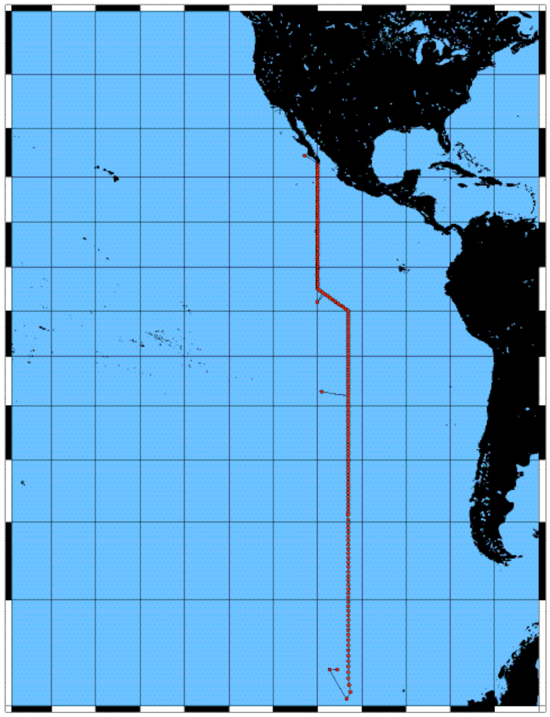
CRUISE REPORT: P18_2007

(Updated MAY 2011)



A. HIGHLIGHTS

A.1. CRUISE SUMMARY INFORMATION

WOCE section designation	**P18**	
Expedition designation (ExpoCodes)	**33RO20071215**	
Chief Scientists	**Dr. John L. Bullister / PMEL**	**Leg 1**
	Dr. Gregory C. Johnson / PMEL	**Leg 2**
Co-Chief Scientists	**Dr. Dong-Ha Min / UT**	**Leg 1**
	Dr. Alejandro Orsi / TAMU	**Leg 2**
Dates	15 DEC 2007 to 18 JAN 2008	Leg 1
	21 JAN 2008 to 23 FEB 2008	Leg 2
Ship	*R/V RONALD H. BROWN*	
Ports of call	San Diego, CA - Easter Island, Chile	Leg 1
	Easter Island - Punta Arenas, Chile	Leg 2
Station geographic boundaries	24° 27.56" N 112° 54.39" W 102° 32.47" W 69° 26.63" S	
Stations	174	
Floats and drifters deployed	24 ARGO floats, 17 SVP drifters deployed	
Moorings deployed or recovered	8 TAO Buoy Sites Visited	

Chief Scientists:

Dr. John L. Bullister
Tel: 206-526-6741 • Fax: 206-526-6744
Email: John.L.Bullister@noaa.gov

Dr. Gregory C. Johnson
Tel: 206-526-6806 • Fax: 206-526-6744
Gregory.C.Johnson@noaa.gov

Pacific Marine Environmental Laboratory (NOAA-PMEL)
7600 Sand Point Way N.E. • Seattle, WA 98115 • USA

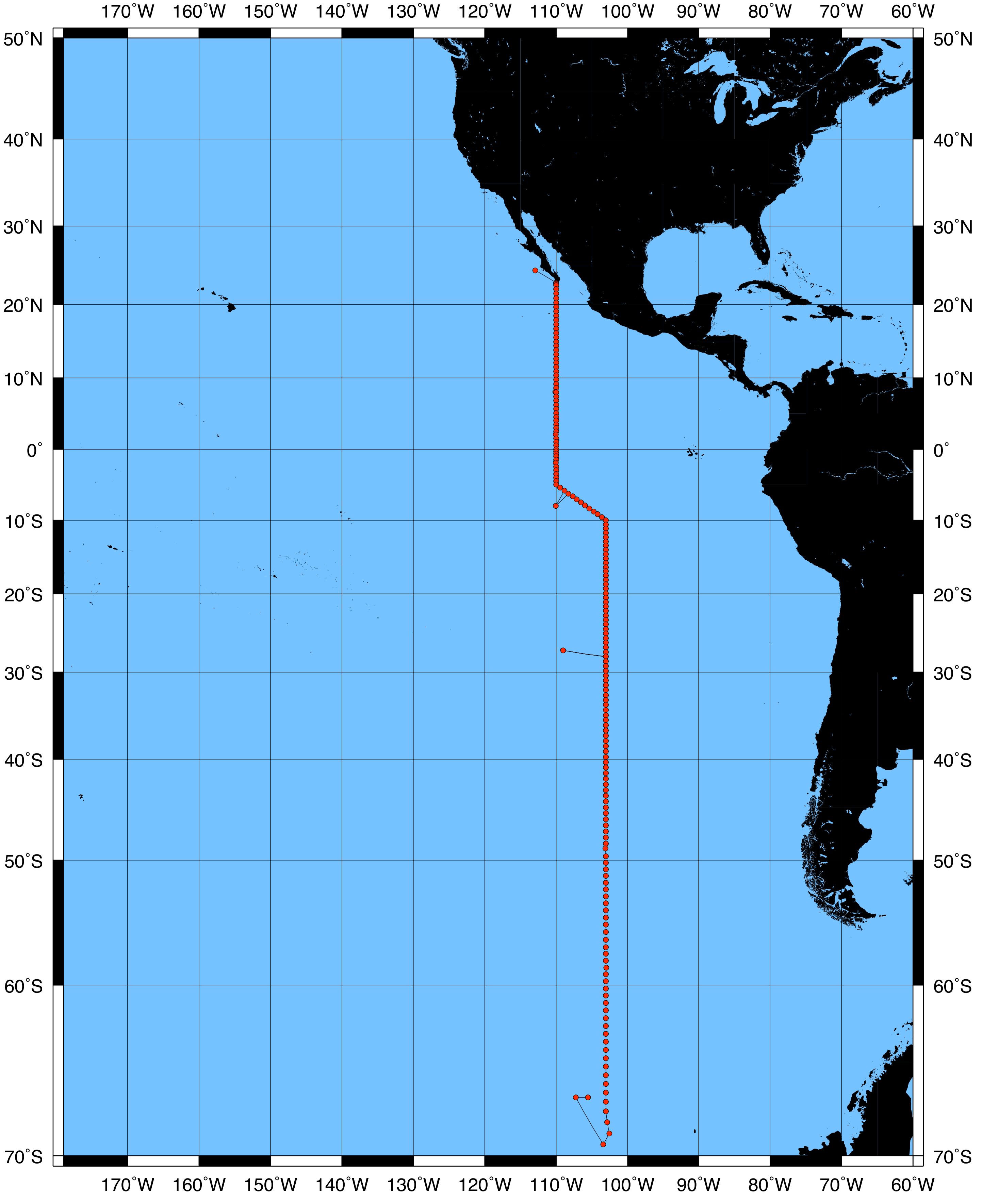
Dr. Dong-Ha Min • The University of Texas at Austin, Marine Science Institute
750 Channel View Drive, Port Aransas, TX 78373-5015
Tel: 361-749-6743 • Fax: 361-749-6777 • dongha@mail.utexas.edu

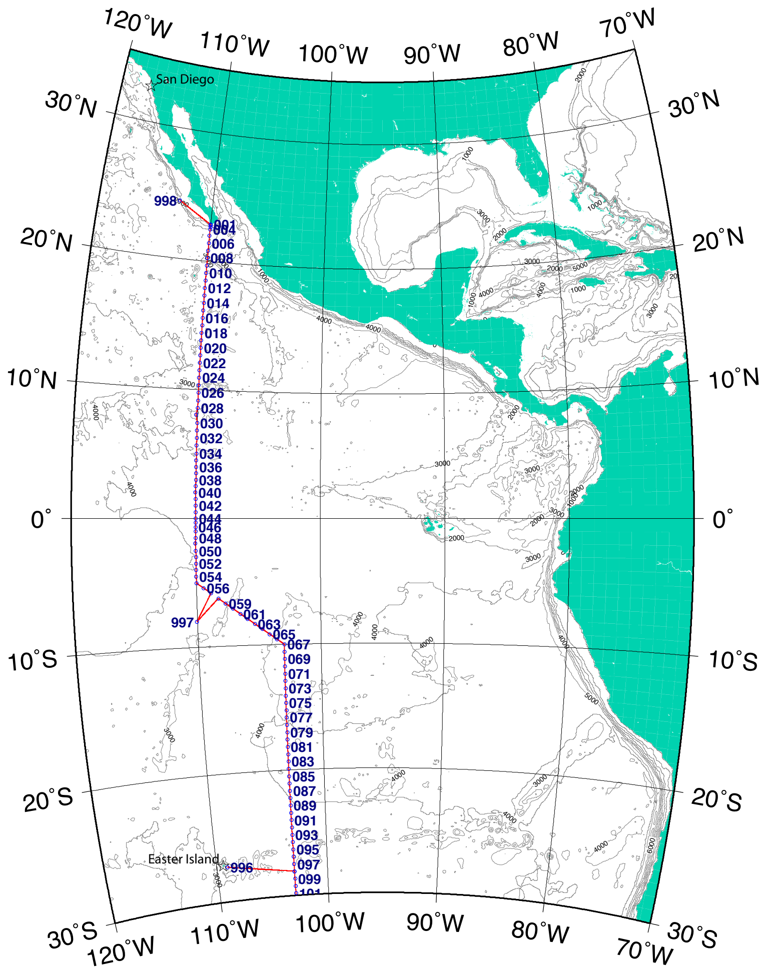
Dr. Alejandro Orsi • Texas A&M University • Room 616 • Oceanography and Meteorology
Tel: (979) 845-4014 • Fax: (979) 847-8879 • Email: aorsi@tamu.edu

CRUISE AND DATA INFORMATION

Links to text locations. Shaded sections are not relevant to this cruise or were not available when this report was compiled

P18S_2007 Station Locations • Bullister/Johnson • R/V Ronald H. Brown

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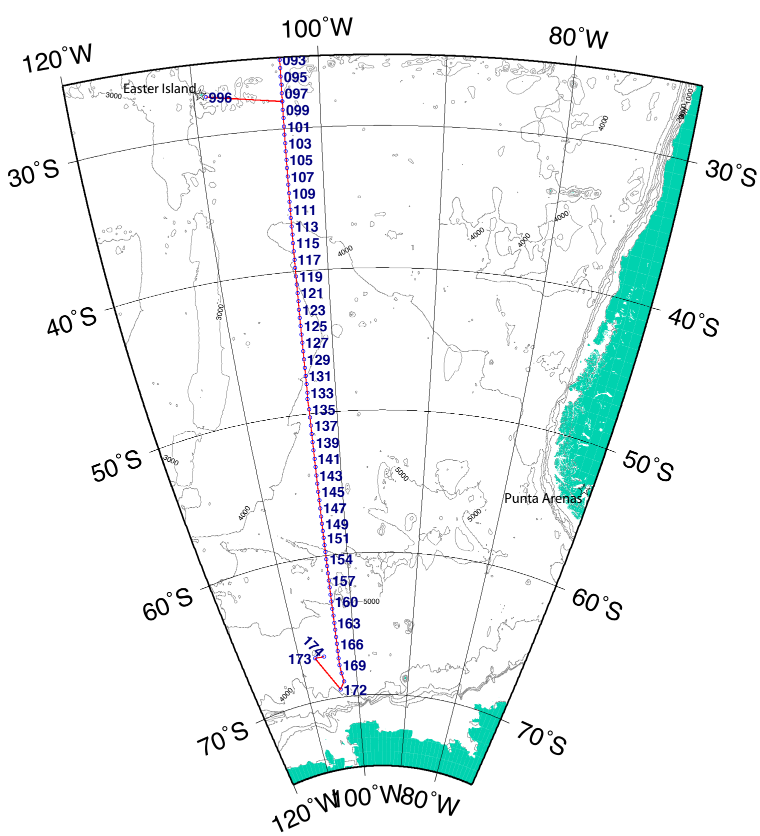
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Summary

A hydrographic survey (CLIVAR/Carbon P18) was carried out on the NOAA Ship Ronald H. Brown from December 2007 through February 2008 in the eastern Pacific. Most of the survey work was a repeat of a 1994 occupation of a meridional section nominally along 110 - 103° W (WOCE P18). Two stations along a 1992 section along 67° S west of 103° W (WOCE S4P) were also taken towards the end of the cruise. Operations included CTD/LADCP/Rosette casts and radiometer casts. Underway data collected included upper-ocean currents from the shipboard ADCP, surface oceanographic and meteorological parameters from the ship's underway systems, and bathymetry data. Ancillary operations included surface drifter deployments, Argo float deployments, and XBT drops. NDBC TAO buoy servicing was also performed during the first leg of the cruise.

After an 8-day delay, NOAA Ship Ronald H. Brown departed San Diego, CA on 15 December 2007 at 0215 UTC. The ship anchored off Easter Island, Chile from 18-21 January 2008 for a personnel change and short break between leg 1 and leg 2. CLIVAR/Carbon P18 ended in Punta Arenas, Chile on 23 February 2008.

A total of 174 stations and 7 TAO Buoy sites were occupied during P18. 179 CTD/LADCP/Rosette casts (including 2 Test casts, 2 TAO calibration casts and 2 casts at station 98: the first to end leg 1 and the second to start leg 2) plus 54 radiometer casts were made. 24 ARGO floats were deployed, 17 SVP drifters were deployed, and approximately 82 XBTs were dropped. CTD data, LADCP data and water samples (up to 36) were collected on most Rosette casts, in most cases to within 10-20 meters of the bottom.

Salinity, dissolved oxygen and nutrient samples were analyzed for up to 36 water samples from each cast of the principal CTD/LADCP/Rosette program. Water samples were also measured for CFCs, pCO_2, Total CO_2 (DIC), Total Alkalinity, pH, CDOM and Chlorophyll a. Additional samples were collected for ^3He, Tritium, $^{13}C/^{14}C$, ^{32}Si, Millero Density, ONAR, DOC, DON, POC, and CDOM2C/CDOM3C.

Introduction

A sea-going science team gathered from multiple oceanographic institutions participated on the cruise. Several other science programs were supported with no dedicated cruise participant. The science team and their responsibilities are listed below.

Principal Programs of CLIVAR/Carbon P18

Analysis	Institution	Principal Investigator	email
CTDO/Salinity	NOAA/PMEL	Gregory C. Johnson	Gregory.C.Johnson@noaa.gov
	NOAA/AOML	Molly Baringer	Molly.Baringer@noaa.gov
Data Management	UCSD/SIO	James H. Swift	jswift@ucsd.edu
Chlorofluorocarbons (CFCs)	NOAA/PMEL	John Bullister	John.L.Bullister@noaa.gov
	UWashington	Mark Warner	warner@u.washington.edu
^{3}He/Tritium	LDEO	Peter Schlosser	peters@ldeo.columbia.edu
O_2	NOAA/AOML	Chris Langdon	clangdon@rsmas.miami.edu
Total CO_2(DIC)/pCO_2	NOAA/PMEL	Richard Feely	Richard.A.Feely@noaa.gov
	NOAA/AOML	Rik Wanninkhof	Rik.Wanninkhof@noaa.gov
Total Alkalinity/pH/Density	UMiami	Frank Millero	fmillero@rsmas.miami.edu
Nutrients	NOAA/PMEL	Calvin Mordy	Calvin.W.Mordy@noaa.gov
	NOAA/AOML	Jia-Zhong Zhang	Jia-Zhong.Zhang@noaa.gov
CDOM/POC/Chlor.a	UCSB	Craig Carlson	carlson@lifesci.ucsb.edu
$^{13}C/^{14}C$	UWashington	Paul Quay	pdquay@u.washington.edu
DOC	UMiami	Dennis Hansell	dhansell@rsmas.miami.edu
DON	UMass	Mark Altabet	maltabet@umassd.edu
Noble Gases (ONAR)	UWashington	Steve Emerson	emerson@u.washington.edu
$^{30}Si/^{28}Si$	IGMR/ETH Zurich	Ben Reynolds	reynolds@erdw.ethz.ch
Transmissometer	TAMU	Wilf Gardner	wgardner@ocean.tamu.edu
Lowered ADCP	LDEO	Andreas Thurnherr	ant@ldeo.columbia.edu
Shipboard ADCP	UHawaii	Eric Firing	efiring@hawaii.edu
TAO Servicing	NOAA/NDBC	Lex LeBlanc	Lex.LeBlanc@noaa.gov
Argo Float deployments & XBT drops	NOAA/PMEL	Gregory C. Johnson	Gregory.C.Johnson@noaa.gov
Drifter Deployment	NOAA/AOML	Shaun Dolk	Shaun.Dolk@noaa.gov
Underway surface ocean, meteorological and bathymetry data	NOAA	Ship personnel	

Scientific Personnel CLIVAR/Carbon P18

P18 Leg 1 Scientific Personnel

Duties	Name	Affiliation	email
Chief Scientist	John L. Bullister	PMEL	John.L.Bullister@noaa.gov
Co-Chief Scientist	Dong-Ha Min	UTexas	min@utmsi.utexas.edu
Grad Student	Christian Briseño	LSU	cbrise1@lsu.edu
Grad Student	Hristina Hristova	MIT/WHOI	hhristova@whoi.edu
Grad Student	Lindsey Visser	TAMU	lvisser@ocean.tamu.edu
TAO Mooring	James Rauch	NDBC	James.Rauch@noaa.gov
TAO Mooring	William Thompson	NDBC	William.Thompson@noaa.gov
Chief Survey Tech.	Jonathan Shannahoff	NOAA	
Deck/Salinity	Carlos Fonseca	AOML	Carlos.Fonseca@noaa.gov
ET/LADCP/Salinity	Pedro Peña	AOML	Pedro.Pena@noaa.gov
CTD	Kristy McTaggart	PMEL	Kristene.E.Mctaggart@noaa.gov
LADCP	Cheng Ho	LDEO	ho@ldeo.columbia.edu
Data Manager	Mary C. Johnson	SIO/STS/ODF	mary@odf.ucsd.edu
CFC	David Wisegarver	PMEL	David.Wisegarver@noaa.gov
CFC	Robert Letscher	UMiami	rletscher@rsmas.miami.edu
^{3}He/Tritium	Kevin Cahill	WHOI	kcahill@whoi.edu
Oxygen	George Berberian	AOML	George.Berberian@noaa.gov
Oxygen	Charles Featherstone	AOML	Charles.Featherstone@noaa.gov
pCO_2	Bob Castle	AOML	Robert.Castle@noaa.gov
DIC	Simone Alin	PMEL	Simone.R.Alin@noaa.gov
DIC	Dana Greeley	PMEL	Dana.Greeley@noaa.gov
Alkalinity	Nancy Williams	UMiami	n.williams6@umiami.edu
Alkalinity	Gabriele Lando	UMiami	g.lando@tin.it
pH	Remy Okazaki	UMiami	rokazaki@rsmas.miami.edu
pH	Andres Suarez	UNAL	afsuareze@unal.edu.co
DOC/ ^{15}N/ ^{18}O	Stacy Brown	UMiami	mcstacmcspace@yahoo.com
Nutrients	Charles Fischer	AOML	Charles.Fischer@noaa.gov
Nutrients	Erik Quiroz	TAMU	erik@gerg.tamu.edu
CDOM/POC/Chl.a	Mary-Margaret Murphy	UCSB	mmkm03220@yahoo.com
CDOM/POC/Chl.a	Sam Schick	UCSB	samtschick@gmail.com

P18 Leg 2 Scientific Personnel

Duties	Name	Affiliation	email
Chief Scientist	Gregory C. Johnson	NOAA/PMEL	Gregory.C.Johnson@noaa.gov
Co-Chief Scientist	Alejandro Orsi	TAMU	aorsi@neo.tamu.edu
Grad Student	Chrissy Wiederwohl	TAMU	chrissy@ocean.tamu.edu
Grad Student	Amoreena MacFadyen	UWash	amoreena@u.washington.edu
Chief Survey Tech.	Jonathan Shannahoff	NOAA	
Deck/Salinity	Andrew Stefanick	NOAA/AOML	Andrew.Stefanick@noaa.gov
ET/LADCP/Salinity	Kyle Seaton	NOAA/AOML	Kyle.Seaton@noaa.gov
CTD	Kristene McTaggart	NOAA/PMEL	Kristene.E.McTaggart@noaa.gov
CTD	Sarah Purkey	NOAA/PMEL	Sarah.Purkey@noaa.gov
LADCP	Christof Thurnherr	LDEO	cthurnherr@mydiax.ch
Data Manager	Mary C. Johnson	SIO/STS/ODF	mary@odf.ucsd.edu
CFC	Nathaniel Nutter	UWash	nnutter@u.washington.edu
CFC	Nicholas Beaird	UWash	nlbeaird@u.washington.edu
^{3}He/Tritium	Anthony Dachille	LDEO	dachille@ldeo.columbia.edu
Oxygen	George Berberian	NOAA/AOML	George.Berberian@noaa.gov
Oxygen	Chris Langdon	UMiami	clangdon@rsmas.miami.edu
ONAR/ ^{14}C/ ^{13}C	Laurie Juranek	UWash	juranek@ocean.washington.edu
pCO_2	Christopher Kuchinke	UMiami	kuchinke@server.physics.miami.edu
DIC	David Wisegarver	NOAA/PMEL	David.Wisegarver@noaa.gov
DIC	Sylvia Musielewicz	NOAA/PMEL	Sylvia.Musielewicz@noaa.gov
Alkalinity	Cynthia A. Moore	UMiami	cmoore@rsmas.miami.edu
Alkalinity	Ryan J. Woosley	UMiami	rwoosley@rsmas.miami.edu
pH	Mareva Chanson	UMiami	mchanson@rsmas.miami.edu
pH	Jason F. Waters	UMiami	jwaters@rsmas.miami.edu
DOC/ ^{15}N/ ^{18}O	Charles Farmer	UMiami	cfarmer@rsmas.miami.edu
Nutrients	Calvin Mordy	Genwest Systems	Calvin.W.Mordy@noaa.gov
Nutrients	Natchanon Amornthammarong	NOAA/AOML	Natchanon.Amornthammarong@noaa.gov
CDOM/POC/Chl.a	David Menzies	UCSB	davem@icess.ucsb.edu
CDOM/POC/Chl.a	Mary-Margaret Murphy	UCSB	mmkm03220@yahoo.com
Observer/Chile	Nadin Ramirez		nadinc@gmail.com

Description of Measurement Techniques

1. CTD/Hydrographic Measurements Program

The basic CTD/hydrographic measurements consisted of salinity, dissolved oxygen, and nutrient measurements made from water samples taken on rosette casts; plus pressure, temperature, salinity, dissolved oxygen, transmissometer, and fluorometer profiles collected from the CTD. A total of 179 CTD/rosette casts were made, usually to within 10-20m of the bottom. Problems encountered are described later in this documentation. The distribution of samples is illustrated in figures 1.0-1.3.

