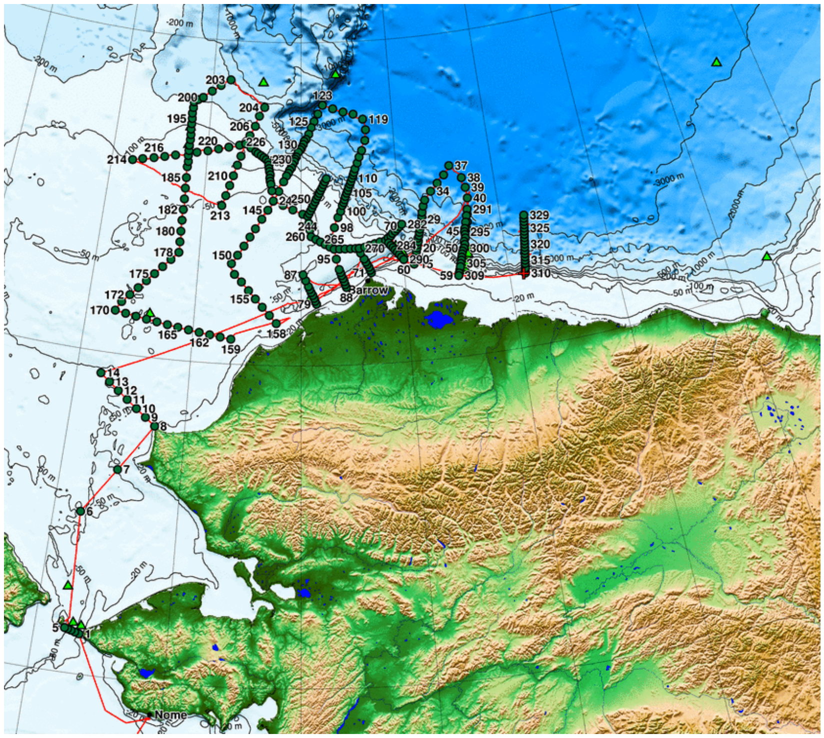
Cruise Report: SBI

(Updated OCT 2010)



Highlights

Cruise Summary Information

WOCE Section Designation	**SBI**
Expedition designation (ExpoCodes)	**320620030705**
Chief Scientists	**Dr. James Swift / SIO** **Dr. Louis Codispoti / HPL**
Dates	05 JUL 2003 - 18 AUG 2003
Ship	*NATHANIEL B. PALMER*
Ports of call	Dutch Harbor, Alaska - Barrow, Alaska
Geographic Boundaries	74.40367 N 168.91787 W 148.63085 W 53.85128 N
Stations	329
Floats and drifters deployed	0
Moorings deployed or recovered	0

Chief Scientists:

Dr. James Swift • Scripps Institution of Oceanography • Oceanographic Data Facility
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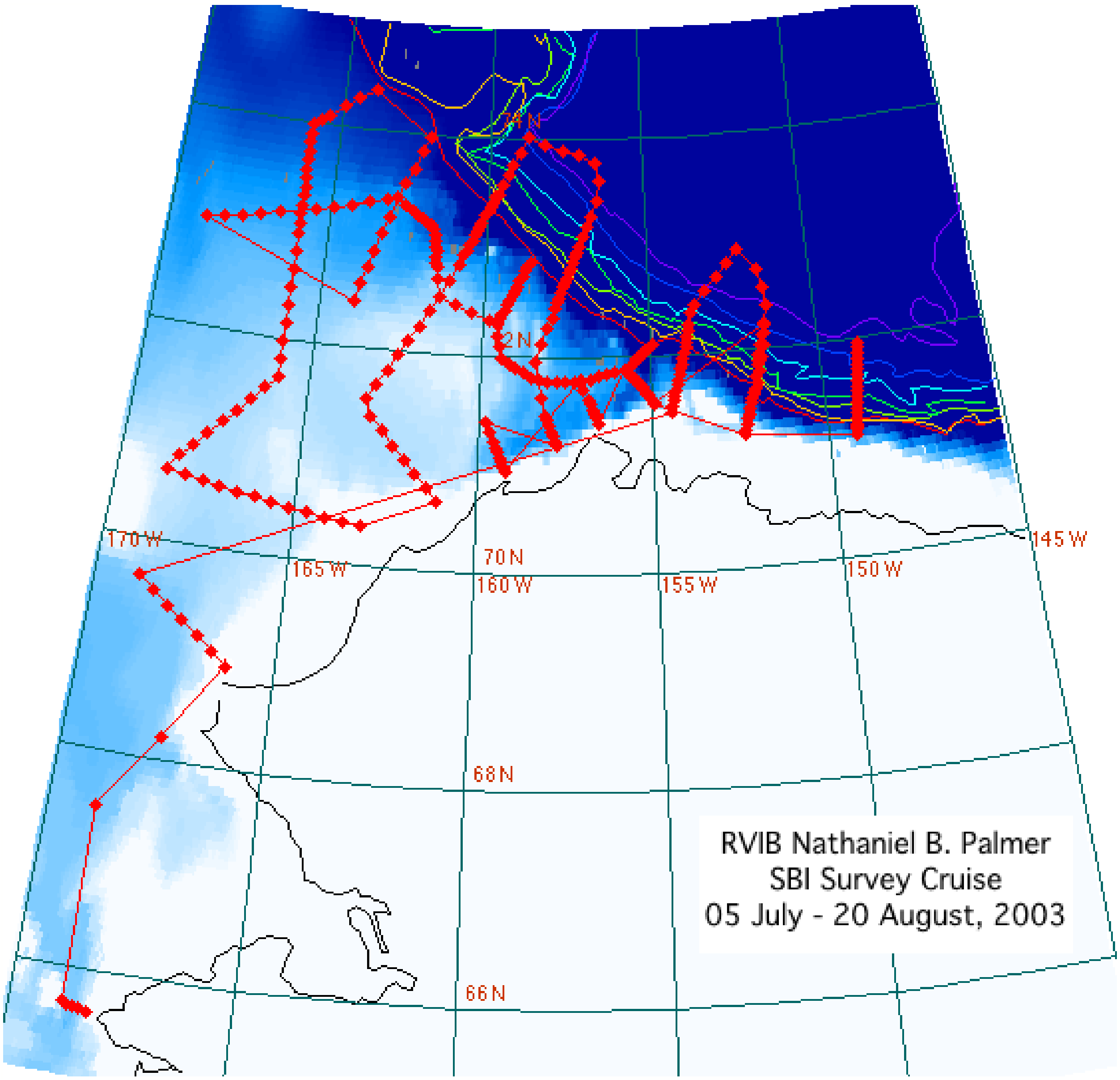
Links to Select locations

Shaded sections are not relevant to this cruise or were not available when this report was compiled

Cruise Report - SBI Survey Cruise RVIB Nathaniel B. Palmer

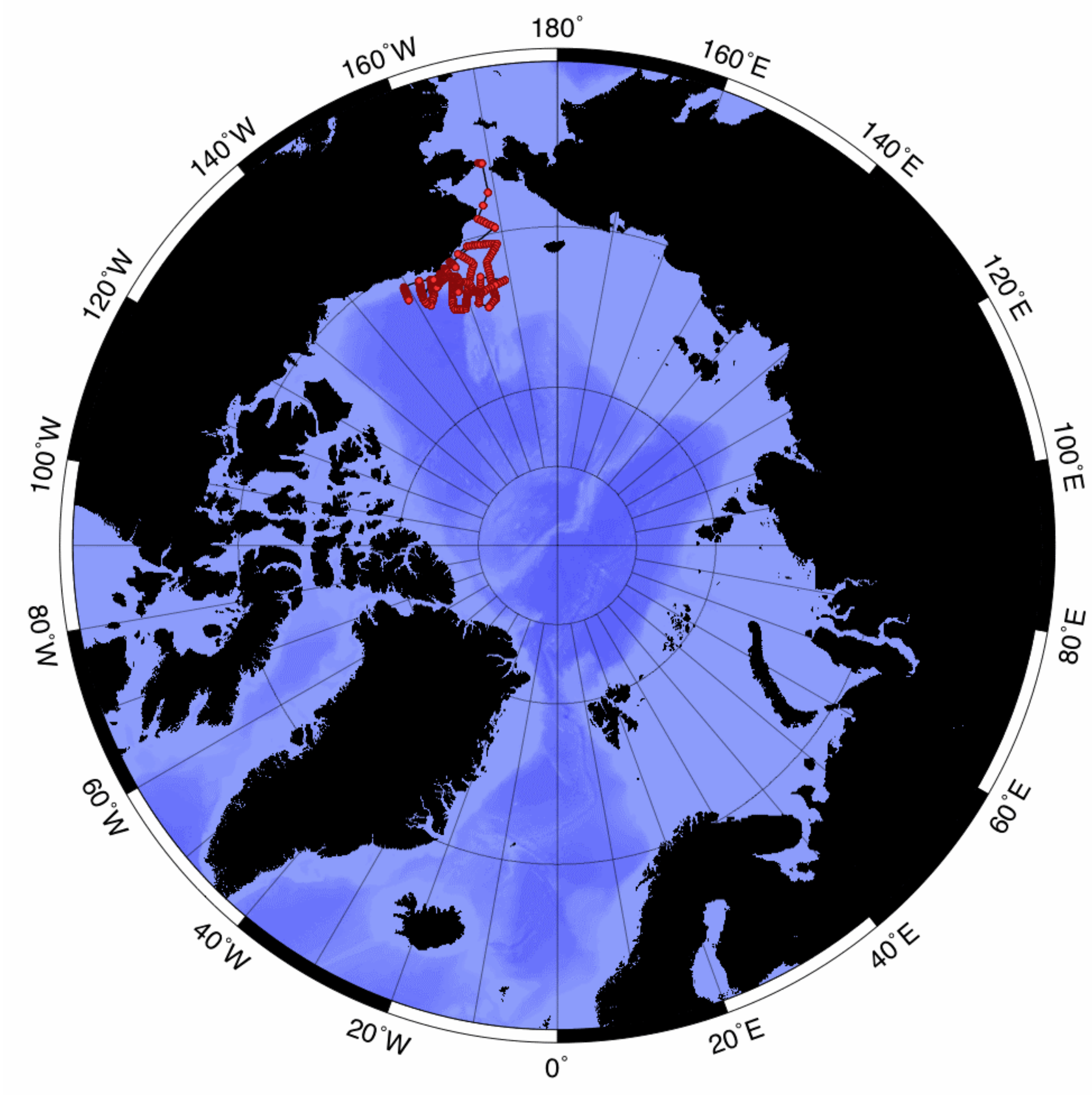
05 July - 20 August 2003

Dutch Harbor to Barrow, Alaska



A colored line joins consecutive stations. From it one may discern that two sections of stations were repeated during the cruise, one near the mouth of Barrow Canyon and the other on the section near 152°W. The shaded bathymetry is drawn from the ETOPO-5 bathymetric database with blue shading chosen to emphasize bottom depth variations nonlinearly between 35 and 500 meters. The coastline and colored isobaths - 500, 1000, 1500, 2000, 2500, 3000, and 3500 meters - were taken from the isobath database prepared by Professor Joseph Reid, UCSD/SIO.

SBI 2003 • 320620030705 • Swift/Codispoti • R/V Nathaniel B. Palmer



Produced by CCHDO

Purpose of the Cruise

The Arctic Shelf-Basin Interactions (SBI) project focuses on shelf, shelf break and upper slope water mass and ecosystem modifications, material fluxes and biogeochemical cycles on the outer shelf and slope of Chukchi and Beaufort seas. This is the region where it is believed that key processes control water mass exchange and biogeochemical cycles, and where the greatest responses to climate changes are expected to occur. The primary scientific goal of the SBI 2003 Survey cruise was to carry out a CTD/lADCP/O_2/nutrient/chl-a survey of the US SBI Phase 2 Field Program study region. It was planned that the survey include high-resolution sections across key regions, cover the entire SBI study area more comprehensively than feasible during other SBI cruises, and repeat one or more of the intensely-sampled sections during the cruise. The cruise was one of eight during 2002-2004 planned for the Western Arctic Shelf-Basin Interactions Phase II Field Program (SBI), and was intended to be the only survey-type cruise of that program. Note:

CTD	Conductivity/Temperature/'Depth'(pressure) measurement device
LADCP	Lowered Acoustic Doppler Current Profiler
O_2	Dissolved Oxygen
nutrient	Silicate, Phosphate, Nitrate, Nitrite, Ammonia, Urea
chl-a	Chlorophyll-a and other related phyto pigments

Pre-Cruise Advisory Planning

Prior to the cruise the SBI Advisory Committee issued the following priorities for the cruise:

1. Occupation of the four shelf-basin sections made during the 2002 process cruises, with close station spacing in the bathymetric zones sampled closely during the 2002 mooring cruise.
2. Reoccupation during the survey cruise (two occupations during the cruise) of as many of the four 2002 shelf-basin sections as feasible. Close spacing on the second occupation if feasible.
3. Occupation of cross-canyon Barrow Canyon sections, including reoccupation during the cruise.
4. Occupation of SBI stations and lines from Bering Strait to just north of 70°N.
5. Occupation of a Beaufort shelf-slope section east of the 2002 sections.
6. Occupation of a meridional section in the western portion of the SBI study area along the longitude where the 2002 mooring cruise carried out a high-resolution section.
7. If time, extending sections, for example extending the shelf-basin sections deeper into the Arctic Ocean interior than was possible in 2002. The SBI Advisory Committee set lower priority to (a) carrying out a meridional section on the far west boundary of the SBI study area (e.g., just east of the treaty line), or (b) carrying out a section along the northern boundary of the SBI study area.

The SBI Science Team chose early/mid-June through July 2003 as the optimum time for the SBI survey cruise, based on overall SBI objectives. The SBI Survey cruise was scheduled on the Antarctic research vessel Nathaniel B. Palmer due to a lack of availability of suitable Arctic-based icebreaking vessels in that time frame. Consultants advised NSF and ECO regarding the ship's ice capabilities versus expected early-mid summer ice conditions in the SBI study region. Their advice was to delay the cruise somewhat to a time with more open areas and larger leads, specifically more navigation room around multi-year floes and chunks.

Acknowledgements

All hands, whether from Edison Chouest Offshore, Raytheon Polar Services, or the nine institutions comprising the scientific party, showed outstanding teamwork and professionalism, working together superbly to bring about this achievement. It is a pleasure to acknowledge and thank the National Science Foundation Office of Polar Programs, not only for the fiscal and logistics support which made this expedition possible, but equally for the continuing advice and encouragement received from our program managers.

If one person were to be singled out for praise - among the many who deserve praise - it would be nutrient analyst Susan Becker (UCSD/SIO). Not only did she cope with a higher daily sample load than usual (the cruise was planned for two nutrient analysts but one was unable to participate), and accomplish this with a 6-channel autoanalyzer significantly more complex and troublesome than the usual 4-channel machine, but she did this while maintaining a standard of data quality that was second to none, period. All on board were continually impressed with her dedication, perseverance, and expertise.

Science Team Personnel

Bruce Andrews	Prism Helicopters	helicopter pilot
Bob Anthony	Prism Helicopters	helicopter mechanic
Craig Aumack	UofTexas	CTD operator, stable isotopes (student)
Susan Becker	UCSD/SIO	nutrient analyst
John Bengtson	NOAA	marine mammal studies
Marie-Claude Beaupre	UCSD/SIO	data processing, chemistry
Jerry Bucher	RPSC	electronics technician
John Calderwood	UCSD/SIO	oxygen analyses, marine/electronics tech
Mike Cameron	NOAA	marine mammal studies
Emily Constantine	RPSC	marine technician
Jesse Doren	RPSC	marine technician
Paul Ellis	UCSD/SIO	oxygen analyses, marine tech
Brent Evers	RPSC	electronics technincian
Kathleen Gavahan	RPSC	computer/network technician
Eric Hutt	RPSC	marine science technician
Eric Johnson	Earth & Space Resources	CTD operator, lowered ADCP
Luther Leavitt, Jr.	Barrow, AK	community participant
Leopoldo Llinàs	UofMiami	CTD operator, plankton tows (student)
Jeremy Mathis	UofMiami	CTD operator, particulate and dissolved organic matter (student)
Charles Menadelook	Little Diomede, AK	community participant
Stephanie Moreland	UofAlaska	pigments
Karl Newyear	RPSC	Marine Projects Coordinator
Robert Palomares	UCSD/SIO	electronic technician, salinity analyes
Jim Rogers	Polson School District, Polson, Montana	Teachers Experiencing the Arctic and Antarctic, sample cop
Kristin Sanborn	UCSD/SIO	data processing
Heather Smith	UofWashington	marine mammal studies (student)
Dean Stockwell	UofAlaska	pigments
James Swift	UCSD/SIO	Chief Scientist
Jim Waters	RPSC	computer/network technician
Jenny White	RPSC	marine technician

Principal Investigators

Patameter	P.I.	Institution
Hydrography	J. Swift	SIO/UCSD
Nutrients, Oxygen, Ammonium	L. Codispoti	HPL
DOC, Chloroa, Phaeophytin, Urea	D. Hansell	RSMAS/MAC

HPL:	Horn Point Laboratory
MAC:	Marine and Atmospheric Chemistry
RSMAS:	Rosenstiel School of Marine and Atmospheric Science
SIO:	Scripps Institutin of Oceanography
UCSD:	University of California, San Diego

Edison Chouest Offshore Personnel

Joe Borkowski III	Captain
Vladimir Repin	Ice Consultant / Navigator
Mike Watson	Chief Mate
Jay Bouzigard	2nd Mate
Robert Potter	3rd Mate
Dave Munroe	Chief Engineer
Johnny Pierce	Chief Engineer
Robert Morris	1st Engineer
Edward Forbes	2nd Engineer
Gerald Tompsett	2nd Engineer
Fredy Dela Cruz	3rd Engineer
Victor Maskey	Oiler
Rolly Rogando	Oiler
Doyle Lee	Oiler
David Cooley	Oiler
Tim Kennedy	Cadet
Ric Tamayo	Deck / Winch Operator
Enrque Alvezo	Deck / Winch Operator
Danilo Plaza	Deck / Winch Operator
Ronald Mack	Deck
Marcelo Mera	Deck
Lorenzo Sandoval	Deck
George Rayford	Deck
Ernest Stelly	Chief Steward
Mark Stone	Chief Steward
Jody Keown	Galleyhand
Alejandra Monje	Galleyhand

Narrative

Most SBI equipment was loaded during the Palmer's pre-cruise port stop in Honolulu, although items were also loaded in Dutch Harbor, Alaska. All members of the scientific party reached the Palmer in Dutch Harbor before departure on 05 July, although many of the group experienced air travel delays of one or two days due to flight cancellations (low ceilings at Dutch Harbor), and so the vessel's departure was delayed about eight hours - into the early evening - to allow those who finally made flights that day to join the ship.

The ship departed Dutch Harbor in excellent weather, and the weather remained excellent during the two and one half day run north to Nome, Alaska. During that time the science party carried out safety and emergency training, brought equipment to final readiness, organized the watch teams, and carried out a CTD/rosette wet test cast. In Nome the Palmer was joined by the helicopter, pilot, and mechanic who were intended to support ice reconnaissance, a marine mammal observation program, and ferrying the science party ashore at the end of the cruise.

The SBI science program began early on the morning of 09 July with a five-station CTD/hydrographic section across US waters in Bering Strait. The stations went well, the only problem of note being a hydraulic failure on the starboard A-frame which cancelled the first of three planned bongo net tows on the section, but that program was soon back in action. Ceilings lowered and fog increased late that morning, making weather unsuitable for flying, so friends of Community Participant Charles Menadelook brought him out to the ship by small boat from his home on Little Diomede Island, after which the Palmer began its steam north to the primary SBI study region over the shelf-slope-basin transition zone.

On 09 July 2003 at 1934 Alaska Time the distinguished Antarctic research vessel RVIB Nathaniel B. Palmer crossed 66 deg 33 min North Latitude, and thus became, for at least one cruise, an Arctic research vessel. One short section across US waters in the southern Chukchi Sea and two other stations were completed during the steam north.

The first high resolution CTD/hydrographic section across the Alaskan continental slope and into the Arctic Ocean interior northeast of Barrow began on 12 July. Stations were only 3 miles apart for much of the section. This provided a finely detailed, coherent view of the variations across the shelf and continental slope. Over the slope concentrations of chlorophyll and dissolved oxygen were high in the biologically active layer and there were strong lateral gradients in nutrients, with appreciable concentrations of nitrite, ammonia, and urea. This contrasted with the basin interior, where the concentrations of these nutrients were very low. There, the underside of the sea ice appeared relatively clean, contributing to the impression of reduced biological activity in the upper layer, compared to the slope region.

Because this was first penetration of the Arctic ice pack by the Palmer, there was much interest in the ship's performance. As it turned out, the ice was mostly broken and loose, with many leads and sometimes considerable areas of open water. Hence the Palmer very rarely experienced any significant impediments to progress, both during this first section and later during the expedition. Ice performance forecasts provided pre-cruise had been based largely on a 1983 statistical compilation. It is the Chief Scientist's opinion that there may have been in the last few years a change in the character of the ice cover on this region from a permanent, multi-year pack ice cover to a more nearly seasonal ice cover, dominated almost to exclusion by first-year ice. This is based, however, on anecdotes from recent cruises and local observers, and even if it is the case, it may represent an anomaly rather than a trend.

The ship returned to the shelf along a second high-resolution section. Both sections were east of Barrow Canyon, the principal bathymetric cut from the deep ocean into the Chukchi shelf in US waters. Because both shelf-basin sections showed a narrow band of high-oxygen water throughout most of the water column, sited over the same isobath, and because other measured characteristics were also distinctive in this zone, this heightened interest in the subsequent oceanographic survey of Barrow Canyon with four high-resolution cross-canyon sections. The first was across the mouth of the canyon, and the second, occupied one tidal cycle later, was approximately 50 km up-canyon, with the other two sections each an additional 50 km up-canyon. Indeed, these proved to be interesting sections from an oceanographic standpoint, each clearly exhibiting zones of water similar to the distinctive waters seen a few days earlier over the Beaufort Slope, the inference being that all six sections had crossed the core of the 2003 version of the Barrow Canyon early summer outflow. There were also hints that the canyon sections crossed shelf outflow water entering the upper reaches of Barrow Canyon on the west side, and then being pushed over to the east side (by rotational effects).

Flying weather had for the most part not been favorable during the first two shelf-basin transects, but near the end of the second transect a change of weather provided fine flying conditions. The marine mammal group completed seven aerial surveys with the helicopter over ice habitats in the basin and shelf zones. They encountered low densities of ringed and bearded seals, with higher densities of bearded seals over the shelf in the marginal ice zone. They also observed numerous groups of walrus at the ice edge, and spotted beluga whales near the shelf slope. Then the weather turned foggy again.

The original plan had been to set Charles Menadelook off at Barrow after 3-5 days aboard but it was not convenient to do so at the time and thus he was aboard 9 days. Finally good flying conditions coincided with proximity to Barrow, and the helicopter flew him ashore and returned with Community Participant Luther Leavitt, Jr., from Barrow. The Palmer was just offshore of Barrow at the same time that the Sir Wilfrid Laurier was disembarking a science party including Jackie Grebmeier of the SBI Advisory Committee.

Meanwhile, after a short crossing of the shelf near Barrow Canyon, the cruise continued with another pair of high-resolution shelf-slope-basin sections, this time west of Barrow Canyon, first doing the eastern member of the pair and then the western section. As the of this section pair progressed and the daily data updates were assembled, it became clear that on the eastern section a trio of eddies had been crossed, two of which had distinctive halocline cold, high-oxygen cores.

It is worthwhile mentioning that the LADCP program had been off to a slow start on this cruise regarding interpretation due to problems with the software used to process the data. But about the time the first of the west-of-Barrow-Canyon sections were being run, LADCP plots were coming available. These showed a velocity structure to the eddies which extended laterally well past the cold-core signature. In fact, some of the highest velocities were in an outer layer which was high in nutrients and low on oxygen, giving rise to speculation that the core and edge waters had split from a source region as a unit.

On the first of the western pair of sections there were no obvious signs of upper slope water property structures similar to those that had led to the Barrow Canyon outflow, i.e. there were at first no obvious signatures of a similar outflow from Herald Valley, a canyon in the shelf nominally upstream from the section. There was then a growing realization that while this was true, there had been a second distinctive water type in Barrow Canyon on its west side, low in oxygen and high in nutrients. This water was not seen on the eastern member of the pair of shelf-slope-basin sections west of Barrow Canyon but was clear on the western member of the pair. This observation of water to the west of Barrow Canyon nearly the same as water in Barrow Canyon, but apparently separated by a zone where that water type was not found, later became an important element in the planning of the final third of the expedition.

The next planned activity for the cruise was a shelf survey to map out whatever regional property variations occurred there. The depth of the shelf is about 50 meters, so casts were short and survey progress was usually rapid.

It should be mentioned that the marine mammal program was impacted by unsuitable flying weather but the team felt that they were proceeding well despite intermittent foggy days. During aerial survey flights over ice habitats in the basin and shelf zones they encountered low densities of ringed and bearded seals, with higher densities of bearded seals over the shelf in the marginal ice zone. Numerous groups of walrus were also observed at the ice edge, and beluga whales were spotted during the surveys near the slope of the continental shelf.

During all four excursions well into the Canada Basin none of the predicted multiyear ice was observed. Ice concentrations were sometimes high, but the ice was first-year ice with no large or consolidated floes. Most of the ice was rotten and in apparent melt, although nearer the ice edge on the Chukchi shelf there was a band of heavier ice, mostly pieces of pressure ridge and jumbled ice, that presented a much different appearance. But in the far north, as over most of the area, there were substantial open areas, some so large that ice was difficult to see in some directions. This is similar, if not even more open conditions, to ice observations made from the Polar Star during the 2002 Chukchi Borderlands field program.

The bongo net tow program decreased its frequency of casts mid-way through the cruise because good catch success earlier in the cruise was using up preservatives and sample jars faster than expected.

On 28 July it was necessary to reterminate the CTD wire: During a cast there was an unidentified error but with the bottom contact switch suspected even though the rosette was 1250 meters above the bottom. After aborting the cast and inspecting, the cast was begun again but an identical error occurred. On the third try, the cast worked OK until the deck unit lost power on the up cast. Eventually it was determined there was an electrical arc between two pins on a data cable which disabled the main CTD underwater unit (the 'fish') and possibly blew a fuse in the deck box. In short order the central CTD underwater unit was installed, along with two new sensor cables, and the wire was reterminated. The casts following this procedure were problem-free.

At the completion of one of the shelf sections of CTD casts and bongo net tows, the vessel was a few miles off the Alaskan coast, southwest of Wainwright. This afforded an opportunity to fly the second Community Participant, Luther Leavitt, Jr., back to Barrow some 75 miles away. His stay on board turned out to be 12 days, instead of the 3-5 planned, due to the sparse coincidence of proximity to Alaska with flying weather. For that matter the weather was a bit foggy for the return flight, but the expert crew from Prism Helicopters took all necessary precautions and made the trip safely.

The next shelf section took the vessel west, closer to Russian waters, into an area anticipated to be a source region for water similar to the low oxygen, high nutrient Barrow Canyon water. Indeed, that turned out to be the case, temporarily deepening the mystery attending to the path the water would take if it were to reach a Barrow Canyon without crossing the first of the shelf-slope-basin sections west of Barrow Canyon.

On 02 August there was radio contact with the Xue Long, a Chinese vessel conducting SBI-like research in the area. The vessel was actually quite close by, but heavy fog made sighting impossible.

From the individual CTD profiles from the shelf survey, the larger spatial structure of the property distributions was not always apparent. Sometimes there were three or more layers at a shelf station, and when the individual profiles were combined into the long sections which formed the survey, meaningful patterns came clear. It was possible to trace a Bering Strait component with an unusual nutrient signature, to locate a shelf region where the near-bottom waters are very high in nutrients, to uncover transition zones where the chlorophyll maximum shifted significantly in the vertical, and to identify areas where shelf waters might break into the slope region.

On 04 August the Palmer reached the highest latitude for the cruise, and also completed the top priority aspects of the cruise, with two weeks of sampling time remaining. A plan was devised for the remainder of the science time which permitted reoccupation of two sections done earlier during the cruise and conduct a survey of the outer Chukchi shelf, a survey which it was hoped would identify better the sources and pathways of the low oxygen, high nutrient shelf bottom water. The outer shelf section included a section along the shelf edge, including closely-spaced stations across the mouth of Herald Valley, and two spur sections over the slope into the Canada Basin. The hydrographic data defined a likely path for the high-nutrient shelf bottom water around subtle bathymetric features into Barrow Canyon, a path that bypassed the first of the long shelf-slope-basin sections west of the canyon. The lowered-ADCP data revealed a shelf edge flow supporting these inferences. The earlier deep basin observations of high-nutrient outer reaches on cold core eddies may indicate one mechanism which could move these waters away from the slope into the basin interiors.

Next came a reoccupation of the section of stations across the mouth of Barrow Canyon, followed by a repeat of the section of stations east of Barrow Canyon, both in the vicinity of SBI moored arrays.

The sampling program for the cruise concluded with a section of stations from the Beaufort shelf to the deep Canada Basin, east of any yet done for the SBI program. When this section began the ship was in open water while the winds rose and were sustained to over 25-30 knots. The ship handled well in the developing swell, and other than some wave slop wetting down the Baltic Room there were no untoward incidents. By the time the section was completed, early on 17 August, the weather had improved and the seas were slowly dying. Surface salinities were low at the easternmost locations, perhaps due in part to presence of Mackenzie River water as well as summer ice melt. There was a surprise oceanographic feature seen at the final stations over the Canada Basin: a strong westward flow of water with nearly identical properties to those over the Beaufort slope.

During the last three days of the cruise, samples were analyzed, data were processed, science equipment was packed and secured, the laboratories were cleaned, and other final business of a research expedition was completed. The CTD/rosette and most other data which were the prime product of the cruise were prepared for posting at the SBI website hosted by JOSS, so that SBI investigators could begin working with what the sea team provided.

The primary and secondary CTD temperature and conductivity sensors remained in use throughout the cruise. Near the end of the cruise, as the final section was being completed, the oxygen sensor failed. Its replacement was a little slow to settle in, causing a loss of CTD oxygen sensor data in the upper layer at two stations. But the deeper oxygens fit quite well with those from the previous oxygen sensor.

A realtively frequent problem with the CTD data in some regions was apparent ingestion of biological debris (or, by observation, entire organisms such as jellyfish) into the CTD pumps and sensors. Sometimes this cleared rapidly, but at other times it was necessary to haul the package out of the water and flush out the sensors. Another ongoing problem was modulo noise errors, sometimes 0-3 per cast but occasionally much more often. An investigation of the severity and effect of these errors is planned after the cruise. It was, however, possible to process all CTD data except for a very few severely impacted groups of CTD data scans.

262 stations were planned, an optimistic number which assumed good progress in the ice and few problems with equipment. The final tally was 329 CTD stations and 90 vertical bongo net tows completed, evidence partly of the easy ice conditions but mostly of outstanding teamwork and professionalism.

Three graduate students were funded by NSF to participate at sea. They not only ran CTD and bongo tow casts, but also helped with sampling, carried out research programs of their own (and of their advisors), and worked up property-property plots and vertical sections comparing the 2003 data to data from the three 2002 SBI cruises, and excellent plots of the ship's underway data.

The lowered-ADCP was a very useful adjunct to the CTD profiles. The ship's hull-mounted ADCP did not perform acceptably in shallow water (a known and expected problem) and so the LADCP velocity profiles were the only velocity measurements during approximately one-half the cruise. The velocity profiles show features which fit well with the hydrography across each section, and there were substantive velocity features geographically consistent between sections.

The marine mammal surveys produced good results, although unfavorable weather limited use of the helicopter. Across the study area, the team observed lower densities of seals than expected, presumably due to declining haulout rates following the annual molting period. Consistently high densities of walrus were observed hauled out on a band of ice just inside the outer fringe of the marginal ice zone.

Cruise participants were treated to frequent wildlife sightings: bald eagles and puffins in Dutch Harbor, polar bears, walrus, and seals in the pack ice, and whales as well as various species of sea birds. This and views of the ever-changing ice added welcome reprieve from the sometimes unending-seeming sequence of stations.

The SBI Survey cruise was also host to Jim Rogers, a high school teacher from Polson in northwestern Montana (and an avid birder), supported by the NSF's Teachers Experiencing the Antarctic and Arctic program. He stood watch (as sample cop) and participated in the overall program. He made a verified sighting of an Ivory Gull during this trip, a species that breeds in eastern Arctic Canada but is rarely found near Alaska. His URL <http://tea.rice.edu/tea_jrogersfrontpage.html> includes logs and photos about life and work aboard the Palmer and the people who participated in this cruise.

The first steps of the trek home for the scientific party commenced from Barrow, which was hosting a conference that completely filled the town. But the same flights which brought the conferees to Barrow had plenty of empty seats heading south. Personnel, luggage, and cargo were disembarked via helicopter flights during 18-20 August as the Palmer stood offshore.

RVIB Palmer returned to Dutch Harbor, and then sailed on to Honolulu, where most SBI equipment was unloaded, finally heading to port in New Zealand.

Hydrographic Measurement Techniques and Clibrations

5 July to 20 August 2003

On board team:

Kristin Sanborn, Marie Beaupre, Susan Becker, John Calderwood, Paul Ellis, Rob Palomares Other team members: Leopoldo LLinas, Jeremy Mathis, Craig Amuck, Jim Rogers (TEA), Dean Stockwell and Stephanie Moreland (Chlorophyll), Charles Menadelook (Community Participant), Erik Johnson (LADCP and ADCP)

Data Set Overview

329 CTD stations were occupied. Eight of these stations had aborted casts, Cast 1 on stations 027, 175, 227, 282, 310and 313. Station 132 had 3 aborted casts and Station 032 cast 1 was a special cast for C13, N15 and is not reported in the CTD data set. Stations 69, 70 and 329 did not have any water samples. Also note that an ADDENDUM with data quality notes based on a post-cruise QA analysis is appended to this report.

Instrumentation

CTD casts were performed with the Raytheon Polar Services Company's (RPSC) rosette system consisting of a 24-place rosette frame with 10-Liter Niskin-type bottles equipped with internal plastic coated springs and a 24-place SBE-32 Carousel pylon. Underwater electronic components included the following:

Sea-Bird Electronics, Inc. (SBE) 911plus CTD,
WetLabs C-Star transmissometer with a 25cm pathlength and 660nm wavelength,
Biospherical Instruments, Inc. Photosynthetically Active Radiation (PAR) sensor,
Chelsea MkIII Aquatracka fluorometer, and
Simrad, 5 volt = 500 meters altimeter.

Additionally a Dr. Haardt fluorometer designed to detect colored organic matter (CDOM) and a Woods Hole Oceanographic Institution (WHOI) Lowered ADCP pair were mounted on the rosette. The CTD, transmissometer and fluorometers were mounted horizontally along the bottom of the rosette frame. The PAR sensor was located at the top of the rosette. All sensors except the LADCP were interfaced with the CTD system. This instrument package provided pressure, dual temperature and dual conductivity channels as well as light transmissivity and fluorometric signals at a sample rate of 24 scans per second. The CDOM fluorometer was removed from the package at Station 020 after it was finally deemed inoperative. At Station 137, a WetLabs fluorometer was added for an additional fluorometric trace.

