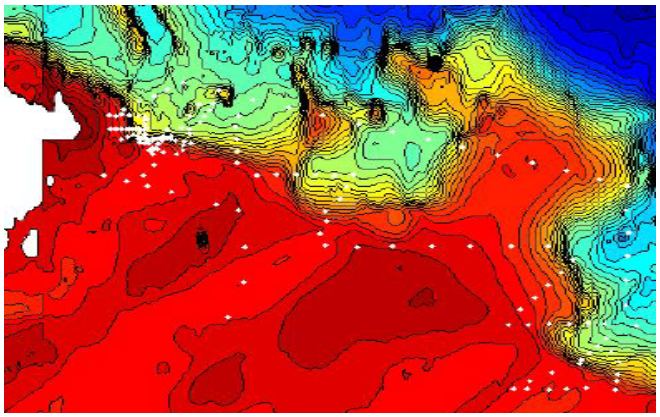
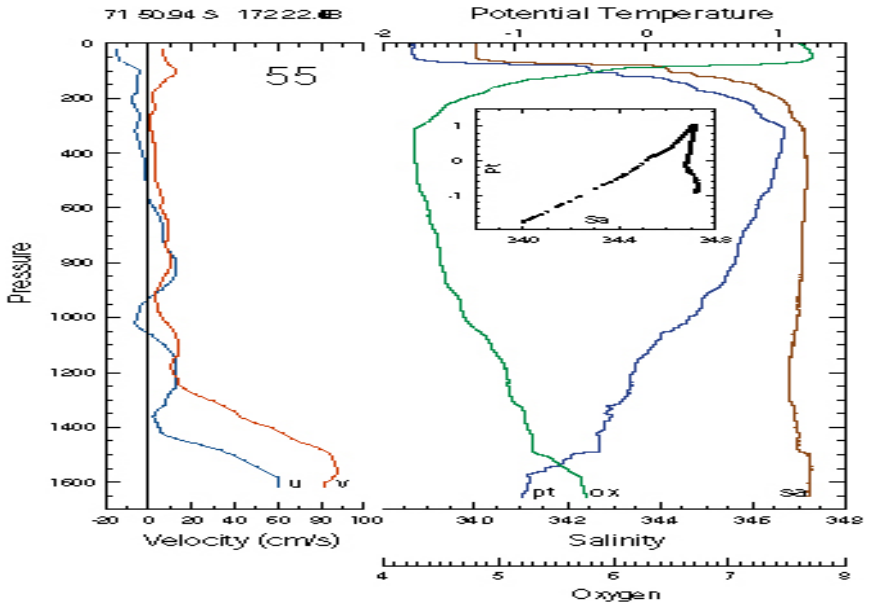
# AnSlope Cruise #1 NATHANIEL B. PALMER 0302
# McMurdo, Antarctica to Port Lyttelton, New Zealand; 25 February to 9 April 2003
# Cruise Report

**The Top**



**The Bottom**




**And in-between**

## I Introduction & Overview [A.Gordon, Chief Scientist]

### [A] AnSlope, the Program:

AnSlope's primary goal is to identify the principal physical processes that govern the transfer of shelf-modified dense water into intermediate and deep layers of the adjacent deep ocean. At the same time, we seek to understand the compensatory poleward flow of waters from the oceanic regime. We identify the upper continental slope as the critical gateway for the exchange of shelf and deep ocean waters. Four specific objectives: [A] Determine the ASF mean structure and the principal scales of variability (spatial from ~1 km to ~100 km, and temporal from tidal to seasonal), and estimate the role of the Front on cross-slope exchanges and mixing of adjacent water masses; [B] Determine the influence of slope topography (canyons, proximity to a continental boundary, isobath divergence/convergence) on frontal location and outflow of dense Shelf Water; [C] Establish the role of frontal instabilities, benthic boundary layer transports, tides and other oscillatory processes on cross-slope advection and fluxes; and [D] Assess the effect of diapycnal mixing (shear-driven and double-diffusive), lateral mixing identified through intrusions, and nonlinearities in the equation of state (thermobaricity and cabbeling) on the rate of descent and fate of outflowing, near-freezing Shelf Water.

AnSlope core elements are: moorings; CTD-$O_2$/ADCP and CTD-mounted Microstructure Profiling System (CMiPS); CFC, oxy-18, tritium/helium tracers; and basic tidal modeling. The cruise activities of these elements are reported below:
• CTD/LADCP/Tracer by Bruce Huber;
• Moorings by Alejandro Orsi;
• Microstructure by Laurence Padman.

International Collaboration: The Italian CLIMA [Climate Long–term Interaction of the Mass balance of Antarctica ] program in the Ross Sea provides a valuable international enhancement for the AnSlope observational component. Andrea Bergamasco, who joined the NBP0302 science team from the R/V Italica (CLIMA's ship) brought with him the Italica CTD data. These data provide a view of the western Ross Sea stratification conditions for January-February 2003, complementing the February-March 2003 data set of NBP 0302.

The German BRIOS-2 coupled ice-ocean GCM program is complementary to the US process-oriented modeling studies, and provides a test-bed for AnSlope-generated parameterizations of cross-front exchange.

The AnSlope field phase consists of three cruises within 12 to 14 months, with moorings in place throughout the period:

AnSlope 1: February 25 to April 11 2003: deploy the mooring array; thermohaline, oxygen and tracer [CFC, oxy-18, tritium/Helium] stratification, circulation and microstructure at beginning of mooring time series. In addition, water samples for nutrient analyses were collected at 60 selected stations to complement the measurements carried out in the Ross Sea in January and February 2003 by the Italian CLIMA project.

AnSlope 2: December 3, 2003 to January 16 2004: thermohaline, oxygen and tracer [CFC, oxy-18, tritium/Helium] stratification, circulation and microstructure during mooring time series;

AnSlope 3: February 29 to April 11, 2004: thermohaline and oxygen stratification, circulation at time of mooring recovery;

**[B] AnSlope-1 Personnel**:

**Science Staff**

| | |
|---|---|
| 1. Assmann, Karen | AIW [BRIO-2] |
| 2. MacKay, Chris | ESR [Microstrucure] |
| 3. Padman, Laurence | ESR [Microstrucure] |
| 4. Zambianchi, Enrico | Universita Parthenope [CLIMA] |
| 5. Bergamasco, Andrea | National Research Council [ISMAR; CLIMA] |
| 6. Boda, Ken | LDEO [CTD/LADCP] |
| 7. Curchister, Enrique | LDEO [CTD/LADCP] |
| 8. Dachille, Anthony | LDEO [Tracer Chemistry] |
| 9. Gordon, Arnold | LDEO[Chief Scientist] |
| 10. Huber, Bruce | LDEO [CTD/LADCP] |
| 11. Mathieu, Guy | LDEO [Tracer Chemistry] |
| 12. Mathieu, Sally | LDEO [Tracer Chemistry] |
| 13. Mele, Philip | LDEO [CTD/LADCP] |
| 14. Stanton, Basil | LDEO [CTD/LADCP] |
| 15. Stone, Erin | LDEO [CTD/LADCP] |
| 16. Brooksforce, Kathryn | OSU [Moorings] |
| 17. Simpkins, John | OSU [Moorings] |
| 18. Bratcher, Amy | TAMU [Moorings] |
| 19. Orsi, Alejandro | TAMU [Moorings] |

AIW = Alfred Wegener Institute for Polar & Marine Research
CLIMA = Climate Long–term Interaction of the Mass balance of Antarctica
ISMAR = Institute for Marine Science
LDEO = Lamont-Doherty Earth Observatory
ESR = Earth & Space Research
OSU = Oregon State University
TAMU = Texas A&M University

**Raytheon Polar Services Company Staff:**

| | |
|---|---|
| 1. Blackman, Sheldon | Electronics Technician |
| 2. Coward, Annie | Marine Technician |
| 3. Felix, Bruce | Electronics Technician |
| 4. Gavahan, Kathleen | Information Technology |
| 5. Huckins, Paul | Information Technology |
| 6. Huggins, Jen | Marine Technician |
| 7. Klostermayer, Bryan | USCG observer |

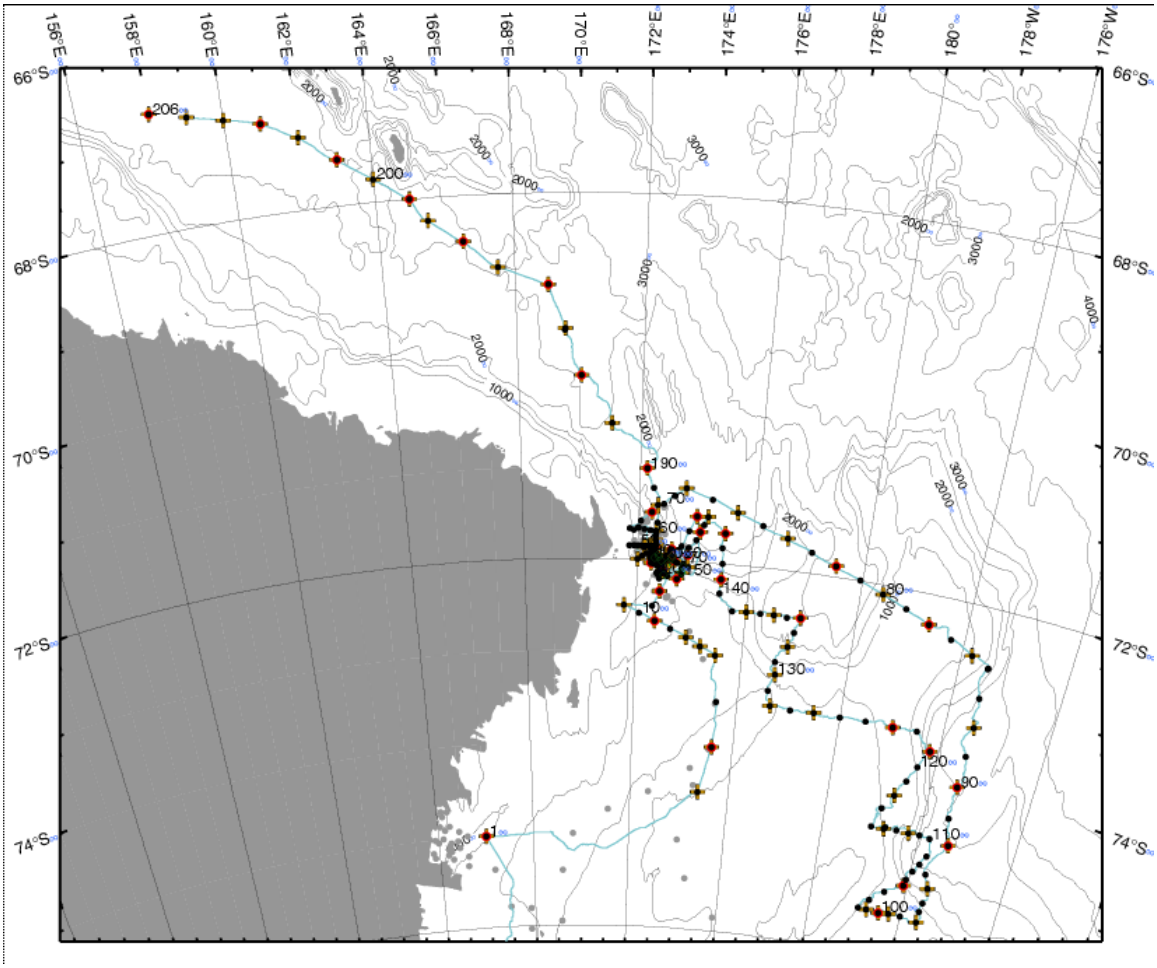
| | |
|---|---|
| 8. Liben, Robbie | Information Technology |
| 9. McGuier, Chris | Marine Technician |
| 10. Newyear, Karl | Marine Projects Coordinator |
| 11. Tarrant, Steve | Marine Technician |
| 12. Tudor, Laura | Marine Science Technician |