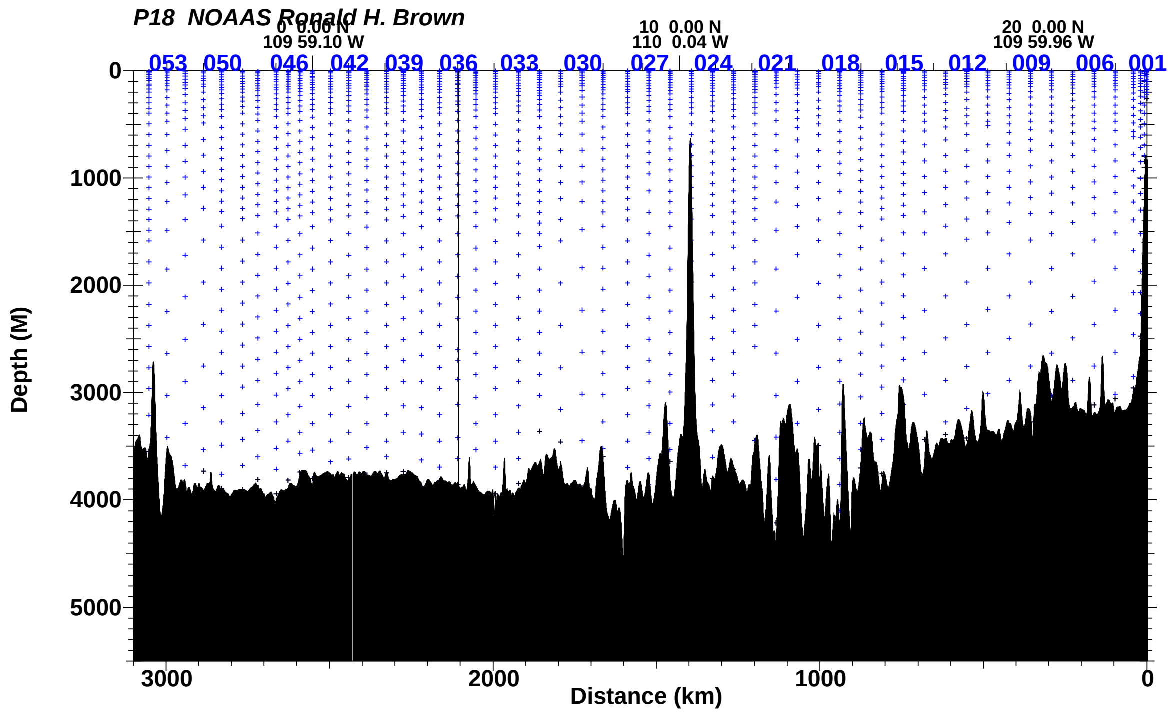

Figure 1.0 Sample distribution, stations 1-54.

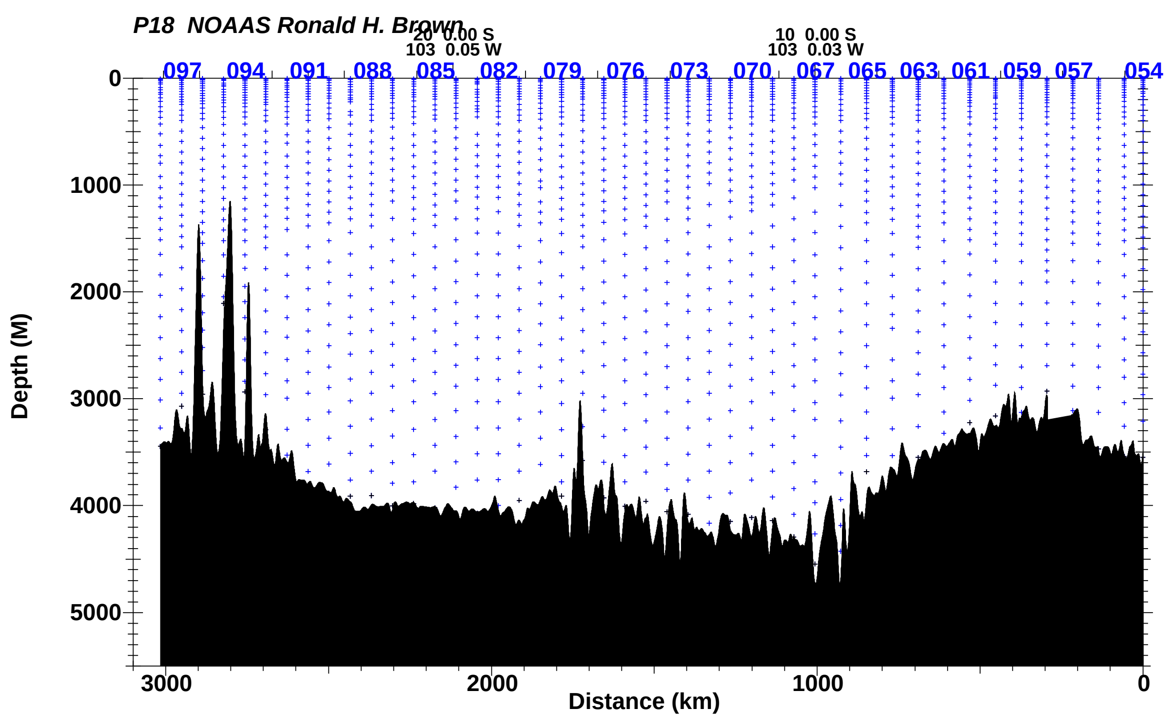

Figure 1.1 Sample distribution, stations 54-98/1.

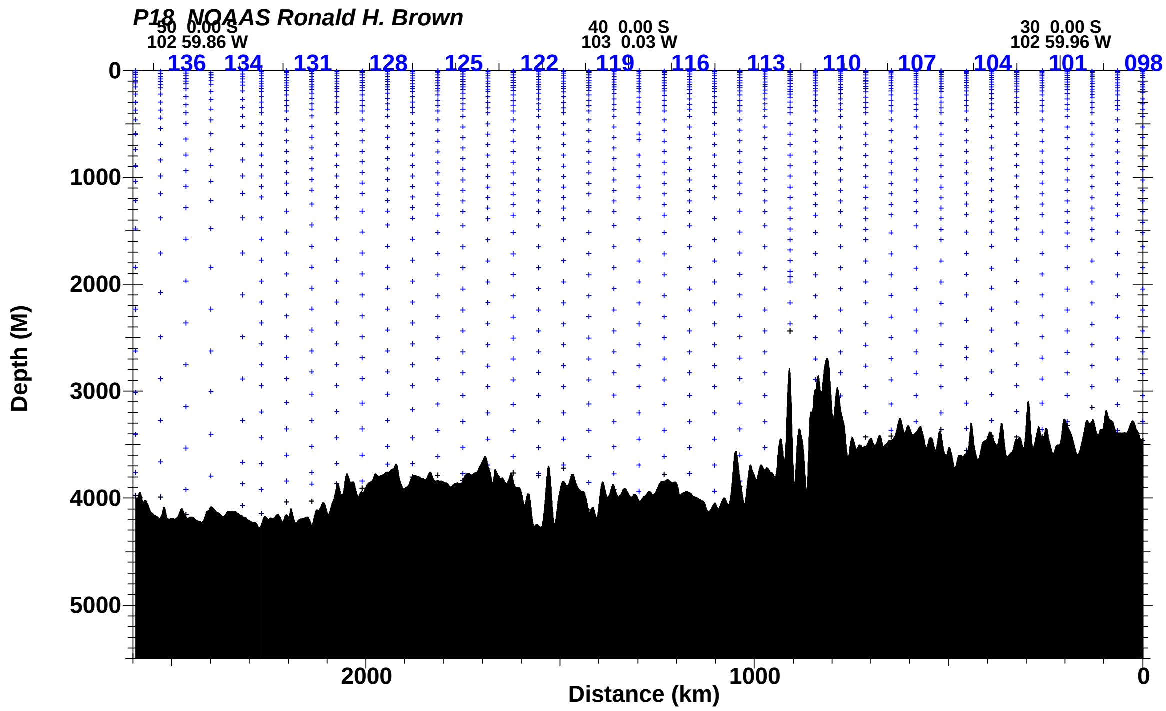

Figure 1.2 Sample distribution, stations 98/2-137.

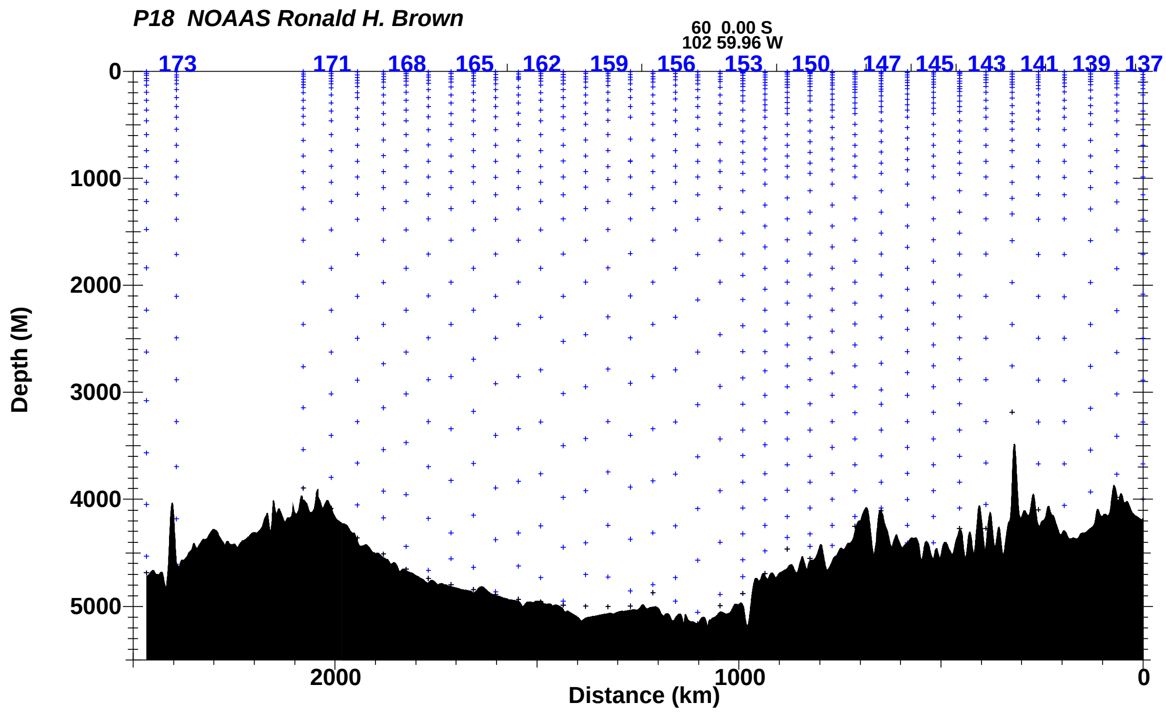

Figure 1.3 Sample distribution, stations 137-185.

1.1. Navigation and Bathymetry Data Acquisition

Navigation data were acquired at 2-second intervals from the ship's P-Code GPS receiver by a Linux system beginning December 15.

Bathymetric data were logged from the ship's 3.5kHz ODEC Bathy 2000 echosounder beginning 22 December 2007 at 2030 UTC. The echosounder was turned off during casts, and cast pinger-return data was recorded instead of bottom depth. It was usually turned back on between casts.

Raw Seabeam data were also logged from 22 December, but not otherwise processed. Seabeam centerbeam depths were displayed continuously, and data were manually recorded at cast start/bottom/end on CTD Cast Logs.

Both the Seabeam and Bathy 2000 transducers were located on the hull of the ship, at approximately 5.8m depth. Ship's Seabeam data recorded during CTD casts were already corrected for transducer depth, but used 1500m/sec sound velocity to determine depth. The manually recorded Seabeam depths were Carter-table corrected via software using actual latitude and longitude before reporting in data files.

Etopo2 bathymetry data were merged with navigation time-series data after each cast and used for bottle sections shown earlier in this report.

1.2. Underwater Electronics Packages

The SBE9*plus* CTDs were connected to SBE32 carousels (24-place for CTD 209, 36-place for CTD 315), providing for single-conductor sea cable operation. Within the 0.322 sea cable, two conducting wires were soldered together as positive and the third conducting wire was used as negative. The sea cable armor was not used for ground (return). Power to the CTDs and sensors, carousels and altimeters was provided through the sea cable from the SBE11*plus* deck unit in the main lab.

CTD data were collected with a Sea-Bird Electronics SBE9*plus* CTD (PMEL #209 or #315). The CTDs supplied a standard SBE-format data stream at a data rate of 24 Hz. These instruments provided pressure, dual temperature (SBE3*plus*), dual conductivity (SBE4), dissolved oxygen (SBE43), load cell (PMEL) and altimeter (Benthos or Simrad 807) channels. The 36-place system (CTD 315) also provided fluorometer (Wetlabs CDOM) and transmissometer (Wetlabs CStar) channels. An LADCP (RDI) was mounted on the rosette frames and collected data independently.

Table 1.2.0 P18 24-Place Rosette/CTD #209 Configuration.

Manufacturer/Model	Serial No.	Stations Used
Sea-Bird SBE32 24-place Carousel Water Sampler	471	
Sea-Bird SBE11*plus* Deck Unit	367	
Sea-Bird SBE9*plus* CTD	PMEL #209	998, 1-14, 19-21, 29/1, 30-31, 51-53, 134-143, 154-174
Paroscientific Digiquartz Pressure Sensor	209-53586	
Primary Sea-Bird Sensors:		
SBE3*plus* Temperature Sensor (T1)	03P-4211	
SBE4C Conductivity Sensor (C1)	04-2887	
SBE43 Dissolved Oxygen Sensor	43-0315	
SBE5 Pump	3438	998, 1-14
SBE5 Pump	819	19-21, 29/1, 30-31, 51
SBE5 Pump	1114(RB)	52-53, 134-143, 154-174
Secondary Sea-Bird Sensors:		
SBE3_02/F Temperature Sensor (T2)	03-1455	
SBE4C Conductivity Sensor (C2)	04-2882	
SBE5 Pump	819	998, 1-14
SBE5 Pump	3481	19
SBE5 Pump	2631	20-21, 29/1, 30-31, 51-53, 134-143, 154-174
Wetlabs CDOM Fluorometer [V]	FLCDRTD-428	154-174
Benthos Altimeter	1034	998, 1-9
Benthos Altimeter	1035	19
Simrad 807 Altimeter	98110	20-21, 29/1, 30-31, 51-53, 134-143, 154-174
PMEL Load Cell	8756	
RDI LADCP	7280	1-14, 19-21, 29/1, 30-31, 51-53 (Master)
	754	1-14, 19-21, 29/1, 30-31, 51-53 (Slave), 154-174 (Master)
Benthos Pinger	1006	

Table 1.2.1 P18 36-Place Rosette/CTD #315 Configuration.

Manufacturer/Model	Serial No.	Stations Used
Sea-Bird SBE32 36-place Carousel Water Sampler	431	
Sea-Bird SBE11*plus* Deck Unit	367	all but sta.49
Sea-Bird SBE11*plus* Deck Unit	314	sta.49 only
Sea-Bird SBE9*plus* CTD	0315	15-18, 22-28, 29/2, 32-50, 54-57, 997, 58-98/1, 996, 98/2-133, 144-153
Paroscientific Digiquartz Pressure	315-53960	
Primary Sea-Bird Sensors:		
SBE3*plus* Temperature (T1)	03P-4341	
SBE4C Conductivity (C1)	04-3157	
SBE43 Dissolved Oxygen	43-0664	
SBE5 Pump	3956	
Secondary Sea-Bird Sensors:		
SBE3*plus* Temperature (T2)	03P-4335	
SBE4C Conductivity (C2A)	04-3068	through 66 + 997
SBE4C Conductivity (C2B)	04-1467	67-133, 144-153 + 996
SBE5 Pump	3481	15-16
SBE5 Pump	3438	17-133, 144-153 + 996
Wetlabs CDOM Fluorometer [V]	FLCDRTD-428	
Wetlabs CStar Transmissometer	CST-507DR	
Simrad 807 Altimeter	98110	
Load Cell	1109	
RDI LADCP	7280	15-18, 22-28, 29/2, 32-50, 54-88 (Master); 93-133, 144-153 (Slave)
	754	15-18, 22-28, 29/2, 32-50, 54-88 (Master); 89-133, 144-153 (Master)
	150	89-91 (Slave)
Benthos Pinger	1134	

Table 1.2.2 P18 Micro Profile Radiometer Casts

Manufacturer/Model	Serial No.
Satlantic Micro-Profiler II	069
WetLabs ECO-FLNTU Chlorophyll Fluorometer	087

Each CTD was outfitted with dual pumps. Primary temperature, conductivity and dissolved oxygen were plumbed into one pump circuit; and secondary temperature and conductivity into the other. The sensors were deployed vertically. The primary temperature and conductivity sensors were used for reported CTD temperatures and salinities on all casts except 30, 31 and 51 (primary pump problems) and 39 (severe bio-fouling of primary sensors). The secondary temperature and conductivity sensors were used as calibration checks.