The rosette system was suspended from a standard UNOLS 3-conductor 0.322" electromechanical cable.

CTD serial number 09P4857-0232 with a 401K-105 pressure sensor, S/N 43528, was used for Stations 1 through 132, cast 3. For the remainder of the expedition CTD serial number 09P10716-0377 with 401K-105, S/N 58949, was used. Serial numbers for other sensors are listed in Table 1. Mounting heights for sensors are listed in Table 2.

TABLE 1: Instrument/Sensor Serial Numbers

Primary Temperature	Primary Conductivity	Secondary Temperature	Secondary Conductivity	Pressure	Transmissometer
SBE 3plus	SBE 4C	SBE 3plus	SBE 4C	401K-105	C-Star
03-2367	04-2513	03-2299	04-2067	43528/58949	CST-397DR

Dissolved Oxygen	Fluorometer	PAR	Altimeter	Auxiliary Fluorometer
SBE 43	Chelsea Aqua 3	QSP-200	Simrad	WetLabs AFL
0080/ 0139	88080	4361	9704077	AFLD-016

Equipment Positions

TABLE 2: Instrument mounting heights

Sensor	Height above base of rosette	Sensor	Height above base of rosette
Altimeter	15 cm	Pressure	17 cm
Transmissometer	8 cm	T (pri)	15 cm Sta. 1-213
Fluorometer (Chelsea)	9 cm	T (sec)	12 cm Sta. 214+
Fluorometer (Haardt)	18 cm Sta. 1-20	Par	180 cm Sta. < 1000m
Fluorometer (Wetlabs)	18 cm Sta.< 1000m	"Zero"	253 cm

The temperature, conductivity, and oxygen sensors were mounted on a panel on the rosette frame. The horizontal separation between primary and secondary intakes was ~50 cm on Stations 1-204. For Stations 205-213, the separation was reduced to ~33 cm. After Station 213 the mounting was changed again, positioning the intakes ~10cm apart. The vertical distance between the TC duct intakes and the pressure sensor was 2 cm on Stations 1-213. Starting with Station 214, the intakes were 5 cm below the pressure sensor.

The distance of the mid-points of the 10-Liter Niskin bottles from the bottom-mounted sensors was ~0.97 m. The PAR sensor was ~0.66m above the mid-point of the Niskin bottles. The distance between the PAR sensor and the pressure sensor was ~1.64m. The 10-Liter Niskin bottles are ~0.87m long.

The 10-Liter Niskin-type bottles were equipped with Buna-N O-rings and the springs were coated with epoxy to minimize the occurrence of rust. They were inspected before the cruise. Problems with the bottles were reported to the RPSC MTs, who inspected and made repairs as required. Any necessary touch-ups were done with Scotch-Kote and allowed to air dry for 24 hours before being put back into service.

Problems & Changes to Instrumentation

- The Haardt Fluorometer was removed after Station 20. This instrument did not respond to the water column.
- CTD -0232 failed at Station 132 during cast 03. CTD -0377 was installed before Station 132 cast 04.
- A WetLabs AFL fluorometer was attached at Station 137 to confirm the response of the Chelsea fluorometer

- Dissolved Oxygen sensor #0080 (SBE 43) failed at Station 318. Another SBE 43, #0139, replaced it for the remaining stations.

Overview of Science Programs

CTD Measurements

There was at least one (almost always only one) CTD/rosette cast at each SBI station, using USAP-owned SeaBird 911+ CTDs. There was a dissolved oxygen sensor on the CTD. Although the O2 data were not processed, availability of the O2 traces during the down cast was of great assistance with guiding bottle sampling in these waters. Also, the unprocessed CTD oxygen profiles were useful in assessing the bottle oxygen measurements. In addition to the P, C, T, and O2 data from the CTD, there were transmissometer, fluorometer, Haardt fluorometer, and PAR sensor data from the SeaBird. The Palmer's CTDs were used, augmented with some ODF and SBI sensors. ODF calibrated the pressure sensors in advance of the cruise.

The investigator for the Haardt fluorometer is Dr. Ron Benner (University of South Carolina; benner@biol.sc.edu; 803-777-9561). He was not on the cruise. ODF looked after this instrument.

There was a lowered-ADCP on the rosette. The PI supplying the lowered ADCP was Dr. Robert Pickart (WHOI; rpickart@whoi.edu; 508-289-2858). The person responsible for the lowered ADCP and hull-mounted ADCP data during the cruise was Dr. Eric Johnson (Earth and Space Research; ejohnson@esr.org; 206-726-0501 ext.12).

The CTD was mounted on an RPSC 24-place rosette frame, with SeaBird pylon, and outfitted with 24 10-liter ODF-constructed bottles owned by RPSC. ODF will supplies a Simrad xxxxxx altimeter as part of the underwater package.

The RPSC CTD contacts were Karl Newyear (NewyeaKa@usap.gov) and Paul Olsgaard (OlsgaaPa@usap.gov). ODF CTD contacts were Robert Palomares (ET; rpalomares@ucsd.edu; 858-534-1907), Kristin Sanborn (data processing; kris@odf.ucsd.edu; 858-534-1903), and Marie Beaupre (data processing; marie@odf.ucsd.edu; 858-534-1906).

*bottle sampling depth*s

Bottle sampling depths on this cruise were focused on obtaining samples from cores of principal water masses, well-mixed layers, 20-meter or less bottle spacing through the halocline, primary extrema of T/S/O2, and near-bottom. Standard sampling depths applied to a degree.:

salinity

The CTD exhibited stable conductivity behavior, and thus primary salinities came from processed CTD data. Salinity samples were drawn and analyzed to calibrate the CTD. This ranged from a minimum of 2 samples to a maximum of about 12. ODF used the Palmer's Autosal.

oxygen

A dissolved oxygen value was obtained from each level sampled with the rosette. There were 3422 oxygen analyses. ODF supplied the equipment and personnel for dissolved oxygen analyses. The primary contact is Susan Becker (SIO/ODF; susan@odf.ucsd.edu; 858-534-9831).

nutrients

A 6-channel suite of nutrient values was acquired from each level sampled with the rosette. The total was 3422 nutrient analyses. ODF supplied the equipment and all chemicals. The primary contact is Susan Becker (SIO/ODF; susan@odf.ucsd.edu; 858-534-9831).

Chl-a and other Pigments

Samples for pigment analyses were drawn from a subset of the rosette bottles and analyzed on board by a two person team from the University of Alaska, Fairbanks. The primary contact is Dr. Dean Stockwell (dean@ims.uaf.edu; 907-474-5556).

DOM Sampling

Samples were drawn, frozen, and stored for Dissolved Organic Matter for return to shore. Equipment, any chemicals, and one person will be provided by the University of Miami (Jeremy Mathis; jtmathis@hotmail.com). Freezer storage space is required for the samples. The pre-cruise contact is Dr. Dennis Hansell (University of Miami; dhansell@rsmas.miami.edu; 305-361-4078).

$^{18}O/^{16}O$ Sampling

Sampling containers were provided for oxygen-18 samples. The requested samples were collected and returned to shore for analyses. The data contact is Dr. Lee Cooper (lcooper1@utk.edu; 865-974-2990; fax 865-974-7896).

Plankton Tows

A total of 90 vertical bongo tows were completed aboard the 2003 SBI cruise. Of these, 12 tows were to depths of 1000 meters while the rest were to depths of 100 meters or shallower. These tows resulted in 180 preserved zooplankton samples along the arctic coast in two distinct size fractionations (>335 mm and >153 mm). Another 150-160 samples were preserved for molecular analysis. Dry weight percentage at three different size ranges (>1050 mm, 1050>x>550 mm, and 550>x>202 mm) was also calculated at 80 sites from both fractionations. The data contacts are Dr. Sharon Smith (University of Miami; ssmith@rsmas.miami.edu; 305-361-4177) and Leopoldo Llinás (University of Miami; lllinas@rsmas.miami.edu; 305-361-4702).

Stable Isotopes

Over 400 samples were taken for isotopic analysis ($d^{13}C$ and $d^{15}N$). Of these, 180 were organic particulate (POM) samples. The rest were a variety of zooplankton collected from individual bongo tows including the copepods *Calanus glacialis*, *Calanus hyperboreus*, *Metrida longa*, and *Paraeuchaeta novergeica*. The data contact is Dr. Ken Dunton, University of Texas, xxx-xxx-xxxx, xxx@xxxxx.edu.

The plankton and stable isotope teams note that the number of sampling locations and opportunities far exceeded their expectations. As such, the 2003 summer cruise aboard RVIB Palmer was considered a huge success by both the zooplankton ecology and marine botany representatives.

Underway Systems

Multibeam sonar data was acquired. A display available in the vicinity of the CTD operator, and the multibeam data were recorded (without post-processing), and the data provided to JOSS.

An underway measurement suite including centerline depth to bottom, seawater temperature & salinity, fluorometry, ADCP, standard meteorological parameters, position, time, ship speed/heading/etc., and other routine parameters was carried out by RPSC technicians.

TEA

Jim Rogers, a science teacher from Polson, Montana, was on board experiencing oceanographic field research first hand as part of NSF's Teachers Experiencing the Antarctic and Arctic program. He stood watch as a sample cop, and worked on other TEA activities. Contact information: phone 406-883-3611; jrogers@polson.k12.mt.us.

JOSS

The cruise wassupported ashore by the SBI team at the Joint Office for Science Support at UCAR. This included data catalogs, data distribution, cruise maps, cruise reports, etc. Contact: Jim Moore, JOSS; jmoore@ucar.edu; 303-497-8635.

Marine Mammal Survey

Marine mammal surveys were carried out transparent to the CTD survey program on a not-to-interfere basis. The primary marine mammal program was helicopter-borne sweeps on specified tracks with a team of two observers. Contact: John Bengtson, NOAA; john.bengtson@noaa.gov; 206-526-4016.

Raytheon Polar Service Corporation (RPSC)

There were 9 RPSC technicians on the cruise, each working 12-hour shifts: one Marine Projects Coordinator (MPC), one marine science technician, 3 marine technicians, two network/computer techs, and two electronics techs.

RPSC techs supervised rosette launch and recovery.
RPSC techs handled underway data logging, including systems maintenance and routine review of data for reasonableness.

RPSC techs carried out multibeam sonar data logging, including system maintenance and routine oversight of data for reasonableness.

Network assistance and email was handled by the RPSC techs.

Hazmat laboratory wastes were collected in RPSC-provided containers. RPSC handled the paperwork.

LADCP Data Collection Summary (Earth and Space Research)

The Lowered Acoustic Doppler Current Profilers were deployed and returned data from all 329 stations of the RVIB Nathaniel B. Palmer's 2003 SBI cruise. The first 44 stations were compromised by compass errors in the downward looking instrument, apparently due to a coil of power leads secured to the rosette framework nearby. This problem has been corrected in the data processing by rotating to the upper instrument's compass which was not significantly affected. Of the 329 stations 316 have been successfully processed and made available in Matlab format as vertical profiles of velocity. Of the 13 stations not yet successfully processed 6 consist of upward-looking data only, and cannot be processed without further software modifications. The other seven unprocessed stations consist of data taken in shallow water using instrument settings optimized for deeper water. These stations should be recoverable with more robust processing software, though vertical resolution is likely to be poor.

The data itself are very robust except were shallow water limited the range and duration of data gathering. Tidal amplitudes appear to be small in that no obvious tidal signal has been discerned, consistent with expectations reported from tide models. The outstanding features include strong flow down Barrow Canyon during the earlier part of the cruise with some evidence of water feeding into it from the surrounding shelf; strong eastward flow along the shelf edge east of Barrow canyon, evidently a continuation of its outflow; a lesser outflow from Harold Valley to the west: and seaward of these a consistent westward flow along the outer shelf edge, particularly massive in the last, eastern-most section. Beyond this westward flow there is abundant evidence of eddies that were not fully resolved by the sampling scheme. Velocity in the aforementioned major features ranges from 30 to 110 cm/s. Over the shelf smaller, more confused velocities prevailed. Their significance is not yet apparent, and they certainly contain aliased time and space variability. Nevertheless it is possible that in conjunction with the hydrography they may yet prove useful in outlining some general sense of water mass movement across the shelf.

Technically the only result worth mentioning is that shallow water results were much improved by restricting the instruments to only twelve 5 m bins, lengthening the ping interval to 1.5 sec, and switching to broadband mode to enhance data reliability at shorter ranges.

CTD Data

CTD Laboratory Calibration Procedures

Pre-cruise laboratory calibrations of CTD pressure, temperature and conductivity sensors were used to generate coefficients for the calculation of these parameters from their respective sensor frequencies. The conductivity and temperature calibrations were performed at Sea-Bird Electronics, Inc. in Bellevue, Washington. Calibration of the pressure sensors was performed by SIO/STS/ODF personnel. The laboratory temperature calibrations were referenced to the International Temperature Scale of 1990 (ITS-90).

CTD Data Acquisition

The CTD 911plus was operated generally as suggested in the Sea-Bird CTD Operating and Repair Manual, which contains a description of the system, its operation and functions (Sea-Bird Electronics, Inc., 2002). Unlike Sea-Bird's suggested procedure, data acquisition was started on deck. This allows a check of the pressure offset and an unblocked reading from the transmissometer. The SeaSave acquisition program, (SeaSave WIN32 Version 5.28e,) provided a real-time graphical display of selected parameters adequate to monitor CTD performance and information for the selection of bottle-tripping depths. Raw data from the CTD were archived on the PC's hard disk at the full 24 Hz sampling rate.

A CTD Station Sheet form was filled in for each deployment, providing a record of times, positions, bottom depth, bottle sampling depths, and every attempt to trip a bottle, as well as any pertinent comments. When the equipment and personnel were ready, data acquisition was started.

After activation, the rosette/CTD system was lowered into the water and held at 5 meters for 3-5 minutes to permit activation of the CTD pumps and equilibration of the sensors. Then, the operator requested that the CTD be brought to the surface. Once at the surface, usually 2-3 meters depending on sea-state, the operator requested that the winch operator start the package down to a desired target depth, usually within 5-10 meters of the EM-120 Multibeam depth reading. Just as the winch operator started the package down, the CTD operator created a flag in the "inventory" file. The operator also created a flag at the deepest point of the cast. Bottom depths were calculated by combining the distance above bottom, reported by the altimeter, and the maximum depth of the CTD package when bottom altimeter readings were available. If there was no altimeter reading, then the bottom depth is reported from the ship's Seatex Seapath 200 depth recorder. This depth, corrected for the draft of the transducer, was logged in uncorrected meters (assuming a sound velocity of 1500 m/sec). If the altimeter and depth recorder data were unavailable, the final resort was to use depth data from the Multibeam system (corrected sound velocities). The CTD operators were instructed to wait for the sensor readings to stabilize, at least 30 seconds, before tripping the bottle.

The depth of each bottle trip was written on the station log and flagged in the data file. The performance of all sensors was monitored during the cast. Prior to recovering the rosette, the operator created a flag marking the end of cast. When rosette recovery was complete, the operator ended data acquisition. Any faulty equipment or exceptionally noisy data were noted on the log sheet.

Problems and Procedural Changes

- Prior to station 114, position information was not being appended to every scan.
- At Station 132, cast 3, the primary CTD blew a fuse. For some stations preceding there had been an inconsistent number of modulo errors, dropping of bytes in the data stream.

- After Station 174, a procedure of using a detergent solution to flush the sensors after every third shallow station was adopted.
- After Station 284, the equilibration depth was increased to 20 meters.

  (At Station 284, after detergent cleaning, a ~20 minute clean water flush, and clearing the air bleed, the sensors failed to clear. The CTD was sent down to 20 meters and the problem cleared. We suspect that bubbles were being trapped within the conductivity cell, and pressure and agitation were required to dislodge them.)

CTD Data Processing

Pressure

CTD values determined on deck before and after each cast were compared to determine a pressure offset correction. The comparison suggested that no pressure offset was necessary.

Temperature

The primary temperature sensor was calibrated just before the expedition. The dual temperature sensors were monitored during the expedition and exhibited good agreement. It appears that no additional corrections need to be applied.

Conductivity

Corrected CTD pressure and temperature values were used with bottle salinities to back-calculate bottle conductivities. Comparison of these bottle values with the CTD primary conductivity values indicated that a slope and offset needed to be applied to the data from the beginning of the expedition. The sensors drifted over the length of the expedition and an additional slope and offset should be applied to the data. This has not been done as there was not enough time to finish this process. It is anticipated that the correction would not be more than 0.003 and may be applied to the data after Station 121.

Transmissometer

A WetLab calibrated Transmissometer was utilized throughout the cruise. An on deck calibration check was performed and even though there was little degradation from the last calibration the new coefficients were applied to the data set.

Oxygen, Fluorometer, and PAR

The CTD oxygen data are intended only for qualitative use. Similarly, the fluorometric and PAR data are not calibrated.

Data Processing Procedure

Sea-Bird Seasoft CTD processing software was employed. The processing programs are outlined below. A more complete description may be found in the Sea-Bird Software Manual which is available from the Sea-Bird website (www.seabird.com).

The sequence of programs that were run in processing CTD data from this cruise are as follows:

- ***DATCNV*** - Converts data from raw frequencies and voltages to corrected engineering units
- ***WILDEDIT*** - Eliminates large spikes
- ***CELLTM*** - Applies conductivity cell thermal mass correction
- ***FILTER*** – A low pass filter to smooth pressure for LOOPEDIT
- ***LOOPEDIT*** - Marks scans where velocity is less than selected value to avoid pressure reversals from ship roll
- ***DERIVE*** - Computes calculated parameters
- ***BINAVG*** - Average data into desired pressure bins

The quality control steps included:

- ***Sensor verification*** consisted of rechecking CTD sensor serial numbers and locations after initial entry into the computer to verify that there were no tabulation errors.
- ***Seasoft Configuration File*** was reviewed to verify that individual sensors were represented correctly, with the correct coefficients.
- ***Temperature*** was verified by comparing primary and secondary sensor data.
- ***Conductivity*** was checked by comparison of the two sensors with each other and with bottle salinity samples.
- ***Position Check*** consisted of producing a chart of the ship's track which was reviewed for any serious problems. The positions were acquired from the ship's Trimble P-code navigation system.
- ***Visual Check*** consisted of producing plots for each usable cast. These were reviewed for any noise and spikes that may have been missed by the processing programs.
- The density profile was checked for inversions which might have been produced by sensor noise or response mismatches.
- Additional Sea-Bird programs were run on all or some stations to maximize the data quality.

CTD Data Footnoting

WHP water bottle quality flags were assigned as defined in the WOCE Operations Manual (Joyce and Corry, 1994). These flags and interpretation are tabulated in the CTD and Bottle Data Distribution, Quality Flags section of this document.

Data Comments

Fine structure including minor density inversions that may appear in approximately the upper 10 meters of the profiles is most likely caused by ship discharges/turbulence. To minimize the ship effect, engine cooling water discharges were restricted to the port side of the ship. The ship's draft is 6.7 meters; it is suspected that the ship's thrusters and props disturb the water to 20 meters depth.

All salinity, nutrient and dissolved oxygen data collected have gone through several stages of editing and are not likely to change significantly. The chlorophyll observations reported are, however, preliminary and may undergo significant post-cruise editing. Due to a lack of necessary solvent, some chlorophyll data were not able to be processed during the cruise. These data will be submitted later.

Bottle Data

Generally speaking, the sampling order for each cast was as follows, but there was some cast-to-cast variation.

- Hydrographic
- *Oxygen,*
- *Chlorophyll/Phaeophytin*
- *Phytoplankton*
- *Nutrients*
- *Salinity*
- $^{18}O/^{16}O$
- ^{13}C, *N15*
- *Particulate Organic Matter*
- *Dissolved Organic Matter*

The correspondence between individual sample containers and the rosette bottle from which the sample was drawn was recorded on the sample log for the cast. This log also included any comments of anomalous conditions noted about the rosette and bottles. Normal sampling practice included opening the drain valve before the air vent on the bottle, to check for air leaks. The valve was then shut and the vent opened to check for water leaks. These observations, together with other diagnostic comments (e.g., "lanyard caught in lid", "valve left open") that might later prove useful in determining sample integrity, were routinely noted on the sample log. Drawing oxygen samples also involved taking the sample draw temperature from the bottle.

Bottle Data Processing

After the samples were drawn and analyzed, the next stage of processing involved merging the different data streams into a common file. The rosette cast and bottle numbers were the primary identification for all ODF-analyzed samples taken from the bottle, and were used to merge the analytical results with the CTD data associated with that bottle.

Diagnostic comments from the sample log, and notes from analysts and/or bottle data processors were entered into a computer file associated with each station (the "quality" file) as part of the quality control procedure. Sample data from bottles suspected of leaking were checked to see if the properties were consistent with the profile for the cast, with adjacent stations, and, where applicable, with the CTD data. Direct inspection of the tabular data, property-property plots and vertical sections were all employed to check the data. Revisions were made whenever there was an objective reason to delete, annotate or re-calculate a datum. WHP water sample codes were selected to indicate the reliability of the individual parameters affected by the comments. WHP bottle codes were assigned where evidence showed the entire bottle was affected, as in the case of a leak, or a bottle trip at other than the intended depth.

Bottle Data Footnoting

WHP water bottle quality flags were assigned as defined in the WOCE Operations Manual [Joyce]. These flags and interpretation as tabulated in the Data Distribution, Bottle Data, Quality Flags section of this document.

Pressure and Temperatures

All pressures and temperatures for the bottle data tabulations were obtained by averaging CTD data for a brief interval at the time the bottle was closed and then applying the appropriate calibration data. The temperatures are reported using the International Temperature Scale of 1990.

Salinity

There were a total of 1438 salinity samples analyzed.

Sampling and Data Processing

Salinity samples were drawn into 200 ml high-alumina borosilicate bottles, which were rinsed three times with sample prior to filling. The bottles were sealed with custom-made plastic insert thimbles and Nalgene screw caps This container provides very low container dissolution and sample evaporation.

Equipment and Techniques

Both a SIO/STS/ODF Guildline Autosal 8400A, #55-654, and the RVIB N.B.Palmer's Guildline Autosal 8400B, #59-213, standardized with IAPSO Standard Seawater (SSW), batch P-141, were used to measure the salinities. Prior to the analyses, the samples were stored in the temperature regulated analysis room to permit equilibration to laboratory temperature, usually 8-20 hours. Both salinometers were outfitted with an ODF-developed interface for computer-aided measurement. The salinometer was standardized with a fresh vial of standard seawater at the beginning of each analysis run. Instrument drift was determined by running a SSW vial after the last sample was run through the autosal. The salinometer cell was flushed twice, and readings taken until two readings met software criteria for consistency; these were then averaged for a final result. The estimated accuracy of bottle salinities run at sea is usually better than 0.002 PSU relative to the particular standard seawater batch used.

Laboratory Temperature

Temperature stability in the salinometer laboratory was good. Salinity analysis was performed in a converted refrigeration room that has been modified to maintain a consistent ambient temperature within a range of ±2ºC centered around 22ºC. Autosal bath temperature of 24ºC was used for analysis.

Comments

- Autosal #55-654 Thermistor #1 failed. The unit was used with circuit #2 for the first 2 "runs" (Stations 1-21). Bath repaired at Station 213.
- Autosal #59-213 used from Station 22 until the cruise ended.

Oxygen Analysis

There were a total of 3457 oxygen samples analyzed.

Sampling and Data Processing

Samples were collected for dissolved oxygen analysis soon after the rosette was brought on board. Using a Tygon drawing tube, nominal 125ml volume-calibrated iodine flasks were rinsed, then filled and allowed to overflow for at least 3 flask volumes. The sample draw temperature was measured with a small platinum resistance thermometer embedded in the drawing tube. Reagents were added to fix the oxygen before stoppering. The flasks were shaken twice to assure thorough dispersion of the precipitate, once immediately after drawing, and then again after about 20 minutes. Thiosulfate normalities were calculated from each standardization and corrected to 20ºC. The 20ºC normalities and the blanks were plotted versus time and reviewed for possible problems. Oxygen concentrations were converted from milliliters per liter to micromoles per kilogram using the sampling temperature ("draw temperature") and the salinity to calculated the density of the sample at atmospheric pressure.

Equipment and Techniques

Dissolved oxygen analyses were performed with an ODF-designed automated oxygen titrator using photometric end-point detection based on the absorption of 365nm wavelength ultra-violet light. The titration of the samples and the data logging were controlled by PC software. Thiosulfate was dispensed by a Dosimat 665 buret driver fitted with a 1.0ml buret. The ODF method used a whole-bottle modified-Winkler titration following the technique of Carpenter (1965) with modifications by Culberson (1991), but with higher concentrations of potassium iodate standard (approximately 0.012N) and thiosulfate solution (55-65 g/l). Standard KIO3 solutions prepared ashore were run at the beginning of each run. Reagent and distilled water blanks were determined, to account for presence of oxidizing or reducing materials.

Volumetric Calibration

Oxygen flask volumes were determined gravimetrically with degassed deionized water to determine flask volumes at ODF's chemistry laboratory. This is done once before using flasks for the first time and periodically thereafter when a suspect bottle volume is detected. The volumetric flasks used in preparing standards were volume-calibrated by the same method, as was the 10ml Dosimat buret used to dispense standard iodate solution.

Standards

Potassium Iodate was obtained from Johnson Matthey Chemical Co. and was reported by the supplier to be >99.4% pure.

Comments

Beginning at Station 27, a new procedure was adopted for casts deeper than ~ 250 meters. Sampling began at the deepest bottle to be sampled for chlorophyll and continued up to the surface bottle, then resumed with the deepest bottle.

The primary sampling thermometer failed during Station 25. The secondary was then used. This thermometer read 0.4ºC low (e.g. 0ºC read as –0.4ºC). The primary had no offset at the beginning of the cruise.

Nutrient Analysis

There were 3476 nutrient samples analyzed.

Sampling and Data Processing

Nutrient samples were drawn into 45ml polypropylene, screw-capped "oak-ridge type" centrifuge tubes. The tubes were cleaned with 10% HCl and rinsed with sample three times before filling. Samples were refrigerated, for up to 16 hours, between collection and analysis.

Standardizations were performed at the beginning and end of each group of analyses (typically 24-30 samples) with an intermediate concentration mixed nutrient standard prepared prior to each run from a secondary standard in a low-nutrient seawater matrix. Sets of 6-7 different standard concentrations covering the range of sample concentrations were analyzed periodically to determine the deviation from linearity, if any, as a function of concentration for each nutrient analysis. A correction for non-linearity was applied to the final nutrient concentrations when necessary. After each group of samples was analyzed, the raw data file was processed to produce another file of response factors, baseline values, and absorbances. Computer-produced absorbance readings were spot checked for accuracy against values taken from a strip chart recording.

Nutrients, when reported in micromoles per kilogram, were converted from micromoles per liter by dividing by sample density calculated at 1 atm pressure (0 db), *in situ* salinity, and an assumed laboratory temperature of 25ºC.

Equipment and Techniques

Nutrient analyses (phosphate, silicate, nitrate+nitrite, urea, ammonium, and nitrite) were performed on an ODF-modified 6-channel Technicon AutoAnalyzer II. The analog outputs from each of the six channels were digitized and logged automatically by computer (PC) at 2-second intervals.

Silicate was analyzed using the technique of Armstrong *et al*., (Armstrong, 1967). The sample was passed through a 15mm flowcell and the absorbance measured at 660nm.

A modification of the Armstrong *et al*. (Armstrong 1967) procedure was used for the analysis of nitrate and nitrite. For the nitrate plus nitrite analysis, the seawater sample was passed through a cadmium reduction column where nitrate was quantitatively reduced to nitrite. The stream was then passed through a 15mm flowcell and the absorbance measured at 540nm. The same technique was employed for nitrite analysis, except the cadmium column was bypassed, and a 50mm flowcell was used for measurement. Periodic checks of the column efficiency were made by running alternate equal concentrations of NO2 and NO3 through the NO3 channel to ensure that column efficiencies were high (> 95%). Nitrite concentrations were subtracted from the nitrate+nitrite values to obtain nitrate concentrations.

Phosphate was analyzed using a modification of the Bernhardt and Wilhelms (Bernhardt 1967) technique. The reaction product was heated to ~55ºC to enhance color development, then passed through a 50mm flowcell and the absorbance measured at 820m.

Ammonium was determined by the Berthelot reaction (Patton and Crouch 1977) in which sodium hypochlorite and phenol react with ammonium ion to produce indophenol blue, a blue compound, with an absorption maximum at 637nm. The solution was heated to 55°C and passed through a 50mm flowcell at 640nm.

Urea was analyzed via a modification of the method of Rahmatullah and Boyde (1980), which is based on the classic diacetyl monoxime method. A solution of diacetyl monoxime, thiosemicarbizide and acetone is followed by the addition of ferric chloride, which acts as a catalyst. The resultant solution is heated to 90°C and passed through a 50mm flowcell. The absorbance is measured at 520nm.

Nutrient Standards

- Na_2SiF_6, the silicate primary standard, was obtained from Johnson Matthey Company and was reported by the supplier to be >98% pure.
- Primary standards for nitrite ($NaNO_2$) were obtained from Johnson Matthey Chemical Company. The supplier reported purities of 97%.
- Primary standards for nitrate (KNO3) were obtained from Fisher Scientific. The supplier reported purities of 99.999%.
- Primary standards for phosphate (KH_2PO_4) were obtained from Fisher Scientific. The supplier reported purities of 99.999%.
- Ammonia, (NH4(SO4)2), and Urea primary standards were obtained from Fisher Scientific and reported to be >99% pure.
- The secondary standards were prepared aboard ship by dilution from primary standard solutions. Dry standards were pre-weighed at the laboratory at ODF, and transported to the vessel for dilution to the primary standard.

Chlorophyll-a and other Pigments (University of Alaska, Fairbanks)

(report not yet received)

DOM Sampling (University of Miami)

There were two main University of Miami organic biogeochemistry laboratory objectives for the 2003 SBI Survey Cruise. The main objective was to obtain high-resolution sampling of the East of Barrow Canyon transect. Prior years' sampling of this line revealed the possible presence of eddies. These eddies could be a mechanism for influx of carbon and nitrogen into the deep basin. The second objective of the cruise was to sample the bottom waters of the shelf itself to identify a relationship between sediment character and DOM concentrations.

Sampling for organic matter during the cruise (dissolved organic carbon and nitrogen, DOC and DON; and particulate organic carbon and nitrogen, POC and PON) had two aims. First, DOM samples were taken as a survey of the shelf bottom waters in an effort to determine the relationship between sediment/benthos characteristics and DOM release from the sediments (using bottom water DOM concentrations as an index for release). In previous work (2002 field season) we found that near bottom DOM was occasionally elevated, with indications that the most productive waters (in the western shelf) and the Alaskan Coastal waters overlaid these zones. Areas overlain by Bering Shelf water did not exhibit elevated values of bottom water DOM. Unfortunately, sampling then was not adequate to determine if there was a true causative relationship between sediment character (e.g., POM input, benthic richness, sediment composition, bottom water nutrient concentrations) and DOM concentrations in the overlying water. The present survey was designed to sample the full range of benthic types found in the region, from the inner shelf to the shelf break, from high productive to biologically impoverished. DOM concentrations will be compared to literature assessments of sediment/benthos distributions on the Chukchi Shelf.

Second, DOM and POM samples were collected from the upper 250 m of the densely sampled East of Barrow Canyon (EBC) line. This line crosses a region of eddy formation, and we seek to evaluate the role of these eddies in transporting organic matter from the shelf/shelf break region into the Arctic Basin. This survey was done with the hope that an eddy would be present at the time of sampling and that we could begin the assessment of transport by this mechanism. Figure 1 illustrates the resolution of sampling on the EBC line, which included stations 38 to 59. We collected 229 DOM and 229 POM samples on the EBC line. The POM samples were collected by vacuum filtration of 500-1000 mL of water onto GF/F filters. These samples will take on greater importance if an eddy was indeed present during occupation of the line. If not, their priority for analysis will be reduced.

In the bottom water survey, we took 243 samples for DOM analysis. These samples were collected by gravity filtration through GF/F filters held by in-line filter holders. The Data Set Overview and Data Collection

Dissolved Organic Carbon

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Data Set Overview and Data Collection

The dissolved organic carbon (DOC) data contain in this data set was taken during July and August of 2003 aboard the Nathaniel B. Palmer as part of the Arctic Shelf Basin Interactions (SBI) Project. The 2003 Survey

Cruise aboard the Palmer was designed to study a broad area, from Bering Strait to out over the deep Arctic Basin of the Chukchi Sea. During this cruise, data for DOC was gathered from the bottom waters of the Chukchi Self and one full transect line from on-shelf to off-shelf east of Point Barrow. The bottom water was taken from the deepest cast depth, usually less than 3 meters above the bottom in water depths of less than 250 meters. The high resolution line was sampled for DOC throughout the water column.

Samples were taken using a SeaBird 911+ CTD mounted on a 24- placed rosette frame, with SeaBird pylon, and outfitted with 24 ten liter bottles. To ensure that particulate organic carbon (POC) did not contribute to estimates of DOC in the upper ocean, all samples were filtered through an inline combusted GF/F filter held in acid washed polycarbonate filter holders. The filter cartridge was attached directly to the Niskin bottle with an acid cleaned and MilliQ water rinsed silicone tube. Samples were collected into preconditioned and DOC-free, 60 mL HDPE bottles and frozen in organic solvent free freezers, then shipped in ice to the shore-based laboratories. The filter cartridges were cleaned between uses and newly combusted GF/F filters were loaded prior to sampling each cast.

All samples were analyzed using the Shimadzu TOC-V system. Extensive conditioning and standardization procedures were performed prior to analyzing samples each day. Four point standard curves of potassium hydrogen phthalate (KHP) were used to standardize DOC measurements. In addition, seawater DOC reference standards produced by the Hansell CRM program (http://www.rsmas.miami.edu/groups/organic-biogeochem/crm.html) were also analyzed each day. To maintain highest quality data control, samples were systematically checked against low carbon water and deep and surface reference waters every sixth analysis (Hansell and Carlson 1998a). The between-day precision in the DOC measurement was 1-2 M, or a CV of 2-3%.

Instrument Description Shimadzu TOC-VCSH.

References: http://www1.shimadzu.com/products/lab/toc.html

Data Format DOC data is reported in ìmol/l.

DATA REMARKS

Quality flag 2 are good data. Missing data are -9999.

$^{18}O/^{16}O$ Sampling (University of Tennessee, Knoxville)
(report not yet received)

Zooplankton Distribution and Abundance in the Chukchi and Beaufort Seas
(University of Miami)

Leopoldo Llinás, Research Assistant (lllinas@rsmas.miami.edu)

The purpose of this project is to determine which species of copepods are transported off the Chukchi and Beaufort shelves and the physical processes associated with that transport. Our research also aims at documenting the vertical distribution of copepods in the Chukchi and Beaufort Seas.

We conducted over 80 bongo net tows including eleven 0-1000m bongo net tows. Sampling was carried out every third CTD/hydrographic station with emphasis along the track covering portions of the Chukchi and Beaufort shelves similar to the track followed during the SBI Summer Cruise 2002: HLY-02-03 where fortyfive stations were occupied and fifty-two Bongo tows were completed. Other areas sampled with a lower resolution include the Chukchi shelf where Bongos with depths up to 50 meters were conducted, and a final section east of the previous 2002 sections.