**[C] What was Done:**

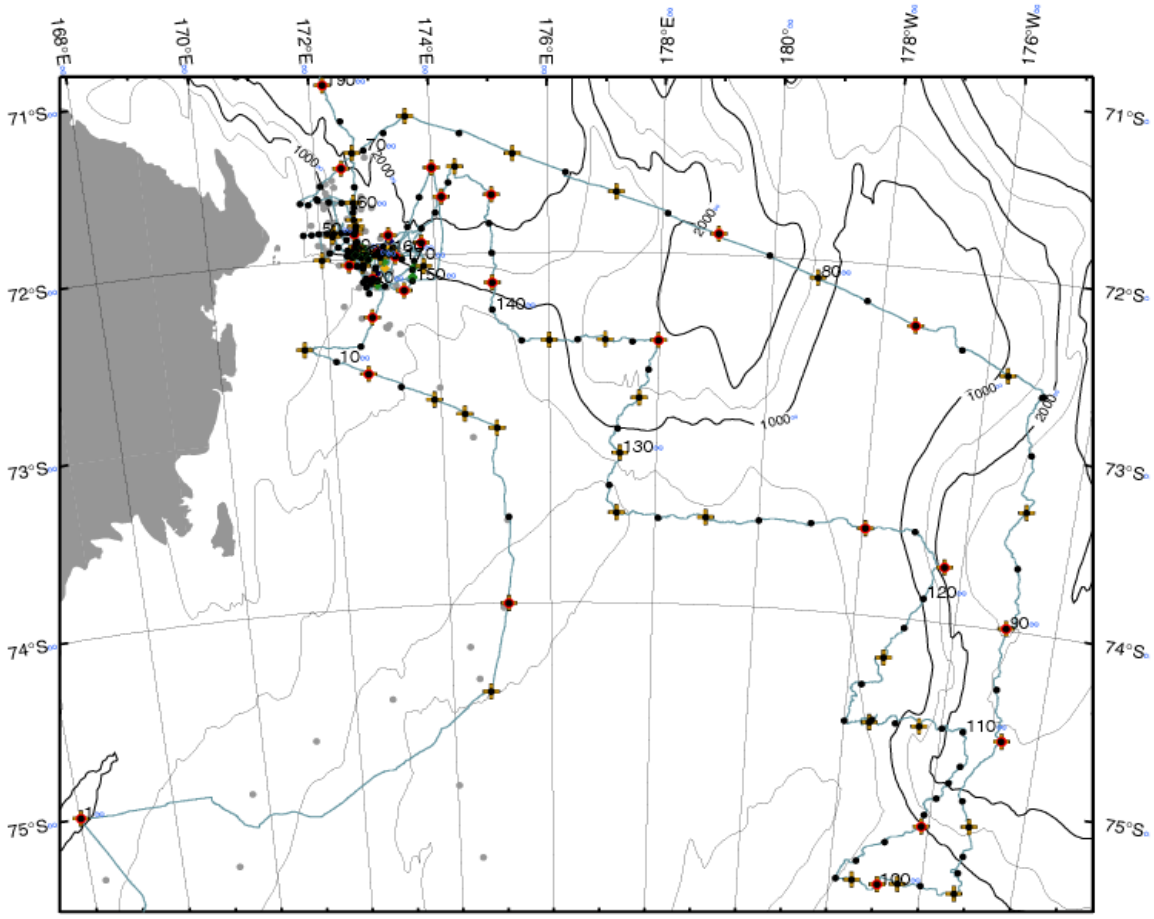
The Chief Scientist's weekly SitReps with those of the Karl Newyear document the activities during the AnSlope-1 cruise. The sea ice cover was far more extensive than expected. However the mooring and CTD station activities were not hindered. Only the planned XBT survey was not done because of ice conditions.

***The Track and Station array:***

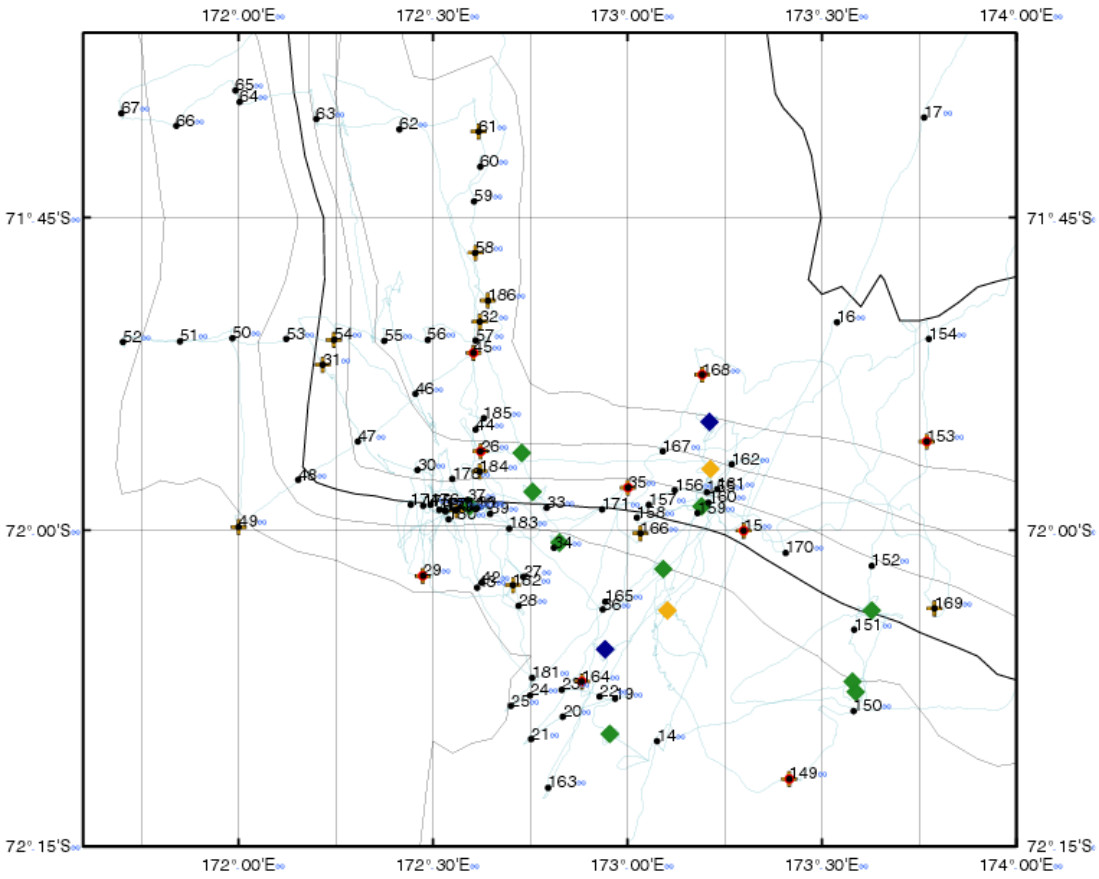
**Figure I-1** Track, CTD stations [tracer activities noted: **red** symbol Tritium/Helium & Oxygen - 18; + CFC], and moorings (see figure 1c; **yellow** is Central E-1 and B-1, which were recovered and redeployed as Central E-2 and B-2, shown by the **blue** symbol; the moorings which were not rotated during the cruise are shown in **green**). Table II- 1[Huber] lists the CTD stations, 206 in total and Table III-1 [Orsi] lists the mooring positions and composition.