1.3. Water Sampling Package

CTD 315 rosette casts were performed with a package consisting of a 36-bottle rosette frame (PMEL), a 36-place carousel (SBE32) and 36 12-liter Bullister bottles (PMEL). The CTD 209 rosette package consisted of a 24-bottle rosette frame (PMEL), a 24-place carousel (SBE32) and 24 11-liter Bullister bottles (PMEL). Underwater electronic components are listed in the previous section.

The CTD was mounted vertically in an SBE CTD frame attached to a plate welded in the center of the rosette frame, under the pylon. The SBE4 conductivity and SBE3*plus* temperature sensors and their respective pumps were mounted vertically as recommended by SBE. Pump exhausts were attached to inside corners of the CTD cage and directed downward level with the intake ports. The transmissometer was mounted horizontally and the fluorometer vertically, attached to a rigid fiberglass screen that did not impede water flow. The altimeter was mounted on the interior side of the screen. The RDI LADCP was mounted vertically on one side of the 36-place frame between the bottles and the CTD. Its battery pack was located on the opposite side of the frame, mounted on the bottom of the frame.

During leg 1, the LADCP was mounted on the outside of the 24-place frame. On leg 2, the LADCP "outrigger" cage was removed and the LADCP was not mounted on the 24-place frame during the first series of 10 casts with the smaller frame (stations 134-143). Beginning with station 154, the fluorometer and LADCP were both mounted inside the 24-place frame. The LADCP was mounted with only the downward-facing heads installed, in order to keep all 24 Niskin bottles on the frame.

The NOAA Ship Ronald H. Brown Aft Markey winch was used for stations 1-14 (24-place rosette casts) and all 36-place rosette casts. The Forward Markey winch was used for 24-place rosette casts at stations 19-21, 29/1 and 30-31. The 24-place rosette was switched back to the Aft winch for stations 51-53 in order to troubleshoot problems with the 36-place system. The Forward winch was used again during leg 2 for two series of casts with the 24-place rosette, from stations 134-143 and again from station 154 to the end of the leg.

The rosette systems were suspended from one of two UNOLS-standard three-conductor 0.322" electro-mechanical sea cables. Several reterminations were made during the cruise, prior to stations 20 (Fwd), 29/2 (Aft) and 32 (Aft).

The deck watch prepared the rosette 10-20 minutes prior to each cast. The bottles were cocked and all valves, vents and lanyards were checked for proper orientation. The CTD was powered-up after arriving on station (or 10 min prior to arriving on southern stations). The data acquisition system in the computer lab started when directed by the deck watch leader. The rosette was unstrapped from its tiedown location on deck. The pinger was activated and syringes were removed from the CTD intake ports. The winch operator was directed by the deck watch leader to raise the package, the boom and rosette were extended outboard and the package quickly lowered into the water. The package was lowered to 10 meters, by which time the sensor pumps had turned on. After 1-2 minutes, the winch operator was then directed to bring the package back to the surface (0 m. winch wireout) and to begin the descent.

Each rosette cast was lowered to within 10-20 meters of the bottom, using both the pinger and/or altimeter to determine distance.

The winch operator was directed to stop the winch at each bottle trip depth during the up-cast. The CTD console operator waited 30 seconds before tripping a bottle to insure the package wake had dissipated and the bottles were flushed, then an additional 10 seconds after bottle closure to insure that stable CTD comparison data had been acquired. Once a bottle had been closed, the winch operator was directed to haul in the package to the next bottle stop.

Three sampling plans were used in rotation to choose standard sampling depths on each station throughout CLIVAR/Carbon P18.

Recovering the package at the end of the deployment was essentially the reverse of launching, with the additional use of poles to grab the rosette. The rosette was secured on deck under the block for sampling, except during a few stations in the Southern Ocean, when the rosette was brought into the staging bay. The bottles and rosette were examined before samples were taken, and anything unusual was noted on the sample log.

Each bottle on the rosette had a unique serial number. This bottle identification was maintained independently of the bottle position on the rosette, which was used for sample identification. No bottles were replaced on this cruise, but various parts of bottles were occasionally changed or repaired.

Routine CTD maintenance included rinsing the conductivity and DO sensors with a dilute Triton-X solution and storing it in the conductivity cells (but not in the oxygen sensors) between casts to maintain sensor stability and to eliminate any accumulating biofilms. Rosette maintenance was performed on a regular basis. O-rings were changed and lanyards repaired as necessary. Bottle maintenance was performed each day to insure proper closure and sealing. Valves were inspected for leaks and repaired or replaced as needed.

The 36-place SBE32 carousel had problems releasing some lanyards, causing mis-tripped bottles on multiple casts. This problem improved as the cruise continued, after several repair attempts and bottle height/lanyard adjustments.

The Forward winch readout was shorter than the maximum cast depths by 1.4-1.6%. The largest difference was used to apply a sloped correction (raw wireout* 1.0158) to the maximum wireout values reported for each cast on the Forward winch. The Aft winch readouts were nominally 0.5% larger than maximum cast depths, with a few being negative. No corrections were applied to Aft winch wireout values.

1.4. CTD Data Acquisition and Rosette Operation

The CTD data acquisition system consisted of an SBE-11*plus* (V2) deck unit and a networked generic PC workstation running Windows 2000. SBE SeaSave v.7.14c software was used for data acquisition and to close bottles on the rosette.

CTD deployments were initiated by the console watch after the ship had stopped on station. The watch maintained a CTD Cast log containing a description of each deployment, a record of every attempt to close a bottle and any pertinent comments.

Once the deck watch had deployed the rosette, the winch operator would lower it to 10 meters. The CTD sensor pumps were configured with a 60 second startup delay, and were usually on by this time. The console operator checked the CTD data for proper sensor operation, waited an additional 60 seconds for sensors to stablize, then instructed the winch operator to bring the package to the surface, pause for 10 seconds, and descend to a target depth (wire-out). The profiling rate was no more than 30m/min to 50m, no more than 45m/min to 200m and no more than 60m/min deeper than 200m depending on sea cable tension and the sea state.

The console watch monitored the progress of the deployment and quality of the CTD data through interactive graphics and operational displays. Additionally, the watch created a sample log for the deployment which would be later used to record the correspondence between rosette bottles and analytical samples taken. The altimeter channel, CTD pressure, wire-out, pinger and bathymetric depth were all monitored to determine the distance of the package from the bottom, usually allowing a safe approach to within 10-20 meters.

Bottles were closed on the up cast by operating an on-screen control, and were tripped at least 30 seconds after stopping at the trip location to allow the rosette wake to dissipate and the bottles to flush. The winch operator was instructed to proceed to the next bottle stop at least 10 seconds after closing bottles to insure that stable CTD data were associated with the trip.

After the last bottle was closed, the console operator directed the deck watch to bring the rosette on deck. Once out of the water, the console operator terminated the data acquisition, turned off the deck unit and assisted with rosette sampling.

1.5. CTD Data Processing

Shipboard CTD data processing was performed automatically at the end of each deployment using SIO/ODF CTD processing software v.5.1.0. The raw CTD data and bottle trips acquired by SBE SeaSave on the Windows 2000 workstation were copied onto the Linux database and web server system, then processed to a 0.5-second time series. CTD data at bottle trips were extracted, and a 2-decibar down-cast pressure series created. This pressure series was used by the web service for interactive plots, sections and CTD data distribution; the 0.5 second time series were also available for distribution.

CTD data were examined at the completion of each deployment for clean corrected sensor response and any calibration shifts. As bottle salinity and oxygen results became available, they were used to refine shipboard conductivity and oxygen sensor calibrations.

TS and theta-O_2 comparisons were made between down and up casts as well as between groups of adjacent deployments. Vertical sections of measured and derived properties from sensor data were checked for consistency.

A few CTD acquisition problems were encountered during P18. The aft winch had level wind problems during test cast 998. The CTD went to depth a second time from 540db on the upcast to correctly spool the cable onto the winch drum.

Slower winch speeds were observed with the 24-position rosette during the first six casts to break in the new sea cable. Normal winch speeds resumed with the 24-position rosette for the next nine casts. Then the 36-position rosette was employed.

Neither of the Benthos altimeters brought by PMEL performed well and were retired after cast 19. AOML's Simrad altimeter was passed between rosettes as they were employed.

Secondary pump s/n 3481 was retired from the 24-position rosette after cast 19. Poor data, likely owing to pump problems, were observed during casts 15 and 16 when pump s/n 3481 was used on the 36-position rosette.

Hundreds of modulo errors during cast 19 prompted retermination of the forward winch cable used for the 24-position rosette. The armor was not used as the return (ground) as recommended by Sea-Bird. Instead one of the three conducting wires was used as ground. The other two conducting wires were soldered together as the positive lead. This is the same electrical termination scheme that had to be used on the aft winch cable prior to the test cast to eliminate modulo errors while the rosette was still on deck.

During the recovery of the rosette after cast 28, the boom was brought in too far and the block hit the ship, damaging the aft winch cable. The cable was reterminated prior to cast 29/2 after cutting off 5m of cable, then again prior to cast 32 after cutting of 10m more of cable.

Primary pump s/n 819 was retired from the 24-position rosette after cast 51. Bad primary data, likely owing to pump problems, were observed during casts 30, 31 and 51.

A few modulo errors and corresponding spikes in all data channels occurred intermittently during casts 36-50. The errors ceased after all connections at the CTD were reseated.

Small spikes in all data channels occurred intermittently during casts 65-75 between about 1300-1550 dbars, mostly on the downcast. No modulo errors. The spikes disappeared after a new pump y-cable was installed.

Secondary conductivity sensor s/n 3068 was retired after cast 66. Its behavior during the cast was indicative of a cracked cell.

Several broken strands in the outer armor of the aft cable were detected around 3400 m wire out during cast 153. The 36-position package and the aft cable were not used for the remainder of the cruise.

Frozen water in the pump tubes affected both primary and secondary sensors at the start of cast 172. Secondary sensors recovered within a few seconds after going in, but primary conductivity did not come back fully until about 8db on the second down (after the surface yoyo). A later start time was used for pressure-sequencing to bypass the questionable data. Water was "frozen solid" in the syringes removed prior to cast 173, but there were no problems during the cast itself.

A total of 179 CTD casts were made (including two test casts, two TAO calibration casts, and two casts for station 98: the first to end leg 1 and the second to start leg 2). The 24-place (CTD #209) rosette was used for stations 998 (Test), 1-14, 19-21, 29/1 (TAO calibration), 30-31 and 51-53 on leg 1; and for stations 134-143 and 154-174 on leg 2. The 36-place (CTD #315) rosette was used for the remainder of the casts.

1.6. CTD Sensor Laboratory Calibrations

Laboratory calibrations of the CTD pressure, temperature, conductivity and dissolved oxygen sensors were performed prior to CLIVAR/Carbon P18. The calibration dates are listed in table 1.6.0 and 1.6.1.

Table 1.6.0 CLIVAR/Carbon P18 CTD #209 sensors (24-place rosette).

Sensor Model/ Description	Serial No.	Calibration Date	Calibration Facility
Paroscientific Digiquartz Pressure	209-53586	09-Jul-2007	SBE
Sea-Bird SBE3*plus* Temperature (Primary/T1)	03P-4211	08-Nov-2007	SBE
Sea-Bird SBE3_02/F Temperature (Secondary/T2)	03-1455	13-Nov-2007	SBE
Sea-Bird SBE4C Conductivity (Primary/C1)	04-2887	18-Oct-2007	SBE
Sea-Bird SBE4C Conductivity (Secondary/C2)	04-2882	18-Oct-2007	SBE
Sea-Bird SBE43 Dissolved Oxygen	43-0315	16-Oct-2007	SBE

Table 1.6.1 CLIVAR/Carbon P18 CTD #315 sensors (36-place rosette).

Sensor Model/ Description	Serial No.	Calibration Date	Calibration Facility
Paroscientific Digiquartz Pressure	315-53960	27-Jul-2007	SBE
Sea-Bird SBE3*plus* Temperature (Primary/T1)	03P-4341	13-Nov-2007	SBE
Sea-Bird SBE3*plus* Temperature (Secondary/T2)	03P-4335	13-Nov-2007	SBE
Sea-Bird SBE4C Conductivity (Primary/C1)	04-3157	18-Oct-2007	SBE
Sea-Bird SBE4C Conductivity (Secondary/C2A)	04-3068	18-Oct-2007	SBE
Sea-Bird SBE4 Conductivity (Secondary/C2B)	04-1467	18-Oct-2007	SBE
Sea-Bird SBE43 Dissolved Oxygen	43-0664	16-Oct-2007	SBE
Wetlabs CDOM Fluorometer [V]	FLRTD-428	unknown	
Wetlabs CStar Transmissometer [V]	CST-507DR	30-Apr-2007	

1.7. ODF Shipboard CTD Processing

PMEL CTD #209 or #315 was used for all P18 casts. The CTDs were deployed with all sensors and pumps aligned vertically, as recommended by SBE.

Primary temperature and conductivity sensors (T1 & C1) were used for all reported CTD data except four casts: 30/1, 31/1 and 51/1 (CTD #209 primary pump problems); and 39/1 (CTD #315 severely "slimed" by organic matter through most of cast). In addition, secondary data were used for CTD bottle trip information on stations 20/1 and 21/1 (spiky/noisy salinity caused by CTD #209 primary pump problems) and station 27/1 (due to salinity spike/offset problems on the upcast). The secondary sensors (T2 & C2) usually served only as calibration checks.

Upcast data were reported shipboard for 3 casts because of sensor problems on the downcasts: 29/2, 46/1 and 116/1.

In situ salinity and dissolved O_2 check samples collected during each cast were used to calibrate the conductivity and dissolved O_2 sensors.

1.7.1. CTD Pressure

The Paroscientific Digiquartz pressure transducers (S/Ns 209-53586 and 315-53960) were calibrated on the 9th and 27th of July 2007 at SBE. Calibration coefficients derived from the calibrations were applied to raw pressures during each cast. Residual pressure offsets (the difference between the first and last submerged pressures) were examined to check for calibration shifts. All were < 0.4db, until stations 128-133, where the end residual pressure offset was just below -0.5db. The offsets were low again until station 152, when start and end pressures out-of-water were slowly decreasing to as much as -0.9db, presumably because of the significantly colder water and air temperatures near the end of the cruise. No adjustments were made to the calculated pressures.

1.7.2. CTD Temperature

The same four SBE3 temperature sensors were used throughout the cruise: primary sensors (T1): S/Ns 03P-4211 (CTD #209) and 03P-4341 (CTD #315), and secondary sensors (T2): S/Ns 03-1455 (CTD #209) and 03P-4341 (CTD #315). All but one were SBE3*plus* sensors; 03-1455 was an SBE3_02/F sensor. Calibration coefficients derived from the pre-cruise calibrations (8-13 November 2007) were applied to raw primary and secondary temperatures during each cast.

Calibration accuracy was monitored by tabulating T1-T2 over a range of pressures and temperatures (bottle trip locations) for each cast. No significant time- or pressure-dependent slope was evident during the cruise for either pair of temperature sensors. The T1-T2 differences for CTD #315 show good agreement during the cruise. However, there is an average +0.0008 to +0.001°C T1-T2 difference for deep CTD #209 temperatures, whether or not casts with pump problems are included.

A -0.0006°C offset was applied to both temperature sensors, to account for heating effects on the sensors from pressure (from PMEL, as recommended by SBE). The differences between the dual temperature sensors for each CTD are summarized in Figures 1.7.2.0-1.7.2.1.

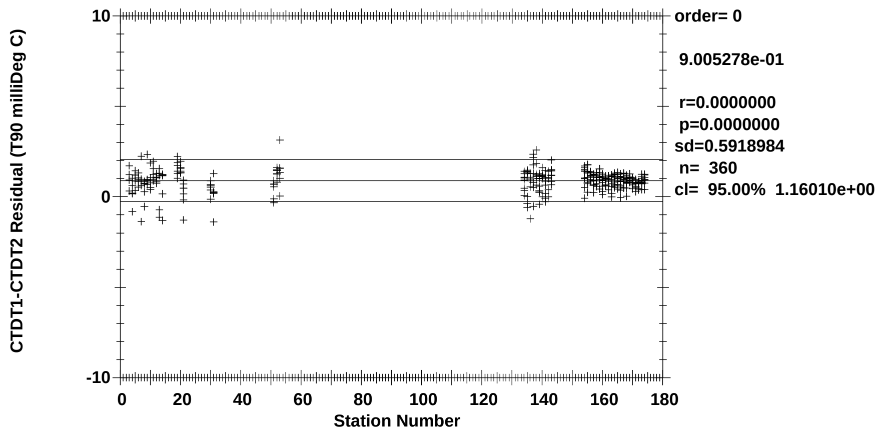

Figure 1.7.2.0 CTD #209 T1-T2 by station, pressure>1600db only.

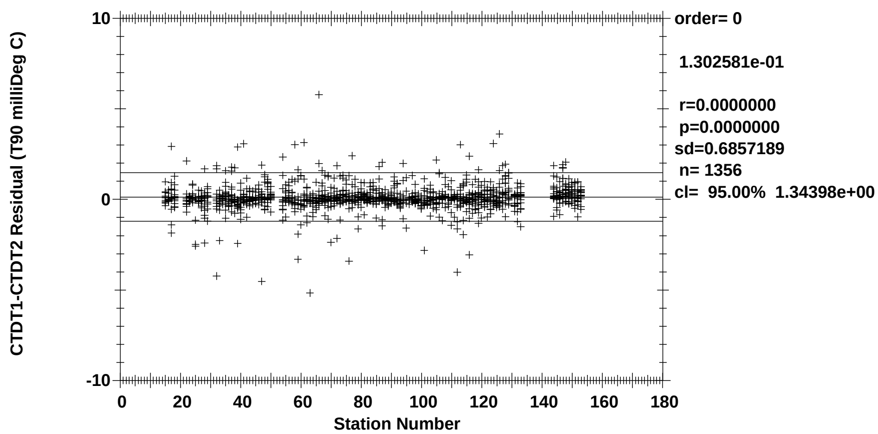

Figure 1.7.2.1 CTD #315 T1-T2 by station, pressure>1600db only.

1.7.3. CTD Conductivity

The same two conductivity sensors were used throughout the cruise on CTD #209 (Primary/C1: S/N 04-2887, Secondary/C2: S/N 04-2882). CTD #315 used the same Primary sensor (C1: S/N 04-3157), but the Secondary sensor was changed after displaying a large pressure drift during Station 66 (C2A: S/N 04-3068, C2B: S/N 04-1467). All conductivity sensors were model SBE4C except the replacement sensor for CTD #315, which was model SBE4. Conductivity sensor calibration coefficients derived from the 18 October 2007 pre-cruise calibrations were applied to raw primary and secondary conductivities. Comparisons between the primary and secondary sensors, and between each of the sensors to check sample conductivities (calculated from bottle salinities), were used to monitor conductivity drifts and offsets.

There was a -0.0015 mS/cm deep offset between the CTD #209 conductivity sensors, and an apparent pressure effect on at least one of the sensors. The deep Bottle - C1 conductivity residual was nearly +0.006 mS/cm from the start of the leg.

A linear pressure-dependent slope between conductivity sensors was observed for CTD #315 from the start of the cruise; the C1-C2A difference (stations 1-65) approached -0.002 mS/cm in the deepest (near 5000db) water. The deep bottle - C1A conductivity offset started near +0.004 mS/cm, and rose fairly steadily to +0.009 by the end of the leg.

Inspection of the conductivity sensor calibration reports showed that all 6 sensors brought on P18 were calibrated on the same date, with the same calibration standard values (likely in the same bath). Three of the first four sensors used looked strangely similar: all showed little change since the previous calibration, other than a "dip" of ~0.0035 mS/cm in the 28-30 mS/cm range for the previous calibrations displayed on the plot. The fourth sensor showed a fairly consistent offset above 40 mS/cm, then dipped -0.003 in the 28-30 mS/cm range. The previous calibrations were on 3 different dates; the only thing all 4 had in common was their most recent calibration date.