Portions of each sample were split on board. For taxonomical analysis, 50% of each sample was preserved in 4% buffered formalin solution. For bulk biomass estimates, 20% was filtered for different size meshes (>1050μm, 1050-560μm, and 560-202μm) and dried at 60ºC. For molecular analysis, another 20% was preserved in ethanol. The remaining 10% was given to Craig Aumack. Aumack will measure the isotopic ratios of Carbon 12 and Nitrogen 14 on the large-bodied zooplankton to identify the source (ice algae, diatoms) of the carbon and nitrogen.

Few problems occurred while towing the Bongo nets. At station 001, the planned Bongo was cancelled due to a hydraulic failure of the A-frame on the aft deck. After the five-station section in Bering Strait, time constrains required for the Raytheon Polar Services Company science support team to take over the Bongo collection for the rest of the cruise, an assignment our team was very grateful for. Later on, while rinsing the nets on board at station 204, the occurrence of strong winds (> 40 mph) flailed the nets and broke the shackle of a cod-end against the deck floor.

In general, deep tows (0-1000m) contained the copepods *Paraeuchaeta sp.* and *Metrida sp.*, while on the 0-100m the large-bodied zooplankton was dominated by *Calanus hyperboreus*, *C. glacialis* and chaetognatha. Preserved samples will be analyzed for taxonomy and abundance at the Rosenstiel School of Marine and Atmospheric Sciences, and Bongo net data will result in a qualitative record of the vertical distribution of copepods in the Arctic Basin. In the future, to obtain a quantitative knowledge of the vertical distributions of zooplankton we expect to use a vertically hauled opening-closing net system.

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Stable Isotopes
(University of Texas)

A total of 90 vertical bongo tows were completed aboard the 2003 SBI cruise. Of these, 12 tows were to depths of 1000 m. while the rest were to depths of 100 m. or shallower. These tows resulted in 180 preserved zooplankton samples along the arctic coast in two distinct size fractionations (>335 µm and >153 µm). Another 150-160 samples were preserved for molecular analysis. Dry weight percentage at three different size ranges (>1050 µm, 1050>x>550 µm, and 550>x>202 µm) was also calculated at 80 sites from both fractionations.

Over 400 samples were taken for isotopic analysis (Δ^{13}C and Δ^{15}N). Of these, 180 were organic particulate (POM) samples. The rest were a variety of zooplankton collected from individual bongo tows including the copepods *Calanus glacialis*, *Calanus hyperboreus*, *Metrida longa*, and *Paraeuchaeta novergeica*. The magnitude of sampling locations and sampling opportunity far exceeded expectations. As such, the 2003 summer cruise aboard the R/V Palmer was considered a huge success by both the zooplankton ecology and marine botany representatives.

Marine mammal distribution in the Chukchi and Beaufort Seas

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Background

The shelf, slope, and basin zones of the western arctic provide productive habitats for polar marine mammals. Determining the seasonal patterns of marine mammal abundance and distribution is key to understanding the ecological interactions involving these apex predators and the ecosystem "hotspots" where they are often found. Different marine mammal species integrate the environment across variable spatial and temporal scales, with the composite result reflecting oceanographic primary and secondary productivity derived from transport processes and mesoscale oceanographic features. During the 2003 SBI survey cruise, although abundance and distribution data on all marine mammal species observed was recorded, our main focus was on two species of seals in the sea ice zone: bearded seals (benthic foragers), and ringed seals (fish and crustacean predators). Our principal research objectives were to determine marine mammal distribution, relative abundance and habitat associations via visual surveys, and to relate these patterns to measures of mesoscale oceanographic structure and potential prey availability.

Ringed seals are small phocids (adults are typically 1.3 – 1.5 meters in length) found throughout the arctic in areas of seasonal sea ice as well as within the permanent polar ice cap (Smith 1987, Kelly 1988, Ramsay and Farley 1996, Reeves 1998). In the Chukchi and Beaufort Seas, ringed seals haul out in highest densities in shorefast ice during the May-June molting season, immediately following the March-April pupping season (Johnson et al. 1966, Burns and Harbo 1972, Frost et al. 1988, 1997, 1998, 1999, Bengtson et al. 2000). It is often assumed that the May-June distribution of seals reflects their winter-long distribution in the shorefast ice, although ringed seals may begin to disperse from their wintering grounds during May-June (Kingsley 1991). Little is known about the distribution of ringed seals during the 'open water' season, July-October, but ringed seals have been seen both hauled out on pack ice and foraging in open water some distance away from the nearest sea ice (Smith 1987). Whether ringed seals foraging in open water commute from ice edge haulouts or forage in open water all summer long without hauling out is currently unknown. Ringed seals migrate north and south with the retreat and advance of the sea ice edge, but some seals in areas of seasonal shorefast sea ice may be sedentary (Burns 1970; Smith 1987). In addition to ice-associated migrations, ringed seals can also travel long distances east or west (> 2000 km), particularly young seals (Smith 1987, Kapel et al. 1998). Ringed seals in the SBI study area reportedly prey primarily upon arctic cod during the winter (November-April) and upon pelagic, benthic, and sympagic (ice-associated) macrozooplankton during spring and summer (Lowry et al. 1980b). Ringed seals feed less frequently and lose weight during March-June when their behavior is constrained by breeding, pupping, and molting (Lowry et al. 1980b). They increase their food intake in late summer or autumn, when locally dense concentrations of prey appear to be important (Lowry et al. 1980b).

Bearded seals inhabit circumpolar arctic and subarctic waters in relatively shallow water depths that are seasonally ice-covered (Stirling et al. 1982, Kingsley et al. 1985). The distribution of bearded seals appears to be strongly influenced by water depth and prey biomass (Kelly 1988b). Bearded seals feed at depths less than 200 m (Burns et al. 1981, Stirling et al. 1982, Kingsley et al. 1985). In Alaska, bearded seals are distributed over the ice-covered continental shelves of the Bering, Chukchi, and Beaufort seas (Burns 1981b). In the Bering and Chukchi seas, the majority of bearded seals move south with the seasonally advancing ice in winter, and north with the retreating sea ice in spring. Bearded seals are benthic feeders, consuming clams, shrimp, crabs, benthic invertebrates, and fish (Johnson et al. 1966, Burns 1967, Lowry et al. 1980a). Of these items, clams, shrimp and crabs appear to be the most important prey species in the

Bering and Chukchi Seas (Lowry et al. 1980a). In the Beaufort Sea, crabs and shrimp appear to be primary prey items, though clams are important prey species in August, and arctic cod is a primary prey species in November and February.

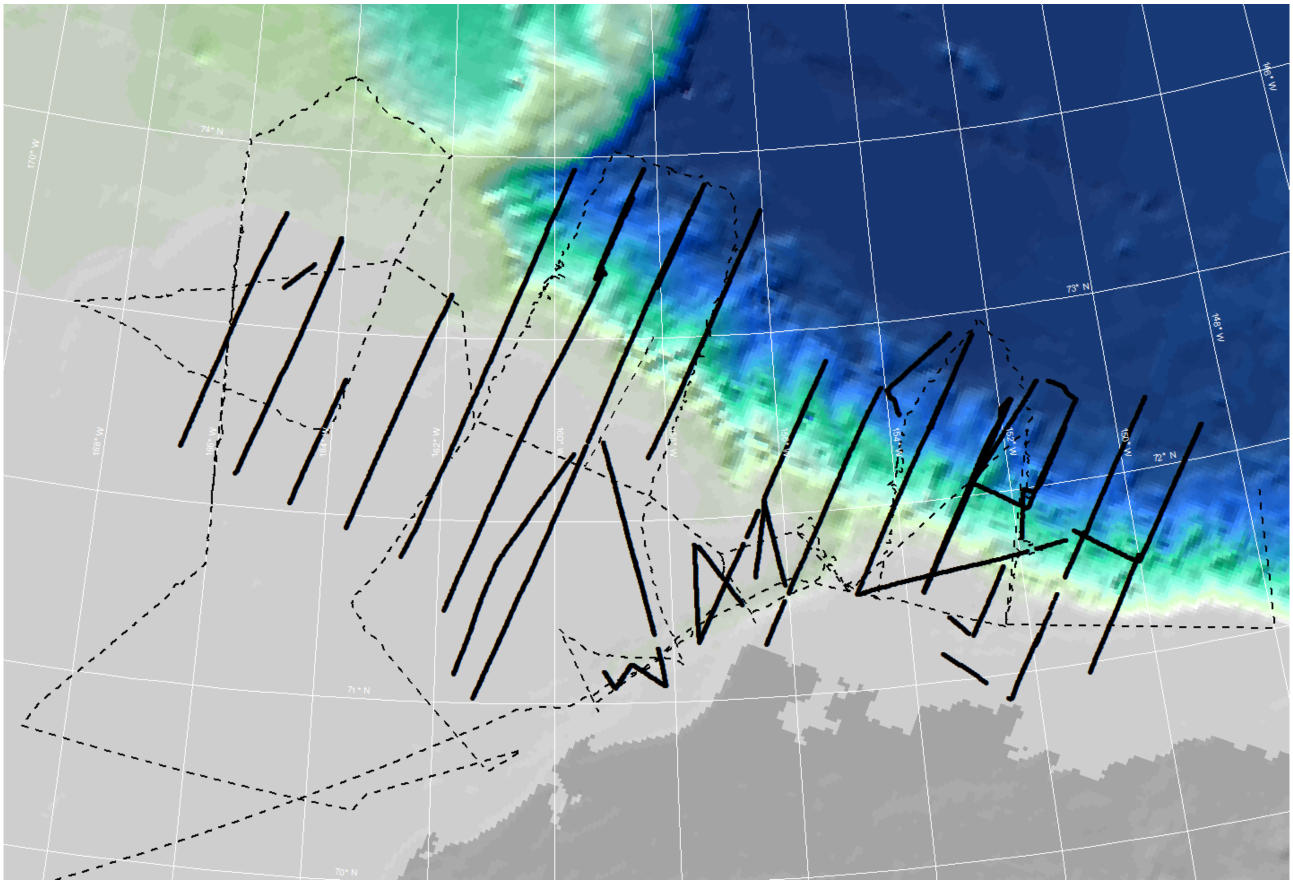

Figure 1: Distribution of aerial surveys for marine mammals in the SBI study area (July – August 2003). Thick solid lines show locations of "on effort" line transect sampling; thin dashed line shows the cruise track of the R/V *N.B. Palmer*.

Survey protocols

Pinniped aerial surveys were flown at a speed of approximately 100-170 km/h (60-100 knots) at 90 m (300 ft) during mid-day (2 hours either side of local solar noon) when the greatest proportion of seals were expected to be hauled out. As conditions allowed, helicopter survey tracks were set out perpendicular to bathymetric and sea ice gradients (Figure 1). An observer positioned at each window on the right and left sides of the aircraft counted seals seen during each flight. Data were recorded by audio/video recorder and later transcribed to computer files. Perpendicular distances of seals from the survey line were estimated by sighting along six fixed 10^o vertical angles (0^o-60^o from the horizon in 10^o increments) on a plexiglass strip attached to the helicopter's window. The perpendicular distance intervals were computed from the helicopter's altitude and the assigned angle category. The area beneath the aircraft (60^o- 90^o) was not visible to the observers, so this survey strip was monitored by a downward-looking digital video recorder mounted inside the helicopter behind the lower plexiglass window near the foot rest of the co-pilot's seat. These data provide information on sea ice characteristics as well as an independent record of seal densities.

When weather conditions were not suitable for flying, surveys were conducted from the Palmer's ice tower as the ship moved through the pack ice. Shipboard surveys of pinnipeds were conducted between 1000 and 1600 hours local solar time whenever the ship was transiting through ice capable of supporting a seal's weight. Survey effort outside of this time window was of limited usefulness because very few seals haul out then. Routine survey data collection included pinniped sightings, location, ice classification, and visibility conditions.

Preliminary results

The R/V *N.B. Palmer* proved to be an efficient platform from which to conduct surveys of this type, and the helicopter flights had virtually no impact upon the other science missions. Despite foggy weather during most of the cruise, approximately 3,655 km (2,193 nm) of linear transects of sea ice habitat were surveyed during 18 helicopter flights (Figure 1, Table 1). Six species of marine mammals were seen: 4100 walrus, 48 ringed seals, 16 bearded seals, 3 gray whales, 24 beluga whales, and 6 polar bears. Shipboard surveys yielded sightings of 310 walrus, 33 bearded seals, 5 ringed seals, and 6 polar bears. Density estimates based on these tallies and their relationships to environmental features await further data processing and analysis.

Across the study area, lower densities of ringed and bearded seals than expected were observed, presumably due to declining haulout rates following the seals' annual molting period. Consistently high densities of walrus were observed hauled out on bands of ice just inside the outer fringe of the marginal ice zone, where several thousands of walrus were seen in relatively localized areas. Relatively high densities of bearded seals were encountered on the continental shelf in the western portion of the study area, presumably in a zone where the benthic productivity is high. We are eager to compare these results with relevant findings from other SBI investigators.

Table 1. Aerial survey flights for marine mammals during the July – August SBI survey cruise, 2003.

Date	Event no.	Survey time (h)	Survey distance (nm)
14-Jul-03	1	0.8	70.0
17-Jul-03	2	1.3	106.6
17-Jul-03	3	1.5	120.9
19-Jul-03	4	1.3	122.7
19-Jul-03	5	1.8	147.9
20-Jul-03	6	1.8	148.7
20-Jul-03	7	1.6	141.5
28-Jul-03	8	1.1	70.6
5-Aug-03	9	1.5	128.6
5-Aug-03	10	1.8	167.8
6-Aug-03	11	0.3	22.4
7-Aug-03	12	1.7	137.6
7-Aug-03	13	1.5	148.2
8-Aug-03	14	2.0	172.2
8-Aug-03	15	2.1	181.5
8-Aug-03	16	1.2	104.7
13-Aug-03	17	1.5	140.8
13-Aug-03	18	0.6	59.8
	Totals	25.3	2,192.5

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Data Distribution

The CTD and bottle data can be obtained through NCAR's Earth Observing Laboratory web-site, www.eol.ucar.edu/project/sbi. The data are reported using the WHP-Exchange (WOCE Hydrographic Program) format and the quality coding follows those outlined by the WOCE program (Joyce, 1994). In addition, the format can be obtained through the WOCE Hydrographic Program web-site, WHPO.ucsd.edu. The descriptions in this document have been edited from the reference to annotate the format specific to this data distribution. ASCII files for each station were created with comments recorded on the CTD Station Logs during data acquisition. These ASCII files include data processing comments noting any problems, the resolution, and footnoting that may have occurred. A separate ASCII file was also created with the comments from the Sample Log Sheets that include problems with the Niskin bottles that could compromise the samples. Comments arising from inspection and checking of the data are also included in the ASCII file. These comment files are also in the EOL/JOSS database. Raw (unprocessed) CTD data are located in the EOL/JOSS database as well. The file nbp03_ctd_raw.zip contains ssscc.cfg, ssscc.con, ssscc.dat and ssscc.hdr (where sss = station number and cc = cast number) files as acquired by the SeaBird SeaSave acquisition program, sbscan.sum file and calibration information for all sensors. The *.cfg file is datcnv.cfg with the beginning scan number and *.con files may include a correction based on the bottle salinity samples. The sbscan.sum file is a list of stations and beginning scan number. Configuration files for the various SeaBird CTD processing programs are also included where applicable.

General rules for WHP-exchange:

1. Each line must end with a carriage return or end-of-line.
2. With the exception of the file type line, lines starting with a "#" character, or including and following a line which reads "END_DATA", each line in the file must have exactly the same number of commas as do all other lines in that file.
3. The name of a quality flag always begins with the name of the parameter with which it is associated, followed by an underscore character, followed by "FLAG", followed by an underscore, and then followed by an alphanumeric character, W.
4. The "missing value" for a data value is always defined as -999, but written in the decimal place format of the parameter in question. For example, a missing salinity would be written -999.0000 or a missing phosphate -999.00.
5. The first four characters of the EXPOCODE are the U.S. National Oceanographic Data Center (NODC) country-ship code, then followed by up to an 8 characters expedition name of cruise number, i.e. 3206NBP0304A.

CTD Data

CTD data is located in file 3206NBP0304a_ct1.zip. This file contains ssscc_ct1.csv files for each station and cast where sss=3 digit station identifier and cc=2 digit cast identifier.

Description of ssscc_ct1.csv file layout.

1st line	File type, here CTD, followed by a comma and a DATE_TIME stamp YYYYMMDDdivINSwho YYYY 4 digit year MM 2 digit month DD 2 digit day div division of Institution INS Institution name who initials of responsible person
# lines	A file may include 0-N optional lines at the start of a data file, each beginning with a "#" character and each ending with carriage return or end-of-line. Information relevant to file

	change/update history may be included here, for example.
2nd line	NUMBER_HEADERS = n (n = 10 in this table and the example_ct1.csv file.)
3rd line	EXPOCODE = [expocode] The expedition code, assigned by the user.
4th line	SECT_ID = [section] The SBI station specification. *Optional*.
5th line	STNNBR = [station] The originator's station number
6th line	CASTNO = [cast] The originator's cast number
7th line	DATE = [date] Cast date in YYYYMMDD integer format.
8th line	TIME = [time] Cast time that CTD was at the deepest sampling point.
9th line	LATITUDE = [latitude] Latitude as SDD.dddd where "S" is sign (blank or missing is positive), DD are degrees, and dddd are decimal degrees. Sign is positive in northern hemisphere, negative in southern hemisphere
10th line	LONGITUDE = [longitude] Longitude as SDDD.dddd where "S" is sign (blank or missing is positive), DDD are degrees, and dddd are decimal degrees. Sign is positive for "east" longitude, negative for "west" longitude
11th line	DEPTH = [bottom] Reported depth to bottom. Preferred units are "meters" and should be specified in Line 2. In general, corrected depths are preferred to uncorrected depths. Documentation accompanying data includes notes on methodology of correction. *Optional.*
next line	Parameter headings.
next line	Units.
data lines	A single _ct1.csv CTD data file will normally contain data lines for one CTD cast.
END_DATA	The line after the last data line must read END_DATA, and be followed by a carriage return or end of line.
other lines	Users may include any information they wish in 0-N optional lines at the end of a data file, after the END_DATA line.

Parameter names, units, format, and comments

Parameter	**Units**	**Format**	**Comments**
CTDPRS	DB	F7.1	CTD pressure, decibars
CTDPRS_FLAG_W		I1	CTDPRS quality flag
CTDTMP	ITS-90	F8.3	CTD temperature, degrees C (ITS-90)
CTDTMP_FLAG_W		I1	CTDTMP quality flag
CTDSAL		F8.3	CTD salinity
CTDSAL_FLAG_W		I1	CTDSAL quality flag
CTDOXY	UMOL/KG	F7.1	CTD oxygen, micromoles/kilogram
CTDOXY_FLAG_W		I1	CTDOXY quality flag
XMISS	%TRANS	F7.1	Transmissivity, percent transmittance
XMISS_FLAG_W		I1	XMISS quality flag
FLUOR	VOLTS	F8.3	Fluorometer, voltage
FLUOR_FLAG_W		I1	Fluorometer quality flag
PAR	VOLTS	F8.3	PAR, voltage
PAR_FLAG_W		I1	PAR quality flag
SPAR	VOLTS	F8.3	Surface PAR, voltage
SPAR_FLAG_W		I1	Surface PAR quality flag

Quality Flags

CTD data quality flags were assigned to the CTDTMP (CTD temperature), CTDSAL (CTD salinity) and XMISS (Transmissivity) parameters as follows:

2 Acceptable measurement.
3 Questionable measurement. *The data did not fit the station profile or adjacent station comparisons (or possibly bottle data comparisons). The data could be acceptable, but are open to interpretation.*
4 Bad measurement. *The CTD data were determined to be unusable.*
5 Not reported. *The CTD data could not be reported, typically when CTD salinity is flagged 3 or 4*.
9 Not sampled. *No operational sensor was present on this cast*

WHP CTD data quality flags were assigned to the CTDOXY (CTD O_2), FLUORO (Fluorometer), PAR (PAR), SPAR (Surface PAR), and HAARDT (Haardt Fluorometer CDOM) parameter as follows:

1 Not calibrated. *Data are uncalibrated*.
9 Not sampled. *No operational sensor was present on this cast. Either the sensor cover was left on or the depth rating necessitated removal.*

Bottle Data

Description of 3206NBP0304A_hy1.csv file layout.

1st line	File type, here BOTTLE, followed by a comma and a DATE_TIME stamp YYYYMMDDdivINSwho YYYY 4 digit year MM 2 digit month DD 2 digit day div division of Institution INS Institution name who initials of responsible person
#lines	A file may include 0-N optional lines, typically at the start of a data file, but after the file type line, each beginning with a "#" character and each ending with carriage return or end-of-line. Information relevant to file change/update history of the file itself may be included here, for example.
2nd line	Column headings.
3rd line	Units.
data lines	As many data lines may be included in a single file as is convenient for the user, with the proviso that the number and order of parameters, parameter order, headings, units, and commas remain absolutely consistent throughout a single file.
END_DATA	The line after the last data line must read END_DATA.
other lines	Users may include any information they wish in 0-N optional lines at the end of a data file, after the END_DATA line.

Header columns

Parameter	Format	Description notes
EXPOCODE	A12	The expedition code, assigned by the user.
SECT_ID	A7	The SBI station specification. *Optional*.
STNNBR	A6	The originator's station number.
CASTNO	I3	The originator's cast number.
BTLNBR	A7	The bottle identification number.
BTLNBR_FLAG_W	I1	BTLNBR quality flag.
DATE	I8	Cast date in YYYYMMDD integer format.
TIME	I4	Cast time (UT) as HHMM
LATITUDE	F8.4	Latitude as SDD.dddd where "S" is sign (blank or missing is positive), DD are degrees, and dddd are decimal degrees. Sign is positive in northern hemisphere, negative in southern hemisphere
LONGITUDE	F9.4	Longitude as SDDD.dddd where "S" is sign (blank or missing is positive), DDD are degrees, and dddd are decimal degrees. Sign is positive for "east" longitude, negative for "west" longitude
DEPTH	I5	Reported depth to bottom. Preferred units are "meters" and should be specified in Line 2. In general, corrected depths are preferred to uncorrected depths. Documentation accompanying data includes notes on methodology of correction. *Optional.*

Parameter names, units, and comments:

Parameter	Units	Format	Comments
CTDPRS	DB	F9.1	CTD pressure, decibars
CTDPRS_FLAG_W		I1	CTDPRS quality flag
SAMPNO		A7	Cast number *100+BTLNBR. *Optional*
CTDTMP	ITS-90	F9.4	CTD temperature, degrees C, (ITS-90)
CTDTMP_FLAG_W		I1	CTDTMP quality flag
CTDCOND	MS/CM	F9.4	CTD Conductivity, milliSiemens/centimeter
CTDCOND_FLAG_W		I1	CTDCOND quality flag
CTDSAL		F9.4	CTD salinity
CTDSAL_FLAG_W		I1	CTDSAL quality flag
SALNTY		F9.4	bottle salinity
SALNTY_FLAG_W		I1	SALNTY quality flag
SIGMA	THETA	F9.4	Sigma Theta
SIGMA_FLAG_W		I1	Sigma Theta quality flag
CTDOXY	UMOL/KG	F9.1	CTD oxygen, micromoles/kilogram
CTDOXY_FLAG_W		I1	CTDOXY quality flag
CTDOXY	ML/L	F9.3	CTD oxygen, milliliters/liter
CTDOXY_FLAG_W		I1	CTDOXY quality flag
OXYGEN	UMOL/KG	F9.1	bottle oxygen
OXYGEN_FLAG_W		I1	OXYGEN quality flag
OXYGEN	ML/L	F9.3	bottle oxygen, milliliters/liter
OXYGEN_FLAG_W		I1	OXYGEN quality flag

O2TEMP	DEGC	F6.1	Temperature of water from spigot during oxygen draw, degrees C
O2TEMP_FLAG_W		I1	O2TEMP quality flag
SILCAT	UMOL/KG	F9.2	SILICATE, micromoles/kilogram
SILCAT_FLAG_W		I1	SILCAT quality flag
SILCAT	UMOL/L	F9.2	SILCATE, micromoles/liter
SILCAT_FLAG_W		I1	SILCAT quality flag
NITRAT	UMOL/KG	F9.2	NITRATE, micromoles/kilogram
NITRAT_FLAG_W		I1	NITRAT quality flag
NITRAT	UMOL/L	F9.2	NITRATE, micromoles/liter
NITRAT_FLAG_W		I1	NITRAT quality flag
NITRIT	UMOL/KG	F9.2	NITRITE, micromoles/kilogram
NITRIT_FLAG_W		I1	NITRIT quality flag
NITRIT	UMOL/L	F9.2	NITRITE, micromoles/liter
NITRIT_FLAG_W		I1	NITRIT quality flag
PHSPHT	UMOL/KG	F9.2	PHOSPHATE, micromoles/kilogram
PHSPHT_FLAG_W		I1	PHSPHT quality flag
PHSPHT	UMOL/L	F9.2	PHOSPHATE, micromoles/liter
PHSPHT_FLAG_W		I1	PHSPHT quality flag
NH4	UMOL/KG	F9.2	AMMONIUM, micromoles/kilogram
NH4_FLAG_W		I1	NH4 quality flag
NH4	UMOL/L	F9.2	AMMONIUM, micromoles/liter
NH4_FLAG_W		I1	NH4 quality flag
UREA	UMOL/KG	F9.2	UREA, micromoles/kilogram
UREA_FLAG_W		I1	UREA quality flag
UREA	UMOL/L	F9.2	UREA, micromoles/liter
UREA_FLAG_W		I1	UREA quality flag
FLUORO	VOLTS	F8.3	Fluorometer, voltage
FLUORO_FLAG_W		I1	Fluorometer quality flag
PAR	VOLTS	F8.3	PAR, voltage
PAR_FLAG_W		I1	PAR quality flag
SPAR	VOLTS	F8.3	Surface PAR, voltage
SPAR_FLAG_W		I1	Surface PAR quality flag
HAARDT	VOLTS	F8.3	CDOM Fluorometer, voltage
HAARDT_FLAG_W		I1	CDOM Fluorometer quality flag
N**	UMOL/L	F9.2	N**, micromoles/liter
N**_FLAG_W		I1	N** quality flag
CHLORO	UG/L	F8.2	Chlorophyll, micrograms/liter
CHLORO_FLAG_W		I1	Chlorophyll quality flag
PHAEO	UG/L	F8.2	Phaeophytin, micrograms/liter
PHAEO_FLAG_W		I1	Phaeophytin quality flag
BTL_DEP	METERS	F5.0	bottle depth, meters
BTL_LAT		F8.4	Latitude at time of bottle trip, decimal degrees
BTL_LONG		F9.4	Longitude at time of bottle trip, decimal degrees
JULIAN		F8.4	Julian day and time as fraction of day of the bottle trip.

Quality Flags

CTD data quality flags were assigned to CTDPRS (CTD pressure), CTDTMP (CTD temperature), CTDCOND (CTD Conductivity), and CTDSAL (CTD salinity) as defined in Data Distribution, CTD Data, Quality Flags section of this document. CTDOXY (CTD O_2), FLUORO (Fluorometer), PAR (PAR), and SPAR (Surface PAR) parameters are flagged with either a 2, acceptable or 9, not drawn.

Bottle quality flags were assigned to the BTLNBR (bottle number) as defined in the WOCE Operations Manual [Joyce] with the following additional interpretations:

2 No problems noted.
3 Leaking. *An air leak large enough to produce an observable effect on a sample is identified by a flag of 3 on the bottle and a flag of 4 on the oxygen. (Small air leaks may have no observable effect, or may only affect gas samples.)*
4 Did not trip correctly. *Bottles tripped at other than the intended depth were assigned a flag of 4. There may be no problems with the associated water sample data.*
9 The samples were not drawn from this bottle.

WHP water sample quality flags were assigned to the water samples using the following criteria:

1 The sample for this measurement was drawn from the water bottle, but the results of the analysis were not (*yet*) received.
2 Acceptable measurement.
3 Questionable measurement. *The data did not fit the station profile or adjacent station comparisons (or possibly CTD data comparisons). No notes from the analyst indicated a problem. The data could be acceptable, but are open to interpretation.*
4 Bad measurement. *The data did not fit the station profile, adjacent stations or CTD data. There were analytical notes indicating a problem, but data values were reported. Sampling and analytical errors were also flagged as 4.*
5 Not reported. *The sample was lost, contaminated or rendered unusable.*
9 The sample for this measurement was not drawn.

Not all of the quality flags are necessarily used on this data set.

APPENDIX A: Bottle Quality Comments

Remarks for deleted samples, missing samples, PI data comments, and WOCE codes other than 2 from NBP03-04A, SBI Survey. Comments from the Sample Logs and the results of ODF's investigations are included in this report. Investigation of data may include comparison of bottle salinity and oxygen data with CTD data, review of data plots of the station profile and adjoining stations, and rereading of charts (i.e. nutrients). Units stated in these comments are degrees Celsius for temperature, Practical Salinity Units for salinity, and unless otherwise noted, milliliters per liter for oxygen and micromoles per liter for Silicate, Nitrate, Nitrite, Phosphate and Urea and Ammounium, if appropriate. The first number before the comment is the cast number (CASTNO) times 100 plus the bottle number (BTLNBR).

Station 001.001

101 Salinity analysis: "Three tries for good reading." PI: "Salinity is acceptable."
102 SampleLog: "Samples were only drawn for DOM/POM."
103 Salinity analysis: "Three tries for good reading." PI: "Salinity is acceptable."
103-105 Cast 1 Nuts: NH4 not reported due to equipment malfunction for this channel.

Station 002.001

101 Samples were only drawn for DOM/POM.
105 Sample Log: "First two draws had small bubbles. O2 draw was taken after 3 draws." High oxygen; could have been degassing. PI: "Oxygen is acceptable." Salinity analysis: "Three tries for good reading." PI: "Salinity is acceptable."
106 PI: "PO4 low, not in good agreement with bottle 109." DQ: "Density inversion and poor CTD vs. bottle salinity agreement, probably a gradient." This is a gradient, primary and secondary agree with one another, but the 1 meter bottle difference makes a difference in the bottle salinity. Nutrients: "Rechecked po4 = real."
107-108 Samples were only drawn for C13/N15.
109 PI:"PO4 high, not in good agreement with bottle 106." Nutrients: "Rechecked po4 = real."

Station 003.001

101 SampleLog: "Tentacles on spigots."
106-107 Samples were only drawn for C13/N15.

Station 004.001

101 Samples were only drawn for DOM/POM.
104 PI:"02 may be a little high, compared to CTD. Also nuts, but leave as is."
107 Oxygen: "Long delay between unstoppering and analysis." PI: "Oxygen is acceptable."

Station 005.001

101 Samples were only drawn for DOM/POM.
102 Oxygen: "3 small bubbles." PI: "Oxygen agrees well with nuts but not so well with CTD. Oxygen is acceptable." CTDO-bottle difference is ˜0.05, but bottle O2 could be low by ˜0.02 as compared with Station 004. DQ: "Oxygen is acceptable".
103 SampleLog: "O2 drawn twice." PI: "Oxygen is acceptable."
104 Sample Log: "O2 drawn twice. Still small bubble on third try." PI: "Oxygen is acceptable."
106-107 Samples were only drawn for C13/N15.
109 SampleLog: "O2 drawn twice; still small bubble." PI: "Oxygen is acceptable."

Station 006.001

101 Samples were only drawn for DOM/POM.

105 Fromlooking more closely at data (nutrient data in particular), looks like sample 105 is from slightly deeper water than sample 106. There does not appear to be a problem with the CTD bottle trip files. It may be that this was a flushing problem, and that there was still deeper water being carried along when the bottle was tripped. Bottle

106 would have had time to be completely flushed. Data should be marked as questionable. Salinity analysis: "Four tries for good reading." Agreement with CTD is reasonable, but will still leave coding as questionable.

105-106 PI: "105 and 106 have identical pressures. Were they really both tripped at 18.7db?" See 105 comments.

107-108 Sample Log: "C13/N15 only drawing 7 liters of water per bottle; 3 rinses on bottle, but no water left when spigot pushed in. MT's checking bottles; found slow leak on

108. Bottom o-ring, bottle changed between stas 6 & 7." Samples were only drawn for C13/N15. Cast 1 Sample Log: "10 meter bottle not tripped; missed during acquisition."

Station 007.001

101 Samples were only drawn for DOM/POM.

104-105 Samples were only drawn for C13/N15.

107 Bottle salinity is high compared with CTD. Footnote bottle salinity questionable.

108-109 Samples were only drawn for C13/N15.

Station 008.001

102 DQ:"CTD salinity seems high." Primary and secondary temperature and conductivity agree with one another. Temperature is lower than duplicate trip which could account for higher salinity. Since agreement between the sensors is reasonable, leave data as is. Samples were only drawn for DOM/POM.

103,106 Sample Log: "Phyto (Flint) sample taken at 12m & surf bottles."

104-105 Samples were only drawn for C13/N15.

Station 009.001

101 Nuts:NH4: not reported due to equipment malfunction for this channel.

102 Samples were only drawn for DOM/POM.

105 PI:"Salt difference larger than usual, 0.127."

Station 010.001

101 DQ: "Disagreement between CTD vs. bottle salinity." CTD primary and secondary agree with one another, could possibly be shed-wake effect, less saline water from shallower in the water column. However, other data do not indicate this phenomenon. Footnote salinity bad.

101,103-107 Nuts: NH4: not reported due to equipment malfunction for this channel.

102 Samples were only drawn for DOM/POM.

103 DQ:"Disagreement between CTD vs. bottle salinity." Gradient, leave as is.

103-107

105 PI:"O2 a little low compared to CTD and nutrient profiles."

Station 011.001

101 DQ: "CTD questionable." Primary and secondary conductivity agree with one another. account for higher salinity. Since agreement between the sensors is reasonable and bottle salinity and oxygen agrees with CTD, leave data as is.

102 Samples were only drawn for DOM/POM.

103-104 Samples were only drawn for C13/N15.

107 Large Bottle-CTD difference, 0.04, gradient, leave as is.

108 Bottle-CTD difference, 0.01, gradient, leave as is, also within data tolerance.
109-110 Samples were only drawn for C13/N15.

Station 012.001
102 Samples were only drawn for DOM/POM.
103 Oxygen: "1 tiny bubble." PI: "Oxygen is acceptable."
104 Oxygen: "small bubble." PI: "Oxygen is acceptable."

Station 013.001
102 Samples were only drawn for DOM/POM.
106 Oxygen: "bubble." PI: "Oxygen sample missing. No explanation." Corrected bottle number entered incorrectly. Cast 1 PI: "No problem seen in oxygen data."

Station 014.001
101 Samples were only drawn for DOM/POM.
102-103 Samples were only drawn for C13/N15.
109-110 Samples were only drawn for C13/N15.

Station 015.001
101 Samples were only drawn for DOM/POM.
104-105 Samples were only drawn for C13/N15.

Station 016.001
101 Samples were only drawn for DOM/POM.