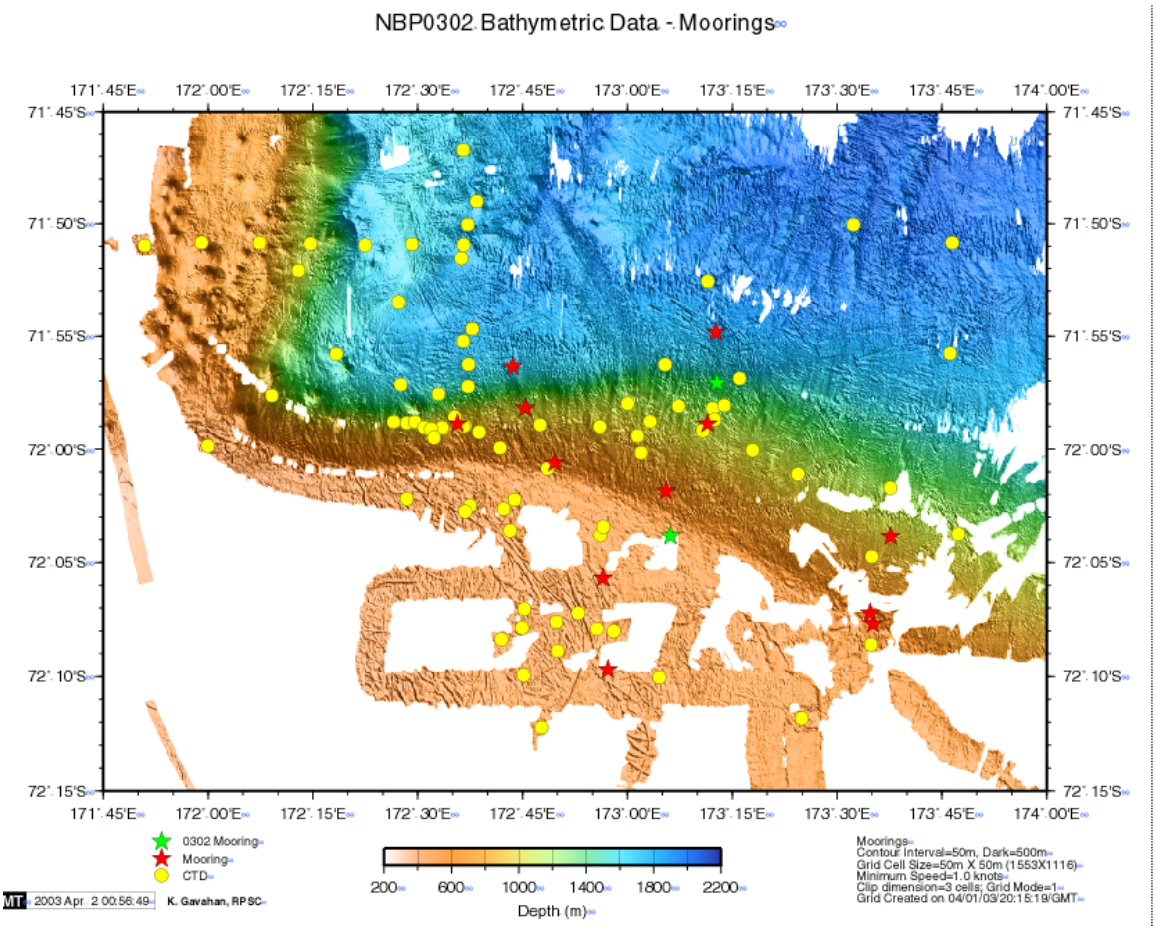

## I-1a The full Station Array




**I-1b the primary AnSlope area**



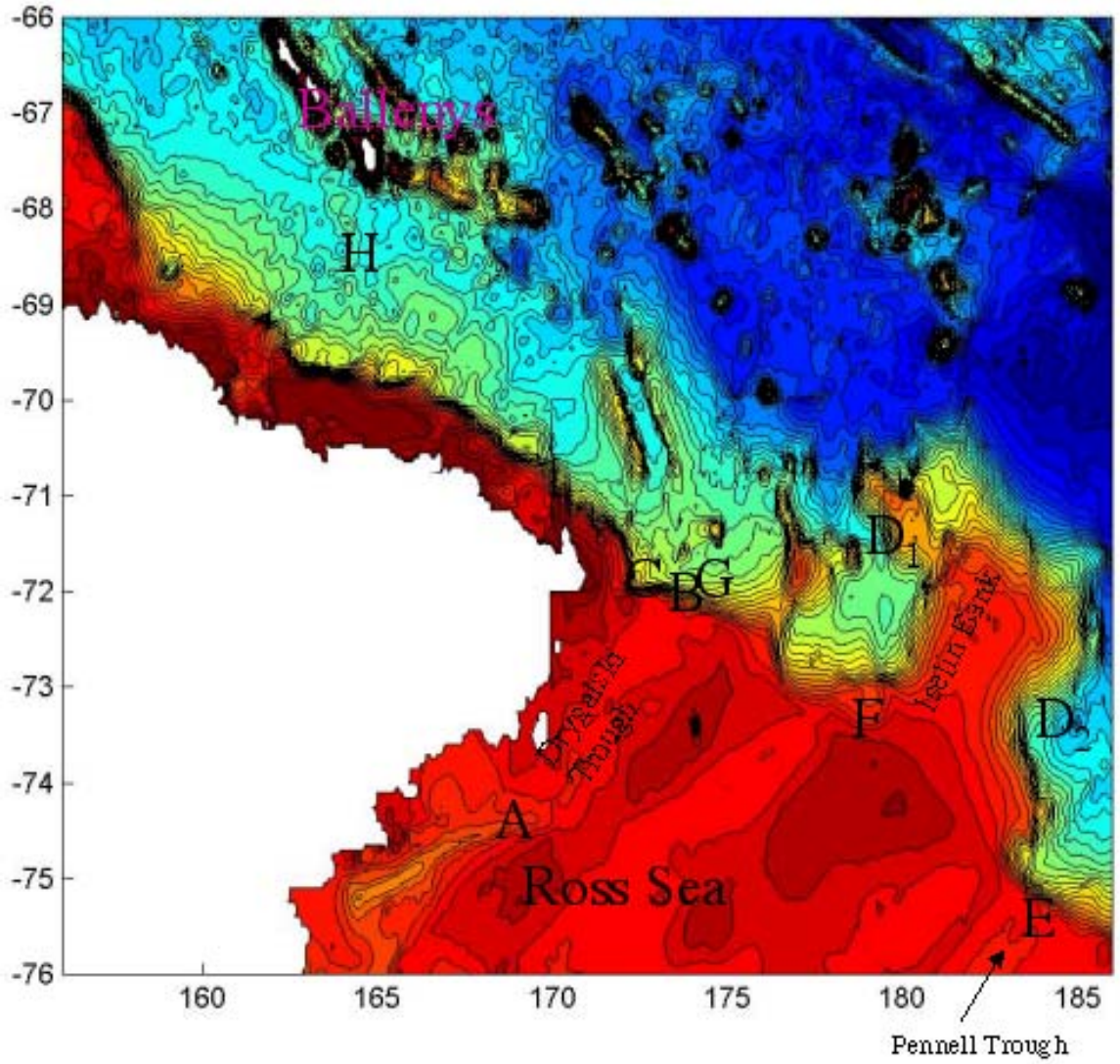

**I-1c Close up of mooring region, SW corner of AnSlope Coverage**




**I-1d Multibeam base of Close up of the SW corner of AnSlope Coverage**

***Research "Blocks":*** AnSlope-1 cruise activities may be segmented into research blocks, A to H (Figure I-2). A 'Station' consists of CTD/LADCP; microstructure; water samples; a 'Section' is a sequence of stations, generally with spacing of 5 to 15 nm.

**Figure I-2 Map of Research Blocks**




[A] Enroute from McMurdo [stations 1- 18] : The first station was in Terra Nova Bay, near the CLIMA current meter mooring **L** 74° 44.57 S; 164° 08.42 E. This was followed with a few stations along the west wall of mega-iceberg C-19 and a section across Drygalski Trough. These stations define the February 2003 characteristics of the dense shelf water within Drygalski, which is the prime source of slope plumes expected in the mooring area. A section [stations at 10 nm] was obtained along the trough axis, passing CLIMA mooring **G**, 73° 18.00 S; 171° 36.00 E, extending across the slope into the deep ocean, providing our first glimpse of the shelf/slope front and slope plume characteristics. The front over the continental slope separates the relatively warm deep waters from the cold dense water over slope floor. Above 500 m the front conforms to the shelf-slope exchange processes.

[B] Moorings deployment [stations 19- 42]: Deployment of the 12 AnSlope moorings (including the pressure sensor near East-A) with regional CTD / LADCP stations. Tidal currents are a very noticeable part of the flow field, particularly over the shelf. Within the mooring area, over the slope and deeper ocean we find low salinity bottom water spreading westward across the mouth of the Drygalski trough, eventually over-riding saltier slope water derived from Drygalski. While

there is general agreement of the stratification observed during AnSlope-1 with that found by Italica [January-February 2003] there is some variability: the Italica data reveals slightly greater extent of the saline slope water.

[C] Western boundary [stations 43-71]: Five closely spaced sections [5 nm] were obtained across the outer shelf to deep ocean within the western 'bend' and western boundary formed by the slope isobaths. These sections show the behavior of the shelf-slope front as the continental margins executes its abrupt turn. Above 500 m the modified warm deep water seems to just keep going west, spreading at least to with 15 nm of the shore. Pressed up against the slope and deeper adjacent ocean is strong northward flow of saline bottom water. Water mass characteristics and the bottom tracked LADCP data indicate that there are significant downslope components of salty shelf water from Drygalski, prompting use of the descriptive word 'Plume'. The northern cross slope section [stations 67-72] in this grouping defines the characteristics of the Ross Sea saline bottom water as they exit their formation site.

[D] Northern [$D_1$] and Eastern [$D_2$] boundary sections [stations 72-97]: The deep water side of the AnSlope survey region is enclosed by a northern (72-86; nominally along 72°S) and an eastern (87-97; along 175°E) boundary sections. These sections define the open ocean boundary condition for the AnSlope area. The northern section crosses the Iselin Bank near 178°E. The northward protrusion of Iselin Bank forms a major perturbation to the otherwise SE-NW trending Ross Sea slope. The eastern slope of the Bank is characterized by northward flowing water derived from Pennell Trough shelf water. The top of the Bank is covered with outer shelf waters derived from Pennell region. The front for the most part follows the contours of Iselin Bank, but the slope water along the western flank is not as cold as observed to the east, indicating that the Pennell formed bottom water passes into the southeast Pacific Basin rather then curl their way to the western Ross margin.

[E] Pennell Trough [stations 98-110]: Pennell Trough holds the potential source water for local slope plumes, both ice shelf water and high salinity shelf water. The latter being similar to that within Drygalski, but here at its eastern extend it forms a thinner benthic layer. Within Pennell Trough there are two CLIMA moorings: **H-1** 75°57.461'S; 177°38.709'W 632-m, and **H-2** 75°09.936'S; 176°14.603'W 738-m. We took a station at H-2, but ice was too heavy to spare the fuel to reach H-1. At the shelf break, at H-2, we found vigorous mixing of the shelf and modified warm deep waters, with very high offshore speeds, feeding the northward flowing slope waters observed along the eastern slope of Iselin Bank.

[F] Continental slope crossings [stations 111-144]: From Pennell Trough to the mooring area we crisscrossed the continental slope and associated front 8 times (including the two crossings at Pennell and the 175W section) with a station spacing of about 5 nm. These sections examine the connectivity between the Pennell Trough frontal and plume characteristics with those at the western mooring area. The southern root of Iselin Bank was transversed near 73.5S, which with the northern boundary section define the extent of the Bank's disturbance to the margin stratification/circulation. There appears to be both low and high salinity benthic water derived from Joides Basin along the downstream slope.

[G] Recovery/redeployment of two moorings [stations 145-186]: Central E-1 and Central B-1 moorings were recovered and re-deployed as Central E-2 and B-2. E-1 and B-1 were not quite in the desired placement, and E-1 was too shallow exposing it to iceberg impact. The three week mooring records provide a tantalizing hint of things to come when we recover the full year's data. Sections were obtained at close spacing (<5nm at the mooring sites) along the three mooring sections to enable current meter referenced geostrophic calculations. The sections along the eastern and western mooring lines were extended off shore to deeper waters. Repeated lowering (yo-yo station) of the CTD for a period of 25 hours were performed at the ADCP mooring site, revealing very vigorous, time varying conditions.

[H] Balleny Trough [stations 187-206]: The bottom water formed along the western margin of the Ross Sea exits the region within the passage between the Balleny Islands and Antarctica. We know this mainly from data west of 150°E. There are a few, but not many stations in the Balleny Passage. In order to trace the movement and mixing of the Ross Sea water westward through this passage, and evaluate the impact of possible local sources of dense deep/bottom water, we ended the cruise with a series of CTD stations at WOCE spacing [30 nm] through the Balleny Passage. The time for these stations came from the cancelled XBT survey of the Ross Sea margin.

***Other Activities:***

Ice Observations: Fulfilling a request from Steve Ackley, chairman of the SCAR-GloChAnt ASPeCT program, ice observations were also carried out during the cruise, using the Aspect protocols and software developed at CRC and Australian Antarctic Division by Anthony Worby (see Antarctic CRC Research Report 14, 1999). After a few days of training, a routine of hourly observations was established, under the coordination of Enrico Zambianchi, member of the ASPeCT SSG, and Karl Newyear, involving several volunteer watch standers.

Multibeam: Kathleen Gavahan reports that though the ice was extensive for most of the cruise we were able to add to the regional coverage. We have filled a few data "holes" in the northwestern mooring area, where we have spend most of the time on this cruise. We had pretty good coverage there already from NBP0209. On our excursion to the Pennell area, we added to the definition of the shelf break. However, because of the ice, the quality of data has been patchy on this cruise. Ping editing volunteers were very active during the cruise. Erin Stone proved to be the most persistent of the ping editors.

Multibeam is an indispensable aid in siting moorings and in understanding the sea floor morphology control of the circulation and mixing processes.

**[D] Acknowledgements & comments**:

It's been a great cruise! The NBP is a fantastic ship, staffed with a fine group of capable and congenial people, across the whole spectrum. We have achieved the objectives of AnSlope cruise 1 under unexpected difficult ice conditions: the moorings have been placed to best achieve the AnSlope objectives; we have a detailed view of the stratification and circulation along the margins of the Ross Sea. We succeeded because of the expert ship handling, as critical for the

mooring operations and for weaving and breaking our way through the endless ice. The solid support provide by the Raytheon team, in keeping the equipment and computer network in tip-top shape allowed us to smoothly carry out the cruise activities. The dedicated of group of scientist insured the collection of quality data and in making maximum use of the available facilities. All of individuals in the above mentioned groups deserved commendation. My special appreciation goes to Captain Joe Borkowski III who has earned my highest respect.

Adding to the science and the company was the natural beauty of the environment. The scenery was spectacular, particularly as the sunrise lit up the snow covered mountains to the west of the mooring area and the icebergs of varied sizes and shapes under flattering lighting conditions. There were many penguin, seal and whale sightings. Food is great, with variety to suit nearly every taste, prepared by a knowledgeable staff. [Though 24 hour availability of better coffee would be good; timely coffee brewed by the Raytheon MT was appreciated (just as I typed out this sentence).]

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## II CTD/LADCP/Tracer Chemistry [Bruce A. Huber]:

CTD/LADCP/Tracer

Profiles of temperature, salinity, and dissolved oxygen were obtained using equipment provided by RPSC. The basic package consisted of a Sea-bird Electronics SBE911+ CTD system fitted with 2 sets of ducted conductivity-temperature sensors, dual pumps, and a single SBE 43 dissolved oxygen sensor. The sensor suite was mounted vertically on a flat mounting surface just inboard of the lower frame supports. The sensor pairs generally agreed to within 0.001 for both T and C throughout the cruise, and can be used interchangeably. One-second GPS data from the vessel's Ashtech GPS was merged with the CTD data stream and recorded at every CTD scan. Data were acquired using a PC running Windows 98 and Sea-Bird's Seasave for Windows software. Raw data was copied over the network to a separate drive immediately after the station. Preliminary post-processing was carried out using batch files and scripts prepared by RPSC and modified by LDEO to provide a variety of CTD products to the AnSlope science party. The processed data was copied to a network disk drive and was generally available within 10 minutes after the conclusion of a station.

All profiles were planned to reach within 10 m of the bottom. Approach to the bottom was guided by a 12 kHz pinger (OSI ) mounted on the frame and an SBE bottom contact switch fitted with a 10 m lanyard and weight. The pinger generally worked well, but required service twice during the cruise to replace the batteries. The bottom contact switch gave sporadic results due to large drifts and bottom currents until station 40, when the original ¼" line and set of large shackles as weights were replaced with a much thinner nylon string and single, 5/8" shackle as weight. From this point on, the bottom contact was for the most part reliable.

Water samples were collected using a 24-position SBE 32 Carousel sampler with 10 liter water sample bottles of the SIO Bullister design, modified to include a second, larger-bore valve adjacent to the standard sampling valve on the body of the bottle. Water was collected for on-board analysis of salinity, dissolved oxygen, and CFCs. Salinity and oxygen analyses are primarily for standardizing the CTD conductivity and oxygen sensors. Additional samples were collected for later analysis at LDEO of helium, tritium, oxygen-18. Samples for later analysis of nutrients in Italy were collected and frozen at -80ºC.

The water sampling system was generally trouble-free, with a few noteworthy exceptions:

- the sample valves on most of the bottles are very difficult to operate. The RPSC marine technicians kept a ready supply of spares to install when a valve became troublesome, but more often than not, this was a temporary fix. This issue should be investigated further by RPSC to determine if there is a flaw in the design or manufacture of the valve assemblies which promotes sticking.
- The latch assembly began to stick on station 100. The assembly was replaced with a spare, but the spare proved to be worse than the original. The original was carefully rinsed and replaced, and further sticking was only occasionally a problem.