The next most recent calibrations from SBE (July 2007) for the two CTD #315 conductivity sensors were found, and data were test re-averaged using those coefficients. Deep C1 values from early in the cruise would shift by +0.0023 mS/cm (+0.0028 to CTDS), with insignificant changes to surface data. C2A values would change a similar amount, still +0.0015 higher than C1 data. This could explain most of the starting difference between the CTD and bottle salinities. These older conductivity calibration data were NOT applied during the cruise.

The latest/Oct.2007 conductivity calibration coefficients were applied during the cruise to all CTD data during initial processing. PMEL determined conductivity correction coefficients by comparing CTD data generated by SeaSave with bottle salinities. The same corrections were applied to the ODF CTD data set at the end of the second leg. ODF CTD data reported at the end of the leg will be replaced by PMEL CTD data within a few months after the end of the cruise.

After the CTD #315 secondary sensor died during station 66, the replacement sensor C2B showed a very non-linear difference from C1 with respect to pressure. The C1-C2B deep conductivity difference was -0.007 mS/cm; however, bottle - C2B conductivity differences started at -0.0015 and rose to +0.0005 mS/cm during leg 1 (stations 67-98). This was much closer to bottle values than any of the other 4 conductivity sensors, despite its recent history of a large drift over the 19 months prior to its October calibration.

To reduce the contamination of the comparisons by package wake, differences between primary and secondary temperature sensors were used as a metric of variability and used to qualify the comparisons. The coherence of this relationship is illustrated in Figure 1.7.3.0. The uncorrected comparison between the primary sensors and secondary sensors or bottle conductivities is shown in Figures 1.7.3.1 through 1.7.3.5 (vs pressure), and Figures 1.7.3.6 through 1.7.3.10 (vs station).

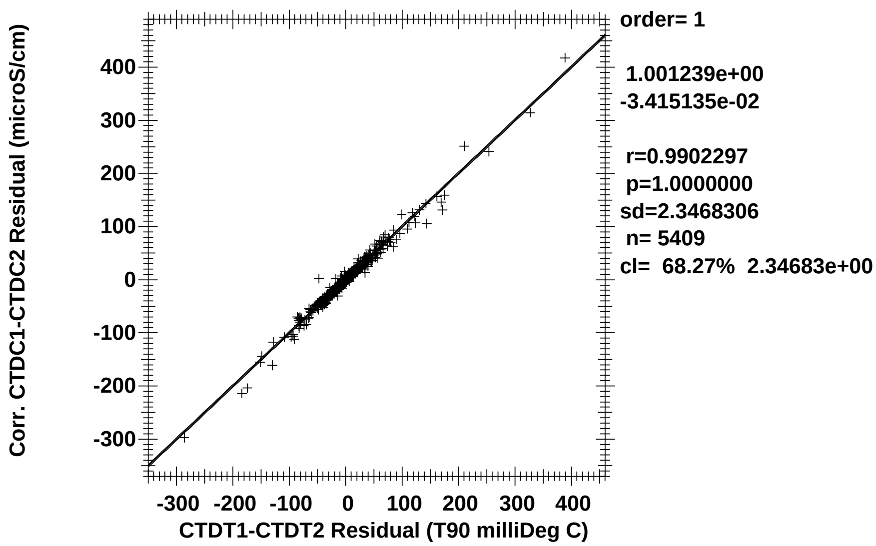

Figure 1.7.3.0 C1-C2 vs. T1-T2, both CTDs, all points.

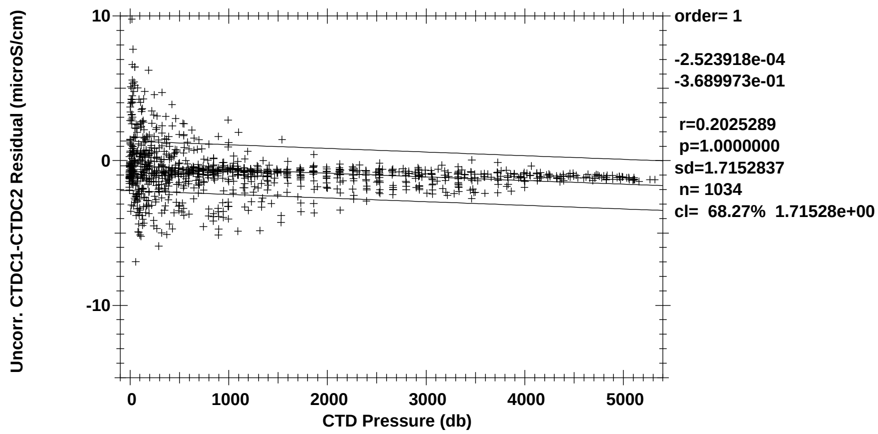

Figure 1.7.3.1 CTD #209 Uncorrected C1-C2 differences by pressure (|T1-T2|<0.005).

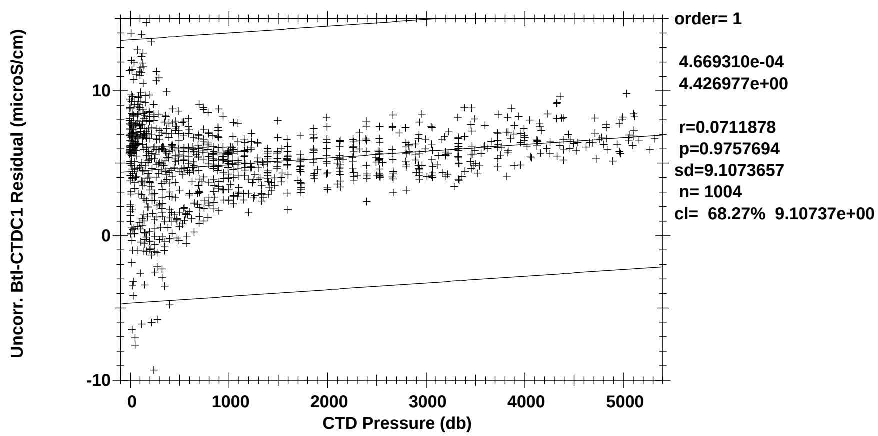

Figure 1.7.3.2 CTD #209 Uncorrected Bottle_Cond.-C1 differences by pressure (|T1-T2|<0.005).

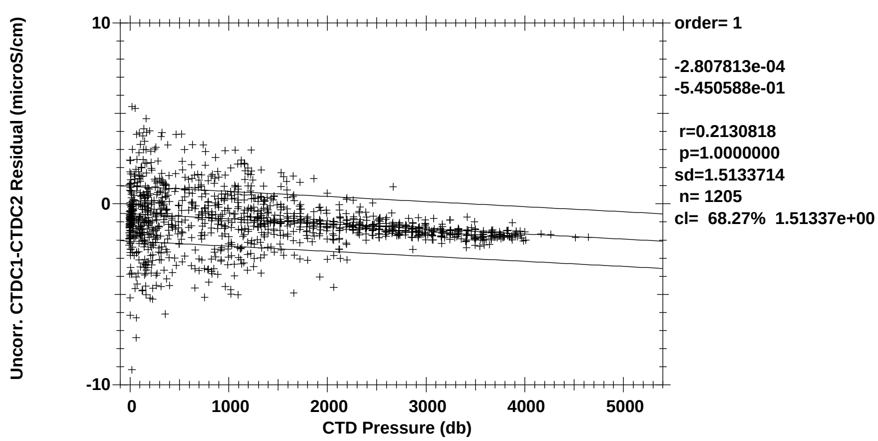

Figure 1.7.3.3 CTD #315 Uncorrected C1-C2A differences by pressure (|T1-T2|<0.005).

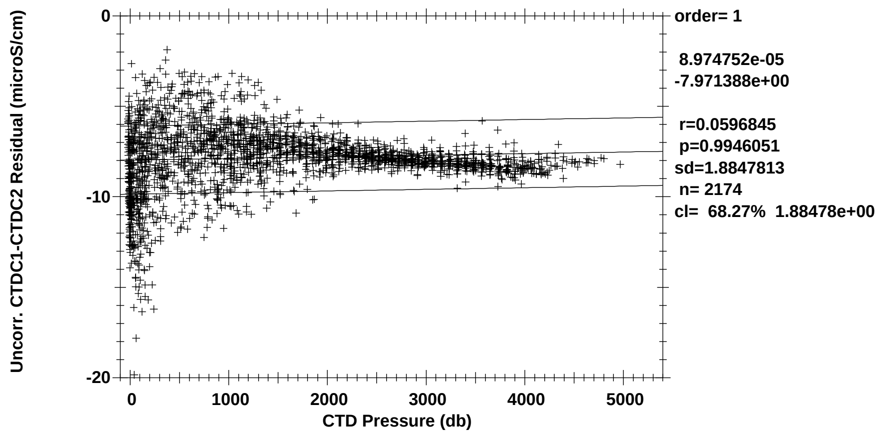

Figure 1.7.3.4 CTD #315 Uncorrected C1-C2B differences by pressure (|T1-T2|<0.005).

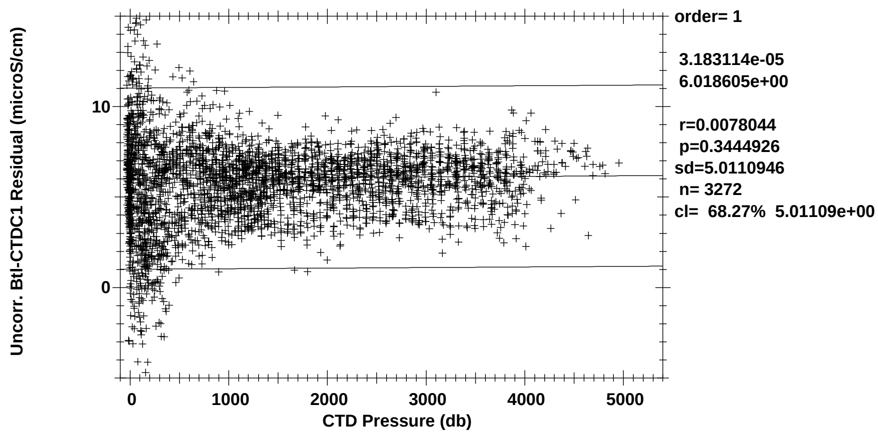

Figure 1.7.3.5 CTD #315 Uncorrected Bottle_Cond.-C1 differences by pressure (|T1-T2|<0.005).

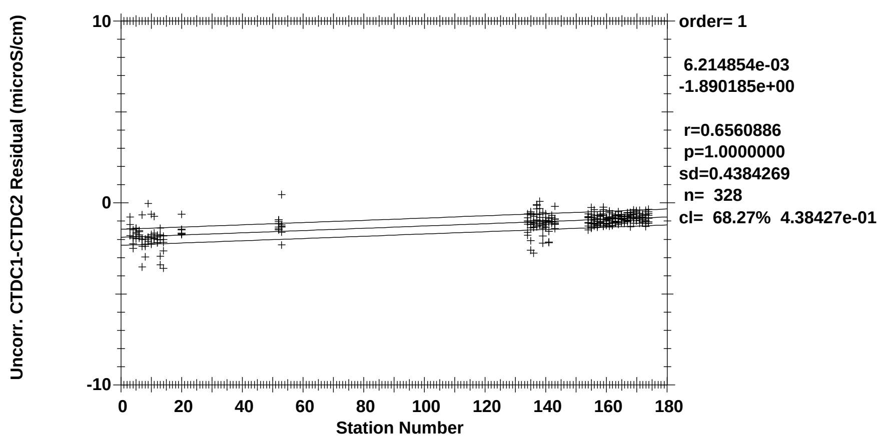

Figure 1.7.3.6 CTD #209 Uncorrected C1-C2 differences by cast (Pressure>1600db).

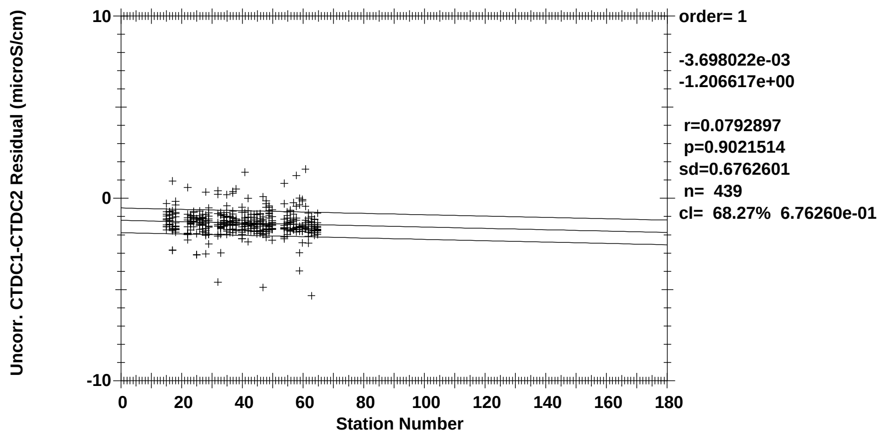

Figure 1.7.3.7 CTD #315 Uncorrected C1-C2A differences by cast (Pressure>1600db).

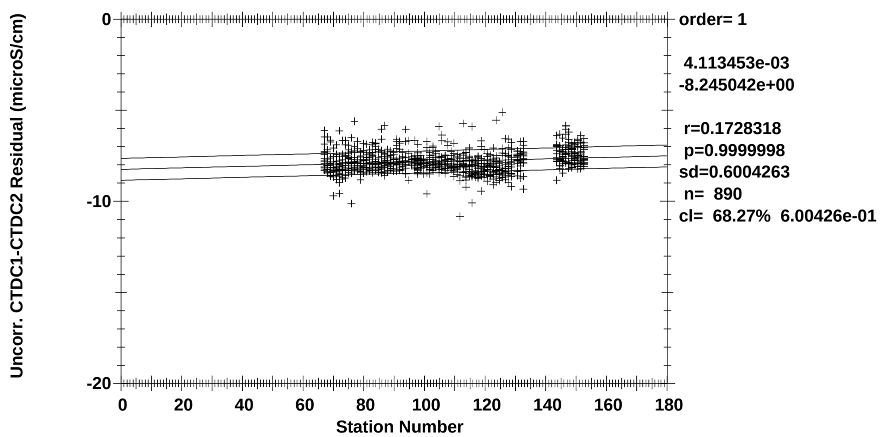

Figure 1.7.3.8 CTD #315 Uncorrected C1-C2B differences by cast (Pressure>1600db).

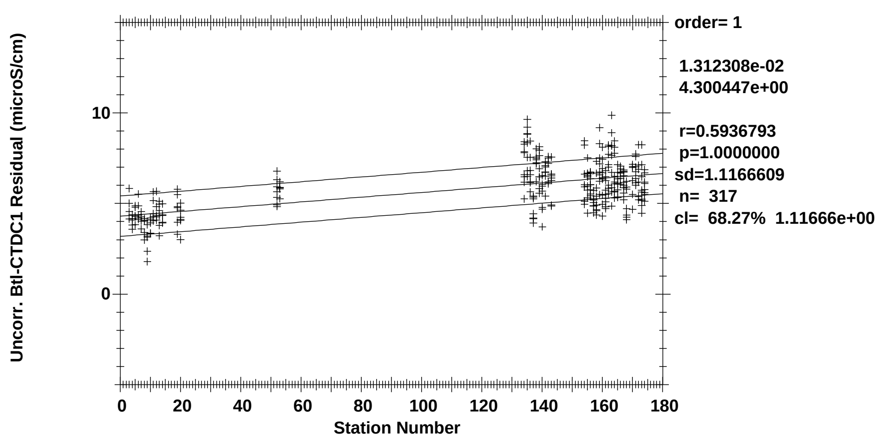

Figure 1.7.3.9 CTD #209 Uncorrected Bottle_Cond.-C1 differences by cast (Pressure>1600db).

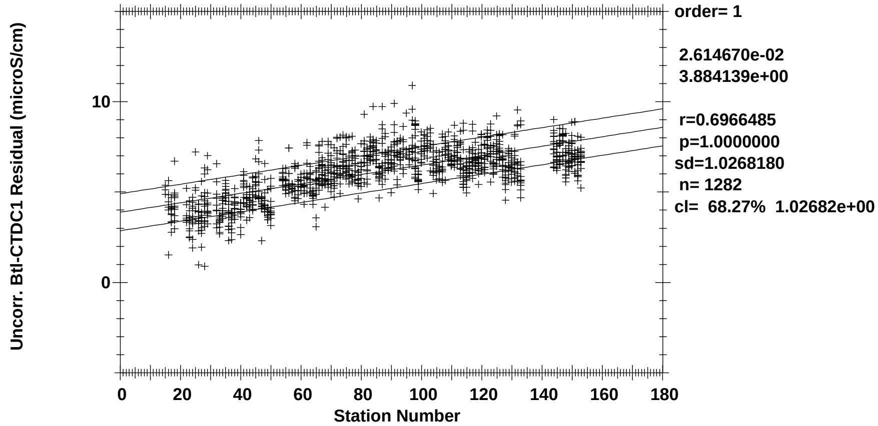

Figure 1.7.3.10 CTD #315 Uncorrected Bottle_Cond.-C1 differences by cast (Pressure>1600db).

The comparison of the primary and secondary conductivity sensors by cast, after applying shipboard corrections determined by PMEL (see next section), is summarized in Figure 1.7.3.11.

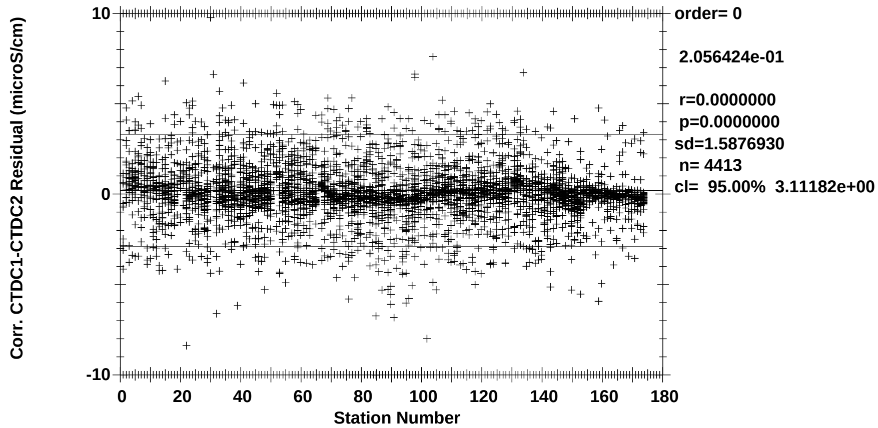

Figure 1.7.3.11 Corrected C1-C2 conductivity differences by cast (|T1-T2|<0.005°C).

Salinity residuals after applying PMEL shipboard corrections to both sensor pairs are summarized in Figures 1.7.3.12 through 1.7.3.14. Secondary conductivity sensors not used for CTD data reporting during P18 were only nominally corrected.

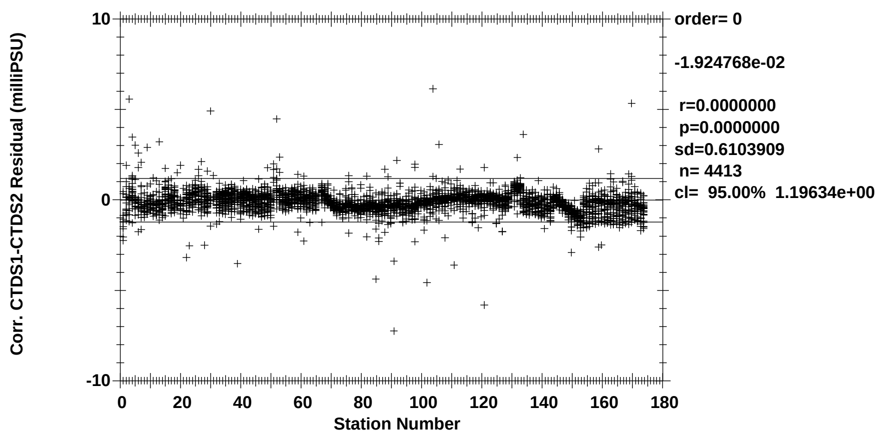

Figure 1.7.3.12 Corrected S1-S2 salinity differences by cast (|T1-T2|<0.005°C).