Station 017.001
102 Samples were only drawn for DOM/POM.
105 PI:"Urea seems very high." Nutrients: "Rechecked urea = real." PI: "Large salt difference." Package came through large gradient, could be a flushing problem. Salinity is ˜0.3 higher than CTD.

Station 018.001
102 Samples were only drawn for DOM/POM.

Station 019.001
102 Samples were only drawn for DOM/POM.

Station 020.001
102 Samples were only drawn for DOM/POM.
107 PI: "Large salt difference." Gradient, even a difference between primary and secondary sensors, -0.02, data are acceptable.

Station 021.001
102 Samples were only drawn for DOM/POM.
106 Oxygen: "Check endpoint" PI: "Oxygen is acceptable."

Station 022.001
102 Samples were only drawn for DOM/POM.
107 SampleLog: "Air vent open." PI: "Oxygen is acceptable."

Station 023.001
102 Samples were only drawn for DOM/POM.
108,110,112 Salinity was not drawn.
114 PI: "Oxygen may be a little low. Compare to CTD." DQ: "Double check O2 scan. " Oxygen trace looks reasonable at 9.1ml/l, value reported is 9.2. Reported value of 9.2 could be a little high, 0.18, because of drift that occurs at bottle trip. DQ: "Values are acceptable." Salinity was not drawn. Cast 1 Sample Log: "Oxygen sensor has a jellyfish in it-on top of rosette, too."

Station 024.001
102 Oxygen, Salinity, and Nutrients were not drawn.
104 PI:"NO2 a little low, and oxygen a little low, compare to CTD." Oxygen agrees with CTD. Nutrients: "Rechecked no2 = real."
109,111,113 Salinity was not drawn.
115,119 Salinity was not drawn.
116-117 Samples were only drawn for C13/N15. Cast 1 Sample Log: "Tentacles on rosette frame and bottles."

Station 025.001
101 Oxygen: "large bubble." PI: "Oxygen is acceptable."
101-109 Nuts: NH4: not reported due to equipment malfunction for this channel.
106,109,111 Salinity was not drawn.
108 PI:"NO3 a little low." Nutrients: "Rechecked no3 = real."
113 SampleLog: "Air leak." PI: "Oxygen is acceptable." Salinity was not drawn.
114,118-119 Salinity was not drawn.
116 Sample Log: "Sampler thought there may be an air leak, reported small dripping." No problem reported on Station 26. No modification made to the bottle." CTD and bottle oxygen agreement is reasonable. Salinity was not drawn.
120 Oxygen: "tentacle?." CTD and bottle oxygen agreement is reasonable. Salinity was not drawn.

Station 026.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
115 Sample Log: "Air leak." Bottle tested after the cast. No leak found could have been the jellyfish tentacle caught in lid." PI: "Oxygen is acceptable."
121 Sample Log: "C13 started sampling before nutrients and salinity. Sampler stopped sampling and there was enough water for nutrients and salinity. Cast 1 Sample Log: "Jellyfish on rosette and bottles."

Station 027.002 Cast 1 Sample Log: "Cast 1 aborted - bottle tripped at surface."
201 Oxygen value looks low - no comments. Noted that nutrients also show something; probably real. Looks real. PI: "Oxygen is acceptable."
201-224 No PAR sensor, sampling too deep for instrument depth rating.
208 SampleLog: "Very small top cap leak."
210,212-216 Salinity was not drawn.
218-223 Salinity was not drawn.

Station 028.001
110,112-116 Salinity was not drawn.
117 Salinity is high compared with CTD, 0.5. There appears to be a difference in the electronics of the instrument on this sample. It was run after a higher sample, but suspect the analyst took this into consideration during flushing. Code salinity bad.
118 PI:"NO3 a little low." Nutrients: "Rechecked no3 = real."
118-123 Salinity was not drawn.

Station 029.001
101-124 No PAR data, sensor removed, sampling depth too deep.
107 PI:"Urea high." Nutrients: "Rechecked urea = peak changed."
110-117 Salinity was not drawn.
115 SampleLog: "Air leak." Oxygen agrees with CTD and appears reasonable.
118 CTDOappears low, code CTDO questionable.
119-122 Salinity was not drawn.

Station 030.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
110-114 Salinity was not drawn.
115 DQ: "Bottle salt has same value as 119 and it looks way off." Rechecked data, no obvious indication that this was a analytical error, could have been a sampling error or analyst could have run the sample twice. Code bottle salinity bad.
116-118 Salinity was not drawn.
120-122 Salinity was not drawn.

Station 031.001
110-115 Salinity was not drawn.
112 PI:"NO2 a little high." Nutrients: "Rechecked no2 = real."
113 DQ: "CTD O2 scan questionable." CTDO agrees with bottle oxygen as well as the rest of the profile.
117-120 Salinity was not drawn.
122-123 Salinity was not drawn.
123 SampleLog: "Tentacles." Data appears reasonable, SiO3 could be a little low.

Station 032.002
201-224 No PAR sensor, sampling too deep for instrument depth rating.
210,212-220 Salinity was not drawn.
211 PI: "Fairly large salt difference." There does appear to be a difference between the down trace and up trace in this gradient area and the primary and secondary sensors have a larger than usual difference, 0.01. Since it is such a large difference, code salinity questionable, The sample should not have been taken in the gradient.
219 Oxygen: "Strange end point, added 1ml to try a new reading." PI: "Oxygen is acceptable."
222-223 Salinity was not drawn.

Station 033.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
105 PI:"Urea high." Nutrients: "Rechecked urea = real."
109 PI: "No O2 data in file." Wrong bottle number was assigned, was entered as 11 instead of 9. Corrected data files.
111-115 Salinity was not drawn.
117-123 Salinity was not drawn.
118 Oxygen: "Overtitrate and backtitrate, 0.86952. Added 1 ml after first titration to get better reading. PI: "Oxygen is acceptable."

Station 034.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
108 SampleLog: "Air leak." PI: Oxygen is acceptable."
110-112 Salinity was not drawn.
114-116 Salinity was not drawn.
115 SampleLog: "Air leak." PI: "Oxygen is acceptable."

118-123 Salinity was not drawn.
121,123 Oxygen: "First titer had bad slope, added 1ml KIO3 to get good reading." PI: "Oxygen is acceptable."

Station 035.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
102 Oxygen: "+10ml KIO3,+O2Raw." Oxygen: "Invalid Endpoint .... Error . . . verror= 806 Illegal Function Call"; decided to add 10ml KIO3 and redo titration so we could subtract std value & possibly get O2 value for sample. PI: "No oxygen value in file." Oxygen was lost.
109,111-114 Salinity was not drawn.
115 SampleLog: "Air leak." PI: "Oxygen is acceptable."
116-119 Salinity was not drawn.
118 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
121-123 Salinity was not drawn.

Station 036.001
101 Oxygen: "Check endpoint; 1 division high." PI: "Oxygen is acceptable."
101-124 No PAR sensor, sampling too deep for instrument depth rating.
102 Oxygen: "No endpoint; wanted to do overtitrate and backtitrate, but hit wrong button, so added 1ml of KIO3 and did titration, calling it cast 91, bottle 1." PI: "Oxygen is acceptable."
105 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
110-115 Salinity was not drawn.
113 Nuts:"Bottle tripped but no water in nuts sample tube."
115 SampleLog: "Air leak." PI: "Oxygen is acceptable."
117-119 Salinity was not drawn.
121-123 Salinity was not drawn.

Station 037.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.
115 SampleLog: "Very small vent or top cap leak on bottle." Oxygen: "Tiny bubble." PI: "Oxygen is acceptable." Cast 1 Sample Log: "Sodium Hydroxide dispenser is sticking."

Station 038.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
110,112 Salinity was not drawn.
114-123 Salinity was not drawn.
115 SampleLog: "No air leak."
120-121 Sample Log: "No bottle samples for 20 and 21, this was for C13, N15."
121-122 Samples were only drawn for C13/N15.
122 DQ: "CTD O2 scan questionable" CTDO trace agrees with Stations 37-40. Bottle oxygen is low, ˜0.3, compared with Station 040. Code bottle oxygen questionable.

Station 039.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
103 PI:"NO3 a little low." Nutrients: "Rechecked no3 looks ok."
109,111 Salinity was not drawn.
111 Nuts:"Bottle tripped but no water in nuts sample tube." Footnote nutrients lost.
113 Sample Log: "Air leak." PI: "Oxygen is acceptable." PI: "NO3 is high." Nutrients: "Rechecked no3 looks good."

113-118 Salinity was not drawn.
120-123 Salinity was not drawn.
121 Samplewas only drawn for C13/N15.

Station 040.001
101 Oxygen: "Long delay." PI: "Oxygen is acceptable."
101-124 No PAR sensor, sampling too deep for instrument depth rating.
108 Large bottle-CTD salinity difference, 0.015. Conductivity sensors agree with each other, gradient, leave as is.
109 Oxygen: "Added acid after stirrer bar." PI: "Oxygen is acceptable."
110 Oxygen: "Check endpoint. PI: "Oxygen is acceptable."
110-111 Salinity was not drawn.
112 Large bottle-CTD salinity difference, 0.03. Conductivity sensors agree with each other, gradient, leave as is.
113-115 Salinity was not drawn.
115 SampleLog: "Air leak." PI: "Oxygen is acceptable.
116 DQ: "Check CTD and bottle salinity." Primary and secondary conductivity sensor agreement is very good. No analyses problems, oxygen could be high, SiO3 low, NO3 low and PO4 low. DQ: "Bottle oxygen looks high. Analyst notes no problem"
117-123 Salinity was not drawn.
124 Oxygen: "Big copepod whirling around in flask during titration." PI: "Oxygen is acceptable."

Station 041.001
101 Oxygen: "Check endpoint." PI: "Oxygen is acceptable."
101-124 No PAR sensor, sampling too deep for instrument depth rating.
102 Oxygen: "Lost sample."
103 PI:"O2 a little high."
111-116 Salinity was not drawn.
118-123 Salinity was not drawn.

Station 042.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.
122 Samples were only drawn for C13/N15.
124 Salt: "Yes! Bottle (salt) 24-Niskin 24 reads 0.66154." Bottle salinity is high compared with CTD. No analyses problem, this was a real measurement; probably came from fresh water lens from melt water which didn’t go as deep as CTD on rosette when bottle tripped. Deck crew talked about how CTD only halfway into "lens". DQ: "Do refractive index need adjustment for surface salinity of 10.343. NOTE: Needs to be corrected CTD salt greater than bottle salinity."

Station 043.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.

Station 044.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
102 Bottle salinity is low compared with CTD. Salinity appears to have been misdrawn from bottle 4. Footnote bottle salinity bad. PI: "Agree with salinity determination, bottle salinity looks bad."
112-123 Salinity was not drawn.
119 Oxygenflask was broken during "second shake". No O2 sample.
121 Samples were only drawn for C13/N15, no other samples taken.

Station 045.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.

Station 046.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
102 Oxygen, Salinity, and Nutrients were not drawn.
113-123 Salinity was not drawn.

Station 047.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable." PI: ""Oxygen a little low, but okay as is."
112-123 Salinity was not drawn.

Station 048.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
106 Oxygen: "Noticed filament streaming from thio burette tip." PI: "Oxygen is acceptable."
107 Oxygen: "Long delay." PI: "Oxygen may be high, but is okay as is."
110-113 Salinity was not drawn.
113 Oxygen: "Check endpoint." PI: "Oxygen is acceptable."
115-116 Salinity was not drawn.
117 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
118-123 Salinity was not drawn.
121 Samples were only drawn for C13/N15.

Station 049.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.
119 Oxygen: "Lost sample" No explanation why the sample was lost.
123 Oxygen: "Tiny bubble." DQ: "Bottle O2 questionable. Density inversion between
123 and 122. Check CTD SCAN." Bottle oxygen agrees well with CTDO. Salinity does become much saltier in the CTD trace, does not look like a spike in the data. The density inversion is ˜0.03, leave as is.

Station 050.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn. Cast 1 1st occupation of Station 300. Sample Log: "10-min delay in sampling while searched for O2 draw tubes."

Station 051.001
103 Sample Log: "Niskin 3 came off its mounting during recovery with some leakage due to cap being jarred." PI: "Oxygen is acceptable." PI: "NO2 is very high, may be real. Trend also seen on station 052.001." Nutrients: "Rechecked no2 = real."
107-111 Salinity was not drawn.
113-119 Salinity was not drawn.

Station 052.001
107-112 Salinity was not drawn.
108 Sample Log: "Very small air leak - probably the top cap." PI: "Oxygen is acceptable."
114-119 Salinity was not drawn. Cast 1 1st occupation of Station 302. Sample Log: "Niskin 3 replaced prior to 05201. (NB 3 is mislabelled as 5.) Needs to be relabeled to 3."

Station 053.001
103 SampleLog: "Bottle has a very slow spigot."
103-106 Salinity was not drawn.
108-113 Salinity wad not drawn.
114-115 Samples were only drawn for C13/N15.
116 PI: "No nutrients, but no note here why." Nutrient data indicates sample from bottle
14, but Sample Log indicates that sample was drawn from bottle 16. Nutrients: "Rechecked, labeled wrong, changed the file."

Station 054.001
102-106 Salinity was not drawn.
103 SampleLog: "Replacement bottle is very slow."
108-109 Salinity was not drawn.

Station 055.001
103 SampleLog: "Original bottle back in place on rosette."
103-107 Salinity was not drawn.

Station 056.001
102-105 Salinity was not drawn.

Station 057.001
102-105 Salinity was not drawn.

Station 058.001
102-103 Salinity was not drawn.

Station 059.001
102,105 Salinity was not drawn.
103-104 Samples were only drawn for C13/N15 and DOM/POM.

Station 060.001
103-104 Salinity not drawn.
104 PI:"Urea seems high." Nutrients: "Rechecked urea = real."
105-106 Samples were only drawn for C13/N15.
109 DQ: "Urea was off-scale and suspiciously high (3.8 micromolar), check peaks, etc. At a minimum this would be questionable because it is outside the calibration range."

Station 061.001
102-104 Salinity was not drawn.
104 PI:"Urea seems high." Nutrients: "Rechecked urea = real."

Station 062.001
102-110 Salinity was not drawn.
105 Nuts: NH4 and urea: bad measurement due to possible sample contamination. Footnote nh4 and urea bad.
108 Oxygen: "Small airleak." Oxygen agrees with CTDO and is acceptable.
111 DQ: "Poor agreement between CTD and bottle salinity = poor flushing or bad CTD scan or bottle salinity. Please check." Large surface gradient. No real problem seen in the CTD profile, but obvious mixing. Deeper more saline water could have been dragged up with the package. There is a fairly large, 0.4, difference between primary and secondary sensors. Leave as is.

Station 063.001
101 Salt: "Thimble was full of water and loose in bottle; suspect this spiked the sample." PI: "Salt is acceptable."
103-106 Salinity was not drawn.
108-112 Salinity was not drawn.
113 DQ: "No footnote about missing nutrient data from 113 and 112." Nutrient data claims bottles 14 and 15 instead of 12 and 13. Corrected data files.

Station 064.001
101 DQ:"No footnote about missing nutrients, also could be a mis-trip. Bottle salt looks like it came from 102 instead of 101. Mis-trip, mis-sample, or wrong data entry. Check bottle salinity! Bottle O2 also looks suspicious. Results in density inversion." Corrected data entry of bottle, station assignment in nutrient data tabulated as Station 066 bottle 1. Appears to be a drawing error on salinity, Bottle-CTD is -0.094. Code salinity bad. DQ: "Poor agreement between CTD and bottle salinity and oxygen."
102-105 Salinity was not drawn.
106 DQ: "Does not fit profile. Analyst notes no problems" Urea questionable.
107-114 Salinity was not drawn.
112-113 Samples were only drawn for C13/N15.

Station 065.001
101 PI:"Large salinity difference, these are all in high salinity bottom layers. May not be possible to get better salinity agreement." DQ: "Bottle salinity suggests poor flushing." Primary and secondary conductivity sensor agreement is reasonable. Bottle salinity was run after a lower value, 5 units lower. Although salinity analyses values do not indicate a problem, it could be that the previous sample influenced the readings on this sample.
102-109 Salinity was not drawn.
110 Oxygen: "Flask order wrong." Salinity: "very fresh value - analyst says a real measurement; probably came from melt water fresh water lens which did not go as deep as CTD on rosette when bottle tripped."

Station 066.001
102-108 Salinity was not drawn.

Station 067.001
101 PI:"Large salinity difference, this is in high salinity bottom layer; may not be possible to get better salinity agreement."
102-108 Salinity was not drawn.

Station 068.001
101 PI:"Large salinity difference, this is in high salinity bottom layer; may not be possible to get better salinity agreement."
102-109 Salinity was not drawn.
107-108 Samples were only drawn for C13/N15.

Station 071.001
102-103 Salinity was not drawn.

Station 072.001
102-105 Salinity was not drawn.
106-107 Samples were only drawn for C13/N15.

Station 073.001
102-109 Salinity was not drawn.

Station 074.001
101 PI: "Large salt difference." DQ: "Suspect this was a mis-trip. Need to check O2's and salts against CTD profile." Even though both pair of sensors show the same higher temperature, higher salinity, the agreement between the conductivity is high, 0.05, and the primary conductivity, -0.29. DQ: "Poor bottle flushing"
103-109 Salinity was not drawn.
106 Nutrients: NH4 off-scale, same when re-ran sample. Nutrients may have been contaminated. Concentration is greater than what could be recorded. Could be real or could be a contaminated sample. Discussed coding this value as questionable, decided it may be a high value and may be higher than what is actually reported, leave this as is. PI: "Suspect NH4 is contaminated." Footnote questionable as per PI and DQ. DQ: "Mark NH4 as off-scale and questionable. Not enough PO4 to justify."
107 Agreement between bottle and CTDO is about 0.4 lower than the rest of the profile. No real problem seen in CTD profile, but it does indicate oxygen minimum which can be seen a little higher in the water column on the down cast. DQ: "Values are acceptable".

Station 075.001
101 DQ:"Bottle salinity seems low. Poor flushing sampled from 102 instead of 101? Also note that no nutrients were sampled. Could there be confusion here?" CTD-bottle salinity difference is -0.011, salinity does appear to be from bottle 2. This is the same sampler as previous large difference salinity samples at this level. Oxygen agreement is reasonable and nutrients appear reasonable. Code salinity questionable. Corrected data entry of bottle, station assignment in nutrient data tabulated as Station 077.
102-109 Salinity was not drawn.
106-107 Samples were only drawn for C13/N15.

Station 076.001
101 DQ:"Why no nutrient samples?" Station assignment error in nutrient data tabulated as Station 078. Entry corrected.
102 PI:"Oxygen is low." No analytical problem noted, code oxygen questionable.
102-106 Salinity was not drawn.

Station 077.001
102-103,107 Salinity was not drawn.
104-105 Samples were only drawn for C13/N15.
107 SampleLog: "Top vent not closed." Oxygen does appear a little high, there were only 7 bottles so sampling went quickly. Code oxygen questionable. Console Log: "Deck crew requested CTD be brought on board as quickly as possible. Ice was closing in on rosette." Cast 1 Sample Log: "Ice on top of rosette."

Station 078.001
102 PI:"SiO3 may be low." Nutrients: "Rechecked sil = real."
102,103,105 Salinity was not drawn.

Station 079.001
102 Salinity was not drawn.
103-104 Samples were only drawn for C13/N15. Cast 1 DQ: "Sigma theta values suggest that this station was entered upside down! Highest sigma theta at surface and lowest at bottom. The differences are small but..." Bottle trip information is machine generated and the bottle number assignment is correct. Primary and secondary sensors agree, data is acceptable.
Station 080.001
102-103 Salinity was not drawn. Cast 1 DQ: "Highest sigma theta for mid-depth sample; check data entry as for Station 79 and check CTD scan data." There is a difference between the down and up cast. The surface is significantly different even as the bottle is being tripped. Data are acceptable.

Station 081.001
102-104 Salinity was not drawn.

Station 082.001
102-105 Salinity was not drawn.

Station 083.001
102-106 Salinity was not drawn.

Station 084.001
101 DQ:"Poor flushing indicated by bottle salinity. Was this the evil watch? We seem to vacillate between good bottle salinity agreement and bad agreement. Sure it could be random error, but I think that we should find the evil watchstanders!" The machines diagnostics indicate a slight electronics difference. Other than that there does not appear to be any problem, if the. salinity agreement was better this signal would not even have been questioned. The sampler is not the same as the last series of questionable bottom salts. Code salinity questionable.
102-104 Salinity was not drawn.

Station 085.001
102-104 Salinity was not drawn.

Station 086.001
101 DQ: "Another station where bottle salinity agrees poorly with CTD scan." Primary and secondary sensor agreement is reasonable. Bottle salinity was run after a lower value, 5 units lower. Although salinity analyses values do not indicate a problem, it could be that the previous sample influenced the readings on this sample. There appears to be a slight offset, 0.1, at the bottom of the cast. The bottle-CTDO is 0.9 higher than normal. Code CTDO questionable.
102 DQ:"Poor agreement between CTD and bottle O2 after adjusting for O2 probe offset. Both values are questionable unless we can identify what happened." The CTD profile indicates a drift of over 1.0 while the package sat at this level for the bottle trip. The trip data could have averaged the lower CTDO values. Code CTDO questionable.
102-103 Salinity was not drawn.

Station 087.001
101 DQ: "All samples seem questionable. Bottle and CTD salts don't agree. Bottle O2 went up, but CTD O2 went down and nutrients look low, all bottle data questionable." Code bottle leaking, and all samples bad.
102-103 Salinity was not drawn.
104-105 Samples were only drawn for C13/N15.

Station 088.001
104-105 Samples were only drawn for C13/N15.
106 Salinity was not drawn. Cast 1 Sample Log: "Tentacles on sensors."

Station 089.001
103 SampleLog: "Bottle did not close." After this cast the carousel was checked and position 3 was cleaned." No samples were drawn.
104 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable." Salinity was not drawn.

Station 090.001
101-105 Salinity was not drawn.
104 See103 bottle firing comment, no samples were drawn from this bottle.
107-108 Salinity was not drawn.
108 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen difficult to judge, leave as is." Cast 1 Sample Log: "All bottle tripped, carousel was cleaned and checked prior to this station." DQ: "No print-out. Were there bottle data from this station?"

Station 091.001
101 Oxygen: flask 1156 has flask 1592 stopper. Oxygen: checked and flask volumes very different - coding as questionable. PI: "Oxygen looks okay." Removed questionable footnote based on PI comments. Oxygen is acceptable.
102 Oxygen: flask 1192 has flask 1556 stopper. Oxygen: checked and flask volumes very different - coding as questionable. Oxygen is acceptable. Removed questionable footnote based on PI comments.
102-110 Salinity was not drawn.
106 PI:"Oxygen is acceptable."
109-109 Samples were only drawn for C13/N15.
111 Oxygen: "Check endpoint." bad endpoint, decided to backtitrate, but program prompted for next sample, then didn’t switch to O2UVLO so second try lost. Diagnostic program used to check and adjust enpoint. Oxygen: Changed sample flask to
1528 from 1148 (duplicated from sample above for 110). Went back and checked box: flask no. 1528 is correct. PI: "Oxygen is acceptable."

Station 092.001
101 DQ:"Once again bottle salinity suggests little or no soak time; although diff is within error bounds."
103-108 Salinity was not drawn.
106 PI: "Oxygen is high, but is in an oxygen gradient, is acceptable." DQ: "Check CTD O2."
109-111 No samples were drawn. Cast 1 Sample Log: "3 bottles tripped at the surface; jellyfish were around the rosette as reported by MT’s. Tripped bottles until the jellyfish went away, then sample from last bottle tripped."

Station 093.001
101 DQ: "Once again bottle salinity suggests poor flushing/little soak time although the absolute difference is small. Created a slight density inversion. Could be offset between autosal and CTD, but I am suspicious."
102-105 Salinity was not drawn.
103 Oxygen: "Sample was overtitrated and backtitrated."

Station 094.001
102-107 Salinity was not drawn.
104-105 Samples were only drawn for C13/N15. Cast 1 Oxygen: Sampler did not put water in tops of flask after 2nd shake. As per analyst, all flasks had small bubbles around edges.

Station 095.001
101 PI:"Large salt difference." DQ: "This is a mis-trip!"
102-104 Salinity was not drawn.
105 Salts: "Salt bottle 11 thimble came out with cap - bottle filled solid - no air space."

Station 096.001
101 PI:"Large salt difference." DQ: "Once again bottle salinity suggests poor flushing (or sampling from wrong bottle)."
102-104 Salinity was not drawn.

Station 097.001
101 Nuts: NH4: not reported due to equipment malfunction for this channel. DQ: "Once again bottle salinity and apparent density inversion suggest very poor bottle flushing."
102 Nuts: NH4 reported as questionable as single readable peak in the middle of bubble trouble, but this one looked like a real peak as per analyst. PI: "NH4 looks reasonable."
102-104 Salinity was not drawn.
103-104,107 Nuts: NH4: not reported due to equipment malfunction for this channel.
105-106 Samples were only drawn for C13/N15.

Station 098.001
101-105 Nuts: NH4: not reported due to equipment malfunction for this channel.
102 PI: "Large oxygen difference, reexamine CTDO trace and the titration; may just be large gradient."
102-104 Salinity was not drawn.

Station 099.001
102-104 Salinity was not drawn.

Station 100.001
102-108 Salinity was not drawn.
106-107 Samples were only drawn for C13/N15.
109 DQ:"Large density inversion. Could be that salinity and temps increased towards surface and that shallow depth of bottle relative to CTD created this apparent inversion, but check CTD scan and bottle salinity. Note sigma theta as questionable." Rechecked CTD trip information, no obvious problem in the CTD data. Agreement between the two sensors is reasonable, -0.008, for a surface trip. Temperature is a little cooler and salinity does increase. There are some different features that the CTD is sensing, so there could be ship's influence. Cannot footnote the sigma theta as suggested by DQ. Cast 1 Console Log: "Near bottom: observed temperature increase with O2 decrease."

Station 101.001
101-103,105 Salinity was not drawn.
103 Oxygen: "sample spilled" PI: "Oxygen is acceptable." DQ: "Notes say oxygen sample spilled, but a value is reported."
107-111 Salinity was not drawn.
108 SampleLog: "Bottle leaking from top vent." PI: "Oxygen is acceptable."

Station 102.001
102-112 Salinity was not drawn.
104,107,108 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
110 Samples were not drawn.
113 DQ:"Poor CTD and bottle agreement, but could be strong gradient." This is a gradient area, no problem with either pair of sensors.

Station 103.001

101 DQ:"Slight density inversion." Primary and secondary sensors agree very well with one another. Water is well-mixed for 10-15 meters before this trip. No problems seen in salinity analyses, except that it was analyzed after a much fresher sample.
101-106 Nuts: NH4: not reported due to equipment malfunction for this channel.
102-116 Salinity was not drawn.
105 DQ:"CTD O2 scan questionable?" CTDO agrees well with the down trace. No problem in the CTD data.
112 DQ:"Density inversion, check CTD scans." Three bottles were tripped at this depth. There appears to be ship roll which could be influencing the sensors. Okay, leave as is.
113-114 Samples were only drawn for C13/N15.

Station 104.001

102 Oxygen: "LONG delay" - started stirring before entered bottle and flask information. PI: "Oxygen is acceptable."
102-111 Salinity was not drawn.
106 DQ: "Check CTD scans." Primary and secondary agree with one another. Gradient, sensing water from deeper in the water column which has either caught up with the package or from ship roll.
113-114 Salinity was not drawn.

Station 105.001

102 Oxygen: "Delay between stirring & titration." started stirring before entering bottle/ flask info. PI: "Oxygen are acceptable."
105-113 Salinity was not drawn.
108 SampleLog: "Very small top cap leak." PI: "Oxygen are acceptable."
114 Nuts:NH4: bad measurement - strange peak. Footnote NH4 bad. Cast 1 DQ: "Salinities suggest poor bottle flushing for this station." There were modulo word errors, 8, on this cast. Most of them were on the down cast, the other two do not affect the trip data. Tried reextracting the trip data using a different timing criteria, this made the primary and secondary agreement better, but made the CTD-salinity difference worse.

Station 106.001

106-114,117 Salinity was not drawn.
115-116 Samples were only drawn for C13/N15. Cast 1 Sample Log: "Note: Nutrient tubes are split between TWO racks - Lite & Dark Blue."

Station 107.001

101 Salts: "note blue thread found lodged under thimble salt btl 18." PI: "Salinity is acceptable."
105-116 Salinity was not drawn.
110 SampleLog: "Air vent leak as vent was loose." PI: "Oxygen is acceptable."
117 Salts: "note thimble came out with cap salt btl 22 - no air gap." DQ: "Density inversion due to bottle salinity looking like it comes from > 10m. Notes suggest that there was a problem with this sample. Should be noted as questionable." Code salinity questionable.

Station 108.001

101-121 No PAR sensor, sampling too deep for instrument depth rating.
110-120 Salinity was not drawn.
115,121 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 109.001
105-119 Salinity was not drawn.
122 Samples was only drawn for C13/N15.
123-124 Salinity was not drawn.

Station 110.001
101 Console Log: "Instead of making a mark at the surface, accidentally fired bottle 1." No data from bottle 1 is being reported.
101-123 No PAR sensor, sampling too deep for instrument depth rating.
102 PI:"Oxygen is acceptable."
103 Sample Log: "Flasks 1504 & 775 may have been reversed in box." 775 may be for
103, and vice versa. Oxygen: "Flask had 1504 top." when? before sampling or with sample? sample drawer sure flasks & stoppers were matched when sampling - possible mix-up when analyzing? flasks have very different volumes (775 vol: 136.9544) & O2 values look ok PI: "Oxygen is okay, but maybe a little bit low." DQ: "Could be a mis-trip; bottle values look the same as bottle 104." Salinity bad. Code bottle did not trip as scheduled and water samples bad. Although CTD data files do not indicate any problem the water samples are a perfect match for bottle 4.
111-115 Salinity was not drawn.
117-120 Salinity was not drawn.
122-123 Salinity was not drawn.

Station 111.001
111-116 Salinity was not drawn.
118-123 Salinity was not drawn.

Station 112.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
111-115 Salinity was not drawn.
113 Sample Log: "Bottle was not tripped when brought to surface; then No samples were drawn. it tripped when it hit the side of the ship during recovery."
117-121,124 Salinity was not drawn.
122 Samples were only drawn for C13/N15.

Station 113.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
107 SampleLog: "Top vent leak." PI: "Data are acceptable."
108 SampleLog: "Top cap leak, not certain if cap or vent." PI: "Data are acceptable."
111-123 Salinity was not drawn.
115 SampleLog: "Leaking; top vent closed water issuing from spigot."

Station 114.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
108 SampleLog: "Air leak." PI: "Oxygen is acceptable."
110-123 Salinity was not drawn.
117 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable." Cast 1 DQ: "No apparent flushing problems. This must be the good watch."

Station 115.001
111-123 Salinity was not drawn.

Station 116.001

101-124 No PAR sensor, sampling too deep for instrument depth rating.

111 DQ: "Check bottle O2." No analytical problems noted. CTDO at bottle trips are questionable. Oxygen agrees weill with Station 114, 113 and 117. Station 115 did not sample at this depth. Code CTDO questionable.

112-123 Salinity was not drawn.

Station 117.001

101-124 No PAR sensor, sampling too deep for instrument depth rating.

109 Oxygen: "Check endpoint." PI: "Oxygen is acceptable."

112-123 Salinity was not drawn. Cast 1 Sample Log: "MnCl2 dispenser is NOT working smoothly."

Station 118.001

101-124 No PAR sensor, sampling too deep for instrument depth rating.

105 Oxygen: "Check endpoint ˜1 division high." PI: "Oxygen is acceptable."

108 Sample Log: "Leak in top vent." Oxygen: "Check endpoint, 5 divisions low." PI: "Oxygen is acceptable." Large bottle-CTD difference, 0.03, gradient area, CTD sensors agree with one another.

109-120 Salinity was not drawn.

111 Oxygen: "Check endpoint 1 division high." PI: "Oxygen is acceptable."

120 Oxygen: "Many mini bubbles." PI: "Oxygen is acceptable."

121 Large bottle-CTD difference, 0.21, gradient area, CTD sensors agree with one another.

122-123 Salinity was not drawn.

123 Oxygen: "Check endpoint 8 divisions high." Oxygen data rechecked and corrected appropriately. PI: "Oxygen is acceptable." Cast 1 DQ: "Flushing not so good - bad watch?"

Station 119.001

101-124 No PAR sensor, sampling too deep for instrument depth rating.

107 PI:"NO3 a little low?" Nutrients: "Rechecked no3 = real."

108 SampleLog: "leaky (top?)."

109-123 Salinity was not drawn.

118 SampleLog: "Leak from top end cap, when vent opened."

118-119 PI: "Identical nutrients. Suggest sampler drew two nuts from same niskin-cannot tell which depth is correct. (The NO2 data are clincher.) No isolayer in salinity or oxygen."

120-121 Samples were only drawn for C13/N15.

Station 120.001

101-124 No PAR sensor, sampling too deep for instrument depth rating.

105 Oxygen: "Overtitrate and backtitrate, (No EP)."

108 Sample Log: "Small leak, air vent, but sampler not certain if endcap or vent." Oxygen flask on Sample Log should be 1520, not 520 - double-checked.

110-123 Salinity was not drawn.

Station 121.001

101 Oxygen: "Sample Lost; forgot to add acid before addition of thio and starting stirring.

107 PI: "Urea is much higher than adjacent stations, footnote questionable." Nutrients: "Rechecked urea = peak changed."

112-123 Salinity was not drawn.

119 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 122.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.
121 Samples were only drawn for C13/N15.

Station 123.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-123 Salinity was not drawn.
116 Oxygen: "Overtitrate and backtitrate, 0.60049." PI: "Oxygen is acceptable."
119 Oxygen: "Overtitrate and backtitrate, 0.75938." PI: "Oxygen is acceptable."

Station 124.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
111-123 Salinity was not drawn.

Station 125.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
112-122 Salinity was not drawn.
118,119 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
123 Nuts: Silicate peak is really lower than surface one on charts. Rest of nutrients look reasonable, so leave as is. PI: "Silicate is acceptable." Nutrients: "Rechecked sil low but real."

Station 126.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
111-121,123 Salinity was not drawn.
122 Samples were only drawn for C13/N15.

Station 127.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
108 Oxygen: changed flask no to 1520 from 150 as per Sample Log and after checking flasks in box R.
110 PI: "Urea, 0.13, is higher than adjacent stations, code questionable." Nutrients: "Rechecked urea peak changed." DQ: "Value is acceptable"
112-123 Salinity was not drawn.
113 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable." Cast 1 Oxygen: standardization run with samples showed bad thio - used standardization results from previous day's run

Station 128.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
106 Oxygen: "Check endpoint 1 division high." PI: "Oxygen is acceptable."
112-123 Salinity was not drawn.
120 DQ:"O2 scan, double check for spikes." No problem seen in CTDO.

Station 129.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
110 Oxygen: "Check endpoint." PI: "Data are acceptable."
112-123 Salinity was not drawn.
113 Oxygen: "Check endpoint 2 div hi." ran o2chk and adjusted endpoint vol from 0.60126 to 0.60102 (skip 4 pts) PI: "Data are acceptable."