- The casousel pylon electronics assembly failed on station 193. A spare was installed from the backup CTD package.

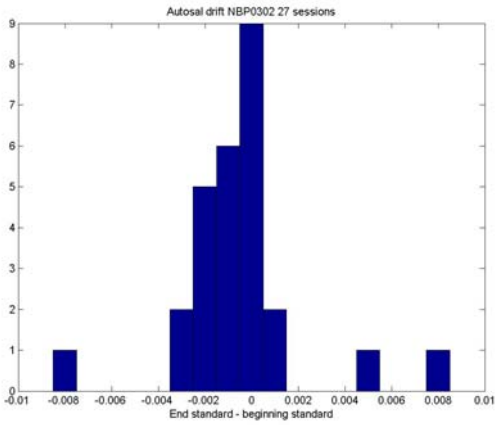
Profiles of water velocity were obtained with the LDEO Lowered Acoustic Doppler Profiler system (LADCP). The LADCP underwater system comprises two RDI Workhorse WH300 ADCPs and an LDEO battery/communications package. The two ADCP heads (sn 150 and 149) are operated in master-slave configuration, with the down-looking head serving as master (sn 150). Ping rate was nominally 1.5 seconds, with a bin length of 10 m. Nominal range for each head was typically 100 m. The data were processed using the LDEO LADCP software version 7b. A one-second time series of the preliminary CTD data with integrated GPS navigation was used during the LADCP processing, accessed via the network immediately after each CTD station. The CTD, GPS and ADCP bottom track data are utilized by the processing software to produce a velocity profile with 20 m vertical resolution, with velocity errors of typically 0.05 m/s . A separate, more detailed report on LADCP operations will be available after the cruise. Of note is the effect of the bottom contact lanyard on quality of the LADCP data – the ¼" lanyard used for the first 39 stations caused data dropouts in the first down-looking bin. It is important to use a thin line and small weight to avoid contaminating the ADCP data.

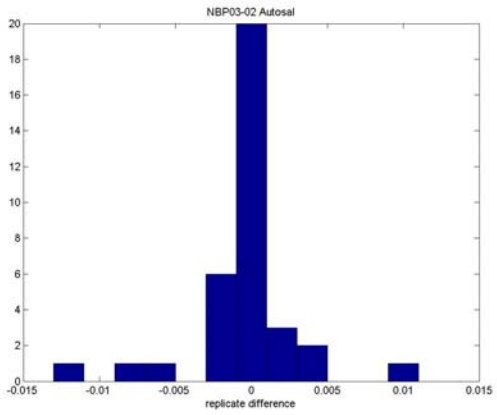
Oxygen titration

An SBE 43 dissolved oxygen sensor was connected to the primary CTD sensor array. There was no discernable sensor drift over the time of the cruise as determined by inter comparison between station pairs at the same location during the beginning and the end of the cruise. A preliminary correction was applied based on temperature, yielding close approximation to rosette bottle data. 1,400 oxygen samples were collected for Winkler titration. An amperometric titrator, designed by Dr. C. Langdon, was used to titrate whole bottle samples. The first eight stations were titrated using the RPS titrator,
after which it was swapped out for the PO titrator due to slow titration speed and the lack of software to change the speed. Except for minor problems, the titrations ran smoothly.

Salinity determination

Water sample salinity was determined using the RPSC Guildline Autosal 8400B laboratory salinometer(number 59-213) , standardized with batch P141 standard water from OSIL. Data from the autosal was captured by computer using an interface and software constructed at Scripps Oceanographic Inst. The salinometer is housed in a temperature-controlled enclosure constructed in the Bio Lab. The room temperature at the level of the salinometer is reasonably well controlled, but we found early on that there was a nearly 5 degree gradient between the deck and the autosal level. Samples to be run are stored on the deck, and so were not






equilibrating to near the salinometer bath temperature, causing some noisy runs. We installed a circulating fan in the autosal room, minimizing the floor-to-ceiling temperature gradient. In order to speed sample processing, sample crates were placed in the aft dry lab sink immediately after drawing the samples, and the crates filled with tap water. Water was changed 2 to 3 times over the next few hours, and the resultant water bath temperature checked with a thermocouple probe provided by RPSC. This procedure stabilized the sample temperatures to around 20ºC within 6 hours and greatly improved the stability of the runs. Overall the system works very well. The combination of SIO interface and software, temperature stability, and excellent maintenance of the autosal yielded very low drift rates, and good repeatability of replicate samples. The bulk of the samples were drawn and run by K. Assmann and E. Curchitser.

Station Summary

**Table II-1** provides summary information for the 206 CTD/LADCP/Tracer stations occupied during NBP03-02. Bottom depths at the start of the CTD are in meters, as indicated by the multibeam center channel display. These depths are corrected for local sound velocity, profiles for which were determined by K. Gavahan from CTD data collected during the cruise.

| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 1 | 74 | 59.976 | 166 | 01.056 | E | 02/25/03 | 21:52 | 1035 | 990 | 10 | 11 | 22 | 23 | 11 | 11 | 22 | | |
| 2 | 74 | 30.096 | 174 | 45.468 | E | 02/26/03 | 20:07 | 502 | 493 | 10 | | 14 | 12 | | | 12 | | |
| 3 | 74 | 00.084 | 175 | 09.906 | E | 02/27/03 | 00:17 | 586 | 580 | 8 | 13 | 14 | 14 | 13 | 13 | 14 | | Tr sample only half full |
| 4 | 73 | 30.474 | 175 | 11.826 | E | 02/27/03 | 04:33 | 404 | 397 | 10 | | | 11 | | | 11 | | |
| 5 | 72 | 59.982 | 175 | 00.876 | E | 02/27/03 | 10:30 | 354 | 351 | 10 | | 11 | 10 | | | 10 | | bottle 2 leaked from bottom endcap-loose o-ring |
| 6 | 72 | 54.942 | 174 | 25.662 | E | 02/27/03 | 13:51 | 365 | 365 | 10 | | 10 | 9 | | | 6 | | |
| 7 | 72 | 49.596 | 173 | 52.398 | E | 02/27/03 | 17:32 | 401 | 392 | 10 | | 12 | 10 | | | 6 | | ladcp up-head data only |
| 8 | 72 | 44.652 | 173 | 16.752 | E | 02/27/03 | 20:22 | 504 | 501 | 8 | | | 12 | | | 6 | | |
| 9 | 72 | 39.810 | 172 | 41.460 | E | 02/27/03 | 23:19 | 529 | 525 | 8 | 12 | 13 | 12 | 12 | 12 | 12 | | bottles 1,2 no trip-lanyards tangled |
| 10 | 72 | 34.884 | 172 | 07.230 | E | 02/28/03 | 01:52 | 553 | 552 | 10 | | | 12 | | | 6 | | |
| 11 | 72 | 30.108 | 171 | 33.618 | E | 02/28/03 | 04:18 | 361 | 348 | 10 | | | 6 | 6 | | 6 | | |
| 12 | 72 | 30.132 | 172 | 34.908 | E | 02/28/03 | 08:52 | 543 | 536 | 8 | | | 6 | | | 6 | | bottle 9 no trip |
| 13 | 72 | 20.352 | 172 | 49.590 | E | 02/28/03 | 12:39 | 527 | 526 | 7 | 12 | 12 | 12 | 12 | 12 | 12 | | |
| 14 | 72 | 10.038 | 173 | 04.590 | E | 02/28/03 | 16:03 | 512 | 512 | 10 | | | 12 | | | 6 | | |
| 15 | 72 | 00.042 | 173 | 17.946 | E | 02/28/03 | 18:41 | 1053 | 1061 | 10 | 19 | 20 | 19 | 19 | 19 | 19 | | bottles 18,19 air vent leak |
| 16 | 71 | 50.052 | 173 | 32.346 | E | 02/28/03 | 21:32 | 1953 | 1950 | 20 | | | 12 | | | 12 | | |
| 17 | 71 | 40.158 | 173 | 45.750 | E | 03/01/03 | 01:12 | 1967 | 1980 | 10 | | | 12 | | | 12 | | |
| 18 | 71 | 30.000 | 174 | 00.072 | E | 03/01/03 | 04:37 | 2132 | 2137 | 10 | 24 | 25 | 24 | 23 | 23 | 24 | | no Tr or 18-O sample niskin 23(smpl 103) |
| 19 | 72 | 08.022 | 172 | 58.062 | E | 03/02/03 | 07:50 | 513 | 505 | | | | | | | | | |
| 20 | 72 | 08.880 | 172 | 50.028 | E | 03/02/03 | 09:26 | 506 | 499 | 5 | | | | | | | | |
| 21 | 72 | 09.942 | 172 | 45.150 | E | 03/02/03 | 10:59 | 507 | 505 | 10 | | | | | | | | |
| 22 | 72 | 07.914 | 172 | 55.656 | E | 03/03/03 | 08:48 | 499 | 496 | 12 | | | | | | | | |
| 23 | 72 | 07.602 | 172 | 49.872 | E | 03/03/03 | 09:58 | 508 | 490 | 10 | | | | | | | | |
| 24 | 72 | 07.872 | 172 | 44.952 | E | 03/03/03 | 11:14 | 502 | 497 | 10 | | | | | | | | |

| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 25 | 72 | 08.370 | 172 | 42.012 | E | 03/03/03 | 12:21 | 504 | 497 | 10 | | | | | | | | |
| 26 | 71 | 56.250 | 172 | 37.308 | E | 03/04/03 | 02:49 | 1674 | 1716 | 10 | 22 | 23 | 24 | 22 | 22 | 24 | | |
| 27 | 72 | 02.232 | 172 | 43.896 | E | 03/04/03 | 06:20 | 521 | 518 | 10 | | | | | | | | |
| 28 | 72 | 03.606 | 172 | 43.212 | E | 03/04/03 | 07:57 | 498 | 496 | 8 | | | | | | | | |
| 29 | 72 | 02.190 | 172 | 28.452 | E | 03/04/03 | 09:59 | 477 | 465 | 10 | 13 | 15 | 13 | 13 | 13 | 13 | | |
| 30 | 71 | 57.144 | 172 | 27.594 | E | 03/04/03 | 12:01 | 1592 | 1598 | 10 | | | | | | | | |
| 31 | 71 | 52.086 | 172 | 12.954 | E | 03/04/03 | 17:15 | 1078 | 790 | | | 16 | 15 | | | 24 | | drifted into shallower water during cast. Bottle 18 lanyard caught in top endcap |
| 32 | 71 | 50.028 | 172 | 37.200 | E | 03/05/03 | 19:32 | 1759 | 1695 | 10 | | 22 | 21 | | | 24 | 2 | air vent o-ring unseated bottle 9 |
| 33 | 71 | 58.938 | 172 | 47.496 | E | 03/05/03 | 22:44 | 888 | 893 | 6 | | | | | | | | |
| 34 | 72 | 00.852 | 172 | 48.612 | E | 03/06/03 | 03:11 | 560 | 602 | 10 | | | | | | | | |
| 35 | 71 | 57.990 | 173 | 00.054 | E | 03/06/03 | 06:33 | 1118 | 1125 | 9 | | 21 | 24 | | 20 | 20 | | 18-O without Tr/He |
| 36 | 72 | 03.780 | 172 | 56.154 | E | 03/06/03 | 08:56 | 532 | | 9 | | | | | | | | |
| 37 | 71 | 58.584 | 172 | 35.298 | E | 03/06/03 | 10:53 | 990 | 1199 | | | | | | | | | biota in sensor plumbing on ut |
| 38 | 71 | 58.980 | 172 | 36.798 | E | 03/06/03 | 12:46 | 852 | 895 | | | | | | | | | |
| 39 | 71 | 59.244 | 172 | 38.790 | E | 03/06/03 | 14:26 | 833 | 824 | | | | | | | | | |
| 40 | 71 | 59.004 | 172 | 36.570 | E | 03/06/03 | 16:07 | 854 | 872 | | | | | | | | | bottom contact lanyard and weight replaced prior to cast |
| 41 | 71 | 59.082 | 172 | 33.600 | E | 03/06/03 | 17:30 | 904 | 890 | | | 20 | 19 | | | 20 | 4 | |
| 42 | 72 | 02.508 | 172 | 37.506 | E | 03/06/03 | 21:56 | 504 | 496 | 8 | | | | | | | | halted on dt at 120m due to ice |
| 43 | 72 | 02.754 | 172 | 36.828 | E | 03/06/03 | 22:47 | 508 | 492 | 8 | | | | | | | | at same site as 42 |
| 44 | 71 | 55.212 | 172 | 36.528 | E | 03/07/03 | 01:13 | 1764 | 1764 | 10 | | | | | | | | |
| 45 | 71 | 51.528 | 172 | 36.246 | E | 03/07/03 | 03:32 | 1759 | 1765 | 10 | 21 | 22 | 21 | 21 | 21 | 21 | 5 | |
| 46 | 71 | 53.490 | 172 | 27.252 | E | 03/07/03 | 06:14 | 1613 | 1609 | 10 | | | | | | | | |
| 47 | 71 | 55.776 | 172 | 18.360 | E | 03/07/03 | 08:10 | 1534 | 1539 | 9 | | | | | | | | |
| 48 | 71 | 57.618 | 172 | 09.180 | E | 03/07/03 | 10:03 | 953 | 965 | 8 | | | | | | | | |
| 49 | 71 | 59.868 | 171 | 59.988 | E | 03/07/03 | 11:55 | 426 | 424 | 8 | | 13 | 12 | | | 12 | 4 | |
| 50 | 71 | 50.832 | 171 | 59.064 | E | 03/07/03 | 14:16 | 639 | 656 | 8 | | | | | | | | |
| 51 | 71 | 50.964 | 171 | 50.958 | E | 03/07/03 | 15:36 | 493 | 486 | 8 | | | | | | | | |
| 52 | 71 | 50.994 | 171 | 42.186 | E | 03/07/03 | 17:12 | 423 | 393 | 8 | | | | | | | | |
| 53 | 71 | 50.844 | 172 | 07.398 | E | 03/07/03 | 19:14 | 753 | 737 | 8 | | | | | | | | |
| 54 | 71 | 50.886 | 172 | 14.700 | E | 03/07/03 | 20:26 | 1122 | 1135 | 8 | | 21 | 20 | | | 20 | 3 | |
| 55 | 71 | 50.940 | 172 | 22.476 | E | 03/07/03 | 22:35 | 1636 | 1653 | 8 | | | | | | | | |

| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 56 | 71 | 50.904 | 172 | 29.172 | E | 03/08/03 | 00:24 | 1573 | 1577 | 10 | | | | | | | | |
| 57 | 71 | 50.922 | 172 | 36.576 | E | 03/08/03 | 02:18 | 1685 | 1687 | 8 | | | | | | | | |
| 58 | 71 | 46.692 | 172 | 36.510 | E | 03/08/03 | 04:13 | 1668 | 1696 | 10 | | 22 | 21 | | | 21 | | ros 11 leaked |
| 59 | 71 | 44.220 | 172 | 36.342 | E | 03/08/03 | 06:50 | 1679 | 1673 | 9 | | | | | | | | |
| 60 | 71 | 42.534 | 172 | 37.242 | E | 03/08/03 | 08:44 | 1639 | 1643 | 8 | | | | | | | | |
| 61 | 71 | 40.830 | 172 | 37.050 | E | 03/08/03 | 10:33 | 1561 | 1565 | 10 | | 23 | 22 | | | 22 | 4 | |
| 62 | 71 | 40.722 | 172 | 24.768 | E | 03/08/03 | 13:22 | 1708 | 1716 | 8 | | | | | | | | |
| 63 | 71 | 40.212 | 172 | 12.000 | E | 03/08/03 | 15:41 | 1350 | 1352 | 6 | | | | | | | | |
| 64 | 71 | 39.402 | 172 | 00.138 | E | 03/08/03 | 17:41 | 625 | | | | | | | | | | cast aborted due to false bottom contact alarm |
| 65 | 71 | 38.844 | 171 | 59.508 | E | 03/08/03 | 18:07 | 622 | 610 | 8 | | | | | | | | |
| 66 | 71 | 40.542 | 171 | 50.424 | E | 03/08/03 | 19:30 | 451 | 476 | 8 | | | | | | | | stopped cast on ut due to ice at 150 and 133 m |
| 67 | 71 | 39.942 | 171 | 41.886 | E | 03/08/03 | 20:41 | 455 | 451 | 5 | | | | | | | | |
| 68 | 71 | 34.506 | 172 | 03.888 | E | 03/08/03 | 22:42 | 673 | 670 | 8 | | | | | | | | |
| 69 | 71 | 28.860 | 172 | 26.802 | E | 03/09/03 | 01:02 | 1853 | 1889 | 10 | 22 | 23 | 22 | 22 | 22 | 24 | | |
| 70 | 71 | 23.214 | 172 | 50.844 | E | 03/09/03 | 04:24 | 2154 | 2170 | 10 | | | | | | | | |
| 71 | 71 | 17.490 | 173 | 12.462 | E | 03/09/03 | 07:48 | 2068 | 2086 | 10 | | | | | | | | |
| 72 | 71 | 12.096 | 173 | 35.244 | E | 03/09/03 | 11:16 | 2230 | 2243 | 8 | | 24 | 24 | | | 24 | 2 | |
| 73 | 71 | 18.702 | 174 | 29.784 | E | 03/09/03 | 16:15 | 2188 | 2168 | 8 | | | | | | | | |
| 74 | 71 | 25.878 | 175 | 23.796 | E | 03/09/03 | 21:09 | 2210 | 2222 | 8 | | 10 | 11 | | | 12 | 6 | |
| 75 | 71 | 32.598 | 176 | 18.276 | E | 06/24/00 | 02:22 | 2034 | 2043 | 7 | | | | | | | | |
| 76 | 71 | 39.210 | 177 | 11.700 | E | 03/10/03 | 07:00 | 954 | 954 | 10 | | 21 | 12 | | | 12 | | |
| 77 | 71 | 46.284 | 178 | 05.634 | E | 03/10/03 | 11:30 | 1848 | 1857 | 8 | | | | | | | | |
| 78 | 71 | 52.860 | 179 | 00.024 | E | 03/10/03 | 15:43 | 2256 | 2235 | 8 | 24 | 25 | 24 | 24 | 24 | 24 | 5 | |
| 79 | 71 | 59.460 | 179 | 54.660 | E | 03/10/03 | 20:32 | 2223 | 2244 | 8 | | | | | | | | |
| 80 | 72 | 06.084 | 179 | 12.432 | W | 03/11/03 | 01:19 | 1314 | 1324 | 7 | | 20 | 12 | | | 12 | 5 | |
| 81 | 72 | 12.816 | 178 | 17.916 | W | 03/11/03 | 05:29 | 742 | 732 | 10 | | | | | | | | |
| 82 | 72 | 19.830 | 177 | 23.808 | W | 03/11/03 | 09:13 | 574 | 568 | 8 | 14 | 14 | 14 | 14 | 14 | 14 | 4 | |
| 83 | 72 | 26.406 | 176 | 30.348 | W | 03/11/03 | 14:11 | 708 | 715 | 8 | | | | | | | | |
| 84 | 72 | 33.438 | 175 | 37.326 | W | 03/11/03 | 18:41 | 1099 | 1084 | 8 | | 20 | 20 | | | 24 | 4 | |
| 85 | 72 | 39.036 | 174 | 55.782 | W | 03/11/03 | 23:35 | 1845 | 270 | | | | | | | | | cast aborted - ctd problems |
| 86 | 72 | 39.192 | 174 | 57.018 | W | 03/12/03 | 00:43 | 1822 | 1835 | 9 | | | | | | | | ctd data spikes |
| 87 | 72 | 59.556 | 174 | 59.430 | W | 03/12/03 | 05:11 | 2694 | 2705 | 7 | | | | | | | | |

| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 88 | 73 | 18.984 | 174 | 55.158 | W | 03/12/03 | 11:29 | 2972 | 3008 | 8 | | 24 | 24 | | | 24 | 4 | |
| 89 | 73 | 38.364 | 174 | 56.298 | W | 03/12/03 | 17:36 | 2767 | 2799 | 10 | | | | | | | | |
| 90 | 73 | 59.226 | 174 | 58.932 | W | 03/13/03 | 03:23 | 2474 | 2505 | 8 | 24 | 25 | 24 | 23 | 23 | 24 | 5 | |
| 91 | 74 | 20.370 | 174 | 59.742 | W | 03/13/03 | 10:28 | 2513 | 2541 | 8 | | | | | | | | ctd data spikes |
| 92 | 74 | 37.728 | 174 | 44.304 | W | 03/13/03 | 17:15 | 2406 | 2442 | 8 | | 23 | 23 | | 4 | 24 | 4 | bottle 6 air vent leak; 18-O in tcline; slip rings replaced prior to station |
| 93 | 74 | 59.634 | 175 | 21.900 | W | 03/13/03 | 23:15 | 1909 | 1927 | 9 | | | | | | | | |
| 94 | 75 | 08.064 | 175 | 08.334 | W | 03/14/03 | 02:17 | 1576 | 1592 | 9 | | 22 | 12 | | | 12 | 8 | bottle 13 mistrip |
| 95 | 75 | 18.324 | 175 | 10.734 | W | 03/14/03 | 06:08 | 1105 | | 7 | | | | | | | | |
| 96 | 75 | 24.102 | 175 | 14.196 | W | 03/14/03 | 12:25 | 758 | 764 | 8 | | | | | | | | 1st cast failed-data dropouts-repeated after making repairs to end termination splice |
| 97 | 75 | 31.344 | 175 | 15.558 | W | 03/14/03 | 16:55 | 542 | 532 | 10 | | 15 | 14 | | | 14 | 5 | |
| 98 | 75 | 30.042 | 176 | 00.432 | W | 03/14/03 | 19:43 | 585 | 578 | 8 | | | | | | | | |
| 99 | 75 | 30.216 | 176 | 30.618 | W | 03/14/03 | 21:26 | 579 | 575 | 8 | | 12 | 12 | | | 12 | 4 | |
| 100 | 75 | 31.086 | 176 | 56.790 | W | 03/14/03 | 23:57 | 607 | 594 | 8 | 16 | 17 | 16 | 16 | 16 | 16 | 7 | |
| 101 | 75 | 30.366 | 177 | 30.546 | W | 03/15/03 | 03:16 | 543 | 535 | 6 | | 11 | 12 | | | 12 | 5 | bottles 1,2,12,19 no trip, carousel latch ass'y replaced |
| 102 | 75 | 30.336 | 177 | 51.924 | W | 03/15/03 | 05:23 | 499 | | 7 | | | | | | | | test trip all bottles |
| 103 | 75 | 23.772 | 177 | 27.798 | W | 03/15/03 | 10:08 | 516 | 509 | 7 | | | | | | | | test trip all bottles. Still have mistrips. Replace carousel latch ass'y with cleaned original. |
| 104 | 75 | 16.542 | 176 | 53.322 | W | 03/15/03 | 13:14 | 564 | 557 | 8 | | | | | | | | test trip all bottles |
| 105 | 75 | 09.840 | 176 | 09.360 | W | 03/15/03 | 16:35 | 883 | 917 | 8 | 18 | 18 | 18 | 18 | 18 | 18 | 5 | |
| 106 | 75 | 05.850 | 176 | 07.218 | W | 03/15/03 | 18:44 | 1358 | 1390 | 9 | | | | | | | | |
| 107 | 74 | 59.724 | 175 | 55.122 | W | 03/15/03 | 23:13 | 1842 | 1858 | 8 | | | | | | | | |
| 108 | 74 | 54.036 | 175 | 42.132 | W | 03/16/03 | 02:12 | 2014 | 2035 | 8 | | | | | | | | |
| 109 | 74 | 47.880 | 175 | 30.270 | W | 03/16/03 | 05:27 | 2136 | 2164 | 9 | | | | | | | | gps froze for 3-5 minutes |
| 110 | 74 | 36.096 | 175 | 33.174 | W | 03/16/03 | 09:27 | 2273 | 2295 | 8 | | | | | | | | all bottles test tripped at bottom |
| 111 | 74 | 35.694 | 175 | 59.088 | W | 03/16/03 | 13:28 | 1951 | 1957 | 8 | | | | | | | | |
| 112 | 74 | 35.928 | 176 | 27.348 | W | 03/16/03 | 17:18 | 1307 | 1215 | 0 | | 21 | 19 | | | 24 | 4 | ctd frame touched bottom |
| 113 | 74 | 35.700 | 176 | 57.396 | W | 03/16/03 | 20:14 | 898 | 912 | 8 | | | | | | | | |
| 114 | 74 | 35.316 | 177 | 25.842 | W | 03/16/03 | 23:35 | 556 | 226 | | | | | | | | | cast aborted at 226m loss of signal, cable reterminated prior to cast 115 |

| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 115 | 74 | 36.384 | 177 | 28.974 | W | 03/17/03 | 08:30 | 541 | 531 | 7 | | 15 | 14 | | | 14 | | |
| 116 | 74 | 36.618 | 178 | 00.006 | W | 03/17/03 | 11:06 | 405 | 397 | 8 | | | | | | | | |
| 117 | 74 | 23.472 | 177 | 43.440 | W | 03/17/03 | 17:06 | 511 | 505 | 8 | | | | | | | | |
| 118 | 74 | 13.854 | 177 | 19.788 | W | 03/17/03 | 21:02 | 646 | 640 | 8 | | 15 | 15 | | | 15 | 4 | |
| 119 | 74 | 03.054 | 176 | 59.748 | W | 03/17/03 | 23:57 | 778 | 771 | 9 | | | | | | | | |
| 120 | 73 | 52.464 | 176 | 40.476 | W | 03/18/03 | 02:36 | 1046 | 1050 | 7 | | | | | | | | |
| 121 | 73 | 40.902 | 176 | 20.550 | W | 03/18/03 | 06:23 | 2308 | 2334 | 8 | 24 | 24 | 24 | 24 | 24 | 24 | 6 | |
| 122 | 73 | 29.904 | 176 | 59.514 | W | 03/18/03 | 13:04 | 1143 | 1147 | 8 | | | | | | | | |
| 123 | 73 | 30.330 | 177 | 56.742 | W | 03/18/03 | 17:01 | 642 | 634 | 8 | 15 | 16 | 15 | 15 | 15 | 12 | 5 | |
| 124 | 73 | 30.096 | 178 | 59.922 | W | 03/18/03 | 20:50 | 392 | 382 | 7 | | | | | | | | |
| 125 | 73 | 30.252 | 179 | 59.934 | E | 03/19/03 | 00:01 | 392 | 382 | 7 | | | | | | | | |
| 126 | 73 | 30.102 | 178 | 58.638 | E | 03/19/03 | 04:03 | 405 | 396 | 8 | | 13 | 12 | | | 24 | | |
| 127 | 73 | 30.708 | 178 | 04.080 | E | 03/19/03 | 07:45 | 349 | 339 | 9 | | | | | | | | |
| 128 | 73 | 29.178 | 177 | 15.786 | E | 03/19/03 | 13:00 | 548 | 537 | | | 14 | 13 | | | 13 | 4 | heavy ice, numerous bergs |
| 129 | 73 | 19.728 | 177 | 07.218 | E | 03/19/03 | 15:52 | 490 | 484 | 8 | | | | | | | | |
| 130 | 73 | 08.598 | 177 | 18.804 | E | 03/19/03 | 19:10 | 620 | 623 | 8 | 16 | 15 | | | | 15 | 5 | |
| 131 | 73 | 00.270 | 177 | 15.744 | E | 03/20/03 | 00:17 | 993 | 988 | 9 | | | | | | | | spikes in ctd data. Rebooted computer prior to next cast. |
| 132 | 72 | 49.596 | 177 | 39.564 | E | 03/20/03 | 04:15 | 1408 | 1409 | 7 | | 22 | 12 | | | 12 | 6 | |
| 133 | 72 | 40.044 | 177 | 49.218 | E | 03/20/03 | 07:51 | 1680 | 1696 | 9 | | | | | | | | |
| 134 | 72 | 29.988 | 177 | 59.376 | E | 03/20/03 | 11:03 | 1912 | 1930 | 8 | 22 | 22 | 22 | 22 | 22 | 22 | 4 | bottle 3 no trip |
| 135 | 72 | 30.486 | 177 | 30.642 | E | 03/20/03 | 14:28 | 1864 | 1884 | 8 | | | | | | | | |
| 136 | 72 | 29.916 | 177 | 01.086 | E | 03/20/03 | 17:47 | 1832 | 1855 | 10 | | 23 | 23 | | | 23 | 3 | |
| 137 | 72 | 29.910 | 176 | 31.248 | E | 03/20/03 | 21:31 | 1373 | 1355 | 8 | | | | | | | | bottom alarm on 165-500 m |
| 138 | 72 | 29.964 | 176 | 00.048 | E | 03/21/03 | 00:13 | 708 | 704 | 8 | | 12 | 12 | | | 12 | 5 | |
| 139 | 72 | 30.162 | 175 | 29.934 | E | 03/21/03 | 02:36 | 536 | 524 | 8 | | | | | | | | |
| 140 | 72 | 19.440 | 174 | 58.860 | E | 03/21/03 | 06:16 | 528 | 528 | 7 | | | | | | | | |
| 141 | 72 | 10.086 | 174 | 59.796 | E | 03/21/03 | 09:13 | 1231 | 1232 | 6 | 20 | 21 | 20 | 20 | 20 | 20 | 6 | |
| 142 | 71 | 59.910 | 174 | 59.934 | E | 03/21/03 | 12:42 | 1753 | 1764 | | | | | | | | | |
| 143 | 71 | 49.758 | 174 | 57.696 | E | 03/21/03 | 16:02 | 2037 | 2050 | 8 | | | | | | | | |
| 144 | 71 | 40.068 | 175 | 01.092 | E | 03/21/03 | 19:45 | 2160 | 2174 | 10 | 24 | 24 | 24 | 24 | 24 | 24 | 5 | |
| 145 | 71 | 29.970 | 174 | 23.940 | E | 03/22/03 | 00:21 | 2225 | 2205 | 9 | | 12 | 12 | | | 12 | 4 | |
| 146 | 71 | 35.292 | 174 | 16.470 | E | 03/22/03 | 03:26 | 2149 | 2162 | 9 | | | | | | | | |

| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 147 | 71 | 40.188 | 174 | 08.940 | E | 03/22/03 | 06:54 | 2118 | 2133 | 8 | 23 | 23 | 24 | 23 | 23 | 24 | 4 | 1st cast aborted - ice in sensor plumbing. Repeated cast. bottle 24 leaked |
| 148 | 71 | 45.558 | 174 | 01.758 | E | 03/22/03 | 10:27 | 2030 | 2051 | | | | | | | | | |
| 149 | 72 | 11.820 | 173 | 24.954 | E | 03/23/03 | 09:30 | 558 | 552 | 8 | 14 | 14 | 14 | 14 | 14 | 14 | 4 | |
| 150 | 72 | 08.604 | 173 | 34.896 | E | 03/23/03 | 11:48 | 558 | 561 | 8 | | | | | | | | |
| 151 | 72 | 04.740 | 173 | 34.986 | E | 03/23/03 | 13:35 | 842 | 879 | 8 | | | | | | | | CMiPS removed for repair |
| 152 | 72 | 01.716 | 173 | 37.668 | E | 03/23/03 | 14:57 | 1206 | 1240 | 8 | | | | | | | | |
| 153 | 71 | 55.764 | 173 | 46.164 | E | 03/23/03 | 17:19 | 1825 | 1857 | 8 | 22 | 23 | 22 | 22 | 22 | 22 | 4 | 23, 24 air leak |
| 154 | 71 | 50.850 | 173 | 46.488 | E | 03/23/03 | 20:55 | 1981 | 2005 | 8 | | | | | | | | ctd data spikes |
| 155 | 71 | 58.200 | 173 | 12.222 | E | 03/24/03 | 02:45 | 1218 | 1206 | 10 | | | | | | | | No CMiPS; stopped at 760 ice; begin yo-yo |
| 156 | 71 | 58.104 | 173 | 07.314 | E | 03/24/03 | 04:49 | 1196 | 1157 | 9 | | | | | | | | No CMiPS |
| 157 | 71 | 58.788 | 173 | 03.246 | E | 03/24/03 | 07:01 | 1024 | 1008 | 8 | | | | | | | | No CMiPS |
| 158 | 71 | 59.412 | 173 | 01.422 | E | 03/24/03 | 08:48 | 933 | 912 | 9 | | | | | | | | No CMiPS |
| 159 | 71 | 59.184 | 173 | 10.830 | E | 03/24/03 | 10:44 | 1074 | 1081 | 8 | | | | | | | | No CMiPS |
| 160 | 71 | 58.698 | 173 | 12.474 | E | 03/24/03 | 12:50 | 1151 | 1177 | 10 | | | | | | | | No CMiPS |
| 161 | 71 | 58.068 | 173 | 13.878 | E | 03/24/03 | 14:46 | 1255 | 1300 | 8 | | | | | | | | No CMiPS |
| 162 | 71 | 56.874 | 173 | 16.074 | E | 03/24/03 | 16:48 | 1504 | 1618 | 8 | | | | | | | | No CMiPS; end yo-yo |
| 163 | 72 | 12.240 | 172 | 47.730 | E | 03/25/03 | 06:00 | 511 | 503 | 10 | | | | | | | | CMiPS reinstalled prior to cast |
| 164 | 72 | 07.224 | 172 | 52.968 | E | 03/25/03 | 07:42 | 527 | 504 | 6 | 12 | 13 | 12 | 12 | 12 | 12 | 4 | |
| 165 | 72 | 03.432 | 172 | 56.574 | E | 03/25/03 | 09:22 | 528 | 524 | 8 | | | | | | | | |
| 166 | 72 | 00.156 | 173 | 02.004 | E | 03/25/03 | 10:39 | 834 | 814 | 10 | | 28 | 14 | | | 12 | 5 | |
| 167 | 71 | 56.256 | 173 | 05.412 | E | 03/25/03 | 12:43 | 1538 | 1555 | 8 | | | | | | | | |
| 168 | 71 | 52.560 | 173 | 11.538 | E | 03/25/03 | 14:45 | 1896 | 1915 | 10 | 22 | 232 | 22 | 22 | 22 | 24 | 4 | CFC in new ampoules drawn from 23,24 |
| 169 | 72 | 03.750 | 173 | 47.340 | E | 03/25/03 | 20:48 | 1105 | 1134 | 8 | | | | | | | | CFC in new ampoules drawn from 1 |
| 170 | 72 | 01.098 | 173 | 24.408 | E | 03/26/03 | 00:57 | 1057 | 1048 | 9 | | | | | | | | begin yo-yo |
| 171 | 71 | 59.010 | 172 | 56.100 | E | 03/26/03 | 04:17 | 944 | 907 | 6 | | | | | | | | |
| 172 | 71 | 59.058 | 172 | 33.504 | E | 03/26/03 | 05:56 | 915 | 891 | 10 | | | | | | | | |
| 173 | 71 | 59.082 | 172 | 31.836 | E | 03/26/03 | 08:54 | 930 | 818 | 6 | | | | | | | | |
| 174 | 71 | 58.806 | 172 | 26.568 | E | 03/26/03 | 11:54 | 1075 | 920 | 6 | | | | | | | | |
| 175 | 71 | 58.854 | 172 | 28.470 | E | 03/26/03 | 14:55 | 1044 | 980 | 8 | | | | | | | | |
| 176 | 71 | 58.794 | 172 | 29.634 | E | 03/26/03 | 17:54 | 1031 | 995 | 125 | | | | | | | | stopped ~125 m above bottom due to ice. Numerous ice stops on ut |
| 177 | 71 | 59.046 | 172 | 30.978 | E | 03/26/03 | 21:35 | 937 | 1112 | | | | | | | | | |