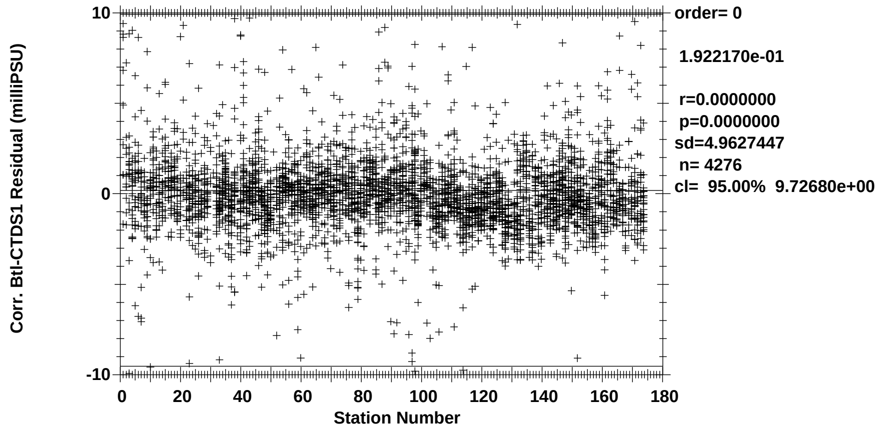

Figure 1.7.3.13 Bottle-CTD salinity residuals by cast (|T1-T2|<0.005°C).

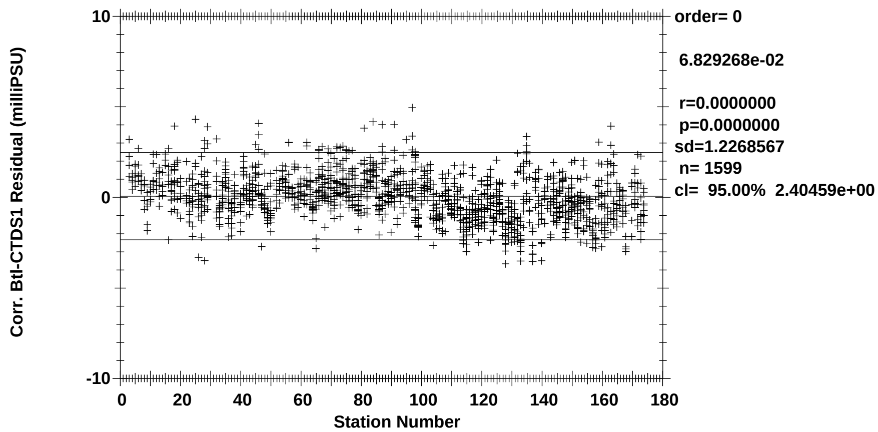

Figure 1.7.3.14 Bottle-CTD salinity residuals by cast (pressure > 1600db).

Figures 1.7.3.12 through 1.7.3.14 represent estimates of the CTD salinity accuracy at the end of P18. The 95% confidence limits are ±0.0012 relative to S2, and ±0.0183 relative to all bottle salts, where |T1-T2|<0.005°C. The 95% confidence limit is ±0.0024 for deep bottle salts, where pressure>1600db. Figure 1.7.3.14 (deep bottle-CTD differences) illustrates a small skew toward +0.001 early in leg 1, and about -0.001 for much of leg 2. Fine-tuning of conductivity corrections will be considered before the final CTD data are submitted by PMEL.

Corrections were also applied to CTD data at bottle trips, used in the WHP- and Exchange-format bottle data files produced at the end of P18 Leg 2.

1.7.4. CTD Dissolved Oxygen

The same two SBE43 dissolved O_2 (DO) sensors were used throughout this cruise (CTD #209: S/N 43-0315, CTD #315: S/N 43-0664). The sensors were plumbed into the primary T1/C1 pump circuits, after C1.

The DO sensors were calibrated to dissolved O_2 check samples at bottle stops by calculating CTD dissolved O_2 then minimizing the residuals using a non-linear least-squares fitting procedure. The fitting procedure determined the calibration coefficients for the sensor model conversion equation, and was accomplished in stages. The time constants for the exponential terms in the model were first determined for each sensor. These time constants are sensor-specific but applicable to an entire cruise. Then casts were fit individually to check sample data via an automated process, and the resulting deep data were checked. Bottle data were slightly high for stations 118 and 165, and slightly low for station 171, on deep theta-O_2 overlays. These three CTD casts were adjusted for deep consistency with adjacent casts' bottle and CTD data. Station 38 had multiple low/eliminated deep bottle O_2 values, but was consistent on deep theta-O_2 comparisons; no adjustments were necessary.

No bottles were tripped at station 29/1 TAO calibration cast: CTDO_2 corrections from station 30 were used, with a -0.01 offset term. The resulting data compared well with nearby casts. There were no bottles above 500db on station 29/2: station 28 corrections were used for this cast. Only a few check samples were drawn on stations 998/1 (test) and 997/1 (second TAO calibration); corrections from stations 4 and 59 were used for 998 and 997 to fit the few bottle O_2 samples and nearby casts best.

There were numerous CTD O_2 signal drops during leg 1 for CTD #209 data, probably caused by primary pump problems (pump changed out after station 51):

sta/cast	low CTDO signal	quality code	
19/1	2284-2400db	4	
21/1	4130-bottom	4	(lower on upcast as well)
30/1	3772-bottom	3	
31/1	3506-bottom	3	
51/1	3762-bottom	3	

Both pumps were turned off for 1 minute following signal cutouts that caused CTD #315 to perceive out-of-water values for primary conductivity. The CTD O_2 signal was low until about 30 seconds after the pumps came back on.

station/ cast	pumps off (downcast)	low CTDO signal (quality code 3)	comment
29/2	436-430db	no data lost	CTD sat at 436db after power cutout
36/1	2426-2491db	2436-2510db	
40/1	1587-1648db	1590-1658db	
40/1	1669-1733db	1674-1742db	
40/1	1875-1941db	1882-1958db	
41/1	1433-1496db	1436-1508db	
45/1	1120-1309db	1124-1330db	(3 back-to-back cutouts)
48/1	1142-1204db	1144-1210db	
49/1	1544-1576db	1544-1578db	
50/1	1202-1225db	1200-1254db	

The CTD #315 O_2 signal dipped when CTDS1 spiked on several casts; the status indicated the pumps did not turn off. Replacing the Y-cable after station 75 fixed the problem.

sta/cast	pressures affected	quality code
65/1	1294-1306db, 1372-1386db, 1446-1458db	3
67/1	1490-1498db, 1528-1540db	3
68/1	1354-1366db, 1478-1504db	3
73/1	1306-1314db, 1342-1348db, 1374-1384db, 1510-1516db	3
74/1	1316-1328db, 1356-1362db, 1404-1412db, 1418-1428db, 1432-1442db, 1536-1548db	3

The surface (0-6db) CTD O_2 data were low (slow to come up at the top of the start-cast yoyo) for station 156/1; these CTDO data were also assigned a quality code of 3.

The dissolved O_2 residuals are shown in Figures 1.7.4.0-1.7.4.2.

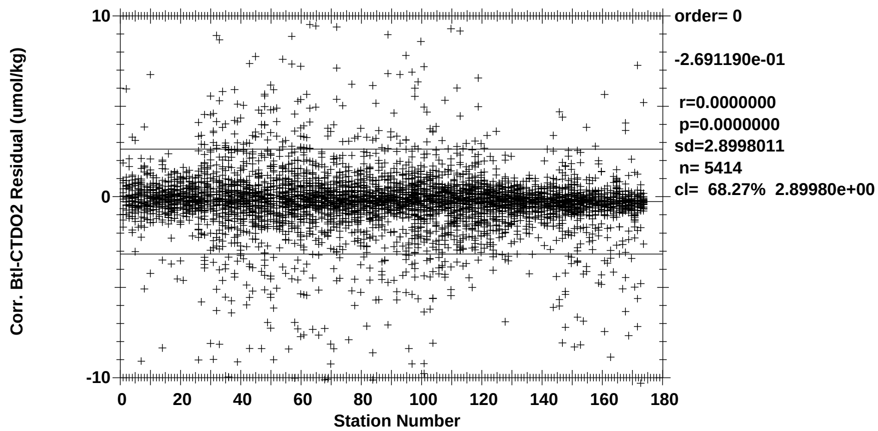

Figure 1.7.4.0 Bottle-CTD O_2 residuals by cast (all points).

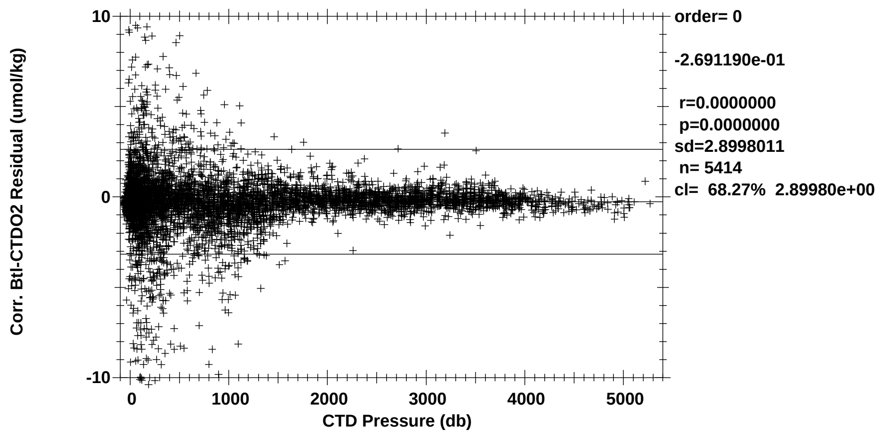

Figure 1.7.4.1 Bottle-CTD O_2 residuals by pressure (all points).

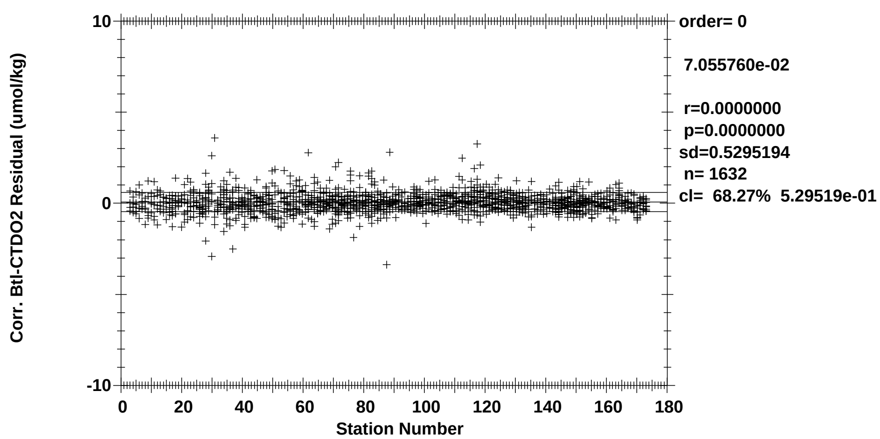

Figure 1.7.4.2 Bottle-CTD O_2 residuals by cast (pressure>1600db).

The standard deviations of 2.900μmol/kg for all oxygens and 0.530μmol/kg for low-gradient oxygens are only presented as general indicators of goodness of fit. ODF makes no claims regarding the precision or accuracy of CTD dissolved O_2 data.

The general form of the ODF O_2 conversion equation for Clark cells follows Brown and Morrison [Brow78] and Millard [Mill82], [Owen85]. ODF models membrane and sensor temperatures with lagged CTD temperatures and a lagged thermal gradient. *In situ* pressure and temperature are filtered to match the sensor response. Time-constants for the pressure response τ_p, two temperature responses τ_{Ts} and τ_{Tf}, and thermal gradient response τ_{dT} are fitting parameters. The thermal gradient term is derived by low-pass filtering the difference between the fast response (T_f) and slow response (T_s) temperatures. This term is SBE43-specific and corrects a non-linearity introduced by analog thermal compensation in the sensor. The O_c gradient, dO_c/dt, is approximated by low-pass filtering 1st-order O_c differences. This gradient term attempts to correct for reduction of species other than O_2 at the sensor cathode. The time-constant for this filter, τ_{og}, is a fitting parameter. Dissolved O_2 concentration is then calculated:

$$O_{2ml/l} = [c_1 O_c + c_2] \cdot f_{sat}(S, T, P) \cdot e^{(c_3 P_l + c_4 T_f + c_5 T_s + c_6 \frac{dO_c}{dt} + c_7 dT)} \tag{1.7.4.0}$$

where:

$O_{2ml/l}$ = Dissolved O_2 concentration in ml/l;
O_c = Sensor current (μamps);
$f_{sat}(S, T, P)$ = O_2 saturation concentration at S,T,P (ml/l);
S = Salinity at O_2 response-time ;
T = Temperature at O_2 response-time (°C);
P = Pressure at O_2 response-time (decibars);
P_l = Low-pass filtered pressure (decibars);
T_f = Fast low-pass filtered temperature (°C);
T_s = Slow low-pass filtered temperature (°C);
$\frac{dO_c}{dt}$ = Sensor current gradient (μamps/secs);
dT = low-pass filtered thermal gradient (T_f - T_s).

1.8. PMEL CTD Data Processing

The reduction of profile data began with a standard suite of processing modules (process.bat) using Sea-Bird Data Processing Win32 version 5.37e software in the following order:

DATCNV converts raw data into engineering units and creates a .ROS bottle file. Both down and up casts were processed for scan, elapsed time(s), pressure, t0, t1, c0, c1, and oxygen voltage. Optical sensor data were converted to voltages but not carried further through the processing stream. MARKSCAN was used to skip over scans acquired on deck and while priming the system under water. MARKSCAN values were entered at the DATCNV menu prompt.

ALIGNCTD aligns temperature, conductivity, and oxygen measurements in time relative to pressure to ensure that derived parameters are made using measurements from the same parcel of water. Primary conductivity was automatically advanced in the V1 deck unit by 0.073 seconds. Secondary conductivity was advanced by 0.073 seconds in ALIGNCTD. It was not necessary to align temperature or oxygen.

BOTTLESUM averages burst data over an 8-second interval (± 4 seconds of the confirm bit) and derives both primary and secondary salinity, primary potential temperature (θ), primary potential density anomaly (σ_θ), and oxygen (in μmol/kg).

WILDEDIT makes two passes through the data in 100 scan bins. The first pass flags points greater than 2 standard deviations; the second pass removes points greater than 20 standard deviations from the mean with the flagged points excluded. Data were kept within 100 of the mean (i.e. all data).

FILTER applies a low pass filter to pressure with a time constant of 0.15 seconds. In order to produce zero phase (no time shift) the filter is first run forward through the file and then run backwards through the file.

CELLTM uses a recursive filter to remove conductivity cell thermal mass effects from measured conductivity. In areas with steep temperature gradients the thermal mass correction is on the order of 0.005 PSS-78. In other areas the correction is negligible. The value used for the thermal anomaly amplitude (α) was 0.03. The value used for the thermal anomaly time constant (β^{-1}) was 7.0 s.

LOOPEDIT removes scans associated with pressure slowdowns and reversals. If the CTD velocity is less than 0.25 m/s or the pressure is not greater than the previous maximum scan, the scan is omitted.

BINAVG averages the data into 1-dbar bins. Each bin is centered on an integer pressure value, e.g. the 1-dbar bin averages scans where pressure is between 0.5 dbar and 1.5 dbar. There is no surface bin. The number of points averaged in each bin is included in the data file.

DERIVE uses 1-dbar averaged pressure, temperature, and conductivity to compute primary and secondary salinity.

TRANS converts the binary data file to ASCII format.

Package slowdowns and reversals owing to ship roll can move mixed water in tow to in front of the CTD sensors and create artificial density inversions and other artifacts. In addition to Seasoft module LOOPEDIT, MATLAB program deloop.m computes values of density locally referenced between every 1 dbar of pressure to compute the square of the buoyancy frequency, N^2, and linearly interpolates temperature, conductivity, and oxygen voltage over those records where N^2 is less than or equal to -1 x $10^{-5}/s^2$. Thirty-eight profiles failed this criteria in the top 12 meters. These data were retained by program deloop_post.m and will be flagged as questionable in the final WOCE formatted files.

Program calctd.m reads the delooped data files and applies final calibrations to primary temperature and conductivity, and computes salinity and calibrated oxygen.

Pressure Calibration

Pressure calibrations for the CTD instrument used during this cruise were pre-cruise. No additional adjustments were applied.

Preliminary Temperature Calibration

In addition to a viscous heating correction of -0.0006 °C, a linearly interpolated temperature sensor drift correction using pre and post-cruise calibration data for the midpoint of the cruise will be determined after the cruise. Viscous and drift corrections are applied to profile data using program calctd.m, and to burst data using calclo.m.

Preliminary Conductivity Calibration

Seasoft module BOTTLESUM creates a sample file for each cast. These files were appended using program sbecal1.f. Program addsal.f matched sample salinities to CTD salinities by station/sample number. Primary sensors s/n 3157 and 2887 were selected for all casts except 30, 31, 39, and 51. Secondary sensor s/n 2882 was used for casts 30, 31, and 51. Secondary sensor s/n 3068 was used for cast 51.
For s/n 3157, program calcos3.m produced the best results for an overall 3rd-order station-dependent fit of sample data from stations 15-18, 22-29, 32-38, 40-50, 54-133, 144-153:

number of points used	3650
total number of points	4344
% of points used in fit	84.02
fit standard deviation	0.001309
fit bias	0.0071014844
min fit slope	0.99988348
max fit slope	1.0000149

For s/n 2887, program calcop1.m produced the best results for an overall linear station- dependent fit of sample data from stations 1-14, 19-21, 52-53, 134-143, and 154-174:

number of points used	339
total number of points	421
% of points used in fit	80.52
fit standard deviation	0.001627
fit bias	0.0034496831
fit co pressure fudge	1.0620737e-006
fit slope	0.99995811

For s/n 2882, program calcos1.m produced the best results for an overall 2nd-order station-dependent fit of sample data from stations 1-14, 19-21, 30-31, 51-53, 134-143, and 154-174:

number of points used	398
total number of points	489
% of points used in fit	81.39
fit standard deviation	0.001819
fit bias	0.0005805286
min fit slope	1.0000168
max fit slope	1.0000724

For s/n 3068, program calcos1.m produced the best results for an overall linear station-dependent fit of sample data from stations 15-18, 22-29, 32-50, and 54-66:

number of points used	1293
total number of points	1469
% of points used in fit	88.02
fit standard deviation	0.00153
fit bias	0.0044191892
min fit slope	0.99994809
max fit slope	0.99999822

Conductivity calibrations were applied to profile data using program calctd.m, and to burst data using calclo.m.

Primary sensor CTD - bottle conductivity differences plotted against station number and pressure were used to allow a visual assessment of the success of the fit.

2. Lowered Acoustic Doppler Current Profiler (LADCP)

An LDEO LADCP system was used to collect data at almost every station. Preliminary processing was completed during the cruise using LDEO LADCP software.

LADCP System Setup

Two different CTD rosettes were used on this cruise, one with 24 bottles and one with 36 bottles. The LDEO LADCP system mounted on the 36-bottle rosette consisted of two Acoustic Doppler Current Profilers (ADCP) heads and an oil-filled rechargeable lead-acid battery pack. The installation on deck consisted of a Macintosh computer system for data acquisition and processing, as well as a battery charger/power supply [Thur06].

The LADCP heads and battery pack were mounted inside the 36-bottle rosette frame and connected using a custom designed, potted cable assembly. One head (master) was placed looking downward underneath the bottles at approximately the same height as the CTD instruments, the other head looking upwards (slave) above the bottle trigger mechanism. The battery pack and LADCP were mounted on opposite sides of the rosette frame center to avoid unequal balancing.