Station 130.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
102 Oxygen: "Endpoint?" Ran diagnostic program and adjusted endpoint. PI: "Oxygen is acceptable."
110 Oxygen: "check endpoint 3 divisions high." Ran diagnostic program and adjusted endpoint. PI: "Oxygen is acceptable."
110-120,123 Salinity was not drawn.
112 Oxygen: "Check endpoint 3 divisions high hi." Ran diagnostic program and adjusted endpoint. PI: "Oxygen is acceptable."
121-122 Samples were only drawn for C13/N15.

Station 131.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
105 Oxygen: "Overtitrate and backtitrate. (No endpoint) over-over-over titrate." analyst reported program kept asking to overtitrate but graph showed lines had gone off to begin with. O2 sample lost.
107 Oxygen: "Overtitrate and backtitrate, (No endpoint)" PI: "Data are acceptable."
109-123 Salinity was not drawn.

Station 132.003 Cast 1 Sample Log: "Cast aborted after first 3 bottles were tripped." Console Log: "Lost power, short in cable possible. Cast aborted on up way up, three bottles were tripped." ODF tech reported deck unit error light was on.
301-303 No PAR sensor, sampling too deep for instrument depth rating.
303 Oxygen: "Overtitrate and backtitrate, (No endpoint)."

Station 132.004
401-403 No samples were drawn.
401-424 No PAR sensor, sampling too deep for instrument depth rating.
408,409 Oxygen: "Overtitrate and backtitrate, (No endpoint)" PI: "Data are acceptable."
409-420,423 Salinity was not drawn.
416-417 PI: "There is a chance that both nutrient tubes were filled from the same bottle, but gradients are small so leave as is."
421-422 Samples were only drawn for C13/N15.
424 Sample Log: "Leak at bottom end cap when top vent open, tried reseating, no relief." PI: "O2 D-C is high, Code bottle oxygen bad."

Station 133.001
101-122 No PAR sensor, sampling too deep for instrument depth rating.
108 SampleLog: "Air Leak." PI: "Data are acceptable."
108-121 Salinity was not drawn.
111 Oxygen: "Overtitrate and backtitrate, 0.63911 bad value, overtitrate fail." Value looks okay from property-property plot. PI: "Data are acceptable."

Station 134.001
101-119 No PAR sensor, sampling too deep for instrument depth rating.
106 Ureais higher than adjacent values. Code urea questionable."
107-118 Salinity was not drawn.

Station 135.001
101-117 No PAR sensor, sampling too deep for instrument depth rating.
105-114,116 Salinity was not drawn.
107 PI:"O2 D-C a little low, but okay for gradient if bottle not flushed well. Leave as is."
115 Samples were only drawn for C13/N15.

Station 136.001
101-115 No PAR sensor, sampling too deep for instrument depth rating.
104-114 Salinity was not drawn.

Station 137.001
103-113 Salinity was not drawn.
110 PI:"Oxygen difference, bottle-CTD, is a little low, but nuts match bottle O2. CTDO2 is too high? Leave as is."

Station 138.001
101-103 Salinity was not drawn.
106-110,113 Salinity was not drawn.
111-112 Samples were only drawn for C13/N15.
114 Oxygen: "Endpoint ˜ 1 division high." PI: "Oxygen is acceptable." PI: "Oxygen difference, bottle-CTD, is a little low, but nuts match bottle O2. CTDO2 is too high? Leave as is."

Station 139.001
101-104 Salinity was not drawn.
106-110 Salinity was not drawn.
110 DQ:"Density inversion bottles 111 and 110. Suspect CTD salinity. No problem seen in CTD salinity or temperature trace. However, the agreement between the two sensors is high even for surface value. Review indicates that the CTD operator held the package longer than other bottle trips, which indicates there was a difference between the two sensors. Leave as is.
111 Oxygen: "Endpoint ˜ 2 divisions high." PI: "Oxygen is acceptable."

Station 140.001
101 DQ: "Bottle salinity looks like it came from 102 - poor flushing? Causes a density inversion between 101 and 102." CTD Operator held the package at the bottom for quite awhile, the shallower, less salty water could have caught up with the package. Leave as is.
102 Oxygen: "1 division high." PI: "Oxygen is acceptable."
102-106 Salinity was not drawn.

Station 141.001
108 Bottle not sampled for chl, pha according to sample log however data received from analyst Bottle not sampled for chl, pha according to sample log however data received from analyst
108-109 Tripped two extra bottles at 11 meters, thought chl max was changed. Chl person said sampling for C13, N15 should stay at the 18 meters.

Station 142.001
102-104 Salinity was not drawn. Cast 1 CTD conductivity and oxygen sensor are not usable from the down cast, suspect biological fouling. Will use the secondary sensors and eliminate the CTD oxygen. The bottle trip information is probably okay.

Station 143.001
102-104 Salinity was not drawn.

Station 144.001
102-103,106 Salinity was not drawn.
104-105 Samples were only drawn for C13/N15.

Station 145.001
102,103,105 Oxygen: "Overtitrate and backtitrate, (No endpoint)"
102-104 Salinity was not drawn.

Station 146.001
102-103 Salinity was not drawn.

Station 147.001
102 Salinity was not drawn.

Station 148.001
102 Salinity was not drawn.

Station 149.001
102 Salinity was not drawn.

Station 150.001
103 Console Log: "Bottle 3 did not close, so we sent the CTD back to the surface to collect the surface sample." Bottle 3 closed when bottle 4 was tripped. Bottle not sampled for chl, pha according to sample log however data received from analyst Bottle not sampled for chl, pha according to sample log however data received from analyst

Station 151.001
101-102 Samples were only drawn for C13/N15.
104-105 Salinity was not drawn.

Station 152.001
102 Salinity was not drawn.

Station 153.001
102 Salinity was not drawn.

Station 154.001
102-103 Salinity was not drawn.

Station 155.001
102,104 Salinity was not drawn.
103 Samples were only drawn for C13/N15.

Station 156.001
101-102 DQ: "Density inversion between bottles 101 and 102. Bottle salinity looks low, either bad salinity or poor flushing OR extreme gradients or some combination."
102-103 Salinity was not drawn.
103 Oxygen: "copepod" PI: "Oxygen is acceptable."

Station 157.001
102 Salinity was not drawn.

Station 158.001
102 Salinity was not drawn.

Station 159.001
102 Salinity was not drawn.
103-104 Samples were only drawn for C13/N15.

Station 160.001
102 Salinity was not drawn.

Station 161.001
102 Salinity was not drawn.

Station 162.001
102-103 Salinity was not drawn.
104 Oxygen: "bubble" PI: "Oxygen is acceptable."

Station 163.001
103 Sample Log: "Did not trip; bottom end cap hung up on sensors tygon tubing; very freak incident. CHL stated this was an extra bottle and there was no need to recast." Bottle not sampled for chl, pha according to sample log however data received from analyst Bottle not sampled for chl, pha according to sample log however data received from analyst

Station 164.001
101 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
102,104 Salinity was not drawn.
103 Samples were only drawn fo C13/N15.

Station 165.001
102-103 Salinity was not drawn.

Station 166.001
101 DQ:"Possible mis-trip. Poor agreement between CTD and bottle salinity and bottom nutrients slightly lower than nutrients on 102. Another possibility is that they tripped bottle too soon because of proximity to bottom. Density inversion between 101 and 102." Temperature and conductivity sensors agree with one another. There are no notes indicating any anyalytical problem for salinity or nutrients. DQ: "poor flushing. Note all samples as questionable".
102-103 Salinity was not drawn.

Station 167.001
102-104 Salinity was not drawn.

Station 168.001
102-104 Salinity was not drawn.

Station 169.001
102-104 Salinity was not drawn.

Station 170.001
102 Samples were only drawn for C13/N15.
103 Salinity was not drawn.

Station 171.001
102-103 Salinity was not drawn.

Station 172.001
102-104 Salinity was not drawn.
103 PI: "PO4 high by about 0.5; no match in NO3. Code PO4 questionable." DQ: "PO4 seems high. Check peak." Nutrients: "Rechecked po4 peak changed." DQ: "Still high. Note as questionable"
104 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 173.001
102-104 Salinity was not drawn.

Station 174.001
102,105-106 Salinity was not drawn.
103-104 Samples were only drawn for C13/N15.

Station 175.002
202-204 Salinity was not drawn.

Station 176.001
102-104 Salinity was not drawn.

Station 177.002
101,103-104 Salinity was not drawn. Cast 1 Sample Log: "All top vents were found open, redid the cast as Cast 2."

Station 178.001
102-103,105 Salinity was not drawn.
103 Oxygen: "copepod" PI: "Oxygen is acceptable."
104 Samples were only drawn for C13/N15.

Station 179.001
101 Salt: "bubble in cell which would not clear - lost sample - cell required cleaning" - "sample lost on last run due to dirty sample cell from algae" Sample not reported, lost.
102-104 Salinity was not drawn.
103 PI:"Oxygen bottle-CTD low, but okay for gradient."

Station 180.001
102 PI:"Oxygen bottle-CTD low, but okay for gradient."
102-103 Salinity was not drawn.

Station 181.001
102-103 Salinity was not drawn.
103 Oxygen: ">10ml, right flask!" PI: "Oxygen bottle-CTD low, but okay for gradient."

Station 182.001
101 DQ:"Mis-trip; CTD and bottle salinity and O2 do not agree, bottom nutrients a little lower than 102 data, density inversion, etc." Temperature and conductivity sensors agree with one another. There are no notes indicating any anyalytical problem for salinity or nutrients. DQ: "Mis-trip or very poor flushing. All samples questionable"
102-104 Salinity was not drawn.
105 Samples were only drawn for C13/N15.

Station 183.001
102-104 Salinity was not drawn.

Station 184.001
102-104 Salinity was not drawn.

Station 185.001
102 Oxygen: "copepods?" PI: "Oxygen is acceptable."
102-104 Salinity was not drawn.

Station 186.001
101 Oxygen: "Endpoint 2 division high, biological?" PI: "Oxygen is acceptable."
103-105 Salinity was not drawn.
104 Oxygen: "2 black bits" PI: "Oxygen bottle-CTD low, but okay for gradient."
106-107 Samples were only drawn for C13/N15.
108 Oxygen: "Endpoint 1 division high." PI: "Oxygen is acceptable."

Station 187.001
102-104 Salinity was not drawn.

Station 188.001
101 Salt: "Take 1st reading - sample continuously increasing - suspect salt crystal; bottle overfull to the rim." PI: "Salinity is acceptable."
102-106 Salinity was not drawn.

Station 189.001
103 PI: "Bottle oxygen high, nutrients low, looks like water from 20 meters. But, down CTD trace shows thin layer matching the oxygen layer. Leave as is." DQ: "Mis-trip." DQ: "Further review indicates mis-trip"
103-106 Salinity was not drawn.
106 Oxygen: "Sample was overtitrated and backtitrated."
107 Oxygen: "Brown deposit, may be high. Flask was used at 177-1 to draw sample, but was an aborted cast & so sample not run and just dumped out; probably residue on flask walls - flask and others used were thoroughly cleaned out." Code oxygen bad.

Station 190.001
102 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
102-105 Salinity was not drawn.

Station 191.001
102-105 Salinity was not drawn.

Station 192.001
102-107 Salinity was not drawn.
106 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 193.001
102-104 Salinity was not drawn.
106-107 Salinity was not drawn.

Station 194.001
102-108 Salinity was not drawn.
104 DQ:"CTD O2 bad??" There is a spike in the CTD data on the up trace. Code CTD oxygen bad.

Station 195.001
102-107 Salinity was not drawn.

Station 196.001
102-108 Salinity was not drawn.

Station 197.001
102-109 Salinity was not drawn.

Station 198.001
102-110,112 Salinity was not drawn.
104 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
108 Console Log: "Surface scratch repaired upper seal surface." PI: "Data are acceptable."
111 Samples were only drawn for C13/N15.

Station 199.001
103-112 Salinity was not drawn.
110 Sample Log: "Bottle was tripped think it was chl max, instead max was at bottle 11 and subsequent bottle tripped to capture the feature. Bottle 10 was not sampled." Cast 1 Sample Log: "Sea tentacles on bottles." PI: "Data are acceptable."

Station 200.001
102 DQ:"Probably a mis-trip. Density inversion, poor CTD-bottle salt agreement, nutrients look like they come from a shallower depth, etc." Temperature and conductivity sensors agree with one another. There are no notes indicating any anyalytical problem for salinity or nutrients. Water is well-mixed and should have been similar to deeper waters. Code bottle leaking and samples bad.
103-111 Salinity was not drawn.
114 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 201.001
104-114 Salinity was not drawn.
110 Oxygen: "Sample was overtitrated and backtitrated." DQ: "Nutrients and O2 look funny. Possible mis-trip. Bottle 11 did not close because of rosette malfunction which increases my suspicion that 110 was a mis-trip." Oxygen, nitrate, and phosphate agree with Stations 200-203. SIO3 appears low compared with adjoining stations. DQ: "Data acceptable"
111 Sample Log: "Bottle did not trip, latch on carousel was half tripped." Footnote no samples drawn from this bottle.

Station 202.001
103 Oxygen: "Sample was overtitrated and backtitrated."
105-116 Salinity was not drawn.
111 Sample Log: "Bottle did not trip, even though MT’s cleaned it, the ET’s will replace the latch." Footnote bottle did not trip as scheduled, no samples.

Station 203.001
105-119 Salinity was not drawn.
112 Nosamples were drawn.
116 Samples were only drawn for C13/N15.

Station 204.001
103 SampleLog: "Bottle got hung-up on primary vent, therefore, there is NO sample."
105-114,116 Salinity was not drawn.
113 PI: "Urea, 0.28, approximately 0.24 higher than above or below no matching feature at nearby stations, but near pycnocline." Nutrients: "Rechecked urea = real." DQ: "Urea value acceptable"
115 Samples were only drawn for C13/N15.

Station 205.001
103-113 Salinity was not drawn.

Station 206.001
103-110 Salinity was not drawn.

Station 207.001
103 Oxygen: "Endpoint 2,5 5 divisions high." Ran diagnostic program and adjusted endpoint. PI: "Oxygen is acceptable."
103-109 Salinity was not drawn.
108 Oxygen: "strand on tip" PI: "Oxygen is acceptable."
110 DQ:"Poor agreement between CTD and bottle salt and between CTD and O2 temps. Gradients? No objective reason to question data." This is a gradient.
111 Oxygen: "copepods" PI: "Oxygen is acceptable." DQ: "Poor agreement between CTD and O2 temps Gradients? No objective reason to question data."
112 CTDoperator tripped two bottles at the surface, thinking that bottle 11 was still having a tripping problem. No samples were taken. CTD data is reported, but no samples were taken.

Station 208.001
101 Sample Log: "Redrew O2, NAOH dispenser had a deposit on it that was not noticed until sample was taken." PI: "Oxygen is acceptable."
102-106 Salinity was not drawn.
107,108 Oxygen: "copepods" PI: "Oxygen is acceptable."

Station 209.001
102-107 Salinity was not drawn.
104 Oxygen: "Endpoint 3 high, copepods." Ran diagnostic program, rechecked endpoint, okay. PI: "Oxygen is acceptable."
108 Oxygen: "Endpoint 2 high, copepods." Ran diagnostic program, rechecked endpoint, okay. PI: "Oxygen is acceptable."

Station 210.001
101-104 Salinity was not drawn.
102 Oxygen: "Check endpoint, copepods." Ran diagnostic program and adjusted endpoint. PI: "Oxygen is acceptable."
104 Oxygen: "Check endpoint 4 divisions high." Ran diagnostic program and to recheck endpoint, okay. PI: "Oxygen is acceptable."

Station 211.001
102-105 Salinity was not drawn.
103 PI:"O2 bottle-CTD high, but nutrients agree with O2. Probably flushing problem."

Station 212.001
102-105 Salinity was not drawn.
106 DQ:"Poor agreement between bottle and CTD salinity. Suspect bad bottle salt analysis. Check autosal run for problems? Density inversion." CTD sensors agree with one another. No problems indicated during salinity analyses.

Station 213.001
101 DQ:"Poor agreement between bottle and CTD salt. Salinity coded questionable. Density inversion due to poor bottle/CTD salt agreement. Check autosal run. " No analytical problems noted for salinity. Water is well mixed, agreement between bottle and CTD is within accuracy. Leave as is.
102-105 Salinity was not drawn.
104 Samples were only drawn for C13/N15.
106 DQ:"CTD O2 scan is questionable." CTD oxygen looks good, well mixed at the surface and agrees with down trace. Bottle oxygen is 0.1 ml/l higher than adjacent stations. Leave as is.

Station 214.001
102-104 Salinity was not drawn.
106-107 Samples were only drawn for C13/N15.

Station 215.001
101 DQ: "Check bottle and CTD salinities." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.15 conductivity units. Should not have effected the sample, but this is the only thing of any mentionable difference.
102-103 Salinity was not drawn.

Station 217.001
101 DQ: "Bottle salinity leading to density inversion. CTD 32.6133, bottle 32.257. Suspect bad bottle salt." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.14 conductivity units. Should not have effected the sample, but this is the only thing of any mentionable difference. Much lower than adjoining stations, CTD sensor agreement is reasonable. Code salinity questionable.
102-104 Salinity was not drawn.

Station 218.001
101 DQ:"Poor agreement between bottle and CTD salinity leading to density inversion." No analytical or sampling problems noted. Within accuracy, leave as is.
102-105 Salinity was not drawn.

Station 219.001
101 DQ:"Suspect bad bottle salinity; density inversion." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.17 conductivity units. Should not have effected the sample, but this is the only thing of any mentionable difference. Much lower than adjoining stations, CTD sensor agreement is reasonable. Code salinity questionable.
102-105 Salinity was not drawn.

Station 220.001
102-105 Salinity was not drawn.

Station 221.001

102-105 Salinity was not drawn. Cast 1 Console Log: "After cast, found significant jellyfish tentacles in both secondary sensors; no change in differences during cast." Data does not appear to have been affected, no unusual differences other than down and up cast differences. PI: "Data are acceptable."

Station 222.001

102-106 Salinity was not drawn.

106 DQ:"Suspect bad CTD scan; density inversion. Check CTD scan salinity." Offset in primary conductivity sensor at ˜50 meters on the up cast. Report the secondary conductivity data for entire cast.

Station 223.001

102-106 Salinity was not drawn.

107 SampleLog: "Top vent was not closed." PI: "Oxygen is acceptable."

Station 224.001

103-108 Salinity was not drawn.

109-110 Samples were only drawn for C13/N15.

111 Oxygen: "Endpoint 2 divisions high." PI: "Oxygen is acceptable."

Station 225.001

101 Console Log: "Fired bottle 1 at surface instead of making a mark. No samples drawn.

106-110 See Cast 1 Sample Log comment. Salinity from primary sensor bad on the up cast. Offset in primary conductivity sensor at ˜43 meters on the up cast. Report the secondary conductivity data for entire cast.

108 SampleLog: "Leak from spigot." PI: "Data are acceptable." Cast 1 Sample Log: "Jellyfish tentacles in primary sensor, drew all salinities." Temperature looks okay, secondary sensors may be okay. MT's took tubing off after the cast, the tentacle of jellyfish was through the intake and out the outflow of the sensors. Console Log: "46 meters wire out, something is wrong with salinity (coming up), jumped from 32 to 29, then at 35 meters wire out jumped from 29 to 30."

Station 226.001

102-108 Salinity was not drawn.

109 Oxygen: "copepod" PI: "Oxygen is acceptable." Cast 1 Sample Log: "Prior to this cast, tubes were removed and cleaned, sensors were flushed with fresh water for 20 minutes."

Station 227.002 Cast 1 Sample Log: "Cast 1 was aborted, CTD was at 100 meters, primary conductivity sensor was "stuck"."

201-209 Salinity was not drawn.

219 Oxygen: "Copepods." PI: "Oxygen is acceptable."

Station 228.001

101 Oxygen: "Copepod" PI: "Oygen is acceptable."

102-113 Salinity was not drawn.

108 SampleLog: "Did not trip."

113 SampleLog: "Leak on bottle, top seal did not seat properly."

Station 229.001

102-113 Salinity was not drawn.

109 Bottle not sampled for chl, pha according to sample log however data received from analyst Bottle not sampled for chl, pha according to sample log however data received from analyst

110 Oxygen: "Bubble" PI: "Oxygen is acceptable."

Station 230.001
103 Oxygen: "Tiny bubble" PI: "Oxygen is acceptable."
103-114 Salinity was not drawn.
104 Oxygen: "Streamers on probe" Not certain what oxygen analyst meant, but PI accepted oxygen data.

Station 231.001
103-114 Salinity was not drawn.
105 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable." PI: "Urea, 0.19, approximately 0.13 higher than other samples and Maximum not seen at neighboring stations. Footnote urea questionable."
112 Samples were only drawn for C13/N15.

Station 232.001
103-111 Salinity was not drawn.

Station 233.001
102-109 Salinity was not drawn.

Station 234.001
102-107 Salinity was not drawn.
103 PI:"Oxygen bottle-CTD high, but okay for gradient." Cast 1 DQ: "Very poor CTD-bottle salinity agreement causing apparent density inversions. Looks like a bad station vis a vis flushing, on salts or CTD readings. Flushing offsets > 10m" CTD sensors agree will with one another.

Station 235.001
102-106 Salinity was not drawn.

Station 236.001
102-105 Salinity was not drawn.

Station 237.001
101 DQ: "Looks like a mis-trip or poor flushing. Poor bottle and CTD salinity and O2 agreement. Density inversion, nutrient inversions." The water is well-mixed for about 7 meters, this could have been a late closure on the bottle, where the lanyard released or hungup. See PI comment on Station 238. DQ: "Data questionable due to mis-trip or poor flushing"
102-104 Salinity was not drawn.
105 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 238.001
101 Oxygen value seems high; salinity and nutrients seem low; no obvious problems; leave as is. Note that sta 249.001 at same isobath is almost identical PI: "Data is acceptable." DQ: "Bad station; mis-trip or poorly flushed. Bad CTD and salinity agreement, density inversion, nutrient inversion, O2% sat inversion, etc."
102-104 Salinity was not drawn.
105 DQ:"Also terrible agreement between bottle and CTD salinity causing apparent density inversion, but nutrients look ok. Same possibilities, mis-trip or poorly flushed." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.11 conductivity, 2.1 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable. Code salinity questionable.

Station 239.001
101 DQ:"Another station where incomplete flushing creates inversions between 101 and 102." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.14 conductivity, 2.4 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable and water is well-mixed for about 10 meters. Code salinity questionable.
102-104 Salinity was not drawn.

Station 240.001
102-103 Salinity was not drawn.
104-105 Sample Log: "2 extra bottles tripped at chl max for C13, N15, found out that samples were not requested and therefore not sampled." No samples drawn from these bottles.

Station 241.001
101 Noanalytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.15 conductivity, 3.0 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable. Water is well-mixed for about 10 meters. Code salinity questionable.
102-104 Salinity was not drawn.

Station 242.001
102-103 Salinity was not drawn.

Station 243.001
101 DQ:"Looks like a mis-trip. Again, bad CTD and bottle salinity agreement, same for CTD and bottle O2, slight NO3 and Si inversions, density inversion could be due to strong gradients and only fair flushing." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.15 conductivity, 3.1 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable. Water is well-mixed for 10 meters. Code salinity questionable.
103 Salinity ws not drawn.
104 Large Bottle-CTD salinity difference. Water is well-mixed for 5 meters. No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.11 conductivity, 2.3 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable. Code salinity questionable.

Station 244.001
102-103 Salinity was not drawn.
104-105 Samples were only drawn for C13/N15.

Station 245.001
102-103 Salinity was not drawn.
103 Oxygen: "Copepods" PI: "Oxygen is acceptable."

Station 246.001
102-105 Salinity was not drawn.

Station 247.001
102-104 Salinity was not drawn.
105 Oxygen: "Copepods" PI: "Oxygen is acceptable."

Station 248.001

101 DQ: "Could be a mis-trip. Again, poor bottle and CTD salinity and O2 agreement, apparent density inversions slight Si inversion, etc. Could be ok - strong gradient." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.15 conductivity, 2.8 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable. Code salinity questionable.
102-104 Salinity was not drawn.
103 PI:"Oxygen bottle-CTD low, but okay if bottle flushing was not ideal."

Station 249.001

101 Oxygen value seems high; salinity and nutrients seem low; no obvious problems; leave as is. Note that sta 238.001 at same isobath is almost identical DQ: "A clear mis-trip - no brainer." Samples coded questionable.
102-104 Salinity was not drawn.

Station 250.001

102-105 Salinity was not drawn.
105 Oxygen: "biota" PI: "Oxygen is acceptable."
106 DQ:"Poor CTD-bottle salinity agreement leading to density inversion. Mis-trip? Bad salt? CTD problem?" No analytical or sampling problems noted. Sample was analyzed after a much higher sample, 0.18 conductivity, 3.5 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable.

Station 251.001

102-106 Salinity was not drawn.
105 Samples were only drawn for C13/N15.

Station 252.001

102-107 Salinity was not drawn.
103 PI:"Oxygen bottle-CTD differences are larger, but okay for flushing and gradient."
105 PI:"Oxygen bottle-CTD differences are larger, but okay for flushing and gradient."

Station 253.001

102-109 Salinity was not drawn.
109 Oxygen: "biota" PI: "Oxygen is acceptable."

Station 254.001

101-104 Salinity was not drawn.
108-113 Salinity was not drawn.
111-112 Samples were only drawn for C13/N15.
113 Oxygen: "Red colored precipitate." PI: "Oxygen is acceptable."

Station 255.001

101-111 Salinity was not drawn.
105 Oxygen: "copepod?" PI: "Oxygen is acceptable."

Station 256.001

102 DQ: "Could be a mistrip, note values for this samples as questionable." Nutrients: "Checked charts, no problem noted." DQ: "Values acceptable"
102-110 Salinity was not drawn.
103 Oxygen: "ABORT, Overtitrate, cracked flask leak." Oxygen: sample lost; not reported.

Station 257.001
102-111 Salinity was not drawn.

Station 257.002 Cast 2 Samples were only drawn for C13/N15.

Station 257.003 Cast 3 Pigments only, cast 01 samples dumped in error.

Station 258.001
101 Sample Log: "Oxygen was drawn 3 times due to faulty MnCl2 dispenser (serial no
1031033), which was finally replaced. DQ: "Could be a mis-trip, but more likely that poor flushing leads to apparent density inversion." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.11 conductivity, 2.3 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable. Code salinity questionable.
102-104 Salinity was not drawn.
105 Sample Log: "Bottle was closed before winch stopped at surface; no samples." Only C13/N15 were drawn.

Station 259.001
102-104 Salinity was not drawn.

Station 260.001
101 while oxygen and nutrients may be OK due to smaller gradients. Note bottle salt 101 as questionable."
101-102 DQ: "Density and PO4 inversions probably due to incomplete flushing." No analytical problems noted. CTD sensors agreement is reasonable. Bottle and CTD oxygen are also lower on 102. Not sure how this could be a flushing problem. Pressure is 39-32db. 050406 DQ: "Tis is a case where a strong salinity gradient causes bottle salt to be questionable,
102-103,105 Salinity was not drawn.
104 Samples were only drawn for C13/N15.

Station 261.001
101 DQ: "Bad bottle salinity != bad sigma theta." No analytical or sampling problems noted. Sample was analyzed after a much lower sample, 0.15 conductivity, 3.0 salinity units. Should not have effected the sample, but this is the only thing of any mentionable difference. CTD sensor agreement is reasonable, 3 meter mixed area after gradient. Code salinity questionable.
102 PI:"Unusual oxygen bottle-CTD is caused by bottle sample missing thin layer seen in CTD. Nutrients and bottle oxygen agree, okay."
102-104 Salinity was not drawn.

Station 262.001
101 DQ:"Bad bottle salinity." Do not know how this could be such a high value, 34.63. Last time this salinity bottle was used, the value was 32.xx, so it could not have been a sampling issue. Code salinity bad.
102-104 Salinity was not drawn.

Station 263.001
102-103,105 Salinity was not drawn.
104 Samples were only drawn for C13/N15.

Station 264.002 Cast 1 Console Log: "Cast 1 aborted at the bottom, thought there was biological debris in the sensors.
202-204 Salinity was not drawn.

Station 265.001
102-105 Salinity was not drawn.

Station 266.001
102-104 Salinity was not drawn.

Station 267.001
102-104 Salinity was not drawn.

Station 268.001
102 DQ: "CTD O2 scan Spike?" CTD oxygen is reasonable, no spikes, "equilibrated" close to down cast.
102-104 Salinity was not drawn.
103 PI:"High oxygen bottle-CTD caused by thin low O2 layer (CTDO) missed by bottle, okay."

Station 269.001
102-103 Salinity was not drawn.

Station 270.001
101 Oxygen: "<1mm bubble" PI: "Oxygen is acceptable."
102-104 Salinity was not drawn.
103 Oxygen: "biota" PI: "Oxygen is acceptable."
104 Oxygen: "biota" PI: "Oxygen is acceptable."

Station 271.001
102-104 Salinity was not drawn. Cast 1 Sample Log: "Top of rosette has a lot of biological matter." PI: "Data are acceptable."

Station 272.001
102-104 Salinity was not drawn.
104 Oxygen: "<1mm bubble" PI: "Oxygen is acceptable."
105 DQ: "Poor agreement between CTD and bottle salinity-poor flushing? Check data. Poor agreement between CTD and bottle O2 also. CTD spikes?" CTD sensors agree well with one another. There is a spike in the data, but it was deleted in the averaging.

Station 273.001
102-105 Salinity was not drawn.

Station 274.001
101 Oxygen: "biota" PI: "Oxygen is acceptable."
102-105 Salinity was not drawn.
106 Oxygen: "copepod" PI: "Oxygen is acceptable."

Station 275.001
102-107 Salinity was not drawn.
105 Oxygen: "biota" PI: "Oxygen is acceptable."
106 Gradient, large difference between the two conductivity sensors.
108 DQ:"Slight density inversion due to incomplete flushing and strong gradient."

Station 276.001
101 Oxygen: "<1mm bubble." PI: "Oxygen is acceptable."
102-108 Salinity was not drawn.
107 Oxygen: "big copepod." PI: "Oxygen is acceptable."
108 Oxygen: "copepod." PI: "Oxygen is acceptable."
109 Samples were only drawn for C14/N15.

Station 277.001
102 Oxygen: "Endpoint 1 division high." PI: "Oxygen is acceptable."
102-111 Salinity was not drawn.

Station 278.001
102 Oxygen: "Endpoint 1 division high." PI: "Oxygen is acceptable."
102-111 Salinity was not drawn.
111 Oxygen: "copepod" PI: "Oxygen is acceptable."

Station 279.001
103-111 Salinity was not drawn.
112 Oxygen: "biota" PI: "Oxygen is acceptable."

Station 280.001
101 Oxygen: "copepod" PI: "Oxygen is acceptable."
102-111 Salinity was not drawn.
111 Oxygen: "Endpoint 1 division high." PI: "Oxygen is acceptable."

Station 281.001
102-111 Salinity was not drawn.
110 Oxygen: "Endpoint 4 divisions high." Diagnostic program used to adjust endpoint. PI: "Oxygen is acceptable."

Station 282.002 Cast 1 Sample Log: "Cast 1 aborted, conductivity sensor difference was 1.+. After in ocean flushing did not resolve this issue, the CTD was brought on board to clean and force DI water through the sensors. This did not resolve the problem. The MT reported that they found during the cleaning a lot of sticky biological matter around the sensors. The CTD was taken to ˜50 meters, a yoyo was done and eventually the "bubble" came out.
202-213 Salinity was not drawn.
210,212 Pigments only. No other samples drawn.
211 Oxygen: "Stir bar added first." PI: "Oxygen is acceptable."
213 Oxygen: "1-in long bug" PI: "Oxygen is acceptable."

Station 283.001
102-108 Salinity was not drawn.
103 DQ: "PO4 data (peaks, etc) from this station should be double checked. Are PO4 maxima and N** minima for bottles 103 and 107 real?" PO4 agrees with Station 67,
107 depth not sampled at 67. Nutrients: "Rechecked po4 peak changed."

Station 284.001
102-107 Salinity was not drawn.

Station 285.001
102-104 Salinity was not drawn.

Station 286.001
102-111 Salinity was not drawn.
105 Oxygen: "Overtitrate and backtitrate, 0.71081. Bad Overtitrate, data bad." coding as 4: Bad Measurement PI: "Oxygen looks okay and and fits nutrients."
113 Sample for DOM only.

Station 287.001
102-113 Salinity was not drawn.
113-115 DQ: "Check CTD scan; Density inversion near surface ship effect?" No problem seen in CTD sensors.
114 Sample for DOM only.

Station 288.001
102-110 Salinity was not drawn.
111 Sample for DOM only.

Station 289.001
102-105 Salinity was not drawn.

Station 290.001
102-103 Salinity was not drawn.
104 Sample for DOM only.

Station 291.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
106 DQ:"Check urea peak." Nutrient analyst: "Rechecked charts, no analytical problem found."
115-123 Salinity was not drawn.
124 Sample Log: "Bottom cap began to leak when opened." Oxygen: "<1mm bubble" PI: "Footnote oxygen questionable."

Station 292.001
103-111 Salinity was not drawn.
106 PI:"Urea high, also seen at Station 293." DQ: "Slightly high urea again. Check peak: contaminated? No objective reason to question value unless peak is funny." Nutrients: "Rechecked urea = real."

Station 293.001
103-111 Salinity was not drawn.
106 PI: "Urea high, also seen at Station 292." DQ: "High urea peak again. Same ˜ depth as at station 292, so it could be real, but was this bottle changed or worked on prior to Station 291?" Nutrients: "Rechecked urea = real."

Station 294.001
103-111 Salinity was not drawn.
104 Oxygen: "Endpoint 1 division high." PI: "Oxygen is acceptable."
105 DQ:"Check NO3 peaks, etc. NO3 looks low, NH4 looks high, no objective reason to question data." Nutrients: "Rechecked no3, nh4 = real."

Station 295.001
102-112 Salinity was not drawn.

Station 296.001

101 PI: "Urea high, 0.90, certainly an error. Footnote urea bad." DQ: "Check urea data." Nutrient analyst: "Rechecked charts, no analytical problem found." The data did not fit the station profile or adjacent station comparisons. The data could be acceptable, but are open to interpretation. Coded Questionable.

102-112 Salinity was not drawn.

107 DQ:"Check CTD O2 scans." CTD O2 did "change' during the bottle trip, but there are no spikes in the O2 trace and during the equilibration the oxygen values became higher.

Station 297.001

102-111 Salinity was not drawn.

Station 298.001

102-111 Salinity was not drawn.

112 PI: "Urea high, 0.26, likely an error. Footnote urea questionable." Nutrients: "Rechecked urea = real." DQ: "Urea value acceptable"

Station 299.001

103-112 Salinity was not drawn.

Station 300.001

103-111 Salinity was not drawn.

Station 301.001

103-112 Salinity was not drawn.

104-105 Sample Log: "Bottle 4 was repaired prior to cast. Bottle 5 fired to ensure sample at depth in the event that 4 failed to close."

