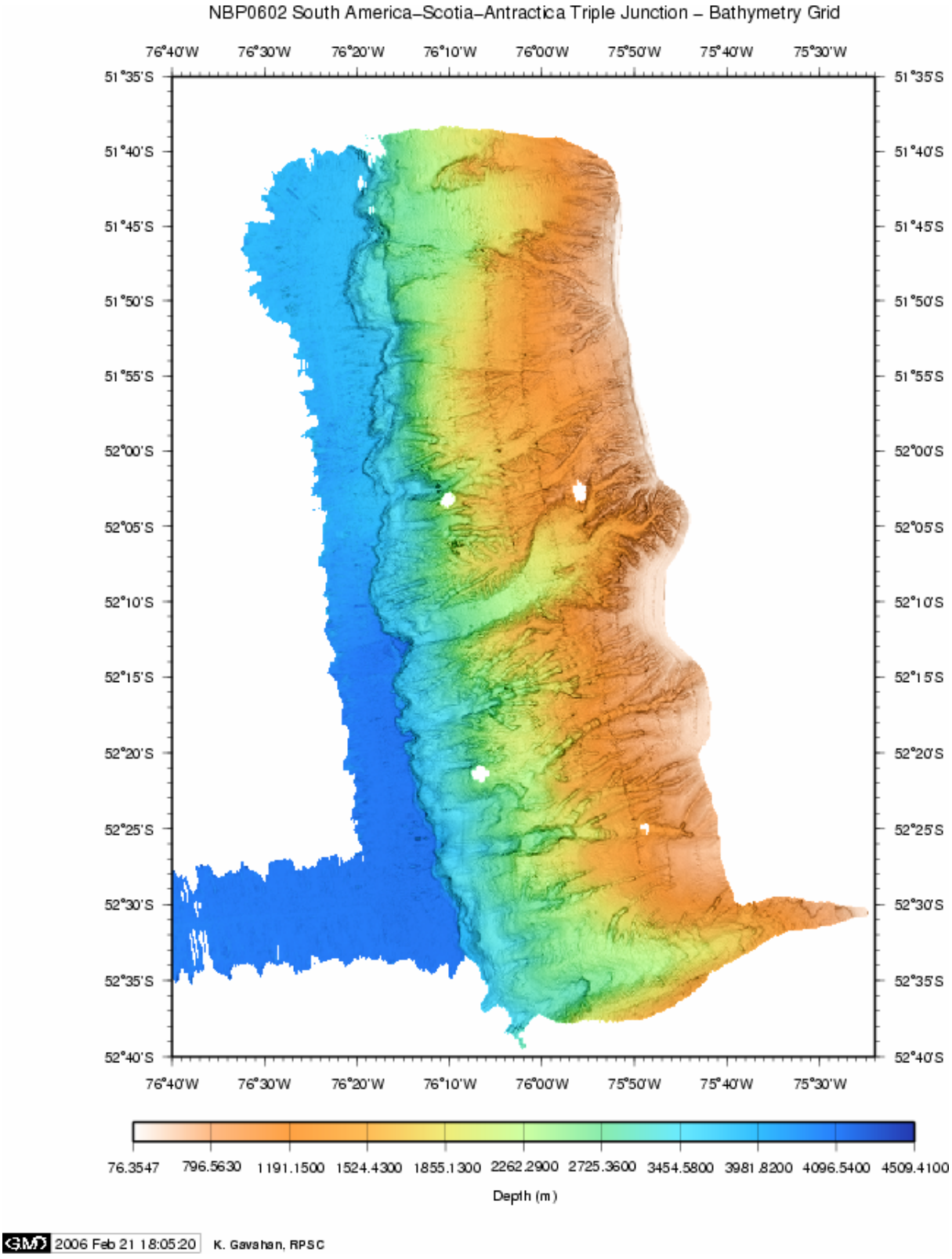


Figure 3. Contoured multibeam bathymetry from the detailed survey of the Antarctica-Scotia trench in the Chilean EEZ west of the Straits of Magellan. Straight lines in orange region are artifacts at edges of swaths which will be removed by post-processing.

These discontinuities are artifacts that may be due to variations in oceanographic conditions

(sound velocity profiles) and may also be due to some tilted pings that were not completely removed during the file editing. This will be investigated in further processing of the data after the cruise, in order to try to remove this problem with the data set.

The data (Figure 3) reveal several very linear canyons coming west off the slope. It is possible that these are controlled by normal faults that are breaking up the Scotia plate and that diverge westward from a NW-striking main plate boundary fault. Canyons with a NW trend (parallel to the inferred strike of the fault in the Straits of Magellan) were only seen at the very northern end of the study area. We were not able to survey in very shallow water (< 100 meters water depth) directly along strike from the Straits of Magellan, so it is possible that the main plate boundary fault goes through there. This area would benefit from another survey in the future.

There is no bathymetric trench between the Antarctica plate and the Scotia plate here. The region that would be expected to be a trench is filled with sediment at a depth of about 4100 meters below sea level. This is similar to the situation in the Cascadia subduction zone, where glacial sediments have completely filled in the trench region.