On the 24-place package there were two settings used on both legs of the cruise respectively. On leg 1 two heads were mounted on an custom made frame extension. On leg 2 only one head was mounted looking downward, placed underneath the bottles on an improvised mounting bracket. In both settings the battery was placed on the opposite side to avoid horizontal tilt due to unequal balancing.

Power supply and data transfer was handled independently from any CTD connections. While on deck the instrument communication was set up by means of a network of RS-232 and USB cables, using LDEO (Columbia University) LADCP software for instrument control, data transmission and processing (using version IX_4) in Matlab [Thur07].

LADCP Operation and Data Processing

On arrival at each station the LADCP heads were ’switched on’ for data acquisition by using the LADCP software. Then communications and power cabling were disconnected and all connections were rinsed with fresh water and sealed with dummy plugs. After each cast the data cable and the power supply were rinsed, reconnected, the data acquisition terminated, the battery charged, and the data downloaded by using the LADCP software.

Immediately after each cast a preliminary processing was executed, combining CTD, GPS, and shipboard ADCP data with the data from the LADCPs to produce both a shear and an inverse solution for the absolute velocities. The preliminary processing produced velocity profiles, rosette frame angular movements, and velocity ascii files. Plots and data files were transferred to the ODF data processing computer on-board for access through the website and from a shared data directory.

Problems

The system worked as planned in all three setups. Nevertheless, some problems were encountered during the cruise.

On leg 1, the LADCP was shifted from the 24-place rosette frame at station 22. The battery on the larger frame had not been charged for 26 hours, and the voltage was very low. Only 10 minutes of useful data were collected before the battery died. The LADCP was not installed on the 24-place rosette frame during station 29/1, the mooring calibration cast. The LADCP was removed from the rosette frame during stations 51 und 52 while persistent CTD signal problems were being diagnosed. At stations 86-88, one of the four beams on the down-looking high-power ADCP head broke. Due to software limitations, data were not processed, and no plots were generated. At station 89, the down-looking ADCP head was replaced by the up-looking ADCP head, a ’regular’ ADCP head. Another ’regular’ head, which also had a broken beam, was placed as up-looker. Data were collected successfully. However, due to lack of solid particles in the low productivity area of the water column, the ADCP could not collect enough reflections from particles. Data quality were very poor, and no useful plots were generated. Stations 90 and 91 had the same problem as station 89. At station 92, in order to increase data quality, the high-power ADCP head was placed for up-looking. However, due to a combination of hardware and software problems, the LADCP system was not ready for data collection and did not collect any data. At stations 93 and 94, data were collected successfully. Data quality in deep water was still poor; no useful plots were produced.

On leg 2, according to the chief scientists’ initial decision not to mount any LADCP on the 24-bottle rosette any more (because of concerns about package rotation voiced by one of the shipboard technicians), no velocity data could be collected on stations 134-143. At station 154 permission was granted to mount one LADCP and battery pack inside the 24-bottle rosette frame, and data were collected accordingly. Due to low insufficient battery voltage at station 173 (bad charging cable), no data were collected on this cast.

3. Bottle Sampling and Data Processing

3.1. Bottle Sampling

At the end of each rosette deployment water samples were drawn from the bottles in the following order:

- Chlorofluorocarbons (CFCs)
- ^{3}He
- O_2
- ONAR
- pCO_2
- Dissolved Inorganic Carbon (DIC)
- pH
- Total Alkalinity (TAlk)
- ^{13}C and ^{14}C
- Dissolved Organic Carbon (DOC)
- Tritium
- Chromophoric Dissolved Organic Matter (CDOM)
- Nutrients
- ^{32}Si
- $^{15}N/^{18}O$
- Salinity
- Millero Density
- Particulate Organic Carbon (POC)
- CDOM2 and/or CDOM3 Characterization

The correspondence between individual sample containers and the rosette bottle position (1-24 or 1-36) from which the sample was drawn was recorded on the sample log for the cast. This log also included any comments or anomalous conditions noted about the rosette and bottles. One member of the sampling team was designated the *sample cop*, whose sole responsibility was to maintain this log and insure that sampling progressed in the proper drawing order.

Normal sampling practice included opening the drain valve and then the air vent on the bottle, indicating an air leak if water escaped. This observation 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. The temperature was noted on the sample log and was sometimes useful in determining leaking or mis-tripped bottles.

Once individual samples had been drawn and properly prepared, they were distributed for analysis. On-board analyses were performed on computer-assisted (PC) analytical equipment networked to the data processing computer for centralized data management.

3.2. Bottle Data Processing

Water samples collected and properties analyzed shipboard were managed centrally in a relational database (PostgreSQL-8.0.3) run on a Linux system. A web service (OpenAcs-5.2.2 and AOLServer-4.0.10) front-end provided ship-wide access to CTD and water sample data. Web-based facilities included on-demand arbitrary property-property plots and vertical sections as well as data uploads and downloads.

The Sample Log (and any diagnostic comments) was entered into the database once sampling was completed. Quality flags associated with sampled properties were set to indicate that the property had been sampled, and sample container identifications were noted where applicable (e.g., oxygen flask number).

Analytical results were provided on a regular basis by the various analytical groups and incorporated into the database. These results included a quality code associated with each measured value and followed the coding scheme developed for the World Ocean Circulation Experiment (WOCE) Hydrographic Programme (WHP) [Joyc94].

Various consistencychecks and detailed examination of the data continued throughout the cruise.

3.3 Chlorofluorocarbon (CFC) and Sulfur Hexafluoride (SF_6) Measurements

PIs: John Bullister and Mark Warner
Analysts: Leg 1 David Wisegarver and Robert Letscher
Leg 2 Nathaniel Nutter and Nick Beaird
(Prepared 2 May 2011)

A PMEL analytical system (Bullister and Wisegarver, 2008) was used for CFC-11, CFC-12 and sulfur hexafluoride (SF_6) analyses on the 2007/2008 CLIVAR P18 expedition. Samples for the analyses of dissolved CFC-11, CFC-12 and SF_6 ('CFC/SF6') were drawn from approximately 3160 of the 5700 water samples collected during the expedition. Analysis of CFC-11, CFC-12, and SF_6 were made on the same water sample. Measurements of carbon tetrachloride (CCl_4) were made on a subset of these samples, primarily in cold, deepwater samples where non-conservative behavior of this compound is less significant. The analytical system was not optimized for CCl_4 measurements on this cruise. CCl_4 measurements in samples shallower than 2000 m are not reported. CCl_4 measurements in samples collected at depths greater than 2000 m have been flagged as '3' (questionable).

In general, the analytical system performed well on the cruise. SF_6 measurements were not made on a routine basis as part of WOCE or on earlier CLIVAR repeat hydrography cruises, and the SF_6 work on CLIVAR P18 is considered to be a pilot study to demonstrate the feasibility of making these measurements more routinely on future CLIVAR cruises. Typical dissolved SF_6 concentrations in modern surface water are ~1-2 fmol kg^{-1} seawater (1 fmol= femtomole = 10^{-15} moles), approximately 1000 times lower than dissolved CFC-11 and CFC-12 concentrations. The limits of detection for SF_6 on CLIVAR P18 were approximately 0.02 fmol kg^{-1}, giving a concentration range of ~ 100:1 for SF_6 measurements at present in the ocean. SF_6 measurements in seawater remain extremely challenging. Improvements in the analytical sensitivity to this compound at low concentrations are essential to make these measurements more routine on future CLIVAR cruises

Water samples on CLIVAR P18 were collected in bottles designed at PMEL that use a modified end-cap design to minimize the contact of the water sample with the end-cap O-rings after closing. Two sizes of these bottles (11 or 12 liter) were used on the expedition. Stainless steel springs covered with a nylon powder coat were substituted for the internal elastic tubing provided with standard Niskin bottles. On the casts where water samples were collected for dissolved CFC-11, CFC-12 and SF_6 analysis, these were the first samples drawn from the bottles. Care was taken to coordinate the sampling of CFC/SF_6 with other samples to minimize the time between the initial opening of each bottle and the completion of sample drawing. Samples more easily impacted by gas exchange (dissolved oxygen, ^{3}He, DIC and pH) were collected within several minutes of the initial opening of each bottle. To minimize contact with air, the CFC/SF_6 samples were drawn directly through the stopcocks of the bottles into 250 ml precision glass syringes equipped with three-way plastic stopcocks. The syringes were immersed in a holding tank of clean surface seawater held at ~5°C until ~30 minutes before being analyzed. At that time, the syringe was placed in a bath of surface seawater heated to ~30°C.

For atmospheric sampling, a ~75 m length of 3/8" OD Dekaron tubing was run from the CFC van located on the fantail to the bow of the ship. A flow of air was drawn through this line into the main laboratory using an Air Cadet pump. The air was compressed in the pump, with the downstream pressure held at ~1.5 atm. using a backpressure regulator. A tee allowed a flow of ~100 ml min^{-1} of the compressed air to be directed to the gas sample valves of the CFC/SF_6 analytical systems, while the bulk flow of the air (>7 l min^{-1}) was vented through the back-pressure regulator. Air samples were analyzed only when the relative wind direction was within 60 degrees of the bow of the ship to reduce the possibility of shipboard contamination. Analysis of bow air was performed at ~25 locations along the cruise track. At each location, at least five air measurements were made to increase the precision of the measurements. The measured CFC-11 and CFC-12 and SF_6 air concentrations are reported in Table 1.

Concentrations of CFC-11, CFC-12 and SF_6 in air samples, seawater, and gas standards were measured by shipboard electron capture gas chromatography (EC-GC) using techniques modified from those described by Bullister and Weiss (1988) and Bullister and Wisegarver (2008), as outlined below. For seawater analyses, water was transferred from a glass syringe to a glass-sparging chamber (volume ~190 ml). The dissolved gases in the seawater sample were extracted by passing a supply of CFC/SF_6 free purge gas through the sparging chamber for a period of 6 minutes at ~175 ml min^{-1}. Water vapor was removed from the purge gas during passage through an 18 cm long, 3/8" diameter glass tube packed with the desiccant magnesium perchlorate. The sample gases were concentrated on a cold-trap consisting of a 1/16" OD stainless steel tube with a 5 cm section packed tightly with Porapak Q (60-80 mesh) and a 22 cm section packed with Carbosieve G. A Neslab Cryocool CC-100 was used to cool the trap to ~70°C. After 6 minutes of purging, the trap was isolated, and it was heated electrically to ~175°C. The sample gases held in the trap were then injected onto a precolumn (~60 cm of 1/8" O.D. stainless steel tubing packed with 80-100 mesh Porasil B, held at 80°C) for the initial separation of CFC-12, CFC-11, SF_6 and CCl_4 from later eluting peaks.

After the SF_6 and CFC-12 had passed from the pre-column and into the second precolumn (5 cm of 1/8" O.D. stainless steel tubing packed with MS5A, 95°C) and into the analytical column #1 (240 cm of 1/8" OD stainless steel tubing packed with MS5A and held at 95°C), the outflow from the first precolumn was diverted to the second analytical column (150 cm 1/8" OD stainless steel tubing packed with Carbograph 1AC, 80-100 mesh, held at 80°C). After CFC-11 had passed through the first pre-column, the flow was diverted to a third analytical column (1 m , Carbograph 1AC, 80°C). The gases remaining after CCl_4 had passed through the first pre-column, were backflushed from the pre column and vented. Column #1 and the second pre-column were held in a Shimadzu GC8 gas chromatograph with an electron capture detector (ECD) held at 340°C. Column #2 and #3, and the first precolumn were in another Shimadzu GC8 gas chromatograph with ECD. The outflow from column #3 was plumbed to a Shimadzu Mini2 gas chromatograph with the ECD held at 250°C.

The analytical system was calibrated frequently using a standard gas of known CFC/SF_6 composition. Gas sample loops of known volume were thoroughly flushed with standard gas and injected into the system. The temperature and pressure was recorded so that the amount of gas injected could be calculated. The procedures used to transfer the standard gas to the trap, precolumn, main chromatographic column, and ECD were similar to those used for analyzing water samples. Four sizes of gas sample loops were used. Multiple injections of these loop volumes could be made to allow the system to be calibrated over a relatively wide range of concentrations. Air samples and system blanks (injections of loops of CFC/SF_6 free gas) were injected and analyzed in a similar manner. The typical analysis time for seawater, air, standard or blank samples was ~11 minutes. Concentrations of the CFC-11 and CFC-12 in air, seawater samples, and gas standards are reported relative to the SIO98 calibration scale (Cunnold et al., 2000). Concentrations of SF_6 in air, seawater samples, and gas standards are reported relative to the CMDL calibration scale (Bullister et al, 2006). Concentrations in air and standard gas are reported in units of mole fraction CFC in dry gas, and are typically in the parts per trillion (ppt) range. Dissolved CFC concentrations are given in units of picomoles per kilogram seawater (pmol kg^{-1}) and SF_6 concentrations in fmol kg^{-1}. CFC/SF_6 concentrations in air and seawater samples were determined by fitting their chromatographic peak areas to multi-point calibration curves, generated by injecting multiple sample loops of gas from a working standard (PMEL cylinder 45186) into the analytical instrument. The response of the detector to the range of moles of CFC/SF_6 passing through the detector remained relatively constant during the cruise. Full-range calibration curves were run at intervals of 4-5 days during the cruise. Single injections of a fixed volume of standard gas at one atmosphere were run much more frequently (at intervals of ~90 minutes) to monitor short-term changes in detector sensitivity.

The purging efficiency was estimated by re-purging a high-concentration water sample and measuring this residual signal. At a flow rate of 170 cc min^{-1} for 6 minutes, the purging efficiency for all 3 gases was >99.9% and no correction for this has been applied to the reported water concentration values.

On this expedition, based on the analysis of ~250 pairs of duplicate samples, we estimate precisions (1 standard deviation) of about 1% or 0.002 pmol kg^{-1} (whichever is greater) for both dissolved CFC-11 and CFC-12 measurements. The estimated precision for SF_6 was 2% or 0.02 fmol kg^{-1}, (whichever is greater). Overall accuracy of the measurements (a function of the absolute accuracy of the calibration gases, volumetric calibrations of the sample gas loops and purge chamber, errors in fits to the calibration curves and other factors) is estimated to be about 2% or 0.004 pmol kg^{-1} for CFC11 and CFC-12 and 4% or 0.04 fmol kg^{-1} for SF_6). As discussed above, carbon tetrachloride was analyzed as a qualitative tracer only on this expedition and all reported concentration values (from samples deeper than 2000 m) have been flagged as '3' (questionable).

Based on the earlier occupation of the P18 section in 1994 as part of the WOCE program and crossings of this section by other WOCE-era sections, the region of the water column between 5°N and 20°S and deeper than 2000 m was thought have near zero levels of CFCs and SF_6 at the time of the CLIVAR P18 section. The means of measured values in this region on the CLIVAR P18 expedition was ~0.0025 pmol kg^{-1} for CFC-11, 0.001 pmol kg^{-1} for CFC-12 and 0 fmol kg^{-1} for SF_6. Based on previous experiments showing a slow grow-in of CFCs in water held in the sample bottles, and the scatter in measured concentrations of these deep samples, we estimate a total sampling and analytical blank of 0.0025 pmol kg^{-1} for CFC-11, 0.001 pmol kg^{-1} for CFC-12 and 0 fmol kg^{-1} for SF_6. The final water concentration data reported here have had these blank corrections applied.

A small number of water samples had anomalously high CFC/SF_6 concentrations relative to adjacent samples. These samples occurred sporadically during the cruise and were not clearly associated with other features in the water column (e.g., anomalous dissolved oxygen, salinity, or temperature features). This suggests that these samples were probably contaminated with CFCs/SF_6 during the sampling or analysis processes.

Measured concentrations for these anomalous samples are included in the data file, but are given a quality flag value of either 3 (questionable measurement) or 4 (bad measurement). Approximately 68 samples out of 3168 (~1.7%) CFC-11, CFC-12 and SF_6 samples were assigned quality flags of 3 or 4. A quality flag of 5 was assigned to samples which were drawn from the rosette but never analyzed due to problems during handling or analysis (e.g., leaking, broken syringe etc.).

Table 1: Air Measurements from 2007/2008 CLIVAR P18

Date YYMMDD	Time HHMM	Lat	Lon	CFC12	CFC11	SF6
071217	0311	27.9	-112.9	539.2		6.30
071219	0255	20.8	-110.0	536.7	243.7	6.12
071222	0034	13.5	-110.0	536.2	243.7	6.58
071225	0009	8.0	-110.0	540.4		6.15
071226	0022	6.2	-110.0	540.8	243.6	6.25
071227	2242	2.0	-110.0	536.1	242.9	6.14
071229	0038	1.5	-110.0	538.1	242.9	6.12
080101	0607	-3.1	-110.0	537.7	243.8	5.88
080104	0958	-6.3	-108.3	539.1	243.9	6.02
080108	0921	-12.3	-103.0	533.6	243.0	6.12
080114	1018	-23.4	-103.0	537.4	242.3	5.98
080116	1943	-27.6	-103.0	529.4	242.1	6.06
080118	0740	-28.0	-103.0	528.8	242.9	5.78
080121	0919	-27.3	-109.0	543.9	241.9	5.96
080125	0503	-32.7	-103.0	534.6	240.1	6.02
080128	0426	-39.2	-103.0	534.0	239.9	6.04
080206	0326	-55.5	-103.0	537.1	239.4	5.93
080206	1912	-55.5	-103.0	531.5	238.9	6.03
080208	0041	-59.3	-103.0	532.9	238.5	6.12
080208	1545	-59.8	-103.0	532.2	232.1	5.99
080209	0525	-60.8	-103.0	535.9	238.6	6.02
080210	2224	-63.7	-103.0	531.4	237.3	5.88
080211	2216	-65.2	-103.0	532.5	240.2	5.95
080214	2153	-69.4	-103.5	533.2	239.7	5.88
080216	1336	-67.0	-107.3	533.2	242.6	5.90

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3.4. Helium and Tritium

Helium and Tritium samples were taken roughly every 2 degrees on even-numbered latitudes.

Helium Sampling

Sampling alternated between taking 16 samples (depths of 0-1200m) and 8 samples (depths of 0-400m) at each station. A duplicate was taken when 16 bottles were sampled. A set of 4 blanks were taken at a depth of ~2500m at five additional stations.

Helium samples were taken in stainless steel sample cylinders. The sample cylinders were leak-checked and backfilled with N_2 prior to the cruise. Additionally, each cylinder was flushed with N_2 just prior to sampling to help eliminate air bubbles. Samples were drawn using tygon tubing connected to the Niskin bottle at one end and the cylinder at the other. Silicon tubing was used as an adapter to prevent the tygon from touching the Niskin per the request of the CDOM group. Cylinders are thumped with a bat while being flushed with water from the Niskin to help remove bubbles. After flushing roughly 1 liter of water through them, the plug valves are closed. As the cylinders are sealed by O-ringed plug valves, the samples must be extracted within 24 hours to limit out-gassing.

Eight samples at a time were extracted using our At Sea Extraction line set up in the wet-lab. The stainless steel sample cylinders are attached to the vacuum manifold and pumped down to less than 4e-7 Torr using a diffusion pump for a minimum of 1 hour to check for leaks. The sections are then isolated from the vacuum manifold and introduced to the reservoir cans which are heated to >90°C for roughly 10 minutes. Glass bulbs are attached to the sections and immersed in ice water during the extraction process. After 10 minutes each bulb is flame sealed and packed for shipment back to WHOI. The extraction cans and sections are cleaned with distilled water and isopropanol, then dried between each extraction.

332 helium samples were taken, 5 were lost due to leaks. Helium samples will be analyzed using a mass spectrometer at WHOI.