105 See 104-105 comment. No samples drawn from this bottle.

111 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."

Station 302.001

103-111 Salinity was not drawn.

Station 303.001

103-110 Salinity was not drawn. Cast 1 Repeat of Station 53. DQ: "I am guessing that this station was taken by the 'bad watch'." The bottom two salinities do have poor agreement with the CTD. However, there does not seem to be consistent problem for one watch vs. the other.

Station 304.001

103-108 Salinity was not drawn.

Station 305.001

102-105,107 Salinity was not drawn.

104 PI: "Urea, 0.26, high, may be okay, or questionable?" Nutrients: "Rechecked urea = real."

106 Oxygen: "Sample was overtitrated and backtitrated." Cast 1 Repeat of Station 55. The secondary conductivity was offset from the primary. Footnote secondary conductivity as bad so it won't come out in the difference reports.

Station 306.001

102-103,105 Salinity was not drawn.

103 SampleLog: "Small leak on bottom end cap. Lots of biological matter on rosette, suspect caught in cap." PI: "Data are acceptable."

Station 307.001
101-102 Salinity not drawn.
103-105 See sample log comment, footnote CTD temp, sal and oxygen bad. Data from secondary sensors.

Station 308.001
103 Salinity was not drawn.

Station 310.002
202-203 Salinity was not drawn.
204-205 Samples were only drawn for C13/N15. Cast 2 Cast 1, aborted due to biological fouling.

Station 311.001
103-105 Use secondary conductivity sensor data for entire cast for CTD salinity and CTD oxygen bad. This could be another occurrence of biological fouling.
104 PI:"CTD salinity low; unstable. Footnote CTD salinity/conductivity questionable."

Station 312.001
101-117 No PAR sensor, sampling too deep for instrument depth rating.
106-116 Salinity was not drawn.

Station 313.002
201-213 No PAR sensor, sampling too deep for instrument depth rating.
202-212 Salinity was not drawn.
210 DQ: "Poor agreement between CTD and bottle O2." There is an oxygen minimum seen in both down and up cast. No problem seen in CTD oxygen. Bottle oxygen could be a little high as compared with Stations 311-315. No analytical problems noted. Cast 2 Cast 1 aborted due to biological fouling.

Station 314.001
106-116 Salinity was not drawn.

Station 315.001
101-120 No PAR sensor, sampling too deep for instrument depth rating.
107-116 Salinity was not drawn.
111 Oxygen: "copepod" PI: "Oxygen is acceptable."
117-118 Samples were only drawn for C13/N15.

Station 316.001
101-121 No PAR sensor, sampling too deep for instrument depth rating.
109-120 Salinity was not drawn.

Station 317.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
111-123 Salinity was not drawn.
119 PI:"Large oxygen bottle-CTD, okay for gradient."
123-124 Bottles appear to have bottom cap leaks after the vents are opened. PI: "Oxygens are acceptable."

Station 318.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
111-123 Salinity was not drawn.

Station 319.001
103 Nosamples were drawn.
104-112 Salinity was not drawn.

Station 320.001
101-114 No PAR sensor, sampling too deep for instrument depth rating.
102 Oxygen: "Sample was overtitrated and backtitrated." PI: "Oxygen is acceptable."
103-108 Salinity was not drawn.
109-110 Samples were only drawn for C13/N15.
111-113 Salinity was not drawn.

Station 321.001
103-111 Salinity was not drawn.

Station 322.001
102-110 Salinity was not drawn.

Station 323.001
102-110 Salinity was not drawn.

Station 324.001
101-112 No PAR sensor, sampling too deep for instrument depth rating.
102-111 Salinity was not drawn.
104 Sample Log: "Slow leak, bottom end cap, reseated still leaking." PI: "Oxygen is acceptable."

Station 325.001
101-114 No PAR sensor, sampling too deep for instrument depth rating.
103 Oxygen: "Sample was overtitrated and backtitrated. Last 5 division high?, noisy." PI: "Oxygen is acceptable."
103-109 Salinity was not drawn.
110-111 Samples were only drawn for C13/N15.
112-113 Salinity was not drawn.
113 SampleLog: "Upper cap leak." PI: "Oxygen is acceptable."

Station 326.001
101-112 No PAR sensor, sampling too deep for instrument depth rating.
103-111 Salinity was not drawn.

Station 327.001
101-112 No PAR sensor, sampling too deep for instrument depth rating.
103-111 Salinity was not drawn.

Station 328.001
101-124 No PAR sensor, sampling too deep for instrument depth rating.
108-124 Salinity was not drawn.
115 Sample Log: "Leak on top cap." Oxygen appears slightly low, but acceptable. Leave as is.
119-124 DQ: "CTD O2 data looks weird." Oxygen sensor appears to have a poor to no response at about 90 meters on the up cast. Code CTD oxygen bad. Sensor could have a poor response from about 160 meters up. The profile seems to be close to the down cast, but deviates by strange amounts.
121 Oxygen: "crash 21(1168) lost" Oxygen: lost sample due to computer crash.
122 PI: "Large oxygen bottle-CTD. Bottle oxygen does not match gradient or possible flushing problem. But, CTD oxygen trace does show the oxygen maximum. Oxygen is acceptable."

ADDENDUM

Additional Notes on Bottle Data and CTD Oxygen Sensor Data

L. A. Codispoti

23 May 2005

At the conclusion of this cruise, the SBI Service Team prepared a cruise report detailing the methods and equipment employed, data formats, etc. that are included with the metadata from this cruise. Further editing of the data continued at Scripps and then the data were sent to L.A. Codispoti for a final review of the bottle salinity, nutrient and dissolved oxygen data. Specific comments on individual measurements arising from LAC's inspection and from data editing during the cruise and by the staff at Scripp's Ocean Data Facility have been incorporated as quality control flags in the data tables following a WOCE format described in the Service Team's cruise report. LAC's review suggests that the following additional comments may be an aid to some users.

1. In general, the data from this cruise appear to be of high quality, but note that the dissolved oxygen data from the CTD's oxygen sensor are uncalibrated and should only be employed for qualitative purposes, such as inferring the shape of oxygen gradients.
2. A comparison of bottle and CTD salinity data showed generally excellent agreement, but there was a tendency for the bottom bottle salinity to be slightly less than the CTD salinity, and for the rest of the bottle salinities to be slightly higher. These results suggest insufficient flushing of the CTD's sample bottles in some cases. In the upper ~200m salinities tend to increase strongly with depth, so a bottom bottle "contaminated" by waters from above the sampling depth would have salinities less than indicated by the CTD and vice versa for the subsequent bottles that would be tripped as the cast ascended. In general the apparent depth offsets caused by incomplete flushing were small, and values > 5 m are rare, but the user interested in fine differences with depth should compare bottle and CTD salts to assess the possibility of incomplete bottle flushing.
3. Normally, our protocols call for storing nutrients samples (in the dark and in a refrigerator) for no longer than 12 hrs before the samples are run, but there was only one nutrient analyst on this cruise, so many samples were stored for more than 12 hours before being run. The data do not display, any obvious problems arising from the undesirably long storage periods.
4. We do not make explicit corrections for "carryover" in our nutrient analyses. In a typical AutoAnalyzer system, sample to sample carryover is ~ 1-2% of the concentration difference between samples. We minimize this effect by running samples in order of increasing depth such that concentration differences between samples are minimized. We also run initial surface samples twice or run a low nutrient sea water sample ahead of the surface sample since these samples generally follow standard peaks or a high nutrient value from a preceding cast.
5. The ammonium and urea analyses are not described in WOCE/JGOFS protocols, and they are the least reliable of our nutrient determinations. In addition, they are the analyses most likely to be effected by differences between sample salinities and the salinity of our standard matrix (S ~30) and by storage. One cannot assign, a precise uncertainty, to these data, over the complete sampling, storage and analysis cycle, but a practical suggestion would be that a robust difference in values for these variables is ~ 0.25 µM.
6. Comments or questions about these data can be addressed to:

James H. Swift : jswift@ucsd.edu
Louis A. Codispoti: codispoti@hpl.umces.edu

APPENDIX B: Raytheon Polar Service Corporation (RPSC)

RPSC Cruise Support
Cruise NBP 03-4A
5 July – 20 August 2003

General

Raytheon Polar Services Company (RPSC) is contracted by the National Science Foundation (NSF) to provide logistical and technical support and infrastructure for the United States Antarctic Program (USAP). Through this mandate, RPSC charters the RVIB Nathaniel B. Palmer (NBP) from Edison Chouest Offshore, Inc. (ECO). RPSC and ECO work together to provide a safe, comfortable, and productive living and working environment for NSF-funded science projects. An unusual series of events prevented the US and Canadian Coast Guards from providing a platform for the 2003 SBI Survey cruise, while at the same time the NBP had a long open period in her schedule because contractually required major upgrades were completed, tested, and accepted ahead of schedule.

The Nathaniel B. Palmer completed a maintenance period in Lyttelton, New Zealand at the end of the 2002-03 austral summer season, then left port on 23 May 2003 to transit north to support the SBI program. Scientific cargo was onloaded during a port call in Honolulu, Hawaii from 11 to 24 June 2003. During this time, Rob Palomares representing the Scripps Institution of Oceanography, Shipboard Technical Support, Oceanographic Data Facility (SIO/STS/ODF) visited the ship to account for all cargo items and to inspect several on-board systems. The vessel continued on to Dutch Harbor, Alaska with a 2 July 2003 arrival. Some remaining cargo items plus fuel and fresh food were onloaded to the NBP, scientists embarked onto the ship, and laboratory setup began. The ship sailed from Dutch Harbor on 5 July 2003 to begin cruise NBP 03-4A.

Prior to beginning the primary survey portion of the cruise, the NBP arrived offshore of Nome, Alaska on 8 July 2003 where a helicopter and crew joined our complement. During the planning process, NSF identified the need for a helicopter to 1.) allow for ice reconnaissance, 2.) assist in passenger offload at Barrow, Alaska at the conclusion of the cruise, and 3.) to support aerial surveys of marine mammals for a funded component of the SBI project. Working through the US Dept. of the Interior's Office of Aircraft Services (OAS), NSF contracted with Prism Helicopters, Inc. for such support. RPSC made arrangements for shipboard support of the aircraft crew including aviation grade fuel and training of passengers in safety and operational matters related to the helicopter. RPSC was delegated to oversee Prism's contract, including properly accounting for flight hours and aircraft availability. In practice, ice conditions did not warrant reconnaissance flights. Two flights were undertaken to transfer community participants to/from shore, exchange of scientific crews and cargo in Barrow required several hours of flight time, while the remainder of the flights were for marine mammal surveys. At total of 51.2 hours of flight time were completed in association with this cruise (not counting offload of passengers at Barrow).

RPSC maintains and logs data from several underway systems including: ship's position, heading, speed, pitch and roll, multibeam sonar, meteorology (air temperature and humidity, wind speed and direction, barometric pressure), upward-looking radiometers (PSP, PIR, PAR), and surface seawater properties (temperature, salinity, transmissivity, fluorometry). For this cruise, RPSC also provided a full CTD system including 24 –10 liter niskin bottles and rosette, SeaBird 911 CTD fish, primary and secondary temperature, salinity, and dissolved oxygen sensors (all from SeaBird), PAR sensor, Chelsea and Wet Labs fluorometers, and a Wet Labs transmissometer. These were supplemented by a lowered ADCP, Simrad altimeter, and Haardt fluorometer provided by the scientists. In addition, RPSC maintains several NSF-funded science of opportunity systems, described below, which are included in the end of cruise data report provided to the science party. These systems are standardized throughout the USAP but can be reconfigured at the science party's request. The purpose of this underway data is to provide science groups with a set of standard measurements for use in interpreting other data specific to the project.

A list of specific makes and models of sensors used during this cruise are included in the end of cruise data report. Pre- and post-cruise sensor calibrations will be provided as available.

Other support provided by RPSC includes the following:

- Computer services including maintenance of the shipboard LAN, printer services, daily backups, disk space management, logging of the underway data described above, end of cruise data distribution of underway data, and email support for all cruise participants including the TEA (Teacher Experiencing the Arctic).
- Provision of general laboratory equipment such as dissecting microscopes and camera system, autosal salinometer, fume hoods, filtration rigs with pumps, and other miscellaneous laboratory materials.
- Deployment and recovery of the CTD rosette and the bongo nets provided by the scientists.
- Collection, documentation, and disposal of all laboratory-generated hazardous waste according the USAP protocols.
- Overseeing the contract for helicopter support from Prism Helicopters, Inc. as negotiated by the US Department of the Interior's Office of Aircraft Services and the NSF.
- Operation of the TeraScan remote-sensing system and coordination of Radarsat SAR imagery from the National Ice Center via an agreement between the NSF and the Canadian Space Agency.

Problems

All systems were generally problem-free throughout cruise NBP 03-4A, though there were minor items of note, some related to water depth.

First, the Simrad EM120 multibeam sonar system collected much more data than is normally the case, leading to difficulties in archiving (i.e. data filled up backup tapes). This is because the ping rate is inversely proportional to water depth and a large portion of this cruise occurred in quite shallow water (<100 meters). The system does not allow the ping rate to be manually changed. Therefore, multibeam data was subdivided into smaller sections to permit recording on several tapes without truncating the data. No data was lost or compromised because of this, but it was a minor annoyance.

Secondly, the hull-mounted ADCP system sometimes had difficulty in calculating the ship's speed through the water because it was hearing acoustic reflections from the bottom and/or multiple reflections from the surface and bottom. Occasionally, the ship's speed as calculated by GPS differed from that calculated by the ADCP by more than 5 knots. While one system outputs speed over ground and the other gives speed through the water, this difference was much greater than local oceanic currents or ship's drift due to wind. This is a recognized problem in data integrity, but there is no easy solution.
The EM120 multibeam crashed twice. The first time was prior to reaching Nome and prior to the start of science data collection. On 7 August 2003, it was down for 41 minutes. The cause of this crash is unknown.

The computer that logs underway data crashed twice. On 3 August 2003, 10 minutes of data were lost. On 6 August 2003, 20 minutes of data were lost. RPSC is continuing to investigate the cause of such instabilities and to remedy the situation.

The slip ring on the CTD winch was swapped out with a spare approximately midway through the cruise because an unacceptable number of modulo errors were observed on casts. The CTD fish suffered an electrical short of unknown cause, also approximately midway through the cruise. A spare unit was installed and the damaged fish will be returned to the manufacturer for repair. During this short interruption in the survey, the electromechanical CTD cable was reterminated. No further problems were encountered after these minor repairs.

Science of Opportunity

There are several permanently installed science of opportunity systems on board the NBP that were operated during this cruise. All data collected from these systems will be included in the cruise-end data report provided to the science party. RPSC personnel monitored these systems as part of their normal duties.

Gravity Meter: This system requires very little maintenance and experienced no problems during cruise NBP 03-4A. As part of the normal upkeep of the gravimeter, a gravity tie was performed in Dutch Harbor prior to the cruise and another will be done immediately afterward. The gravimeter occupies a small room in the Aft Dry Lab and is part of the NSF equipment pool. There is no PI responsible for data collection.

Hull-mounted ADCP: This system is not science of opportunity in the purest sense of the term, since it is an important component of the SBI program and it was slightly reconfigured to SBI's specifications. Dr. Eric Firing of the University of Hawaii is the cognizant PI for this program, and questions about data quality, format, etc. can be directed to him at efiring@hawaii.edu or 808-956-7894.

pCO2: This system measures the concentration of carbon dioxide dissolved in the surface seawater, as a tool for determining the overall carbon exchange between the ocean and atmosphere. Measurements are calibrated against standard gasses provided by Lamont-Doherty Earth Observatory. The PI in charge of this system is Dr. Colm Sweeney (csweeney@splash.princeton.edu, 609-258-6619, 609-258-2850 (fax)), assisted by Tim Newberger (tnewberg@ldeo.columbia.edu, 845-365-8790).

APPENDIX C: DATA REPORT

United States Antarctic Program RVIB Nathaniel B. Palmer Raytheon Polar Services
Data Report Prepared by: Jim Waters and Kathleen Gavahan

INTRODUCTION

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

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

The data is distributed on a DVD-ROM (DVD-R) written in ISO9660 level-1 format. It is readable by virtually every computing platform.

All the data have been compressed using Unix "gzip," identifiable by the ".gz" extension. It has been copied to the distribution media in the Unix tar archive format, ".tar" extension. Tools are available on all platforms for decompressing and de-archiving these formats: On Macintosh, use Stuffit Expander with DropStuff. On Windows operating systems use WinZip.

MultiBeam and BathyW data, if collected, are distributed separately.

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

Raytheon Polar Services 1 United States Antarctic Program

DISTRIBUTION CONTENTS AT A GLANCE

DVD Contents

304A.trk		**rvdas/uw/**	**304Abat.tar**
304A.mgd			**304Aeng.tar**
304A.gmt			**304Agrv.tar**
304Adata.doc			**304Ambdp.tar**
304Acoef.txt			**304Amet.tar**
b304Atrk.ps			**304Apco2.tar**
304Atrk.ps			**304Asim.tar**
s304Atrk.ps			**304Asvp.tar**
			304Atsg.tar
process/	**304Ajgof.tar**	**adcp/**	**304Aadcp.tar**
	304AMGD.tar		
	304Apco2.ta	**ocean/**	**304Actd.tar**

	304Aproc.tarr		**304Axbt.tar**
	304Aqcps.ta		
	304Atsg.tar	**imagery/**	**Isobar.tarr**
			ice.tar
rvdas/nav/	**304Aadcp.tar**		**seaice.tar**
	304Aadu.tar		**wx.tar**
	304Agyr.tar		
	304Apcod.tar	**TEAjnl/**	**TEAjnl.tar**
	304Aseap.tar		

Extracting Data

The Unix tar command has many options. It is often useful to know exactly how an archive was produced when expanding its contents. All archives were created using the command,

```
tar cvf  archive_filename files_to_archive
```

To create a list of the files in the archive, use the Unix command,

```
tar tvf archive_filename > contents.list
```

where contents.list is the name of the file to create

To extract the files from the archive:

```
tar xvf archive_filename file(s)_to_extract
```

Gzipped files will have a ".gz" extension on the filename. These files can be decompressed after de-archiving, using the Unix command,

```
gunzip filename.gz
```

DISTRIBUTION CONTENTS

CRUISE INFORMATION

Cruise Track

The distribution DVD includes a GMT cruise track file (304A.trk). It contains the longitude and latitude at one-minute intervals extracted from the 304A.gmt file.

Three PostScript cruise track files have been produced and placed in the / directory. 304Atrk.ps is standard US Letter sized (8.5" x 11"). s304Atrk.ps is standard US Letter sized (8.5 x 11") showing the main CTD survey area. b304Atrk.ps is archE size.

Satellite Images

Satellite Images processed for this cruise can be found in the directory, /imagery.

Teacher Experiencing Antarctica Journal

The journal created by the Teacher Experiencing Antarctica can be found in the directory /TEAjnl.

NBP DATA PRODUCTS

Two datasets are created on each cruise: JGOFS and MGD77.

JGOFS

The JGOFS data set can be found on the distribution media in the file /process/304Ajgof.tar. The archive contains a single file produced each day named jgDDD.dat.gz where DDD is the year-day the data was acquired. The ".gz" extension indicates that the individual files are compressed before archiving. The daily file consists of 22 columnar fields in text format described in the table below. The JGOFS data set is obtained primarily by applying calibrations to raw data and decimating to whole minute intervals. Several fields are derived measurements from more than a single raw input. For example, Course Made Good (CMG) and Speed Over Ground (SOG) are calculated from gyro and GPS. During the cruise, the JGOFS data set produces the daily data plots. Note: Null, unused, or unknown fields are indicated as "NAN" or as 9999 in the JGOFS data.

Field	Data	Units
01	GMT date	dd/mm/yy
02	GMT time	hh:mm:ss
03	NGL latitude (negative is South)	tt.tttt
04	NGL longitude (negative is West)	ggg.gggg
05	Speed over ground	Knots
06	GPS HDOP	-
07	Gyro Heading	Degrees (azimuth)
08	Course made good	Degrees (azimuth)
09	Mast PAR	µEinsteins/meters2 sec
10	Sea surface temperature	°C
11	Sea surface conductivity	siemens/meter
12	Sea surface salinity	PSU

Field	Data	Units
13	Sea depth (uncorrected, calc. sw sound vel. 1500 m/s)	meters
14	True wind speed (port windbird)	meters/sec
15	True wind direction (port windbird)	degrees (azimuth)
16	Ambient air temperature	°C
17	Relative humidity	%
18	Barometric pressure	mBars
19	Sea surface fluorometry	volts (0-5 FSO)
20	Not used	-
21	PSP	W/m2
22	PIR	W/m2

MGD77

The MGD77 data set is contained in a single file for the entire cruise. It can be found in the top level of the distribution data structure as 304A.mgd. Also at the root level, 304A.gmt is the output of the mgd77togmt utility using 304A.mgd as input. The 304A.gmt file can be used by GMT (Generic Mapping Tool) plotting software.

The data used to produce the 304A.mgd file can be found on the distribution media in the file /process/304AMGD.tar. The data files in the archive contain a day's data and follow the naming convention Dddd.fnl.gz, where ddd is the year-day. These files follow a space-delimited columnar format that may be more accessible for some purposes. They contain data at one-second intervals rather than one minute and are individually "gzipped" to save space. Below is a detailed description of the MGD77 data set format. The other files in the archive contain interim processing files and are included to simplify possible reprocessing of the data using the RVDAS NBP processing scripts.

All decimal points are implied. Leading zeros and blanks are equivalent. Unknown or unused fields are filled with 9's. All "corrections", such as time zone, diurnal magnetics, and EOTVOS, are understood to be added.

Col	Len	Type	Contents	Description, Possible Values, Notes
1	1	Int	Data record type	Set to "5" for data record
2-9	8	char	Survey identifier	
10-12	3	int	Time zone correction	Corrects time (in characters 13-27) to GMT when added; 0 = GMT
13-16	4	int	Year	4 digit year
17-18	2	int	Month	2 digit month
19-20	2	int	Day	
21-22	2	int	Hour	
23-27	5	real	Minutes x 1000	
28-35	8	real	Latitude x 100000	+ = North - = South. (–9000000 to 9000000)
36-44	9	real	Longitude x 100000	+ = East - = West. (–18000000 to 18000000)
45	1	int	Position type code	1=Observed fix 3=Interpolated 9=Unspecified
46-51	6	real	Bathymetry, 2-way travel time	In 10,000th of seconds. Corrected for transducer depth and other such corrections
52-57	6	real	Bathymetry, corrected depth	In tenths of meters.

Col	Len	Type	Contents	Description, Possible Values, Notes
58-59 2	int	Bathymetric correction code	This code details the procedure used for determining the sound velocity correction to depth.	
60	1	int	Bathymetric type code	1 = Observed 3 = Interpolated (Header Seq. 12) 9 = Unspecified
61-66	6	real	Magnetics total field, 1ST sensor	In tenths of nanoteslas (gammas)
67-72	6	real	Magnetics total field, 2ND sensor	In tenths of nanoteslas (gammas), for trailing sensor
73-78 6	real	Magnetics residual field	In tenths of nanoteslas (gammas). The reference field used is in Header Seq. 13.	
79	1	int	Sensor for residual field	1 = 1st or leading sensor 2 = 2nd or trailing sensor 9 = Unspecified
80-84	5	real	Magnetics diurnal correction	In tenths of nanoteslas (gammas). (In nanoteslas) if 9-filled (i.e., set to "+9999"), total and residual fields are assumed to be uncorrected; if used, total and residuals are assumed to have been already corrected.
85-90	6	F6.0	Depth or altitude of magnetics sensor	(In meters) + = Below sea level 3 = Above sea level
91-97	7	real	Observed gravity	In 10th of mgals. Corrected for Eotvos, drift, tares
98-103	6	real	EOTVOS correction	In tenths of mgals. E = 7.5 V cos phi sin alpha + 0.0042 V*V
104-108	5	real	Free-air anomaly	In tenths of milligals G = observed G = theoretical
109-113	5	char	Seismic line number	Cross-reference for seismic data
114-119	6	char	Seismic shot-point number	
120	1	int	Quality code for navigation	5=Suspected, by the originating institution 6=Suspected, by the data center 9=No identifiable problem found

SCIENCE OF OPPORTUNITY

ADCP

The shipboard ADCP system measures currents in the depth range from about 30 to 300 m --in good weather. In bad weather or in ice, the range is less, and sometimes no valid measurements are made. It is the USAP-funded project of Eric Firing (University of Hawaii) and Teri Chereskin (Scripps Institution of Oceanography). ADCP data collection occurs on the both LMG and the NBP for the benefit of the scientists on individual cruises, and for the long-term goal of building a climatology of current structure in the Southern Ocean.

The ADCP data set collected during this cruise has been placed on the distribution media in the archive /adcp/304Aadcp.tar. The archive consists of a single file for each day of data collection. The files are named PINGDATA.xxx where xxx is a day number that is NOT a year-day. For the date, use the file's creation date.

Some ADCP data is also transmitted to RVDAS. East and north vectors for ship's speed relative to the reference layer and ship's heading are archived as304Aadcp.tarin the directory, / rvdas/nav.

PCO2

The NBP carries Lamont-Doherty Earth Observatory's (LDEO) pCO2 system and RPSC staff maintain it. Data is sent to LDEO at the end of each cruise. The pCO2 data is transmitted and archived on RVDAS. You will find it in a file namednpb304Apco2.tarin the rvdas/uw directory, which contains the pCO2 instrument's data merged with GPS, meteorological and other oceanographic measurements. For more information contact Colm Sweeney (csweeney@ldeo.columbia.edu)..

CRUISE SCIENCE

CTD

The ctd data have been placed in the tar file ocean/304Actd.tar. Raw data are contained in the archive's ctd/raw directory.

XBT

During the cruise Expendable Bathythermographs were used to obtain water column temperature profiles. These were used to adjust the sound velocity profile for the SeaBeam system. The data files from these launches are included as 304Axbt.tar in the /ocean directory.

RVDAS

The Research Vessel Data Acquisition System (RVDAS) was developed at Lamont-Doherty Earth Observatory of Columbia University and has been in use on its research ship for many years. It has been adapted for use on the USAP research vessels.

Daily data processing of the RVDAS (Research Vessel Data Acquisition System) data is performed to convert values into useable units and as a check of the proper operation of the DAS. Both raw and processed data sets from RVDAS are included in the data distribution. The tables below provide detailed information on the data. Be sure to read the "Significant Acquisition Events" section for important information about data acquisition during this cruise.

SENSORS AND INSTRUMENTS

RVDAS data is divided into two general categories, underway and navigation. They can be found on the distribution media as archives under the top level rvdas directory: /rvdas/uw, and / rvdas/nav. Each instrument or sensor produces a data file named with its channel ID. Each data file is gzipped to save space on the distribution media. Not all data types are collected every day or on every cruise.

The naming convention for data files produced by the sensors and instruments is

NBP[CruiseID][ChannelID].dDDD

Example: NBP0107.met1.d317

- The CruiseID is the numeric name of the cruise, in this case, 304A.
- The Channel ID is a 4-character code representing the system being logged. An example is "met1," the designation for meteorology.
- DDD is the day of year the data was collected.

UNDERWAY SENSORS

Meteorology and Radiometry

Measurement	Channel ID	Collect. Status	Rate	Instrument
Air Temperature	met1	continuous	1 sec	R. M. Young 41372LC
Relative Humidity	met1	continuous	1 sec	
Wind Speed/Direction	met1	continuous	1 sec	R.M. Young 5106
Barometer	met1	continuous	1 sec	R.M. Young 61201
PIR (LW radiation)	met1	continuous	1 sec	Eppley PIR
PSP (SW radiation)	met1	continuous	1 sec	Eppley PSP
PAR	met1	continuous	1 sec	BSI QSR-240

Geophysics

Measurement	Channel ID	Collect. Status	Rate	Instrument
Gravimeter	grv1	continuous	10 sec*	LaCoste & Romberg
Bathymetry	bat1	Continuous	Varies	ODEC Bathy 2000
Bathymetry	sim1	depth < 2500 m	Varies	Simrad EK500 Sonar

*Data is output every second but it only changes every 10 seconds.

Oceanography

Measurement	Channel ID	Collect. Status	Rate	Instrument
Conductivity	tsg1	continuous	3 sec	SeaBird 21
Salinity	Tsg1	continuous	3 sec	Calc. from pri. temp
Sea Surface Temp	tsg1	continuous	3 sec	SeaBird 3-01/S
Fluorometry	flrtsg1	continuous	3 sec	Turner 10-AU-005
Transmissometry	tsg1	continuous	3 sec	WET Lab C-Star
pCO2	pco2	continuous	150 sec	(LDEO)
ADCP	adcp	continuous	varies	RD Instruments

NAVIGATIONAL INSTRUMENTS

Measurement	Channel ID	Collect. Status	Rate	Instrument
Attitude GPS	adu1	continuous	1 sec	Ashtech ADU2
P-Code GPS	PCOD	continuous	1 sec	Trimble 20636-00SM
Gyro	gyr1	continuous	0.2 sec	Yokogawa Gyro

DATA

Data are received from the RVDAS system via RS-232 serial connections. A time tag is added at the beginning of each line of data in the form,

```
yy+dd:hh:mm:ss.sss [data stream from instrument]
```

where

yy = two-digit year
ddd = day of year
hh = 2 digit hour of the day
mm = 2 digit minute
ss.sss = seconds

All times are reported in UTC.

The delimiters that separate fields in the raw data files are often spaces and commas but can be other characters such as : = @. Occasionally no delimiter is present. Care should be taken when reprocessing the data that the field's separations are clearly understood.

In the sections below a sample data string is shown, followed by a table that lists the data contained in the string.

UNDERWAY DATA

Meteorology (met1)

```
01+322:00:03:27.306 04.5 292 010 05.7 294 010 0959.6 000.2 093 -000.1537
0001.0886 0012.8248
```

Field	Data	Units
1	RVDAS time tag	
2	Port anemometer speed (relative)	m/s
3	Port anemometer direction (relative)	deg
4	Port anemometer standard deviation deg	
5	Starboard anemometer speed (relative)	m/s
6	Starboard anemometer direction (relative)	deg
7	Starboard anemometer standard deviation deg	
8	Barometer	mBar
9	Air temperature	°C
10	Relative humidity	%
11	PSP (short wave radiation)*	mV
12	PIR (long wave radiation)*	mV
13	PAR (photosynthetically available radiation)*	mV

*See page 17 for calculations.