The inner trench wall reveals a somewhat irregular contact with flat-lying sediments of the trench fill. The contact is more linear to the south and more sinuous to the north. It is interesting that the steepest slopes of the inner trench wall are found at the base of the inner trench wall, not higher up. Additionally, canyons cut into the inner trench wall (which one might expect to end downslope in debris fans, if they were hosting active sedimentary systems) show no major evidence for debris fans. It appears that the sediment filling the trench is not coming directly down the canyons; the canyons may be relict topography which are not really active now. It appears that the heavy sedimentation in the trench has completely flooded paleotopography (older canyons) and that the major downcutting in the canyons was earlier, perhaps at the last glacial maximum when sea level was lower and the Patagonian Ice Sheet would have been close to the area.

Additional analysis of these data, in collaboration with our Chilean colleagues, will be conducted after the cruise.

3.4 Seafloor slopes and morphology

Bathymetric trends (dominant strike of the seafloor fabric) were calculated automatically for every hour of multibeam data collected on the cruise. The degree of consistency of the trend was also calculated. This allowed us to identify the direction of abyssal hill fabric, fracture zone trends, and the general degree of linearity of the seafloor morphology. Maps of these results will be finished after the cruise and are not included in this report.

SECTION 4 KNUDSEN 320 B/R ECHOSOUNDER DATA

Continuous Knudsen 320 chirp data (3.5 kHz) were recorded during NBP0602. In addition to bottom records the Knudsen also collected digital *.keb data. Digital data were acquired in

files of various lengths (because they had to be manually stopped and started) and written to disk. These can be viewed using Knudsen's Sounder Suite PostSurvey software for the PC, which is available for free over the internet from the Knudsen web site (http://www.knudsenengineering.com/html/software/postsurvey.htm). This software allows conversion of the *.keb data files to other formats such as SEG-Y. SEG-Y files were not collected during the cruise, so they are not on the original data distribution. However, a set of SEG-Y files will be generated and included with the final Chilean data distribution.

A conversion factor of 1452 m/sec was used throughout the cruise as the soundspeed in water, to convert from two-way travel time to depth. Knudsen data were also plotted in real time on an EPC recorder. After data collection ended, we realized that the time stamp in the Knudsen subbottom (*.keb) file records is ahead of the actual GMT time by approximately 20 minutes. This problem occurred because the Knudsen PC program had not been time synchronized at the start of the cruise.

The times given in the table below are the start and stop times according to the Knudsen time stamp; they are not corrected back to GMT time. However, the name of each file contains the correct GMT hour and minute when the file was started.

File name	"Start time"	"Stop time"	File size (bytes)	Start/end longitude	Start/end latitude
2006_051_2145_018.keb	23:15:37 Day 051	14:34:35 Day 052	19490436	76º6.87515'W 75º24.77463'W	52º 17.647' S 52º30.4946' S
2006_051_1900_017.keb	19:18:01 Day 051	22:12:32 Day 051	4008072	76º12.30423 W 76º6.86966' W	51º50.373235' S 52º17.48016' S
2006_051_0006_016.keb	00:33:49 Day 051	19:27:43 Day 051	26554250	75º48.44604' W 76º12.29782' W	52º18.13110' S 51º50.32219' S
2006_050_0419_015.keb	04:46:34 Day 050	00:33:37 Day 051	39612958	76º3.04459' W 75º48.46115'W	52º16.72211' S 52º18.09998' S
2006_048_1751_014.keb	18:19:00 Day 048	04:46:21 Day 050	40304173	80º40.22827' W 76º3.04779' W	52º45.16525'S 52º16.68800' S
2006_048_0229_013.keb	02:57:06 Day 048	18:00:30 Day 048	16132651	83º55.72083'W 80º43.79517'W	54º41.08932'S 52º47.35291'S
2006_046_0422_012.keb	04:49:17 Day 046	02:56:15 Day 048	53043139	94º56.73019' W 83º55.88928' W	58º20.97015'S 54º41.20148' S
2006_046_0354_011.keb	04:21:00 Day 046	04:47:58 Day 046	409913	95º5.34851' W 94º57.12524' W	58º24.12277'S 58º21.11824' S
2006_045_1634_010.keb	17:00:31 Day 045	03:32:29 Day 046	10967369	98º35.14984' W 95º20.12375' W	59º34.39545'S 58º29.43192'S
2006_043_1702_009.keb	17:28:11 Day 043	16:59:05 Day 045	34014173	113º45.75165'W 98º35.58014'W	65º0.56030'S 59º34.53072'S
2006_043_0127_008.keb	01:52:53 Day 043	17:27:21 Day 043	7008925	120º4.24118' W 113º46.07483'W	66º27.36511'S 65º0.64499'S
2006_042_1737_007.keb	18:02:42 Day 042	01:51:55 Day 043	5536931	123º25.55786' W 120º4.65500' W	67º3.80951'S 66º27.44934'S
2006_041_1525_006.keb	15:49:39	18:01:51	18188206	128º43.78143'W	68º25.11612'S