The helium extractions suffered from an ongoing room temperature problem in the wet-lab. The temperature reached 30°C several times during the cruise and leveled out at 24°C the last 2 weeks. The wet-lab proved to be completely unsuitable for running vacuum equipment. The cold finger had to be repeatedly defrosted and cleaned, as it was quickly icing up due to the excess moisture in the room. The diffusion pump was unable to work properly for an extended period in this kind of environment. Midway through the cruise, the system had to be shut down to replace and clean the diffusion pump. One day was lost servicing the line. This is the first time our group has encountered this problem on a cruise. XBT launches were staged from the wet-lab which necessitated the outside door being propped open for 0.5 to 1.5 hours each day. This added to our temperature and humidity problem. Until the analyses are complete, it is unclear whether these issues affected the quality of the samples. The resulting higher base pressure of the line reduced confidence in the ability to detect leaks prior to the extraction process for some samples. The fact that neither sink in the wet-lab was fully functional also prevented using them as a backup cooling system for the diffusion pump. Various problems with the ship's ice-makers also proved to be an obstacle, resulting in delayed extraction time for some samples.

Tritium Sampling

Sampling alternated between taking 16 samples (0-1200m) and 8 samples (0-400m) at each station. A duplicate was taken when 16 bottles were sampled. A set of 3 blanks were taken at depth from five additional stations. Every three stations, one tritium sample was also taken from the deepest Niskin.

Tritium samples were taken using a silicon adapter and tygon tubing to fill 1-qt glass jugs. The jugs were baked in an oven, backfilled with argon, and the caps were taped shut with electrical tape prior to the cruise. While filling, the jugs are place on the deck and filled to about 2 inches from the top of the bottle, being careful not to spill the argon. Caps were replaced and taped shut with electrical tape before being packed for shipment back to WHOI.

317 tritium samples were taken. Tritium samples will be degassed in the lab at WHOI and stored for a minimum of 6 months before mass spectrometer analysis.

No issues were encountered while taking tritium samples.

3.5. Oxygen Analysis

Equipment and Techniques

Dissolved oxygen analyses were performed with an automated oxygen titrator using amperometric end-point detection [Culb87]. The titration of the samples and the data logging and graphical display was performed on a PC running a LabView program written by Ulises Rivero of AOML. The titrations were preformed in a climate-controlled lab at 18.5-22.5°C. Thiosulfate was dispensed by a 2 ml Gilmont syringe driven with a stepper motor controlled by the titrator. Tests in the lab were performed to confirm that the precision and accuracy of the volume dispensed were comparable or superior to the Dosimat 665. The whole-bottle titration technique of Carpenter [Carp65], with modifications by Culberson *et al.* [Culb91], was used. Four replicate 10 ml iodate standards were run every 24 hours. The reagent blank was determined from the difference between V1 and V2, the volumes of thiosulfate required to titrate 1-ml aliquots of the iodate standard. The reagent blank was determined at the beginning and end of the cruise. This method was found during pre-cruise testing to produce a more reproducible blank value than the value determined as the intercept of a standard curve. The temperature-corrected molarity of the thiosulfate titrant was determined as given by Dickson [Dick94].

Sampling and Data Processing

Dissolved oxygen samples were drawn from Niskin bottles into calibrated 125-150 ml iodine titration flasks using silicon tubing to avoid contamination of DOC and CDOM samples. Bottles were rinsed three times and filled from the bottom, overflowing three volumes while taking care not to entrain any bubbles. The draw temperature was taken using a digital thermometer with a flexible thermistor probe that was inserted into the flask while the sample was being drawn during the overflow period. These temperatures were used to calculate μmol/kg concentrations, and a diagnostic check of Niskin bottle integrity. 1 ml of $MnCl_2$ and 1 ml of $NaOH/NaI$ were added immediately after drawing the sample was concluded using a Re-pipetor, the flasks were then stoppered and shaken well. DIW was added to the neck of each flask to create a water seal. 24 or 36 samples plus two duplicates were drawn from each station, depending on which rosette was used. The total number of samples collected from the rosette was 5598.

The flasks were stored in the lab in plastic totes at room temperature for 1.5 hours before analysis, and the data were incorporated into the cruise database shortly after analysis.

Thiosulfate normalities were calculated from each standardization and corrected to 20°C.

Volumetric Calibration

Oxygen flask volumes were determined gravimetrically with degassed deionized water at AOML.

Duplicate Samples

A total of 351 sets of duplicates were run. An additional 12 samples were collected from the uncontaminated sea water line in the Hydro Lab on NOAAS R.H. Brown. Two sets of triplicate samples were drawn near the end of the CTD casts on station 18 (14°25'N, 110°W) and station 50 (2°30'N, 110°W). One set of triplicates were drawn from the line after it had passed through the Seabird SBE-45 Micro TSG (normal) and the other set of triplicates after the sea water passed through the Vortex de-bubbler and Turner flourometer. The sampling began when the rosette was at 10 meters preparing to trip bottle 35, and ended shortly after the rosette was at 5 meters and Niskin bottle 36 was tripped. A similar test was conducted a couple of weeks later to test for contamination of the uncontaminated seawater line. The line was cleaned with bleach during the in port at Easter Island. A comparison of the difference between the oxygen content of the uncontaminated seawater line and surface tripped samples from the rosette revealed that the water from the line was now only 1.5 μmol/kg lower.

The standard deviation of replicates averaged 0.89 μmol/kg for stations 1-52. Removing a drop on the $NaOH/NaI$ dispenser before fixing a sample improved the reproducibility significantly. The standard deviation of replicates for stations 52-89 averaged 0.14 μmol/kg. The standard deviation of replicates for stations 99-174 averaged 0.15 μmol/kg.

Problems

Several oxygen flasks were removed and replaced with different flasks during the cruise, after giving consistently high values. Duplicates were collected using each questionable flask and analyzed; if the values differed significantly, the flask was removed. The following flasks were replaced:

Orig. Flask	Replacement Flask	After Station
13	123	26
52	122	46
28	38	84
68	128	91

The titration system was replaced with the backup system after it failed on station 79. This system worked well for the remainder of Leg 1 and all of Leg 2.

3.6. ONAR Samples

220 ONAR (oxygen, nitrogen, argon) samples were collected at 20 stations for analysis ashore. Two replicate samples were collected from each Niskin bottle. Surface ONAR samples (5-25m) were collected at an additional 33 stations (no duplicates). The samples were collected in pre-evacuated glass flasks. The side-arm of the flask was connected to a ~75 cm length of tygon tubing. A length of 1/8" nylon tubing with a flow of CO_2 was inserted inside the Tygon tubing and used to flush the sidearm and area between the 2 bottom O-ring seals. After ~30 seconds of flushing, a second 1/8" length of tubing was connected to the Niskin bottle spigot. This tube was flushed with seawater and inserted through the Tygon tube to the flash sidearm as the CO_2 tube was removed. After flushing with seawater for ~30 seconds, the flask valve was opened and seawater flowed into the evacuated flask. Care was taken to adjust the rate of seawater flow into the flask so the water level in the Tygon tube remained at least ~60 cm above the sidearm. The flasks were filled about halfway and then re-sealed.

3.7. Discrete pCO2

Samples were drawn from Niskin bottles into 500 ml volumetric flasks using Tygon© tubing with a Silicone adapter that fit over the petcock to avoid contamination of CDOM samples. Bottles were rinsed while inverted and filled from the bottom, overflowing half a volume while taking care not to entrain any bubbles. About 5 ml of water was withdrawn to allow for expansion of the water as it warms and to provide space for the stopper, tubing, and frit of the analytical system. Saturated mercuric chloride solution (0.2 ml) was added as a preservative. The sample bottles were sealed with a screw cap containing a polyethylene liner. The samples were stored in coolers at room temperature generally for no more than 5 hours.

All analyses were done at 20°C. A secondary bath was used to get the samples close to the analytical temperature prior to analysis. As soon as space was available in the secondary or primary bath, sample flasks were moved into the more controlled temperature bath. No flask was analyzed without spending at least two hours in a bath close to the analytical temperature.

In general, every other station was sampled with samples drawn from at least 15 Niskin bottles with one duplicate at each station. Near the equator an effort was made to increase the sampling density across stations. South of Easter Island we increased the number of samples per station due to the increase in ocean depth. We also reduced the station resolution from 2,2,2 etc. to 2,3,2,3 etc. In total, 782 samples were drawn from 736 Niskin bottles with 46 pairs of duplicates from Leg 1. For Leg 2, the respective amounts were 589, 542 and 47. This gives a total of 1371 samples from 1278 Niskin bottles with 93 duplicates. Most of the duplicates agreed within 1%.

The discrete pCO_2 system is patterned after the instrument described in Chipman *et al.* [Chip93] and is discussed in detail by Wanninkhof and Thoning [Wann93] and Chen *et al.* [Chen95]. The major difference between the two systems is that the Wanninkhof instrument uses a LI-COR© model 6262 non-dispersive infrared analyzer, while the Chipman instrument utilizes a gas chromatograph with a flame ionization detector.

Once the samples reach the analytical temperature, a ~50-ml headspace is created by displacing the water using a compressed standard gas with a CO_2 mixing ratio close to the anticipated pCO_2 of the water. The headspace is circulated in a closed loop through the infrared analyzer that measures CO_2 and water vapor levels in the sample cell. The samples are equilibrated until the running mean of 20 consecutive 1-second readings from the analyzer differ by less than 0.1 ppm (parts per million by volume). This equilibration takes about 10 minutes. An expandable volume in the circulation loop near the flask consisting of a small, deflated balloon keeps the headspace of the flask at room pressure.

In order to maintain analytical accuracy, a set of six gas standards (cylinder serial numbers CA5998 [205.07 ppm], CA5989 [378.71 ppm], CA5988 [593.64 ppm], CA5980 [792.51 ppm], CA5984 [1036.95 ppm], & CA5940 [1533.7 ppm]) is run through the analyzer before and after every ten seawater samples. The standards were obtained from Scott-Marin and referenced against primary standards purchased from C.D. Keeling in 1991, which are on the WMO-78 scale. Prior to station 60, many values at depths from 400 to 2000 meters were higher than the highest standard (1533.7 ppm). For this reason, these values have been flagged as "questionable" (3) for the time being, but after further quality control it is likely that many if not most of these values will be flagged as "good" (2). For most of the stations after 155, nearly all of the samples were within the range of only two standards: 792.51 ppm and 1036.95 ppm.

The calculation of pCO_2 in water from the headspace measurement involves several steps. The CO_2 concentrations in the headspace are determined via a second-degree polynomial fit using the nearest three standard concentrations. Corrections for the water vapor concentration, the barometric pressure, and the changes induced in the carbonate equilibrium by the headspace-water mass transfer are made. The corrected results are reported at the analytical temperature and at a reference temperature of 20°C.

No instrumental problems occurred during the cruise. The relatively time-consuming analyses and the presence of only one analyst limited the spatial coverage. Sampling and analyses focused on precision and accuracy rather than high throughput.

3.8. DIC Measurements

The DIC analytical equipment was set up in a seagoing container modified for use as a shipboard laboratory. The analysis was done by coulometry with two analytical systems (PMEL-1 and PMEL-2) operated simultaneously on the cruise. Each system consisted of a coulometer (UIC, Inc.) coupled with a SOMMA (Single Operator Multiparameter Metabolic Analyzer) inlet system developed by Ken Johnson [John85, John87, John93] ; [John92] of Brookhaven National Laboratory.

In the coulometric analysis of DIC, all carbonate species are converted to CO_2 (gas) by the acidification of the seawater sample [Dick07]. The evolved CO_2 gas is carried into the titration cell of the coulometer, where it reacts quantitatively with ethanolamine to generate hydroxyethylcarbamic acid. A color indicator in the coulometer solution fades with the absorption of CO_2, thereby stimulating the hydrolytic production of a base (hydroxide ions, OH^-), which stoichiometrically titrates the hydroxyethylcarbamic acid. CO_2 is thus measured by integrating the total coulometric OH^- production required to achieve full titration.

Each coulometer was calibrated by injecting and titrating aliquots of pure CO_2 (99.99%) by way of an 8-port valve outfitted with two calibrated sample loops of different sizes (~1 and ~3 mL) [Wilk93]. The instruments were calibrated with two pairs of gas loop injections each time a new coulometer cell was prepared. Secondary standards were also run throughout the cruise on each analytical system at the beginning of each cell. These standards are

Certified Reference Materials (CRMs) consisting of poisoned, filtered, and UV irradiated seawater supplied by Dr. A. Dickson of Scripps Institution of Oceanography (SIO), and their accuracy is determined shoreside manometrically *(http://andrew.ucsd.edu/co2qc/)*. If replicate samples collected from the same Niskin and analyzed within the same batch were different by more than 2 µmol/kg, additional CRMs and/or gas loops were run in the middle or at the end of the batch.

On this cruise, the overall accuracy for the CRMs on both instruments is shown in Table 3.8.0 and Figures 3.8.0 and 3.8.1. Preliminary DIC data reported to the database have not yet been corrected to the Batch 84 CRM value (certified DIC value = 2001.23 µmol/kg), but a more careful quality assurance to be completed shoreside will result in final data being corrected to the secondary standard on a per-instrument basis.

Table 3.8.0 Average values for CRMs and replicates on both SOMMA systems.

	PMEL-1		PMEL-2	
	leg1	leg2	leg1	leg2
Number of CRMs:	68	50	65	51
CRM average (µmol/kg):	2005.35	2005.69	2002.15	2000.64
CRM standard deviation (µmol/kg):	± 1.75	±1.51	± 1.64	±1.78
Number of replicates:	118	137	138	131
Replicate average difference from the mean (µmol/kg):	0.765	0.705	0.676	0.761

Figure 3.8.0 Values for CRMs measured on system PMEL-1 before and after valve 5 was replaced. The red line represents the certified CRM value.

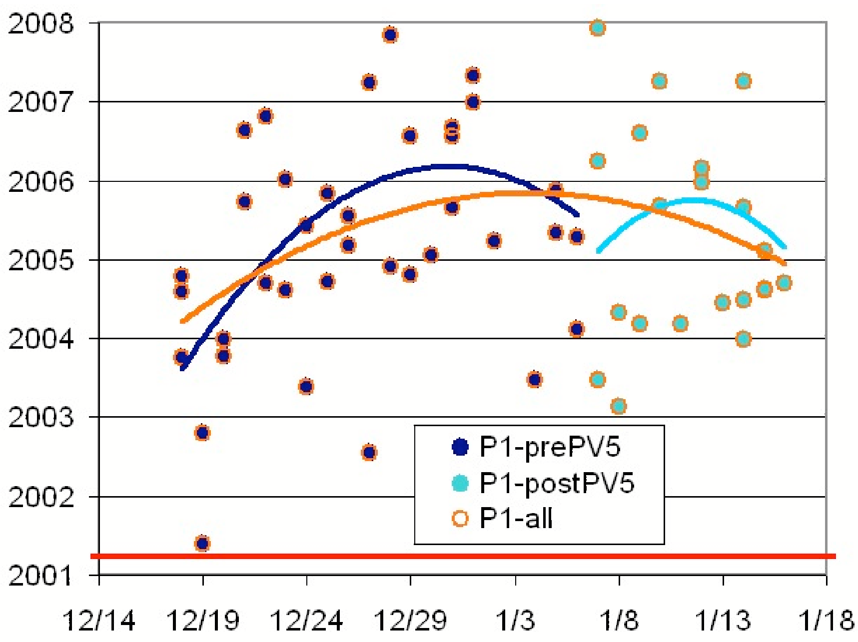
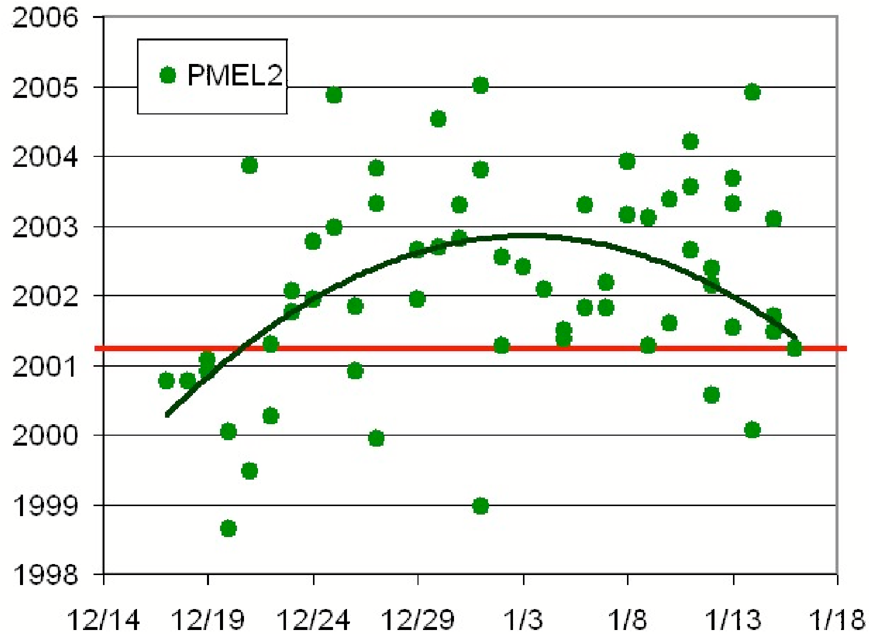


Figure 3.8.1 Values for CRMs measured on system PMEL-2 throughout the cruise. The red line represents the certified CRM value.



Samples were drawn from the Niskin-type bottles into cleaned, precombusted 300-mL Pyrex bottles using silicone tubing. Bottles were rinsed twice and filled from the bottom, overflowing half a volume. Care was taken not to entrain any bubbles. The tube was pinched to stop flow and withdrawn, creating a 6-mL headspace. A small volume (0.2 mL) of 50% saturated $HgCl_2$ solution was added as a preservative. The sample bottles were sealed with glass stoppers lightly covered with Apiezon-L grease.

DIC values were reported for 2711 samples or approximately 82% of the tripped bottles on leg 1 and 2014 or 82% of the tripped bottles on leg 2. Full profiles were completed at every other station, with partial profiles collected at intervening stations. Partial profiles focused on the upper 1300 m of the water column, with fewer samples taken from deeper depths. Two to four sets of duplicate samples were taken from all casts from bottles collected at the surface, bottom, oxygen minimum, and 3000 m depths on all casts (in order of preference). Duplicate samples were interspersed throughout the station analysis for quality assurance of the coulometer cell solution integrity. In total, duplicate samples were drawn from 272 bottles on leg one and 268 bottles on leg two. The average absolute value of the difference between duplicates was 0.71 μmol/kg for both systems on leg one and 0.73 on leg two, with values for each system shown in Table 8.0. No systematic differences between the replicates were observed.

During this cruise, SOMMA system PMEL-1 experienced problems with valve 5, which required the replacement of tubing leading to the calibrated pipette, as well as valve 5 itself. The volume of the pipette will be recalibrated and the change in total pipette volume will be corrected for in the final data quality assurance process.

3.9. Discrete pH Analyses

Sampling

Samples were collected in 10 cm cylindrical glass spectrophotometric cells, cleaned and then incubated to 25.0°C.

Analysis

pH (μmol/kg H_2O) was measured using a Agilent 8453 spectrophotometer according to the methods outlined by Clayton and Byrne [Clay93]. A RTE17 waterbath maintained spectrophotometric cell temperature at 25.0°C. The sulfonephthalein indicator m-cresol purple (mCP) was injected into the spectrophotometric cells using a Gilmont microburette, and the absorbance of light was measured at three different wavelengths (434 nm, 578 nm, 730 nm). The ratios of absorbances at the different wavelengths were input and used to calculate pH on the total and seawater scales, incorporating temperature and salinity into the equations. The equations of Dickson and Millero [Dick87], Dickson and Riley [Dick79], and Dickson [Dick90] were used to convert pH from total to seawater scales. Salinity data were obtained from the conductivity sensor on the CTD. These data were later corroborated by shipboard measurements. Temperature of the samples was measured immediately after spectrophotometric measurements using a Guildline 9540 digital platinum resistance thermometer.

Reagents

The mCP indicator dye was a concentrated solution of 2.0 mM with an R = 1.61350.