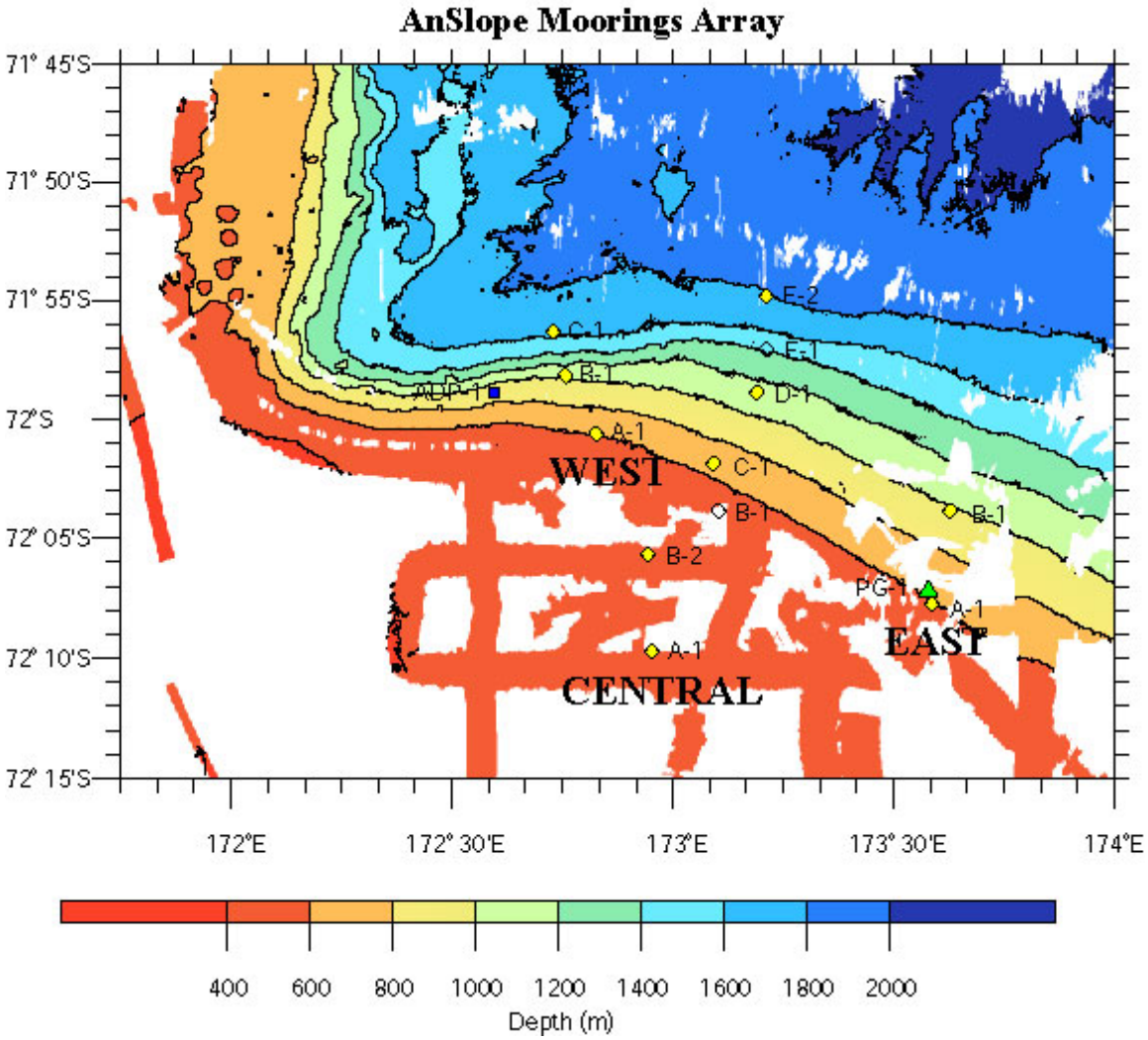
| | Latitude S | | Longitude | | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 178 | 71 | 57.558 | 172 | 32.982 | E | 03/27/03 | 00:02 | 1461 | 1600 | 10 | | | | | | | | |
| 179 | 71 | 59.124 | 172 | 31.944 | E | 03/27/03 | 02:54 | 903 | 1087 | 40 | | | | | | | | large drift caused difficult bottom approach |
| 180 | 71 | 59.490 | 172 | 32.364 | E | 03/27/03 | 05:54 | 820 | 867 | 6 | | | | | | | | end yo-yo |
| 181 | 72 | 07.044 | 172 | 45.294 | E | 03/27/03 | 08:40 | 505 | 493 | 10 | | | | | | | | |
| 182 | 72 | 02.640 | 172 | 42.336 | E | 03/27/03 | 10:13 | 514 | 499 | 10 | | 13 | 12 | | | 12 | 3 | |
| 183 | 71 | 59.940 | 172 | 41.766 | E | 03/27/03 | 11:52 | 671 | 642 | 8 | | | | | | | | |
| 184 | 71 | 57.222 | 172 | 37.230 | E | 03/27/03 | 13:29 | 1480 | 1474 | | | 12 | 12 | | | 12 | 6 | |
| 185 | 71 | 54.660 | 172 | 37.806 | E | 03/27/03 | 15:50 | 1786 | 1806 | 10 | | | | | | | | |
| 186 | 71 | 48.996 | 172 | 38.484 | E | 03/27/03 | 18:22 | 1679 | 1670 | 8 | | 12 | 12 | | | 12 | 5 | |
| 187 | 71 | 35.562 | 172 | 39.462 | E | 03/27/03 | 22:27 | 1787 | 1787 | 8 | | | | | | | | |
| 188 | 71 | 23.814 | 172 | 38.886 | E | 03/28/03 | 01:48 | 2189 | 2212 | 8 | | 24 | 12 | | | 12 | 7 | CFC test ampoules drawn from 2,13,24 |
| 189 | 71 | 12.756 | 172 | 29.046 | E | 03/28/03 | 05:38 | 2255 | 2285 | 9 | | | | | | | | |
| 190 | 70 | 59.988 | 172 | 13.560 | E | 03/28/03 | 11:15 | 2218 | 2235 | 8 | 24 | 24 | 24 | 24 | 24 | 24 | 5 | |
| 191 | 70 | 30.906 | 171 | 00.978 | E | 03/28/03 | 23:20 | 2467 | 2494 | 8 | | 24 | 12 | | | 12 | 7 | CFC test ampoules drawn from 18,23 |
| 192 | 69 | 59.688 | 170 | 01.338 | E | 03/29/03 | 08:39 | 2709 | 2742 | 8 | 24 | 25 | 24 | 24 | 24 | 24 | 4 | |
| 193 | 69 | 29.898 | 169 | 30.324 | E | 03/29/03 | 17:08 | 2721 | 2750 | 10 | | | | | | | | no bottles - no trip confirms so recovered without bottle trips. Problem traced to bad carousel electronics ass'y. Replaced prior to ctd194 at same site.CMiPS removed for safekeeping- will be replaced after ctd 194 |
| 194 | 69 | 28.956 | 169 | 30.630 | E | 03/29/03 | 22:05 | 2728 | 2753 | 8 | | 22 | 12 | | | 12 | 5 | bottles 1,11 air leak; #4 large valve dripped |
| 195 | 69 | 00.078 | 168 | 59.928 | E | 03/30/03 | 05:05 | 2653 | 2656 | 13 | 19 | 24 | 24 | 19 | 19 | 24 | 6 | |
| 196 | 68 | 47.994 | 167 | 29.334 | E | 03/30/03 | 13:02 | 2684 | 2704 | 10 | | 21 | 24 | | | 24 | 5 | |
| 197 | 68 | 29.958 | 166 | 29.268 | E | 03/30/03 | 19:56 | 2647 | 2664 | 8 | 10 | 24 | 24 | 10 | 10 | 24 | 5 | |
| 198 | 68 | 14.964 | 165 | 29.106 | E | 03/31/03 | 03:52 | 2671 | 2693 | 7 | | 14 | 14 | | | 14 | 6 | no bottom contact alarm sounded |
| 199 | 68 | 00.030 | 164 | 59.502 | E | 03/31/03 | 08:52 | 2656 | 2678 | 8 | 12 | 20 | 21 | 12 | 12 | 20 | 5 | air leak bot 7 |
| 200 | 67 | 44.904 | 163 | 59.880 | E | 03/31/03 | 14:55 | 2639 | 2669 | 15 | | 12 | 12 | | | 12 | 5 | no pinger |
| 201 | 67 | 29.640 | 163 | 00.876 | E | 03/31/03 | 21:04 | 2647 | 2670 | 8 | 18 | 18 | 12 | 18 | 18 | 12 | 4 | |
| 202 | 67 | 12.090 | 162 | 00.000 | E | 04/01/03 | 03:35 | 2658 | 2681 | 10 | | 16 | 14 | | | 14 | 4 | |
| 203 | 66 | 59.766 | 161 | 00.192 | E | 04/01/03 | 09:56 | 2670 | 2692 | 8 | 18 | 18 | 18 | 18 | 6 | 18 | 6 | O18 on 16-19,21,23 only |
| 204 | 66 | 53.736 | 159 | 59.826 | E | 04/01/03 | 15:47 | 2618 | 2638 | 8 | | 15 | 14 | | | 12 | | |

| | Latitude S | | Longitude | | | | | | | Water Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CTD | Deg | Min | Deg | Min | | Date m/d/y | Time (z) | Depth (m) | Max Pres | Dist off bot. | He | CFC | Ox | Trit | O18 | Sal | Nut* | Notes |
| 205 | 66 | 47.886 | 159 | 00.210 | E | 04/01/03 | 21:50 | 2748 | 2778 | 8 | | 12 | 12 | | | 12 | | |
| 206 | 66 | 41.418 | 157 | 59.388 | E | 04/02/03 | 04:26 | 2729 | 2758 | 8 | 18 | 19 | 18 | 12 | | 18 | 8 | 23:leak fm bottom O-ring |

## III Moored Current Meters and T/C/P Recorders Array, A. H. Orsi

The AnSlope Mooring Program is lead by A.H. Orsi and T. Whitworth III, Texas A&M University, and D. Pillsbury, Oregon State University. An array of moored current meters, temperature, salinity and pressure recorders were deployed over the Antarctic continental slope near the sill of Drygalski Trough, in the western Ross Sea (FigureIII-1). Measurements from this array will provide information on the flow structure and variability of the Antarctic Slope Front, the water masses carried by its associated current, and the characteristics of the denser bottom water outflow descending from the Trough.

**Figure III-1**




Three groups of moorings (for a total of 12) were arranged around specific isobaths across the eastern, central and western projections of the Drygalski Trough (Table III-1; embedded within the text and as a separate file). Ten moorings on this array are instrumented with a total of thirty Aanderaa RCM8 current meters and twenty one

MicroCat C/T/P recorders, distributed at depths between 400m and the bottom. A separate westernmost mooring was deployed at the 900-m isobath; it is equipped with a near bottom upward looking SonTek Acoustic Doppler Profiler and three MicroCat recorders to provide high-resolution measurements of the benthic layer (750-900m) currents and stratification along the outflow of newly-formed bottom water.

**TABLE III-1 The Moorings**

| MOORING NAME | LATITUDE dd mm.mmm | LONGITUDE dd mm.mmm | DATE INSTALL | DATE RECOVER | TYPE OF INSTRUMENT | SENSORS | DEPTH Meters |
|---|---|---|---|---|---|---|---|
| PG-1 | 72° 07.223' S | 173° 34.696' E | 02-Mar-03 | | SeaCat | C,T,P | 619 |
| | | | | | Bottom | | 620 |
| EAST A-1 | 72° 07.708' S | 173° 35.157' E | 01-Mar-03 | | RCM-8 | T,P,U,V | 397 |
| | | | | | RCM-8 | T,P,U,V | 497 |
| | | | | | RCM-8 | T,U,V | 577 |
| | | | | | MicroCat | C,T | 587 |
| | | | | | Bottom | | 597 |
| EAST B-1 | 72° 03.842' S | 173° 37.684' E | 01-Mar-03 | | RCM-8 | T,P,U,V | 397 |
| | | | | | RCM-8 | T,P,U,V | 597 |
| | | | | | RCM-8 | T,U,V | 977 |
| | | | | | MicroCat | C,T | 987 |
| | | | | | Bottom | | 997 |
| CENTRAL A-1 | 72° 09.701' S | 172° 57.221' E | 02-Mar-03 | | MicroCat | C,T,P | 290 |
| | | | | | RCM-8 | T,P,U,V | 390 |
| | | | | | RCM-8 | T,U,V | 500 |
| | | | | | MicroCat | C,T | 510 |
| | | | | | Bottom | | 520 |
| CENTRAL B-1 | 72° 03.849' S | 173° 06.176' E | 03-Mar-03 | 23-Mar-03 | MicroCat | C,T,P | 304 |
| | | | | | RCM-8 | T,P,U,V | 404 |
| | | | | | RCM-8 | T,U,V | 524 |
| | | | | | SeaCat | C,T,P | 533 |
| | | | | | Bottom | | 544 |
| CENTRAL B-2 | 72° 05.675' S | 172° 56.500' E | 25-Mar-03 | | MicroCat | C,T,P | 278 |
| | | | | | RCM-8 | T,U,V | 378 |
| | | | | | RCM-8 | T,U,V | 498 |
| | | | | | SeaCat | C,T,P | 507 |
| | | | | | Bottom | | 518 |
| CENTRAL C-1 | 72° 01.851' S | 173° 05.518' E | 03-Mar-03 | | MicroCat | C,T,P | 328 |
| | | | | | RCM-8 | T,P,U,V | 428 |
| | | | | | RCM-8 | T,P,U,V | 528 |
| | | | | | RCM-8 | T,U,V | 608 |
| | | | | | MicroCat | C,T | 618 |
| | | | | | Bottom | | 628 |