Gravimeter (grv1)

```
99+099:00:18:19.775 your_line#1999 99 01818 9735.4
```

Field	Data	Conversion	Units
1	RVDAS time tag		
2	Text string		
3	Gravity device date	yyyydddhhmmss	
4	Gravity count	mgal = count x 1.0047 + offset	count

Bathy 2000 (bat1)

```
00+019:23:59:53.901 ;I04485.3ME -23.0, I00000.0,-99.9,0000@01/11/00, 23:59:52.08
          PW2 PF1 SF1 PL3 MO4 SB3 PO0 TX1 TR: GM5 1500 06.7 -72.1
```

Field	Data	Format/Possible Values	Units
1	RVDAS time tag		
2	Flagged low frequency chn. depth w/ units	;FDDDDD.Dun where F = flag (V for valid, I for invalid), D=depth, un = units	meters
3	Low Frequency echo strength	EEE.EE	dB
4	Flagged high freq. chn. depth	not used	
5	High frequency echo strength	not used	
6	Signed heave data SHHHH cm		
7	Date mm/dd/yy		
8	Time hh:mm:ss		
9	Transmit pulse window type	PW1=Rectangular PW2=Hamming PW3=Cosine PW4=Blackman	
10	Primary transmit frequency	PF1=3.5 kHz PF2=12.0 kHz	kHz
11	Parametric mode secondary frequency	SF1=3.5 kHz SF2=12.0 kHz	kHz
12	Pulse length	PL1=200usec PL2=500usec PL3=1msec PL4=2msec PL5=5msec PL6=10msec PL7=25msec If transmit mode is FM: PL1=25msec PL2=50msec PL3=100msec	
13	Operating mode	MO1=CW parametric MO2=CW MO3=FM parametric MO4=FM	
14	Frequency sweep bandwidth	SB1=1 kHz SB2=2 kHz SB3=5 kHz	kHz

Field	Data	Format/Possible Values	Units
15	Power level	PO1 = 0dB PO2 = -6dB PO3 = -12dB PO4 = -18dB PO5 = -24dB PO6 = -30dB PO6 = -30 dB PO7 = -36dB PO8 = -42dB	
16	Transmit mode	TX1=single ping active TX2=pinger listen TX3=multipinging TR TX4=multipinging TR TX5=multipinging TTRR TX6=multipinging TTTTRRRR TX7=multipinging TTTTTRRRRR	
17	Transmit Rate	TR3 = 4Hz TR4 = 2Hz TR5 = 1Hz TR6 = .5Hz TR7 = .33Hz TR8 = .25Hz TR9 = .20Hz TR: = .10Hz TR; = .05Hz	Hz
18	System gain mode	GM0=hydrographic AGC GM1 to GM9=hydrographic +3db to + 27db manual. GMA to GMD=hydrographic + 30db through + 60db manual GME to GMK=sub-bottom 1 through sub-bottom 7	
19	Speed of	sound m/sec	
20	Depth of sonar window below sea-level		meters
21	Background noise level in fixed point reference		dB/V

Simrad (sim1)

```
00+005:00:00:52.388 D1,23583509,1479.6, 17, 1, 0
```

Field	Data	Units
1	RVDAS time tag	
2	Header	
3	Time tag	hhmmss.sss
4	Depth	m
5	Bottom surface backscattering strength	dBar
6	Transducer number (1 = 38 kHz)	

Thermosalinograph (tsg1)

```
00+019:23:59:46.976 15A16CFC163F8C2C100
```

Field	Data	Units
1	RVDAS time tag	
2	Seabird hex string (see page 17 for conversion to real units)	

pCO2

```
00+021:23:59:43.190 2000021.9992 2382.4 984.2 30.73 50.8 345.9 334.1 -1.70
-68.046 -144.446 Equil
```

Field	Data	Units
1	RVDAS time tag	
2	pCO2 time tag (decimal is fractional time of day)	yyyddd.ttt
3	Raw voltage	mV
4	Barometer	mBar
5	Cell temperature	°C
6	Flow rate	cm3/min
7	Concentration	ppm
8	pCO2 pressure	microAtm
9	Equilibrated temperature	°C
10	Latitude (not collected)	
11	Longitude (not collected)	
12	Flow source (Equil = pCO2 measurement)	

NAVIGATIONAL DATA

Seapath GPS (seap)

The Seapath GPS outputs six data strings, four in NMEA format and two in proprietary PSXN format:

- INZDA
- INGGA
- INVTG
- INHDT
- PSXN, 22
- PSXN, 23

INZDA

```
02+253:00:00:00.772 $INZDA,235947.70,09,09,2002,,*7F
```

Field	Data	Units
1	RVDAS time tag	
2	$INZDA	
3	time	hhmmss.ss
4	Day	dd
5	Month	mm
6	Year	yyyy
7	(empty field)	
8	Checksum	

INGGA

```
02+253:00:00:00.938
INGGA,235947.70,6629.239059,S,06827.668899,W,1,07,1.0,11.81,M,,M,,*6F
```

Field	Data	Units
1	RVDAS time tag	
2	$INGGA	
3	time	hhmmss.ss
4	Latitude	ddmm.mmmmmm
5	N or S for north or south latitude	
6	Longitude	ddmm.mmmmmm
7	E or W for east or west longitude	
8	GPS quality indicator, 0=invalid, 1=GPS SPS, 2=DGPS, 3=PPS, 4=RTK, 5=float RTK, 6=dead reckoning	
9	number of satellites in use (00-99)	
10	HDOP	x.x
9	height above ellipsoid in meters	m.mm
11	M	
12	(empty field)	
13	M	
14	age of DGPS corrections in seconds	s.s
15	DGPS reference station ID (0000-1023)	
16	Checksum	

INVTG

```
02+253:00:00:00.940 $INVTG,19.96,T,,M,4.9,N,,K,A*39
```

Field	Data	Units
1	RVDAS time tag	
2	$INVTG	
3	course over ground, degrees true	d.dd
4	T	
5	,	
6	M	
7	speed over ground in knots	k.k
8	N	
9	,	
10	K	
11	Mode	
12	Checksum	

INHDT

```
02+253:00:00:00.941 $INHDT,20.62,T*23
```

Field	Data	Units
1	RVDAS time tag	
2	$INHDT	
3	Heading, degrees true	d.dd
4	T	
5	Checksum	

PSXN,22

```
02+253:00:00:00.942 $PSXN,22,0.43,0.43*39
```

Field	Data	Units
1	RVDAS time tag	
2	$PSXN	
3	22	
4	gyro calibration value since system start-up in degrees	d.dd
5	short term gyro offset in degrees	d.dd
6	Checksum	

PSXN,23

```
02+253:00:00:02.933 $PSXN,23,0.47,0.57,20.62,0.03*0C
```

Field	Data	Units
1	RVDAS time tag	
2	$PSXN	
3	23	
4	roll in degrees, positive with port side up	d.dd
5	pitch in degrees, positive with bow up	d.dd
6	Heading, degrees true	d.dd
7	heave in meters, positive down	m.mm
8	Checksum	

Ashtech GPS (adu1)

The Ashtech GPS outputs three NMEA standard data strings:

• Measurement data (PBN)
• Attitude data (ATT)
• GPS position fix (GGA)

Measurement data (PBN)

```
01+324:00:00:00.064 $PASHR,PBN,172812.00,2129908.6,-1869076.7,-5694992.4,
-063:41.9477,-041:16.0918,00066.2,000.16,002.85,-000.90,08,????,02,01,01,
01*3A
```

Field	Data	Units
1	RVDAS time tag	
2	$PASHR	
3	PBN	
4	GPS Time sec. of the week	seconds
5	Station Position: ECEF X	meters
6	Station Position: ECEF Y	meters
7	Station Position: ECEF Z	meters
8	Latitude (-= South)	deg:min
9	Longitude (-= West)	deg:min
10	Altitude	meters
11	Velocity in ECEF	X m/sec
12	Velocity in ECEF	Y m/sec
13	Velocity in ECEF	Z m/sec
14	Number of satellites used	
15	Site name	
16	PDOP	
17	HDOP	
18	VDOP	
19	TDOP	

GPS Position Fix – Geoid/Ellipsoid (GGA)

```
01+324:00:00:00.323 $GPGGA,235959.00,6341.9477,S,04116.0918,W,1,08,00.9,
+00066,M,,M,,*77
```

Field	Data	Units
1	RVDAS time tag	
2	$GPGGA	
3	UTC time at position	hhmmss.ss
4	Latitude	ddmm.mmm
5	North (N) or South (S)	
6	Longitude	ddmm.mmm
7	East (E) or West (W)	
8	GPS quality: (1 = GPS, 2 = DGPS)	
9	Number of GPS satellites used	
10	HDOP	
11	Antenna height	meters

12	M for	Meters
13	Geoidal height (no data in the sample string)	meters
14	M for meters	
15	Age of diff. GPS data (no data in the sample string)	
16	Differential reference station ID (no data in the sample string)	
17	Checksum (no delimiter before this field)	

Attitude Data (ATT)

```
01+324:00:00:00.845 $PASHR,ATT,172813.0,137.88,+000.52,-001.41,0.0029,
                    0.0254,0*2F
```

Field	**Data**	**Units**
1	RVDAS Time tag	
2	$PASHR	
3	ATT	
4	GPS Time sec. Of the week	seconds
5	Heading (rel. to true North)	degrees
6	Pitch	degrees
7	Roll	degrees
8	Measurement RMS error	meters
9	Baseline RMS error	meters
10	Attitude reset flag	

Trimble P-Code GPS (PCOD)

The P-Code GPS outputs four NMEA standard data strings:

- Position fix (GGA)
- Latitude / longitude (GLL),
- Track and ground speed (VTG)
- Recommended Minimum Specific GNSS Data (RMC)

GGA: GPS Position Fix – Geoid/Ellipsoid

```
01+319:00:04:11.193 $GPGGA,000410.312,6227.8068,S,06043.6738,W,1,06,1.0,
                    031.9,M,-017.4,M,,*49
```

Field	**Data**	**Units**
1	RVDAS Time tag	
2	$GPGGA	
3	UTC time at position	hhmmss.sss
4	Latitude	ddmm.mmm
5	North (N) or South (S)	
6	Longitude	ddmm.mmm
7	East (E) or West (W)	
8	GPS quality: 0 = Fix not available or invalid 1 = GPS, SPS mode, fix valid 2 = DGPS (differential GPS), SPS mode, fix valid 3 = P-CODE PPS mode, fix valid	

9	Number of GPS satellites used	
10	HDOP (horizontal dilution of precision)	
11	Antenna height	meters
12	M for meters	
13	Geoidal height	meters
14	M for meters	
15	Age of differential GPS data (no data in the sample string)	
16	Differential reference station ID (no data in the sample string)	
17	Checksum (no delimiter before this field)	

GLL: GPS Latitude/Longitude

```
01+319:00:04:11.272 $GPGLL,6227.8068,S,06043.6738,W,000410.312,A*32
```

Field	Data	Units
1	RVDAS Time tag	
2	$GPGLL	
3	Latitude	degrees
4	North or South	
5	Longitude	degrees
6	East or West	
7	UTC of position	hhmmss.sss
8	Status of data (A = valid)	
9	Checksum	

VTG: GPS Track and Ground Speed

```
01+319:00:04:11.273 $GPVTG,138.8,T,126.0,M,000.0,N,000.0,K*49
```

Field	Data	Units
1	RVDAS time tag	
2	$GPVTG	
3	Heading	degrees
4	Degrees true (T)	
5	Heading	degrees
6	Degrees magnetic (M)	
7	Ship speed	knots
8	N = knots	
9	Speed	km/hr
10	K = km per hour	
11	Checksum	

RMC: GPS Recommended Minimum Specific GNSS Data

```
03+180:00:00:00.517 $GPRMC,235959.449,A,3802.8974,N,16515.3288,W,
010.7,350.0,280603,12.5,E*47
```

Field	Data	Units
1	RVDAS time tag	
2	$GPRMC	
3	UTC of position fix	hhmmss.ss
4	Status (A=Data valid)	
5	Latitude	degrees
6	North or South	
7	Longitude	
8	East or West	
9	Speed over ground	knots
10	Course over ground	degrees true
11	Date	ddmmyy
12	Magnetic variation	degrees
13	East or West	
14	Mode Indicator	
15	Checksum	

Gyro Compass (gyr1)

```
00+019:23:59:59.952 $HEHRC25034,-020*73
```

Field	Data	Units
1	RVDAS time tag	
2	$HEHRC	
3	Heading XXXXX = ddd.dd	degrees
4	Rate of change SYYY S = +/-, YYY = r.rr	
5	Checksum	

ADCP Course (adcp)

```
00+019:23:59:59.099 $PUHAW,UVH,-1.48,-0.51,250.6
```

Field	Data	Units
1	RVDAS time tag	
2	$PUHAW	
3	UVH (E-W, N-S, Heading)	
4	Ship Speed relative to reference layer, east vector	kn
5	Ship Speed relative to reference layer, north vector	kn
6	Ship heading	degrees

Sound Velocity Probe (svp1)

```
00+348:01:59:52.128 1539.40
```

Field	Data	Units
1	RVDAS Time tag	
2	Sound velocity in ADCP sonar well	m/s

OCEAN

pCO2-merged

```
00+346:23:58:20.672 2000346.9991 2398.4 1008.4 0.01 45.4 350.3 342.6 15.77 Equil
     -43.6826 173.1997 15.51 33.90 0.33 5.28 9.05 1007.57 40.0 14.87 182.44
```

Field	Data	Units
1	RVDAS time tag	
2	PCO2 time tag (decimal is time of day)	yyyddd.ttt
3	Raw voltage	mV
4	Barometer	mB
5	Cell temperature	°C
6	Flow rate	cm3/min
7	Concentration	ppm
8	PCO2 pressure	microAtm
9	Equilibrated temperature	°C
10	Flow Source (Equil = pCO2 measurement)	
11	RVDAS latitude	degrees
12	RVDAS longitude	degrees
13	TSG external temperature	°C
14	TSG salinity	PSU
15	TSG fluorometry	V
16	RVDAS true wind speed	m/s
17	RVDAS true wind direction	degrees
18	Barometric Pressure	mBars
19	Uncontaminated seawater pump flow rate	l/min
20	Speed over ground	knots
21	Course made good	degrees

tsgfl

```
00+075:00:00:04.467 -01.488 -01.720 02.6783 33.63748 1.002442 0.002442
```

Field	Data	Units
1	RVDAS time tag	
2	Internal water temperature	°C
3	Sea Surface Temperature	°C
4	Conductivity	µSiemens
5	Salinity	PSU
6	Fluorometry	V
7	Transmissivity	V

Calculations

The file 304Acoefl.txt located in the / directory contains the calibration factors for shipboard instruments. This was the file used by the RVDAS processing software.

TSG

Raw TSG data is stored as a 20 byte (character) long hex string

Bytes	Data
1-4	Sensor Temperature
5-8	Conductivity
9-14	Remote Temperature
15-17	Fluorometer voltage
18-20	Transmissometer voltage

The coefficients for temperature and conductivity sensors can be found the rvdascal.txt file and on the calibrations sheets in the appendix.

Calculating Temperature – ITS-90

```
T = decimal equivalent of bytes 1-4
Temperature Frequency: f = T/19 +2100
Temperature = 1/{g + h[ln(f0/f)] + i[ln2(f0/f)] + j[ln3(f0/f)]}
273.15 (°C)
```

Calculating Conductivity – ITS-90

```
C = decimal equivalent of bytes 5-8
Conductivity Frequency f = sqrt(C*2100+6250000)
Conductivity = (g + hf2 + if3 + jf4)/[10(1 + dt + ep)] (siemens/meter)
t = temperature (°C); p = pressure (decibars); d = Ctcor; e = CPcor
```

Calculating Fluorometry Voltage

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

Calculating Transmittance

```
Vdark = 0.058 V
Vref = 4.765 V
t = decimal equivalent of bytes 18 – 20
Transmissometer Voltage (Vsignal) = t/819
% Transmittance = (Vsignal – Vdark) / (Vref - Vdark)
```

PAR

```
raw data = mV
calibration scale = 6.08 V/(mEinstiens/cm 2sec)
offset (Vdark) = 0.3 mV
(raw mV - Vdark)/scale x 104 cm2/m2 x 10-3 V/mV= mEinstiens/m2sec
or
(data mV – 0.3 mV) x 1.65 (mEinstiens/m2sec)/mV = mEinstiens/m2sec
```

PIR

```
raw data = mV
calibration scale = 4.13 x 10-6 V/(W/m2)
data mV / (scale x 103 mV/V ) = W/m2
or
data mV x 242.1(W/m2)/mV = W/m2
```

PSP

```
raw data = mV
calibration scale = 8.28 x 10-6 V/(W/m2)
data mV / (scale x 103 mV/V) = W/m2
or
data mV x 120.7 (W/m2)/V = W/m2
```

Acquisition Problems and Events

This section lists problems with acquisition noted during this cruise including instrument failures, data acquisition system failures and any other factor affecting this data set. The format is ddd:hh:mm (ddd is year-day, hh is hour, and mm is minute). Times are reported in GMT.

Start	End	Description
186:00:00		Start RVDAS data collection
205:04:22		ADCP BT off
207:22:27		Fluorometer output string bad
207:23:15		Fluorometer output string bad
210:02:25		Reset Ashtech
210:02:00		Cleaned CTD connectors prior to CTD cast #132-01
210:11:36		Cast #134-04 CTD fish 0322 failed. Replaced with 0377, cut off 60m wireline & reterminated, checked wireline for continuity & shorts using Megger, cleaned all connectors, replaced DO and primary temp cables, replaced 4 Amp deck unit fuse with the correct 1/2 Amp fuse, system started up without any problems
210:03:30		Turned ADCP Bottom Tracking on
211:04:30		Cast 137-01: Added PAR and Wetlabs Fluorometer to CTD Package
212:19:45		Ashtech stopped outputting data, reset
212:23:00		ADCP on/off, BT on/off for debugging. Continued thru 8/1/2003
213:22:57		ADCP Bottom Tracking turned back on
214:14:28		Ashtech stopped outputting data, reset
215:01:24	215:01:31	RVDAS data collection interrupted by server failure
218:10:49	218:11:14	RVDAS data collection interrupted by server failure
216:19:45		Replaced CTD bottle #11 trigger latch assembly
218:08:00		Before Cast 214-01: As per scientists' request, remounted CTD temp and conductivity sensors so they are closer together
219:02:00		Reset Ashtech
222		Windbirds froze up by ice
223:01:25		Reset Ashtech
225:04:01		ADCP Bottom tracking turned off
227:03:01		Removed PAR and Flourometer from CTD
227:14:48		Reset Ashtech
228		Changed Dissolved oxygen sensor prior to cast 318
229:14:42		Reset Ashtech
	229	End RVDAS data collection

Appendix: Sensors and Calibrations

Shipboard Sensors

Sensor	Description	Serial #	Last Calibration Date	Status
Meteorology & Radiometers				
Port Anemometer	RM Young 5106	WM46262	02/25/03	Collected
Stbd Anemometer	RM Young 5106	WM46263	12/08/02	Collected
Barometer	RM Young 61201	01705	05/30/03	Collected
Air Temp/Rel. Hum.	RM Young 41372LC	06135	04/09/03	Collected
PIR (Pyrgeometer)	Eppley PIR	33023F3	11/07/02	Collected
PSP (Pyranometer)	Eppley PSP	33090F3	01/24/03	Collected
Mast PAR	BSI QSR-240	6356	02/03/03	Collected
Underway				
TSG	SeaBird SBE21	21310203198	11/22/02	Collected
TSG Remote Temp	SeaBird 3-01/S	032593	02/06/03	Collected
Fluorometer	Turner 10-AU-005 Lamp: daylight 10-045; ref. filter: 10-032, em. filter: 10-051, ex. filter: 10-050	5651 FRTD	04/20/02	Collected
Transmissometer	WET Labs C-Star	CST-422PR	02/24/03	Collected
Gravimeter	LaCoste & Romberg			Collected
Gravity Meter				
Bathymetry	Simrad EK500	3001	11/1/95	Collected
Bathymetry	ODEC Bathy 2000			Collected
Other				
P-Code GPS	Trimble 20636-00 (SM)	0220035116	Key expired	Collected
Attitude GPS	Ashtech ADU2	700273F2114 FW 7B13-D1C21	N/A	Collected
Seapath GPS	Kongsberg Seatex Seapath 200	2253	N/A	Collected

CTD Sensors

Sensor	Comments	Serial #	Last Calibration Date	Status
Fish #1	SBE-9+	094857-0232	6/3/03	Collected
Fish #2	SBE-9+	094857-0377	6/3/03	Collected
Pressure Sensor #1	410K-105	43528	6/3/03	Collected
Pressure Sensor #2	410K-105	58949	6/3/03	Collected
Temperature #2	Primary	2367	5/20/03	Collected
Temperature #6	Secondary	2299	6/5/03	Collected
Conductivity #3	Primary	42067	6/12/03	Collected
Conductivity #7	Secondary	42513	6/3/03	Collected
Dissolved Oxygen #1	SBE-43	80	6/17/03	Collected
Dissolved Oxygen #2	SBE-43	139	6/17/03	Collected
PAR Sensor	Biospherical Instruments QSP-200L4S	4361	11/11/02	Collected
Fluorometer #1	Chelsea Mk III Aquatracka	88080	2/23/03	Collected
Fluorometer #2	Wetlabs AFL	AFL-016D	2/23/03	Collected
Transmissometer	Wetlabs CST-397DR	CST-397DR	2/25/03	Collected
Pump	Primary	051646 3.0K	2/2/02	
Pump	Secondary	051645 3.0K	2/2/02	
Carousel Water	Sampler	SBE-32	3211265-0066	
Pinger, 12khz	6000 (OIS)	5118		
Bottom Contact Switch		#1		
Deck Unit	SBE 11-Plus	11P19858-0490		Collected
Scripps Altimeter		6/03	Collected	
Harrdt Fluorometer		6/03	Collected	

Calibrations

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

Gravity Tie

SEA-BIRD ELECTRONICS, INC.

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

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

SENSOR SERIAL NUMBER: 2367
CALIBRATION DATE: 20-May-03

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33455103e-003
h = 6.42948151e-004
i = 2.36534171e-005
j = 2.28452825e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.68120843e-003
b = 6.00883355e-004
c = 1.64650083e-005
d = 2.28610948e-006
f0 = 2865.869

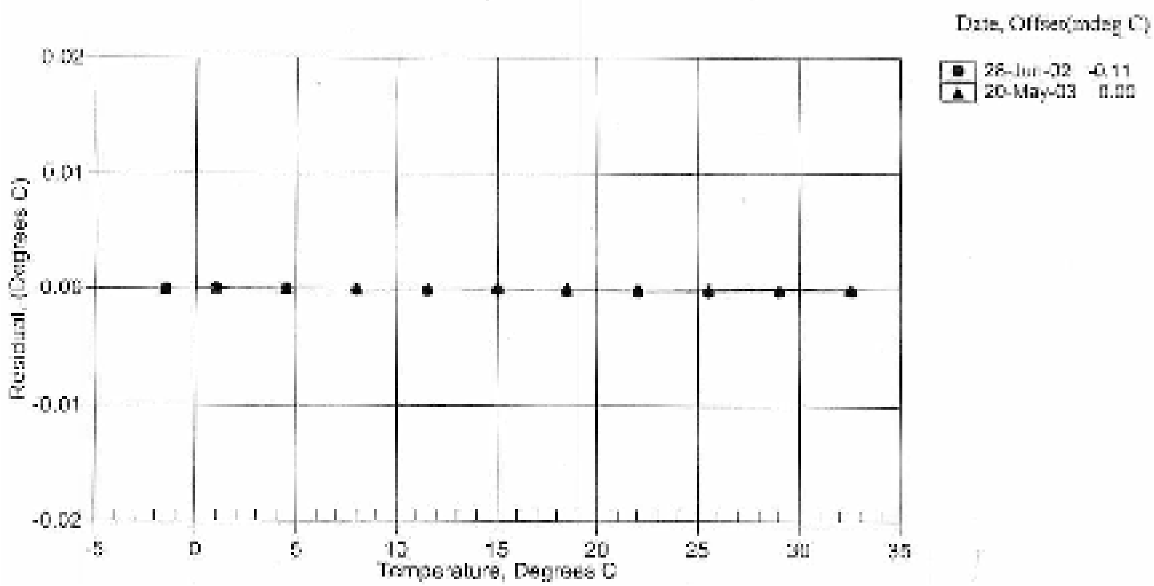
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.4997	2865.669	-1.4997	-0.00001
1.0003	3030.834	1.0003	0.00004
4.5003	3273.198	4.5003	-0.00001
8.0003	3529.229	8.0002	-0.00001
11.5003	3799.313	11.5003	0.00001
15.0003	4084.708	15.0004	0.00005
18.5002	4383.039	18.5003	0.00000
22.0003	4697.322	22.0003	0.00001
25.5003	5027.046	25.5003	-0.00002
29.0003	5372.495	29.0003	-0.00004
32.5003	5733.980	32.5003	0.00003

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

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

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

Residual = instrument temperature - bath temperature



CTD

CTD Pressure Sensor #1

0305N232CON.txt

```
S/N: Pressure Sensor-Fish
43528-0232
Cal Date: 03-June-2003

T1:   3.004968e+01
T2:  -3.340642e-04
T3:   3.958698e-06
T4:   3.087519e-09
T5:   0.000000e+00

C1:  -5.102010e+04
C2:   3.180041e-02
C3:   1.445132e-02

D1:   3.571146e-02
D2:  -2.980957e-05
AD590M:   1.250000e-02
AD590B:  -1.000000e+01

Slope:    1.00000000
Offset:   0.00000
```

Scripps Pressure Sensor Calibration

CTD Pressure Sensor #2

0305N377CON.txt

```
S/N: Pressure Sensor-Fish
58949-0377
Cal Date: 03-June-2003

T1:   2.998410e+01
T2:  -2.451935e-04
T3:   3.711743e-06
T4:   2.102236e-09
T5:   0.000000e+00

C1:  -4.839620e+04
C2:   3.519636e-01
C3:   8.922267e-03

D1:   3.977913e-02
D2:   3.026373e-05
AD590M:   1.250000e-02
AD590B:  -1.000000e+01

Slope:    1.00000000
Offset:   0.00000
```

Scripps Pressure Sensor Calibration

CTD Temperature #1

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

SENSOR SERIAL NUMBER: 2367
CALIBRATION DATE: 20-May-03

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33455103e-003
h = 6.42948151e-004
i = 2.36534171e-005
j = 2.28452825e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.66120843e-003
b = 6.00883355e-004
c = 1.64650083e-005
d = 2.28610948e-006
f0 = 2860.869

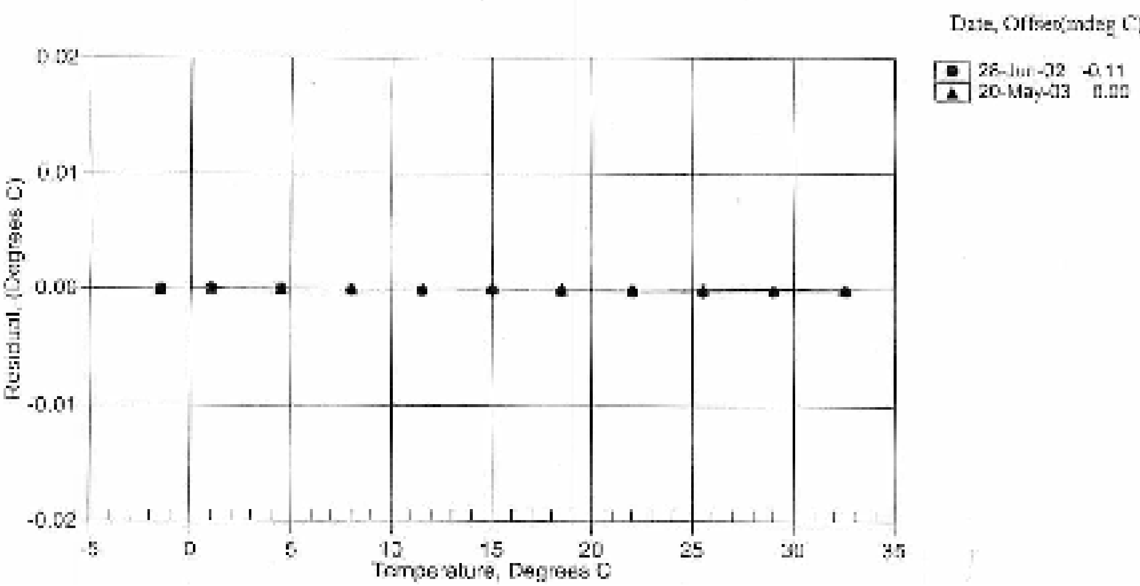
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.4997	2865.669	-1.4997	-0.00001
1.0003	3030.834	1.0003	0.00004
4.5003	3273.196	4.5003	-0.00001
8.0003	3529.225	8.0002	-0.00007
11.5003	3790.310	11.5003	0.00001
15.0003	4064.700	15.0004	0.00005
18.5002	4363.039	18.5003	0.00000
22.0003	4697.322	22.0003	0.00001
25.5003	5027.046	25.5003	-0.00002
29.0003	5372.495	29.0003	-0.00004
32.5003	5733.980	32.5003	0.00003

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

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

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

Residual = instrument temperature - bath temperature



CTD Temperature #2

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 2299
CALIBRATION DATE: 05-Jun-03

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS
g = 4.33209071e-003
h = 6.44170412e-004
i = 2.38916678e-005
j = 2.37236119e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS
a = 3.68120578e-003
b = 6.02094207e-004
c = 1.64608093e-005
d = 2.37395409e-006
f0 = 2848.650

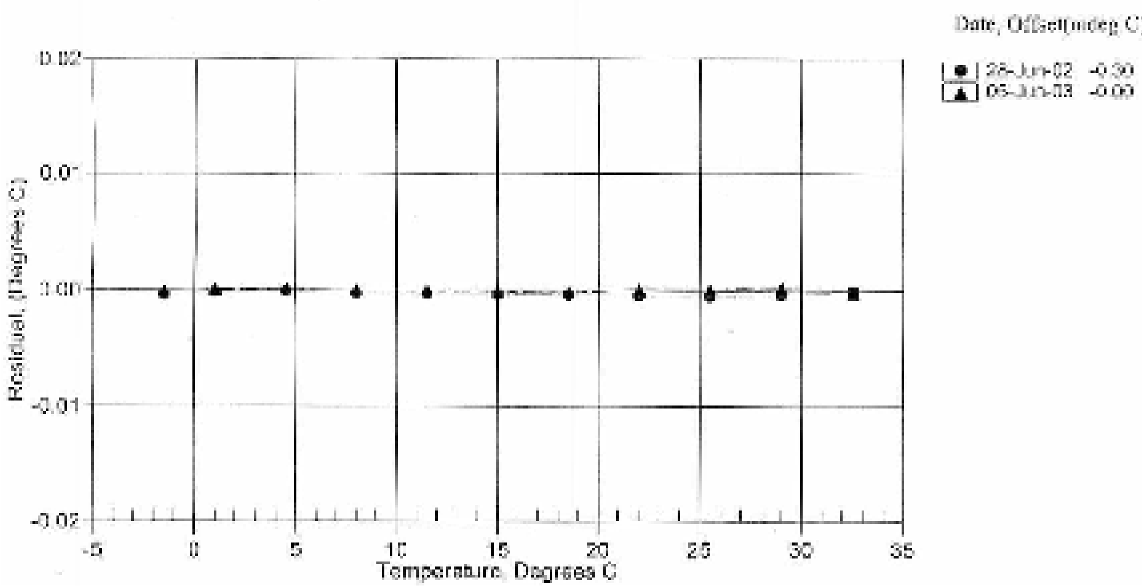
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.4997	2848.650	-1.4998	-0.00011
1.0003	3012.293	1.0004	0.00008
4.5003	3252.675	4.5005	0.00017
8.0002	3506.547	8.0003	-0.00002
11.5003	3774.335	11.5003	-0.00002
15.0003	4056.281	15.0002	-0.00011
18.5003	4352.023	18.5001	-0.00018
22.0003	4664.285	22.0004	0.00009
25.5003	4990.940	25.5004	0.00008
29.0003	5333.122	29.0005	0.00023
32.5002	5691.050	32.5001	-0.00019

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

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

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

Residual = instrument temperature - bath temperature



CTD Conductivity #3

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 2067
CALIBRATION DATE: 12-Jun-03

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

GHIJ COEFFICIENTS
g = -1.01303536e+001
h = 1.46362673e+000
i = -4.77483325e-003
j = 4.15552085e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS
a = 1.02401721e-009
b = 1.45439107e+000
c = -1.01392090e+001
d = -3.56830910e-005
m = 9.2
CPcor = -9.5700e-008 (nominal)

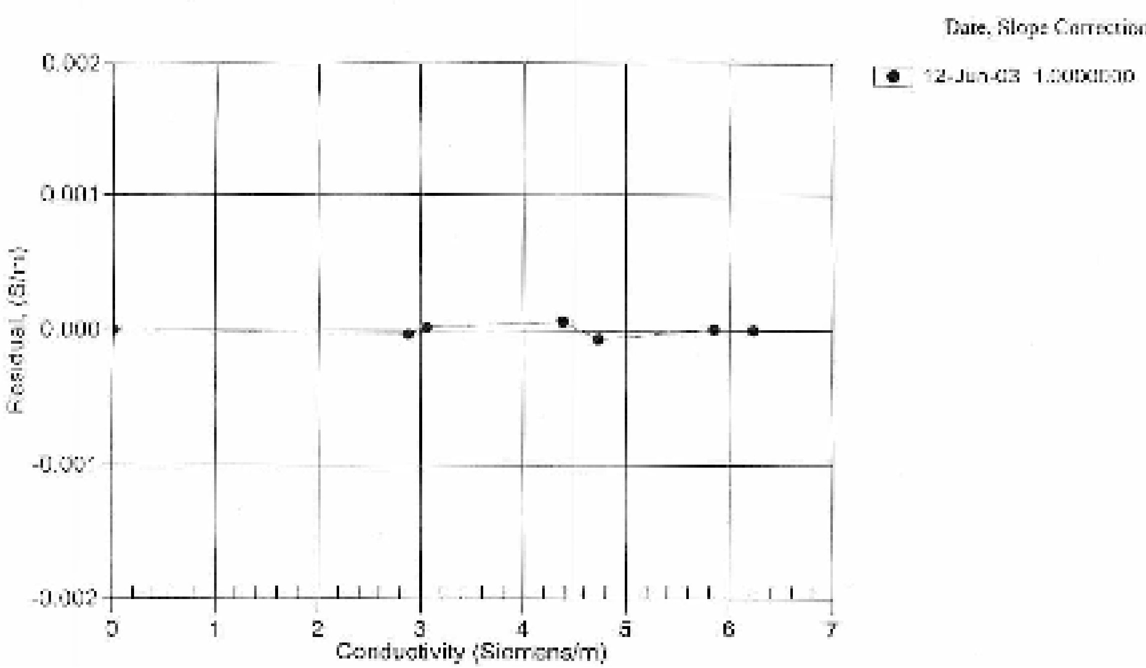
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.67299	0.00000	0.00000
-1.0002	35.8156	2.87762	5.18693	2.87757	-0.00003
0.9997	35.8157	3.05310	5.30405	3.05312	0.00002
14.9997	35.8170	4.38110	6.16378	4.38117	0.00006
18.4997	35.8177	4.73657	6.20041	4.73651	-0.00007
28.9997	35.8140	5.84696	6.87824	5.84696	0.00001
32.4995	35.8062	6.22868	7.06577	6.22865	0.00000

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

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

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

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



CTD Conductivity #7

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 2513
CALIBRATION DATE: 03-Jun-03

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

GHIJ COEFFICIENTS

g = -1.05840630e+001
h = 1.63257987e+000
i = -1.44478609e-003
j = 2.18501545e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 8.75022041e-006
b = 1.62522103e+000
c = -1.01786631e+001
d = -8.59969049e-005
m = 5.1
CPcor = -9.5700e-008 (nominal)

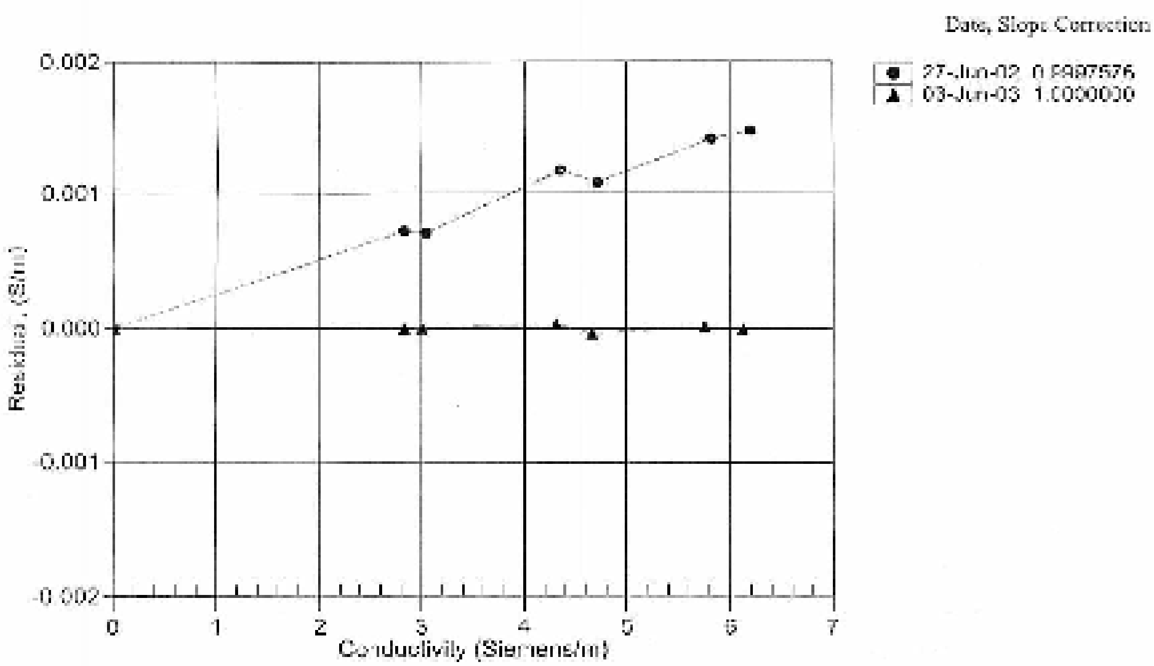
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.54002	0.00000	0.00000
-1.0000	35.1515	2.82532	4.88261	2.82532	-0.00000
0.9997	35.1521	3.00189	4.98585	3.00189	0.00000
14.9997	35.1521	4.30839	5.73574	4.30842	0.00003
18.4997	35.1522	4.65806	5.91527	4.65802	-0.00004
28.9997	35.1488	5.75057	6.45950	5.75059	0.00001
32.4997	35.1416	6.12625	6.62425	6.12625	-0.00001

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

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

t = temperature[°C]; p = pressure[decibars]; δ = CTcorr; ϵ = CPcorr;

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



CTD Dissolved Oxygen #1

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 0080
CALIBRATION DATE: 17-Jun-03w