	Day 041	Day 042		123º25.92224'W	67º03.86902'S
	07:57:51	15:48:48		135º06.53320'W	68º54.30862'S
2006_040_0733_005.keb	Day 040	Day 041	26382464	128º43.57178'W	68º25.23468'S
	03:50:44	07:57:19		149º28.43262' W	70º32.81754'S
2006_039_0327_004.keb	Day 039	Day 040	23185825	135º06.78406' W	68º54.35074'S
	12:56:13	03:50:25		163º0.05951'W	70º57.07626'S
2006_037_1232_003.keb	Day 037	Day 039	20018422	149º28.60840'W	70º32.83401'S
	23:29:02	12:44:11		174º28.17261' W	70º12.85492'S
2006_035_2306_002.keb	Day 035	Day 037	25398979	163º0.10620' W	70º54.75037'S
	04:02:18	23:27:45		176º00.14191'W	73º2134232'S
2006_035_0339_001.keb	Day 035	Day 035	24311296	174º28.68622'W	70º13.01971'S

Table 4.1 List of *.keb digital files of Knudsen subbottom data collected during NBP0602.

SECTION 5: MAGNETIC AND GRAVITY DATA

5.1 Magnetics Data

A Geometrics G-877 proton precession magnetometer was deployed on Feb. 4 (see Table 5.1) in open seas. It was towed behind the ship at 300 meters distance from the stern. We expected based on the satellite photos that the open water would continue, but the next day we found ourselves in increasingly heavy sea ice. The weather was very foggy and it was impossible to tell how far ahead the sea ice would continue. Due to the fog, the bridge needed to constantly change course to dodge icebergs, and the magnetometer was sometimes getting caught on pieces of ice due to the irregular shape of the wake of the ship. We decided to retrieve the magnetometer until we were back in open water. However, during retrieval the instrument separated from its tow cable. Because there was no spare magnetometer on board, we were unable to collect further magnetometer data during the cruise.

Table 5.1. Magnetic Data Acquired on NBP0602

YEAR	JD	H	M	LONG	LAT	ON/ OFF	HOURS
2006	35	8	56	-176.00047	-72.51661	ON	17.3
2006	36	2	15	-174.25346	-69.86251	OFF	

5.2 Gravity Data

Gravity was measured continuously during the cruise. The pre-cruise gravity tie was done at McMurdo base on Jday 030 (Jan. 30, 2006) when the ship was at the McMurdo ice pier, prior to the start of a 3-day cruise that preceded NBP0602. Since no gravity tie was done right before NBP0602, the gravity data starting with Jday 030 is included in the data distribution of cruise NBP0602. A final gravity tie was done in Punta Arenas on Feb. 22 in the early evening. This showed a net drift of 2 mgals over the course of the cruise. This was considered small enough that the gravity data were not re-processed for drift. Details of the

pre-cruise gravity base station tie are given in the NBP0602 Data Report (a separate document from this Science Report, included in the data distribution).

Initial QC was performed as part of daily data processing. The gravity data values showed some excursions in rough seas, due to the gravimeter frame hitting the edge of the mounting system and the gravimeter taking some time to adjust itself back to horizontal. Bad values due to this behavior were edited out of the data set. Spurious spikes appear in the data set at times of turns and changes in ship speed. These are due to the method of applying the Eotvos correction in the gravity reduction software. They have not been edited out of the data set in order to maintain consistency with the data reduction protocols that have been used on previous Palmer cruises.

After the ship reached port, it was discovered that the oil-filled shock absorbers below the gravimeter frame had low oil pressure and were leaking small amounts of oil. This may have caused the extreme behavior of the instrument in rough seas. It is not known when this problem started, whether it was during the cruise, or prior to the cruise.

SECTION 6: ACOUSTIC DOPPLER CURRENT PROFILER (ADCP) DATA

The Acoustic Doppler Current Profiler (ADCP) is a hull-mounted system on the *R/VIB Nathaniel B Palmer* that has been in place for several years. The transducers are RD Instruments narrowband VM-150 profilers 150 kHz, with precision (PPS, or P/Y-code) GPS navigation and with heading corrections provided by Ashtech ADU-2 GPS attitude sensors. This system provides continuous current profile measurements in the top 300 m of the ocean. Dr. Teresa Chereskin at Scripps Institution of Oceanography (http://tryfan.ucsd.edu/antarctic/antarctic.htm) and Dr. Eric Firing at University of Hawaii are funded by the NSF OPP to oversee the operation of the *Palmer* ADCP systems under grants OPP-0338103 and OPP-0337375, respectively.

At sea, data are collected by a DOS PC, and are serially captured by another computer running Linux. Data streams logged by the Linux machine include the standard 5-minute ensembles ("pingdata"), and roughly one-second gyro heading, Ashtech heading, P-code position, speed of sound, and single-ping ADCP data. The Linux computer processes the five-minute ensemble data every day, creating a regularly updated, pre-processed and edited dataset. Processed data onboard are displayed as a series of vector plots and archived by the NODC JASADCP. These plots are included in the cruise data distribution and are not repeated here.

SECTION 7. REFERENCES

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