| MOORING NAME | LATITUDE dd mm.mmm | LONGITUDE dd mm.mmm | DATE INSTALL | DATE RECOVER | TYPE OF INSTRUMENT | SENSORS | DEPTH Meters |
|---|---|---|---|---|---|---|---|
| CENTRAL D-1 | 71° 58.887' S | 173° 11.446' E | 02-Mar-03 | | MicroCat | C,T,P | 423 |
| | | | | | RCM-8 | T,P,U,V | 523 |
| | | | | | RCM-8 | T,P,U,V | 723 |
| | | | | | MicroCat | C,T,P | 923 |
| | | | | | RCM-8 | T,U,V | 1,103 |
| | | | | | MicroCat | C,T | 1,113 |
| | | | | | Bottom | | 1,123 |
| CENTRAL E-1 | 71° 57.090' S | 173° 12.757' E | 03-Mar-03 | 22-Mar-03 | MicroCat | C,T,P | 107 |
| | | | | | RCM-8 | T,P,U,V | 207 |
| | | | | | RCM-8 | T,P,U,V | 407 |
| | | | | | MicroCat | C,T,P | 707 |
| | | | | | RCM-8 | T,P,U,V | 1,007 |
| | | | | | MicroCat | C,T,P | 1,207 |
| | | | | | RCM-8 | T,U,V | 1,387 |
| | | | | | MicroCat | C,T | 1,397 |
| | | | | | Bottom | | 1,407 |
| CENTRAL E-2 | 71° 54.827' S | 173° 12.657' E | 24-Mar-03 | | MicroCat | C,T,P | 380 |
| | | | | | RCM-8 | T,P,U,V | 480 |
| | | | | | RCM-8 | T,P,U,V | 680 |
| | | | | | MicroCat | C,T,P | 980 |
| | | | | | RCM-8 | T,U,V | 1,280 |
| | | | | | MicroCat | C,T,P | 1,480 |
| | | | | | RCM-8 | T,U,V | 1,760 |
| | | | | | MicroCat | C,T | 1,770 |
| | | | | | Bottom | | 1,780 |
| WEST A-1 | 72° 00.603' S | 172° 49.571' E | 06-Mar-03 | | RCM-8 | T,P,U,V | 388 |
| | | | | | RCM-8 | T,P,U,V | 488 |
| | | | | | RCM-8 | T,U,V | 568 |
| | | | | | MicroCat | C,T,P | 578 |
| | | | | | Bottom | | 588 |
| WEST B-1 | 71° 58.182' S | 172° 45.384' E | 06-Mar-03 | | RCM-8 | T,P,U,V | 401 |
| | | | | | RCM-8 | T,P,U,V | 601 |
| | | | | | MicroCat | C,T,P | 801 |
| | | | | | RCM-8 | T,U,V | 981 |
| | | | | | MicroCat | C,T | 991 |
| | | | | | Bottom | | 1,001 |
| WEST C-1 | 71° 56.314' S | 172° 43.656' E | 04-Mar-03 | | RCM-8 | T,P,U,V | 408 |
| | | | | | RCM-8 | T,P,U,V | 608 |
| | | | | | MicroCat | C,T,P | 908 |
| | | | | | RCM-8 | T,P,U,V | 1,208 |
| | | | | | MicroCat | C,T,P | 1,408 |
| | | | | | RCM-8 | T,U,V | 1,588 |
| | | | | | MicroCat | C,T | 1,598 |
| | | | | | Bottom | | 1,608 |
| ADP-1 | 71° 58.887' S | 172° 35.683' E | 06-Mar-03 | | MicroCat | C,T,P | 753 |
| | | | | | MicroCat | C,T,P | 828 |
| | | | | | Doppler CM | T,P,U,V | 887 |
| | | | | | MicroCat | C,T,P | 888 |
| | | | | | Bottom | | 903 |

The deployment of all AnSlope-1 moorings took place during the first week of the cruise, 1-6 March 2003. Unfavorable ice conditions were observed throughout the deployment period and the operational opportunities around the planned mooring sites were much reduced. A decision to not attempt the recovery and redeployment of any of the moorings was made early on. Fast converging ice floes managed to pinch flotation packages and hang three moorings at the sea surface for up to 2.5 hours after anchor launch. In all occasions the freeing of these moorings was possible thanks to Captain Joe's skilful maneuvering of the Palmer. Nonetheless, some instruments were briefly dragged over the ice during the deployment of ice-hang moorings as the anchors eventually fell to the bottom. Because these delayed deployments were also subject to a more significant drift with the ice, the final mooring locations were somewhat off the target isobaths, e.g. moorings Central D-1, B-1, and E-1 landed at 1123m, 544m and 1407m rather than the intended 1000m, 500m and 1600m.

Two of the eleven moorings were subject to relatively high risk of failure for the long-term measuring period. The top instrument of mooring Central E-1 lay just 100m below the sea surface, so that the whole mooring could be dragged and destroyed by passing icebergs. Although the final location of mooring Central B-1 was not ideal, the top two of its four instruments were handled quite roughly during the delayed deployment, likely suffering some damage or malfunction thereafter. These two moorings were recovered on March 22 and 23, 2003. Central B-1 remained hidden under a small ice floe for several hours, while the acoustic release was constantly ranged to narrow down its location. Eventually the Palmer managed to free the mooring by crunching up the offending ice floe.

Except for the top Aanderaa on Central B-1, which experienced a failure of its data storage unit prior to its deployment, data from all other instruments were fully recovered. Three of the recovered Aanderaas had parts replaced prior to redeployment. Preliminary inspection of the data collected from all recovered current meters and MicroCats revealed no gaps or any apparent malfunctioning during the 20-day record length of their first deployment. Central E-2 and Central B-2 moorings were redeployed on March 24 and 25, 2003. Again, less than optimal ice conditions were encountered during these deployments. Central E-2 was suspended from an ice floe for about 35 minutes after anchor launch, and it had to be freed with the Palmer's help.

*Acknowledgements*. The great success of the mooring program carried out during AnSlope-1 was largely due to the detailed and careful direction demonstrated by Jay Simpkins and Kathryn Brooksforce. We are very grateful to Captain Joe for his patience and masterful handling of the N. B. Palmer during mooring work. Deck operations were safe and clear at all times, thanks to the skillful team work provided by Raytheon personnel Steve Tarrant, Annie Coward, Chris McGuire, and Jen Huggins (MTs.); Karl Newyear (MPC); Laura Tudor (MST) and Bruce Felix (ET); Amy Bratcher (Texas A&M university); Bryan Klostermeyer (Coast Guard); Bruce Huber (LDEO); the officers and

crew of the N. B. Palmer (ship's deck machinery); and a legion of other willing assistants that always brought the right instruments at the right time.

# IV Turbulence Measurements, Bottom Pressure Sensor, and Tides Modeling

L. Padman, Earth & Space Research

## CTD-mounted Microstructure Profiling System (CMiPS)

The primary goal of CMiPS is to measure temperature and conductivity gradients (d*T*/d*z* and d*C*/d*z* respectively) at the small spatial scales (~1-20 cm) associated with ocean turbulence and double-diffusive convection. CMiPS records data from two high-resolution temperature sensors and one micro-conductivity probe, plus data from a 3-axis accelerometer and a pressure sensor. Data are recorded internally at 512 Hz per channel, and downloaded after each CTD cast. The effective vertical resolution for vertical gradients of T and C is about 2-5 cm. CMiPS was deployed on most CTD casts during AnSlope-1. The nominal depth rating for CMiPS is 3500 m. The deepest cast during AnSlope-1 was ~2900 m. While not a conclusive observation, it does appear that repeated cycling of CMiPS below ~2000 m degrades the thermistor performance, and we need to look into the manufacturing of new probes for future cruises.

The CMiPS C sensor performed well throughout the program. The primary T sensor (T1) performed well except for a short period (CTDs 155-162). The secondary T sensor T2) was noisier that T1 and in general has not been analyzed at sea since its signal is essentially redundant with T1. The source of the additional noise on the T2 channel has not been determined.

CMiPS is mounted within the CTD rosette, with sensors ~15 cm above the lower rosette frame. To work well, the sensors must see relatively undisturbed water. This is only possible when the CTD fall rate is greater than some value. The standard rate of 50 m/minute generally worked well: the "safety" speeds of 10 and 20 m/minute, used near the surface and when approaching the bottom, generally degrade the data to the point where they cannot be used for turbulence studies. It is possible that some data from the rapidly flowing high-salinity plumes (>120 cm/s) will also be unusable because of the interference from turbulence associated with the rosette cage. In general the most important regions sampled by CMiPS include the base of the mixed layer during periods of significant wind stress, and at the upper edge of cold plumes (both high salinity and low salinity varieties). We also found that, even though large-scale hydrographic conditions are favorable for double diffusive convection (DDC) to occur, no evidence of significant DDC fluxes was found in the CMiPS records, consistent with the dominance of shear-generated turbulence in this region.

Raw CMiPS data are included on the cruise data distribution, but no advanced, processed results are included. These will be web-served after post-processing after the cruise. Plots of roughly calibrated *T*, *C*, d*T*/d*z*, d*C*/d*z*, 3-axis accelerations (Ax, Ay, Az) and filtered fall speed are included in the "Science//NBP0302/CMiPS" directory, along with a README explanatory file. These plots are primarily intended as at-sea quality diagnostics, but can also be used as a rough guide to locating regions of ocean turbulence by focusing on the variance of the d*T*/d*z* and d*C*/d*z* traces.

## Bottom Pressure Recorder (BPR)

The BPR was deployed at 72$^{o}$ 07.223' S, 173$^{o}$ 34.696' E, near the "Eastern-A" mooring. The BPR samples every 30 minutes, and will be used to validate tide models for the region, and in data assimilation studies. The original plan was to recover the BPR towards the end of AnSlope-1 in order to use the 1-month record that we would obtain in AnSlope Year-2 tide-model data assimilation studies. Heavy sea-ice in the region prevented recovery, but the BPR is capable of recording at the present sample rate until recovery in early 2004.

## Tide Modeling

All velocity data, including vessel-mounted and Lowered ADCP (VM-ADCP and LADCP) and ice motion, indicate strong tidal currents in many regions of the AnSlope study area, notably the outer shelf and slope in the western area either side of the mouth of Drygalski Trough. Variability in the ship's ability to move through the ubiquitous thick ice that we encountered this year suggests tidal modulation of the stress divergence on the ice, at least close to the shelf break. Pressure and temperature records from the recovered Central-E and Central-B moorings confirm the strong tides. Ross Sea tides are predominantly diurnal, with the principal components ($K_1$ and $O_1$) having roughly the same kinetic energy levels. The result is a very pronounced spring-neap cycle (~2-week period) from negligible currents at neap tide to spring currents that exceed 1 m/s.

VM-ADCP and LADCP data were frequently compared against the predictions of our barotropic (depth-integrated) tides model, the Circum-Antarctic Tidal Simulation Version 2002.1 (CATS02.01). While more robust calculations will be done after the VM-ADCP data are reprocessed and mooring velocity data become available, it appears now that CATS02.01 underpredicts tidal current magnitudes in the western region by ~25%, and has phase errors of up to 3 hours to the east, past Iselin Bank. In general, these errors can be attributed to bathymetry errors in the model. We will update the Ross Sea bathymetry based on recently acquired depth and multibeam data, and also reduce the grid size for a Ross-Sea-only model from the present ~10 km for CATS02.01 to ~2 km. Increased resolution is necessary to resolve the very steep continental slope to the west of the AnSlope moorings.

*Acknowledgements*. The excellent performance of CMiPS depended heavily on Chris MacKay's patient and methodical handling of the instrument, and the able assistance of the Raytheon Marine Techs, in particular, Steve Tarrant. The large volume of data from CMiPS was managed on the ship's network and backed up by the Raytheon Electronics Techs. Jay Simpkins and Kathryn Brooksforce ably carried out mooring operations in extremely difficult ice conditions. Grateful thanks also to Karl Newyear (Raytheon MPC) for facilitating the logistics associated with CMiPS use in AnSlope, and to Captain Joe, the officers and crew of *N. B. Palmer*, for getting us through the ice to where we wanted to go, and providing a great ship to spend time in.