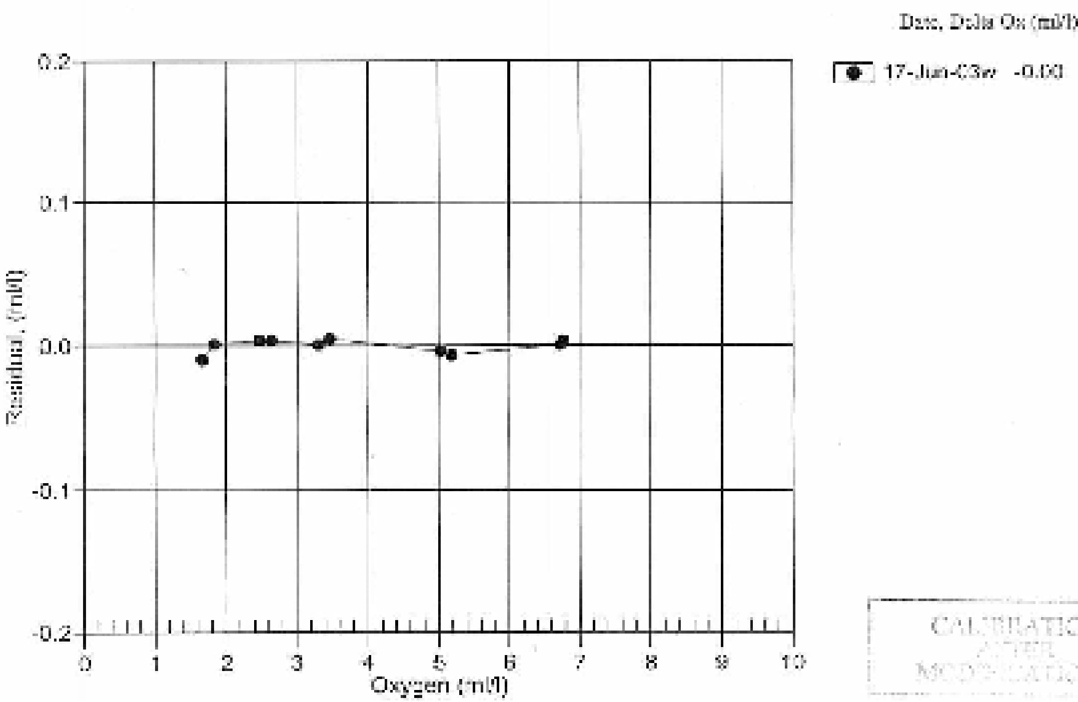
SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS
Soc = 0.3212
Boc = 0.0000
Voffset = -0.6055

TCor = 0.0011
PCor = 1.350e-04

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.66	25.00	0.03	1.669	[illegible]	-0.02
1.84	5.00	0.04	1.244	1.84	0.00
2.47	25.00	0.03	1.903	2.47	0.00
2.64	5.00	0.04	1.532	2.64	0.00
3.31	25.00	0.03	2.341	3.31	0.00
3.46	5.00	0.04	1.808	3.47	0.01
5.03	25.00	0.03	3.244	5.03	-0.00
5.18	5.00	0.04	2.399	5.17	-0.01
6.71	5.00	0.04	2.935	6.71	0.00
6.76	25.00	0.03	4.155	6.77	0.00

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



CALIBRATION
AFTER
MODIFICATIONS

CTD Dissolved Oxygen #2

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9054 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0129
CALIBRATION DATE: 17-Jun-03w

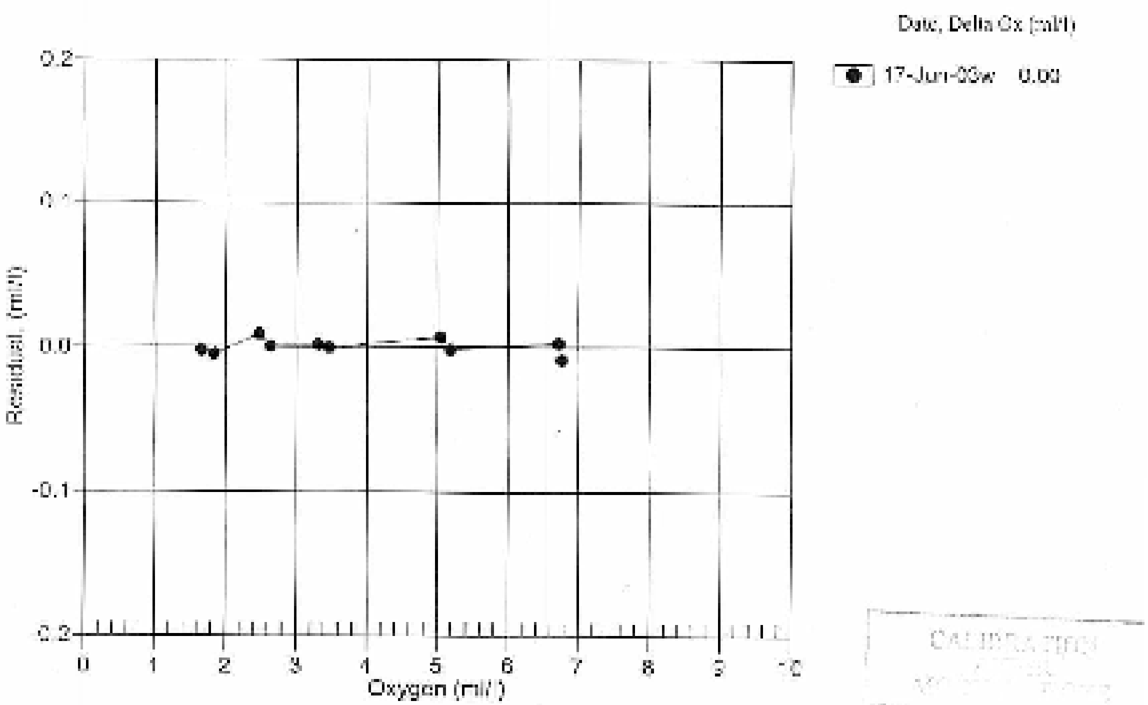
SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS
Soc = 0.3520
Boc = 0.0000
Voffset = -0.6150

TCor = 0.0017
PCor = 1.350e-04

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.65	25.00	0.02	[illegible]	[illegible]	-0.00
1.84	[illegible]	0.04	1.130	1.83	-0.01
2.47	25.00	0.02	1.665	2.48	0.01
2.64	5.00	0.04	1.363	2.64	0.00
3.31	25.00	0.02	2.015	[illegible]	0.00
3.46	5.00	0.04	1.555	3.46	-0.00
[illegible]	25.00	0.02	2.767	5.04	0.01
5.18	5.00	0.04	2.081	5.18	-0.00
[illegible]	5.00	0.04	2.517	6.72	0.00
[illegible]	25.00	0.02	3.47[illegible]	6.75	-0.01

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



CTD PAR

Biospherical Instruments Inc

CALIBRATION CERTIFICATE

UNDERWATER PAR SENSOR WITH LOG AMPLIFIER

Calibration Date: 11/11/02 Job No.: R8185
Model Number: QSP200L
Serial Number: 4361
Operator: TPC
Standard Lamp: 91773(4/12/01)
Operating Voltage Range: 6 to 15 VDC (+)

Note: The QSP-200L uses a log amplifier to measure the detector signal current with V = log I (Amps) / IRef

To calculate irradiance, use this formula:

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

With the appropriate (solar corrected) Irradiance Calibration Factor:

Dry Calibration Factor:	2.42E+12	quanta/cm² sec/"amps"	4.01E-06	µEinsteins/cm² sec/"amps"
Wet Calibration Factor:	4.07E+12	quanta/cm² sec/"amps"	6.76E-06	µEinsteins/cm² sec/"amps"

Sensor Test Data and Results[4]

Sensor Supply Current (Dark):	75.8	mA
Supply Voltage:	6	Volts

Lamp Integrated PAR Irradiance:	8.64E+15	quanta/cm² sec	0.01424	µEinsteins/cm² sec		
SCS Immersion Coefficient:	0.594	Scalar Correction:	1		PAR Solar Correction:	1.0000

Nominal Filter OD	Calibrated Trans.	Sensor Voltage	Measured Trans.		Measured Signal (Amps)	Estimated Signal (Amps)	Calc Output (Volts)	Error (Volts)	Error (%)	Test Irrad. (quanta/cm² sec)
No Filter	100.00%	3.553	100.00%		3.57E-07	3.57E-07	3.553	0.000	0.0	8.64E+15
0.3	36.10%	3.117	36.62%		1.31E-07	1.29E-07	3.111	-0.006	-1.4	3.16E+15
0.5	27.60%	3.005	28.25%		1.01E-07	9.86E-08	2.994	-0.010	-2.3	2.44E+15
1	9.27%	2.560	10.13%		3.62E-08	3.31E-08	2.522	-0.038	-8.5	8.75E+14
2	1.11%	1.882	1.31%		4.69E-09	3.97E-09	1.813	-0.070	-15.4	1.13E+14
3	0.05%	0.677	0.10%		3.42E-10	1.91E-10	0.511	-0.166	-44.2	9.27E+12

Dark Before:	0.125	Volts			
Light - No Filter Hldr.:	3.553	Volts	I_{Ref} =	1.00E-10	Amps
Dark After - NFH:	0.125	Volts	I_{Dark} =	1.33E-10	Amps
Average Dark	0.125	Volts	10^{VDark} =	1.333521	Amps

Notes:

1. Annual calibration is recommended.
2. There is increasing error associated with readings below zero.
3. The collector should be cleaned frequently with alcohol.
4) This section is for internal use and for more advanced analysis.

QSP-200L.xls

CTD Fluorometer #1

CERTIFICATE OF CALIBRATION

ctg Systems Marine

Chelsea Technologies Group

55 Central Avenue
West Molesey,
Surrey KT8 2QZ
United Kingdom
Tel: [illegible]
Fax: [illegible]
[illegible]
[illegible]

Date of issue 23rd February 2003

Description Mk III Aquatracka (Chlorophyll-a)

Serial Number 088080

REPORT

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

$$\text{Conc.} = (0.0157 \times 10^{\text{Output}}) - 0.057$$

Where:-

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

The above formula can be used in the range 0 - 100 microgrammes per litre to an uncertainty of 0.02 microgrammes per litre plus 8% of value.

Notes

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

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

Group Companies

Chelsea Technologies Ltd
Chelsea Instruments Ltd
[illegible]

Serial number 088080 Page 1 of 2

<u>Fluorimeter calibration readings</u>

Ambient temperature 20°C

Output for detector mechanically blanked 0.296 Volts

Output for pure water 0.375 Volts

chlorophyll concentration in acetone (µg/l)	Output (volts)
Acetone (pure)	0.3297
0.1038	0.9715
0.3114	1.3278
1.038	1.8172
3.10362	2.3170
10.2762	2.8166
30.2058	3.2842
94.3542	3.7660

The uncertainty of the chlorophyll concentration is estimated not to exceed 3%. The uncertainty of output voltage measurement is estimated not to exceed 2mV.

Signed Claresttill Date 23.02.03

CTD Fluorometer #2

PO Box 518
620 Applegate St.
Philomath OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
http://www.wetlabs.com

Chlorophyll Fluorometer Characterization

2/11/03 is correct cal date

Date:	2/11/02 Wrong Year
Serial #:	AFLD-016
Job#:	0102007
Tech:	K.C
CWO (Vblank)	**0.178 volts**
CEV	**2.68 volts**
SF	**9.9920**
FSV	**5.45 volts**
Linearity:	**0.999 R^2 (0–1.5 volts)** **0.995 R^2 (0– 5.45 volts)**

Notes:

CWO (Vblank) is the clean water offset value and is obtain using pure filtered de-ionized water.

CEV is the chlorophyll equivalent voltage. This value is the signal output of the fluorometer when using a fluorescent proxy that has been determined to be approximately equivalent to **25 μg/l** of a *Thalassiosira weissflogii* phytoplankton culture.

SF is the scale factor used to derive chlorophyll concentration from the signal voltage output of the fluorometer. The scale factor is determine by using the following equation: SF = (25) / (CEV – CWO) e.g.(25 / (2.865 – 0.238) = 9.516)

FSV is the maximum signal voltage output that the fluorometer is capable of.

Chlorophyll concentration expressed in μg/l (mg/m³) can be derived by using the following equation: (μg/l) = (Vmeasured – CWO) * SF

The relationship between fluorescence and chlorophyll-a concentrations in-situ is highly variable. The scale factor listed on this document was determined by using a mono-culture of phytoplankton (*Thalassiosira weissflogii*). The population was assumed to be reasonably healthy and the concentration was determined by using the absorption method. To accurately determine chlorophyll concentration using a fluorometer you must perform secondary measurements on the populations of interest. This is typically done using extraction based measurement techniques on discrete samples. For additional information on determination of chlorophyll concentration see [Standard Methods For The Examination Of Water And Wastewater] part 10200 H published jointly by: American Public Health Association, American Water Works Association and Water Environment Federation.

CTD Transmissometer

PO Box 518
620 Applegate St.
Philomath OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
http://www.wetlabs.com

C-Star Calibration Sheet

Date:	**02-25-03**
Customer:	**National Science Foundation**
Serial Number:	**CST-397DR**
Job Number:	0009009
Work Order:	002

V_d = V dark	0.059
V_{air} = V out in air	**4.818**
V_{ref} = V out in water	**4.778**
Calibration Temperature of water	**19.4**
Ambient Temperature	**20.5**

% Transmission = $(V_{sig}-V_d)/(V_{ref}-V_d)$
Tr = e^{-cx}
To solve for the attenuation coefficient c in units of m^{-1} use the following equation.
c = $-1/x\ (\ln(V_{sig}-V_d)/(V_{ref}-V_d))$
For further information on these calculations please see C-Star User's Guide, Section 2.

Temperature Error: 0.02% **F.S./°C**

NOTES

- **(V_d)**—analog output of the instrument with the beam blocked. This is an instrumental offset.
- **(V_{air})**—analog output voltage of the instrument with a cleared beam path.
- **(V_{ref})**—analog output voltage of the instrument with clean H_2O in the path.
- **(Calibration Temperature of water)**—temperature of the clean water used to obtain V_{ref}.
- **(Ambient Temperature)**—temperature of the instrument during the calibration procedures.
- **(V_{sig})**—measured signal voltage of the C-Star.

Wetlabs C-Star Transmissometer
N.B.Palmer Onboard Calibration Sheet

Calibration Date: 02/25/03

Serial Number: CST-397DR

Technician: *Wetlabs Job #0009009 (from Wetlabs Cal Sheet)*

Use the following table to enter voltages when performing an annual calibration of the instrument:

$Y_0 = V_d$	0.059	Voltage Blocked
$A_0 = V_{air}$	4.818	Voltage in air
$W_0 = V_{ref}$	4.778	Voltage in pure filtered H_2O from the Nanopure system.
Cal. Temp of Water	19.4	Temperature of the water during calibration. (Centigrade)
Ambient Temp	20.5	Air temperature during the calibration. (Centigrade)

The following equation is used by RVDas to obtain % of Transmittance:

% Transmission = $100\% * (V_{sig} - V_d) / (V_{ref} - V_d)$ V_{sig} = Signal Voltage at any point in time.

Use the following table to enter measured voltages when putting the instrument in use:

Note: Use the system that the instrument is being installed in to measure the voltage.
(i.e., CTD: Use the CTD Deck unit and read the voltage on the CTD Computer with the system on.)
Make sure the lenses are clean and dry!

Date:
Technician: **System:**

	Value	Comments
$Y_1 = V_{dark}$ (current)		Current measured blocked voltage.
$A_1 = V_{air}$ (current)		Current measured voltage in air.
Tw	100%	%Transmission in pure water.

Use the following equations to obtain the M and B constants for Seasave for both the CTD and Thermosalinagraph:

(Select Chelsea/Seatech Wetlab CStar in *Seasave for Windows* or Transmissometer in *Seacon for DOS*).
(Do NOT select Beam Transmissometer or WetLab AC3)

$M = (T_w / W_0) * (A_0 - Y_0) / (A_1 - Y_1)$ $B = -M\,Y_1$

M = (100 /) * (–) / (–) B =

M = B =

Path Length (M) = 0.250

Meteorology System

Anemometer (Port)

RM Young Anemometer Calibration, Model 05106

S/N: 46262 Date: 25-Feb-03 Cal'd By: Bruce Felix

Clockwise Cal Motor RPM	Calculated Windspeed m/s	Measured Windspeed m/s	Delta m/s	Knots
0	0.00	0.0	0.0	0
200	0.98	0.9	0.1	1.904
500	2.45	2.3	0.2	4.76
1000	4.90	4.8	0.1	9.52
1500	7.35	7.3	0.0	14.28
2000	9.80	9.8	0.0	19.04
3000	14.70	14.8	-0.1	28.56
4000	19.60	19.8	-0.2	38.08
5000	24.50	24.8	-0.3	47.6
6000	29.40	29.8	-0.4	57.12
7000	34.30	34.7	-0.4	66.64
8000	39.20	39.7	-0.5	76.16
9000	44.10	44.7	-0.6	85.68
10000	49.00	49.6	-0.6	95.2
12000	58.80	59.4	-0.6	114.24

Direction	Measured Direction	Delta Direction
0	0	0
30	28.5	1.5
60	59	1
90	90	0
120	120	0
150	149	1
180	179	1
210	209	1
240	240	0
270	269.5	0.5
300	300	0
330	330	0
0	0	0

Note: Delta direction should not exceed + or - 3 degrees

Counter Clockwise Cal Motor RPM	Calculated Windspeed m/s	Measured Windspeed m/s	Delta m/s
0	0.00	0.0	0.0
200	0.98	0.9	0.1
500	2.45	2.3	0.2
1000	4.90	4.8	0.1
1500	7.35	7.3	0.0
2000	9.80	9.8	0.0
3000	14.70	14.8	-0.1
4000	19.60	19.8	-0.2
5000	24.50	24.8	-0.3
6000	29.40	29.8	-0.4
7000	34.30	34.7	-0.4
8000	39.20	39.7	-0.5
9000	44.10	44.7	-0.6
10000	49.00	49.7	-0.6
12000	58.80	59.5	-0.7

Caution: Do Not exceed 12000 rpm during Wind Speed test.

Wind Speed Threshold < 2.9 rpm? Yes

Wind Direction Threshold < 30 rpm? Yes

Additional Comments

Note: Delta Windspeed should not exceed + or - 0.3 m/s for 0 - 5000 rpm

Anemometer (Starboard)

RM Young Anemometer Calibration, Model 05106

S/N: 16263 **Date:** 8-Dec-02 **Cal'd By:** Unknown

Clockwise Cal Motor RPM	Calculated Windspeed m/s	Measured Windspeed m/s	Delta m/s	knots
0	0.00	0.1	-0.1	0.0
200	0.98	0.9	0.1	1.9
500	2.45	2.3	0.2	4.8
1000	4.90	4.8	0.1	9.5
1500	7.35	7.4	-0.1	14.3
2000	9.80	9.8	0.0	19.0
3000	14.70	14.8	-0.1	28.8
4000	19.60	19.8	-0.2	38.1
5000	24.50	24.8	-0.3	47.6
6000	29.40	29.7	-0.3	57.1
7000	34.30	34.7	-0.4	66.6
8000	39.20	39.7	-0.5	76.2
9000	44.10	44.7	-0.6	85.7
10000	49.00	49.7	-0.7	95.2
12000	58.80	59.5	-0.7	114.2

Direction	Measured Direction	Delta Direction
0	0	0
30	29	1
60	59	1
90	89	1
120	119	1
150	150	0
180	179	1
210	210	0
240	240	0
270	270	0
300	300	0
330	331	-1
0	0	0

Note: Delta direction should not exceed + or - 3 degrees.

Counter Clockwise Cal Motor RPM	Calculated Windspeed m/s	Measured Windspeed m/s	Delta m/s
0	0.00	0.1	-0.1
200	0.98	0.9	0.1
500	2.45	2.3	0.2
1000	4.90	4.8	0.1
1500	7.35	7.4	-0.1
2000	9.80	9.8	0.0
3000	14.70	14.8	-0.1
4000	19.60	19.8	-0.2
5000	24.50	24.8	-0.3
6000	29.40	29.7	-0.3
7000	34.30	34.7	-0.4
8000	39.20	39.7	-0.5
9000	44.10	44.7	-0.6
10000	49.00	49.6	-0.6
12000	58.80	59.5	-0.7

Do Not exceed 12000 rpm during Wind Speed test.

Wind Speed Threshold < 2.8 gm?	Yes
Wind Direction Threshold < 30 gm?	Yes

Additional Comments

Calibration measurements copied to new formatted cal sheet. Technician who performed calibration is unknown.

Note: Delta Windspeed should not exceed + or - 0.3 m/s for 0 - 5000 rpm

PIR

THE EPPLEY LABORATORY, INC.

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

EPLAB
Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION INFRARED RADIOMETER Model PIR

Serial Number: 33023F3

Resistance: 764 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This pyrgeometer has been compared with Precision Infrared Radiometer, Serial Number 29326F3 in Eppley's Blackbody Calibration System under radiation intensities of approximately 700 watts meter^{-2} and an average ambient temperature of 23 °C.

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

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

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

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

Shipped to:
National Science Foundation
Port Hueneme, CA

S.O. Number: 59204
Date: November 6, 2002

Date of Test: October 25, 2002

In Charge of Test: [signature]

Reviewed by: [signature]

Remarks:

PSP

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

EPLAB
Scientific Instruments for Precision Measurements Since 1917

STANDARDIZATION OF EPPLEY PRECISION SPECTRAL PYRANOMETER Model PSP

Serial Number: 3309073

Resistance: 699 Ω at 23 °C
Temperature Compensation Range: -20 to 40 °C

This radiometer has been compared with Standard Precision Spectral Pyranometer, Serial Number 21231F3 in Eppley's Integrating Hemisphere under radiation intensities of approximately 700 watts meter^{-2} (roughly one-half a solar constant). The adopted calibration temperature is 25 °C.

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

8.52 $\times 10^{-6}$ volts/watts meter^{-2}

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

The calibration of this instrument is traceable to standard self-calibrating cavity pyrheliometers in terms of the Systeme Internationale des Unites (SI units), which participated in the Ninth International Pyrheliometric Comparisons (IPC IX) at Davos, Switzerland in September-October 2000.

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

Shipped to:
National Science Foundation
Port Hueneme, CA

Date of Test: January 24, 2003

In Charge of Test: [signature]

S.O. Number: 59285
Date: January 24, 2003

Reviewed by: [signature]

Remarks:

PAR

Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	2/3/03
Model Number	QSR 240
Serial Number	6356
Operator	TPC
Standard Lamp	93700(5/19/01)
Probe Excitation Voltage Range:	5 to 18 VDC(+)
Output Polarity	Positive

Mast PAR

Probe Conditions at Calibration(in air):

Calibration Voltage:	6	VDC(+)
Probe Current:	1.2	mA

Probe Output Voltage:

Probe Illuminated	92.4	mV
Probe Dark	0.4	mV
Probe Net Response	92.0	mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

9.14E+15	quanta/cm²sec
0.015	uE/cm²sec

Calibration Factor:

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

Dry:	1.01E-17	V/(quanta/cm²sec)
	6.06E+00	V/(uE/cm²sec)

Notes:

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

12406 05/24/95

TSG Calibration Files

Underway Conductivity

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER = 3195
CALIBRATION DATE: 22-Nov-02

SBE 21 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914

GHIJ COEFFICIENTS
g = -4.26666745e+00
h = 5.03225293e-01
i = -4.53054017e-04
j = 4.74361956e-05
CPcor = -9.5700e-08 (nominal)
CTcor = 3.2500e-06 (nominal)

ABCDM COEFFICIENTS
a = 2.82777974e-06
b = 5.02102040e-01
c = -4.25671669e+00
d = -8.80276732e-05
m = 4.4
CPcor = -9.5700e-08 (nominal)

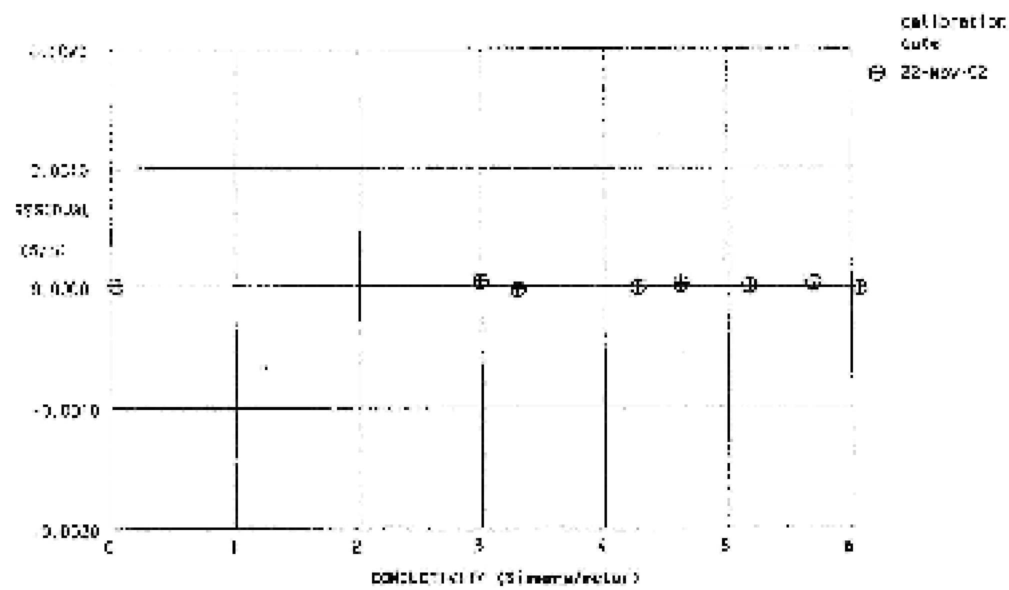
BATH TEMP (ITS 90 °C)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (KHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.81264	0.00000	-0.00000
1.0000	34.5582	2.95602	8.19999	2.95604	0.00002
4.5000	34.5580	3.26281	8.55061	3.26278	-0.00003
14.9999	34.5576	4.24321	9.52714	4.24319	-0.00002
18.5000	34.5572	4.58769	9.87430	4.58770	0.00001
24.0000	34.5565	5.14423	10.51052	5.14423	0.00000
28.9999	34.5551	5.66432	10.98716	5.66434	0.00002
32.5000	34.5531	6.03528	11.31463	6.03526	-0.00002

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

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

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

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



Underway Temperature Sensor

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER = 3108
CALIBRATION DATE: 22-Nov-02

SBE 21 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.22450290e-03
h = 6.25160453e-04
i = 1.99900644e-05
j = 1.39971759e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.64753597e-03
b = 5.95326037e-04
c = 1.60550574e-05
d = 1.40113835e-06
f_0 = 2568.397

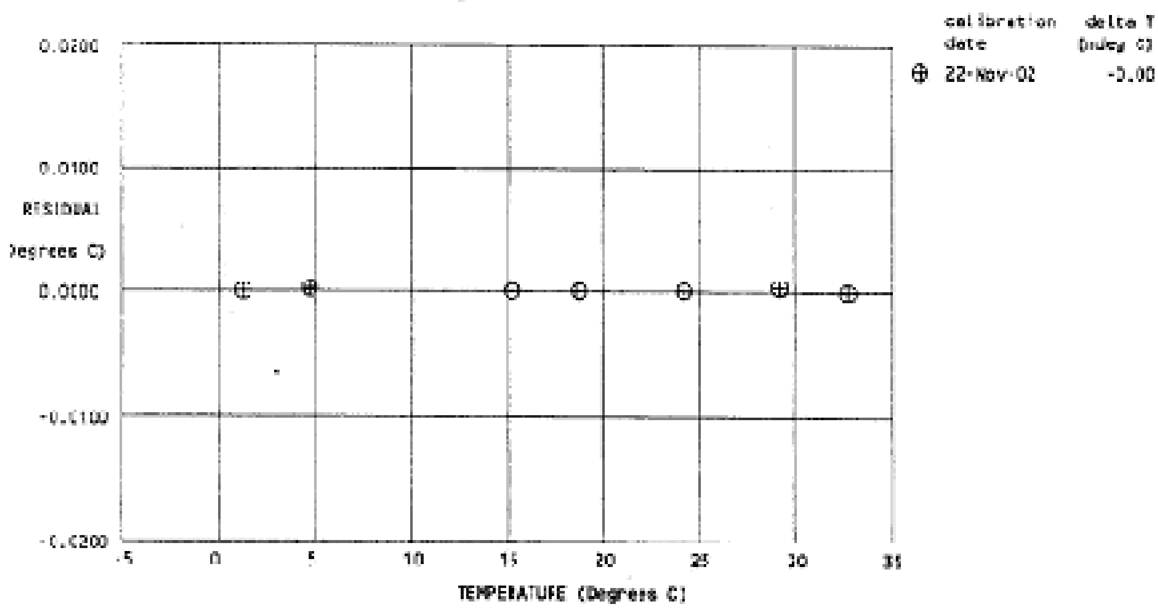
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
1.0000	2560.397	0.9999	-0.00008
4.5000	2775.144	4.5001	0.00013
14.9999	3467.400	14.9998	-0.00006
18.5000	3723.305	18.4999	-0.00006
24.0000	4152.042	24.0000	-0.00004
28.9999	4570.926	29.0001	0.00025
32.5002	4881.105	32.5001	-0.00015

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

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

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

Residual = instrument temperature - bath temperature



Underway Remote Temperature Sensor

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington 98006 USA
Phone: (425) 643 - 9866 Fax: (425) 643 - 9954 Internet: seabird@seabird.com

SENSOR SERIAL NUMBER = 2593
CALIBRATION DATE: 06-Feb-03

TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.27986177e-03
h = 6.19586021e-04
i = 2.06496791e-05
j = 1.61096809e-06
f_0 = 1000.000

IPTS-68 COEFFICIENTS

a = 3.68121314e-03
b = 5.83363745e-04
c = 1.58585118e-05
d = 1.61237533e-06
f_0 = 2709.478

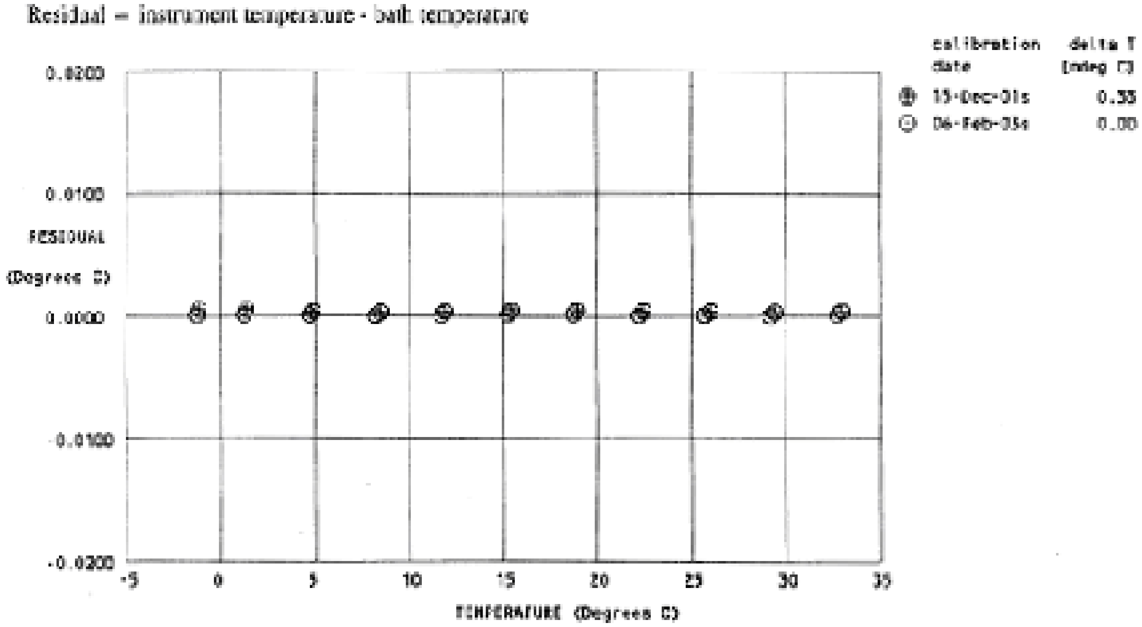
BATH TEMP (ITS-90 °C)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90 °C)	RESIDUAL (ITS-90 °C)
-1.4999	2709.478	-1.4999	-0.00001
1.0001	2870.267	1.0001	0.00003
4.5001	3106.997	4.5001	0.00001
8.0001	3357.587	8.0000	-0.00006
11.5001	3622.778	11.5001	-0.00003
15.0001	3902.600	15.0002	0.00005
18.5001	4197.822	18.5002	0.00007
22.0002	4508.589	22.0002	-0.00004
25.5001	4835.381	25.5001	-0.00000
29.0002	5178.600	29.0001	-0.00007
32.5001	5538.610	32.5001	0.00005

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

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

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

Residual = instrument temperature - bath temperature



Underway Transmissometer

PO Box 518
620 Applegate St.
Philomath OR 97370

(541) 929-5650
Fax (541) 929-5277
http://www.wetlabs.com

WET Labs

C-Star Calibration Sheet

Date:	**02/24/03**
Customer:	**National Science Foundation**
Serial Number:	**CST-422PR**
Job Number:	**0012016**
Work Order:	**005**

V_d = V dark	**0.058**
V_{air} = V out in air	**4.884**
V_{ref} = V out in water	**4.772**
Calibration temperature of water	**19.6**
Ambient temperature	**21.8**

% Transmission = $(V_{sig}-V_d)/(V_{ref}-V_d)$
Tr = e^{-cx}
To solve for the attenuation coefficient c in units of m^{-1} use the following equation.
$c = -1/x\ (\ln(V_{sig}-V_d)/(V_{ref}-V_d))$
For further information on these calculations please see C-Star User's Guide, Section 2.

Temperature Error: 0.02% F.S./°C

NOTES

- **(V_d)**—analog output of the instrument with the beam blocked. This is an instrumental offset.
- **(V_{air})**—analog output voltage of the instrument with a cleared beam path.
- **(V_{ref})**—analog output voltage of the instrument with clean H_2O in the path.
- **(Calibration Temperature of water)**—temperature of the clean water used to obtain V_{ref}.
- **(Ambient Temperature)**—temperature of the instrument during the calibration procedures.
- **(V_{sig})**—measured signal voltage of the C-Star.

Data Processing Notes

Event Date	Person	Date Type	Summary
2010-05-12	*Bartolocci, Danie*	BTL	NetCDF, WOCE files online

Detailed Notes
2010.04.23 DBK

Reformatting for the sbi_320620030705 bottle file. Submitted by Bob Key as part of CARINA.
NOTE: Bob's file is missing DELO18 and DOC. Both parameters were collected on this cruise.

Edits made:
- Parameters: AMMONI to NH4
  PHAEO to PPHYTN
  FLUORO to FLUOR
- Units: DBARS to DBAR
  DEGC to DEG C

In order to merge in time, format check and order the parameters, the following new parameters were added to the parameters list: PAR, SPAR, HAARDT, UREA

Converted file to netcdf and woce formats sbi_320620030705_hy1.csv and sbi_320620030705_nc_hyd.zip. Opened exchange and netcdf in JOA with no errors. Visually checked woce formatted file sbi_320620030705hy.txt. moved all files to new directory created for this cruise and linked all files online.

Sent copy of these notes to Jerry on 2010.05.13

2010-05-14	*Key, Bob*	DOC	to go online

Detailed Notes
The file I sent (320620030705.exc.csv with first line timestamp of 12/4/08) did have DOC data. I had converted the DOC to /kg units using measured salinity and an assumed temperature of 22C. Attached is a copy of the original DOC file (and README) I have (from Hansell). DOC still in /L in this file and #decimals is wrong, but no other problems. I have no record of O-18 data for this cruise, but the cruise report also mentions C13 and N15. I checked the ucar site this morning and didn't see any record of these isotopic data. The documentation I have doesn't say who was responsible for these measurements