Standardization

The precision of the data can be assessed from measurements of duplicate samples, certified reference material (CRM) Batch 84 (Dr. Andrew Dickson, UCSD), which calculated pH is 7.8461 on the seawater scale and at 25°C, and TRIS buffers. CRMs and TRIS buffers were measured approximately every half cast.

Data Processing

Addition of the indicator affects the pH of the sample, and the degree to which pH is affected is a function of the pH difference between the seawater and indicator. Therefore, a correction is applied for each batch of dye. To obtain this correction factor, samples throughout the cruise were measured after two consecutive additions of mCP. From these two measurements, a change in absorbance ratio per mL of mCP indicator is calculated. R was calculated using the absorbance ratio (R_m) measured after the initial indicator addition from:

$$R = R_m + (-0.00173 + 0.000382\ R_m)\ V_{ind} \qquad (1)$$

$$R = R_m + (-0.00254 + 0.000571\ R_m)\ V_{ind} \qquad (2)$$

where V_{ind} is the volume of mCP used.

Clayton and Byrne [Clay93] calibrated the mCP indicator using TRIS buffers [Rame77] and the equations of Dickson [Dick93]. These equations are used to calculate pH_t, the total scale in units of moles per kilogram of solution.

Approximately every other station was partially sampled. Samples from these "half-casts" were used for the indicator correction calculations.

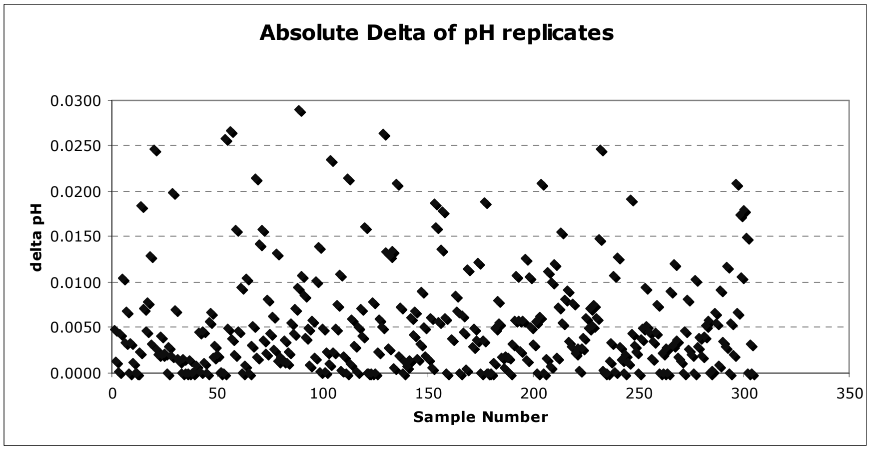
Table 3.9.0 Preliminary quality control of pH.

	Overall	Leg1	Leg2
Total number of samples	4548	2558	1990
Questionable (QC=3)	54	45	9
Bad (QC=4)	30	25	5
Lost (QC=5)	14	6	8
Duplicate (QC=6)	587	278	209

Table 3.9.1 Preliminary accuracy and precision of pH

	Leg 1	Leg 2
CRM	7.8306 ± 0.0180 (n=43)	7.8334 ± 0.0062 (n=13)
TRIS Buffer	7.9069± 0.0149 (n=43)	7.9407± 0.0213 (n=31)
Duplicates	± 0.0054 (n=258)	± 0.0051 (n=200)

Figure 3.9.0 pH Replicate Precision



Problems

The TRIS buffers were sometimes cloudy, indicating a possible source of error in the readings.

3.10. Total Alkalinity Analyses

Sampling

All stations were sampled with the exception of station 064 and 121 due to the need for cell repairs and recalibration. The sampling scheme was roughly an alternation between full (36 Niskins) and partial (18 Niskins) casts. When the 24 bottle roset was used all niskens were sampled. Only 3 samples were taken from stations 117-119 due to cell repairs. All casts had 3 duplicate samples drawn; one from the bottom Niskin, oxygen minimum, and surface Niskin. Samples were drawn from 10-l Niskin bottles into 500 ml borosilicate flasks using silicone tubing that fit over the petcock to avoid contamination of DOC samples. Bottles were rinsed a minimum of two times and filled from the bottom, overflowing half of a volume while taking care not to entrain any bubbles. Approximately 15 ml of water was withdrawn from the flask by arresting the sample flow and removing the sampling tube, thus creating a small expansion volume and reproducible headspace. The sample bottles were sealed at a ground glass joint with a glass stopper. The samples were thermostated at 25°C before analysis.

Table 3.10.0 Preliminary quality control of total alkalinity

	leg 1	leg 2	Combined
Total number of samples	2459	1795	4254
Questionable (QC=3)	9	12	21
Bad (QC=4)	13	37	50
Not Reported (QC=5)	20	54	74
Duplicate (QC=6)	283	147	430

Analyzer Description

The total alkalinity of seawater (TAlk) was evaluated from the proton balance at the alkalinity equivalence point, pHequiv = 4.5 at 25°C and zero ionic strength in one kilogram of sample. The method utilizes a multi-point hydrochloric acid titration of seawater according to the definition of total alkalinity [Dick81]. The potentiometric titrations of seawater not only give values of TAlk but also those of DIC and pH, respectively from the volume of acid added at the first end point and the initial emf, E0.

Two titration systems, A and B were used for TAlk analysis. Each of them consists of a Metrohm 665 Dosimat titrator, an Orion 720A pH meter and a custom designed plexiglass water-jacketed titration cell [Mill93]. Both the seawater sample and acid titrant were temperature equilibrated to a constant temperature of 25 ± 0.1°C with a water bath (Neslab, model RTE-17). The water-jacketed cell is similar to the cells used by Bradshaw and Brewer [Brad88] except a larger volume (~200 ml) is employed to increase the precision. Each cell has a fill and drain valve which increases the reproducibility of the volume of sample contained in the cell. A typical titration recorded the EMF after the readings became stable (deviation less than 0.09 mV) and then enough acid was added to change the voltage a pre-assigned increment (13 mV). A full titration (~25 points) takes about 20 minutes. The electrodes used to measure the EMF of the sample during a titration consisted of a ROSS glass pH electrode (Orion, model 810100) and a double junction Ag, AgCl reference electrode (Orion, model 900200).

Reagents

A single 50-l batch of ~0.25 m *HCl* acid was prepared in 0.45 m *NaCl* by dilution of concentrated *HCl*, AR Select, Mallinckrodt, to yield a total ionic strength similar to seawater of salinity 35.0 (I ≈ 0.7 M). The acid was standardized by a coulometric technique [Mari68] [Tayl59] and verified with alkalinity titrations on seawater of known; alkalinity. Furthermore, Andrew Dickson's laboratory performed an independent determination of the acid molality on sub-samples. The calibrated molarity of the acid used was 0.2648 ± 0.0001 M *HCl*. The acid was stored in 500-ml glass bottles sealed with Apiezon® L grease for use at sea.

Standardization

The volumes of the cells used were determined to ±0.03 ml during the initial steam from San Diego to the test station by multiple titrations using seawater of known total alkalinity and CRM. Calibrations of the burette of the Dosimat with water at 25°C indicate that the systems deliver 3.000 ml (the approximate value for a titration of 200 ml of seawater) to a precision of ± 0.0004 ml, resulting in an error of ± 0.3 μmol/kg in TAlk. The reproducibility and precision of measurements are checked using low nutrient surface seawater and Certified Reference Material (Dr. Andrew Dickson, Marine Physical Laboratory, La Jolla, California), Batch 84. CRM's were utilized in order to account for instrument drift and to maintain measurement precision. Opened CRM bottles, referred to as "old" were provided by the DIC analysts. These opened bottles were used to rinse the cell before using the new CRM bottles. Duplicate analyses provide additional quality assurance and were taken from the same Niskin bottle. Duplicates were either both measured on system A, both on system B, or one each on A and B.

The assigned values of the Certified Reference Material provided by A. Dickson of SIO is:

Batch	Total Alkalinity	Salinity
84	2201.01±0.41 μmol/kg	33.391

Data Processing

An integrated program controls the titration, data collection, and the calculation of the carbonate parameters (TAlk, pH, and DIC). The program is patterned after those developed by Dickson [Dick81], Johansson and Wedborg [Joha82], and U.S. Department of Energy (DOE) [DOE94]. The program uses a Levenberg-Marquardt nonlinear least-squares algorithm to calculate the TAlk, DIC, and from the potentiometric titration data.

Table 3.10.1 Comparison of the measured alkalinity of the CRM and the certified value

CRM-Leg1	Instrument A	Instrument B
Total number of sets	86	75
Standard deviation (new)	± 23.8 μmol/kg (n=45)	± 20.9 μmol/kg (n=40)
Standard deviation (old)	± 23.3 μmol/kg (n=45)	± 22.0 μmol/kg (n=35)
-		
CRM-Leg2	Instrument A	Instrument B
Total number of sets	40	36
Standard deviation (new)	± 7.4 μmol/kg (n=4)	± 2.1 μmol/kg (n=4)
Standard deviation (old)	± 11.7 μmol/kg (n=36)	± 10.7 μmol/kg (n=31)

Table 3.10.2 Comparison of total alkalinity from the same Niskin bottle

Replicates Leg1	Instrument A	Instrument B	Between Systems
Number of sets used	88	54	55
Standard deviation	± 1.4 μmol/kg	± 1.5 μmol/kg	± 2.7 μmol/kg
-			
Replicates Leg2	Instrument A	Instrument B	Between Systems
Number of sets used	59	36	41
Standard deviation	± 1.7 μmol/kg	± 2.4 μmol/kg	± 2.5 μmol/kg

Note: Outliers were determined if the differences were one and a half times larger than the standard deviation. The number omitted is the difference between the total number of set and the sets used.

Problems

The electrodes on both systems became uncalibrated soon after recalibrating the cell volume. This caused CRM values to be different from the certified value and so the standard deviation of CRM values is high. We used the ratio between our value and the certified value of total alkalinity to correct all samples on the stations directly before and after each set of CRM's was run. By using this correction we did not have to routinely recalibrate the cell volume.

For Station 50 on system B the Dosimat screw cap was not airtight and so bubbles were allowed into the acid line which caused the data to be bad. After this station, we replaced the acid bottle with a volumetric flask sealed at the top with a thick layer of parafilm. For Station 74 the pH meter on system B did not work properly due to a loose connection inside the instrument. Unfortunately we did not catch this problem until after the samples were run and the data were analyzed. Upon opening the pH meter we found a burnt connection and so we replaced the pH meter.

Occasionally, if the two systems were filling their cells at the same time, the piston on instrument B would fail to register that the cell is full and so the sample drained and would be lost. Sporadically, a solenoid valve at the bottom of the titration cell would fail to engage or disengage, resulting in the loss of the sample or a failed titration due to a poor rinse or an air bubble.

At the begining of leg 2 the volumetric flask used to hold the acid on system B was replaced with a new dosimat bottle. Leaks in the cells on both systems were also repaired and the cell volumes recalibrated while steaming to the first station of leg 2. The electrodes on system B were also replaced.

At station 116 the titrations which normally take around 20 min each started to take much longer, some over 3 hours, due to the pH meter not becoming stable enough (deviation less than 0.9 mV) to take a reading . It was determined that the stirrer on system B was causing interference with the pH meters and was replaced begining with station 120.

3.11. C-13/C-14 Sampling Program

$^{13}C/^{14}C$ surface water samples were drawn routinely from the rosette casts, about every 1 degree of latitude. Vertical profiles of ~18 depths were collected at ~25 stations. Samples were collected in 500 ml glass stoppered bottles. First, the stopper was removed from the dry flask and placed aside. Using silicone tubing, the flasks were rinsed three times with the water sample from the Niskin bottle. While keeping the tubing touching the bottom of the flask, the flask was filled and allowed to overflow about half its volume. Once the sample was taken, a small amount (~30 cc) of water was removed to create a headspace and ~0.2 cc of a 50% saturated mercuric chloride solution was added. This was the same supply and amount of mercuric chloride solution as used with the DIC samples. Then the neck of the flask was carefully dried up using Kimwipes. The stopper, previously lubricated with 4 lines of Apiezon grease, was inserted into the bottle. The stopper was examined to insure that the grease formed a smooth and continuous film between the flask and bottle. A plastic clip was used to secure the stopper to the flask and two rubber bands were wrapped over the bottle to further secure the stopper. The filled bottles were stored inside the ship's laboratory to minimize temperature changes. The samples will be analyzed in the laboratory of Paul Quay (University of Washington, *pdquay@u.washington.edu*).

3.12. Dissolved Organic Carbon (DOC)

DOC samples were collected by Stacy Brown on leg 1 and Charles Farmer on leg 2 for analysis by Dennis Hansell of Rosenstiel School of Marine and Atmospheric Sciences (RSMAS). A total of approximately 1500 dissolved organic carbon (DOC) samples were collected from every other station during Leg 1. 1221 samples were collected during Leg 2. The total number of samples collected during the entire P18 cruise is ~3720. Data will be available approximately seven months after sample arrival at RSMAS.

Sampling

All samples were collected directly from the Niskin bottles. Because particulate organic carbon (POC) concentrations in the surface waters can be elevated, samples collected from the upper 250 m were filtered. Water was filtered through a combusted GF/F housed in an acid-washed polycarbonate filter cartridge attached directly the Niskin bottle spigot with silicon tubing. Water below 250 m was not filtered because greater than 98% or the total organic carbon is DOC. All samples were collected directly into an acid washed and high density polyethylene (HDPE) bottles (60 ml) flushed with Nanopure. Samples were immediately placed upright in a -20'C freezer and samples were shipped to shore laboratory packed in dry ice. All samples were kept frozen at -20°C in an organic (volatile) free environment. The first approximately 1000 samples taken freeze-thawed one time, which will most likely not affect the integrity of the sample.

Analysis

Samples will be analyzed via the high-temperature combustion technique using Shimadzu TOC-V systems with total nitrogen chemiluminescent detection. Samples will be sparged of inorganic carbon by acidification with *HCl* and sparging with CO_2-free gas for several minutes. A minimum of triplicate injections of 100 μl of sample will be injected onto a Pt alumina combustion catalyst heated to 680°C. The CO_2 signal will then be detected with a non-dispersive infra-red detector. Total nitrogen is converted to NOx and detected via chemiluminescence.

3.13. Chromophoric DOM

3.13.1. Project Goals

Our goals are to determine chromophoric dissolved matter (CDOM) distributions over a range of oceanic regimes on selected sections of the CO2/CLIVAR Repeat Hydrography survey, and to quantify and parameterize CDOM production and destruction processes with the goal of mathematically constraining the cycling of CDOM. CDOM is a poorly characterized organic matter pool that interacts with sunlight, leading to the production of climate-relevant trace gases, attenuation of solar ultraviolet radiation in the water column, and an impact upon ocean color that can be quantified using satellite imagery. We believe that the global distribution of CDOM in the open ocean is controlled by microbial production and solar bleaching in the upper water column, and relative rates of advection and remineralization in intermediate and deep waters. Furthermore, changes in the optical properties of CDOM and its relationship with DOC over time suggest the use of CDOM as an indicator of the prevalence of refractory DOC in the deep ocean. We are testing these hypotheses by a combination of field observation and controlled experiments. We are also interested in the deep-sea reservoir of CDOM and its origin and connection to surface waters and are making the first large-scale survey of the abundance of CDOM in the deep ocean.

3.13.2. Activities on P18

Profiling Instruments

Once each day we cast a hand-deployed free-fall Satlantic MicroPro II multichannel UV/Visible spectroradiometer. This instrument has 11 upwelling radiance sensors and 11 downwelling irradiance sensors in wavelength bands ranging from 305 to 683 nm. In addition to pressure, the package measures X-Y tilt, internal and external temperatures and also mounts a WetLabs ECO chlorophyll fluorometer. The instrument is allowed to trail away behind the port-side stern, then free-falls to 150 m and is hand-recovered. Additionally a Satlantic multichannel UV/Visible spectroradiometer (SMSR) is mounted on the ship to measure the same wavelengths channels of surface irradiance concurrently with MicroPro casts. We are using the radiometric data to study the effects of CDOM on the underwater light environment, to validate satellite ocean radiance sensor data, and to develop new algorithms employing satellite and *in situ* optical sensor data to retrieve ocean properties such as CDOM light absorbance, chlorophyll concentration, and particulate backscattering.

The following table summarizes the 54 MicroPro casts accomplished during P18.

P18 Sta	MicroPro Cast Start Position Latitude	Longitude	UTC Date	Start Time	End Time	Depth (m)
1	22 51.9995 N	109 59.9960 W	17-Dec-2007	21:27	21:30	100
6	21 24.8760 N	109 59.8900 W	18-Dec-2007	20:43	20:46	150
10	19 04.8290 N	109 59.9440 W	19-Dec-2007	19:59	20:03	141
14	16 45.0790 N	109 59.9780 W	20-Dec-2007	18:51	18:54	151
18	14 24.9820 N	110 00.0290 W	21-Dec-2007	19:52	19:55	135
21	12 40.0065 N	110 00.0100 W	22-Dec-2007	20:33	20:36	145
24	10 55.0530 N	110 00.0350 W	23-Dec-2007	18:37	18:40	130
28	8 35.0910 N	109 59.9760 W	24-Dec-2007	19:29	19:32	149
32	6 15.0280 N	110 00.0000 W	25-Dec-2007	21:08	21:12	147
35	4 30.0690 N	109 59.8440 W	26-Dec-2007	20:08	20:11	125
39	2 29.8210 N	110 00.6545 W	27-Dec-2007	19:37	19:40	126
46	0 39.7310 S	109 59.4280 W	30-Dec-2007	19:09	19:13	67
50	2 29.9070 S	110 00.0150 W	31-Dec-2007	19:41	19:45	150
54	4 29.7740 S	110 00.0895 W	01-Jan-2008	20:31	20:35	144
56	5 24.9700 S	109 25.2600 W	02-Jan-2008	18:10	18:14	148
997	8 00.4370 S	110 02.0660 W	03-Jan-2008	18:50	18:53	149
59	6 39.8910 S	107 40.7500 W	04-Jan-2008	19:03	19:06	147
63	8 19.9350 S	105 20.6310 W	05-Jan-2008	18:54	18:56	117
66	9 34.9290 S	103 35.2810 W	06-Jan-2008	19:07	19:11	156
69	11 09.9810 S	103 00.0160 W	07-Jan-2008	17:55	17:59	153
73	13 30.0180 S	103 00.0540 W	08-Jan-2008	20:57	21:01	152
76	15 14.9640 S	103 00.0380 W	09-Jan-2008	19:20	19:24	153
79	16 59.9900 S	103 00.0240 W	10-Jan-2008	17:36	17:40	151
82	18 45.0420 S	103 00.0240 W	11-Jan-2008	17:10	17:13	154
85	20 30.0460 S	103 00.0550 W	12-Jan-2008	17:37	17:41	155
88	22 15.0235 S	103 00.0030 W	13-Jan-2008	19:05	19:08	152
92	23 59.9810 S	103 00.0120 W	14-Jan-2008	17:28	17:32	164
94	25 44.9370 S	103 00.0240 W	15-Jan-2008	17:19	17:23	164
97	27 30.0110 S	102 59.9750 W	16-Jan-2008	18:41	18:45	168
100	29 14.9420 S	103 00.0170 W	23-Jan-2008	14:05	14:09	152
104	31 34.9850 S	103 00.0050 W	24-Jan-2008	15:24	15:28	152
108	33 54.7870 S	102 59.8170 W	25-Jan-2008	17:22	17:25	153
112	36 15.0050 S	102 59.9770 W	26-Jan-2008	18:13	18:16	153
116	38 34.9330 S	103 00.0730 W	27-Jan-2008	20:53	20:57	150
119	40 20.0560 S	102 59.9970 W	28-Jan-2008	19:34	19:38	152
122	42 04.9110 S	102 59.9880 W	29-Jan-2008	17:55	17:58	153
126	44 25.0100 S	103 00.0180 W	30-Jan-2008	20:37	20:40	152
129	46 10.0660 S	102 59.9180 W	31-Jan-2008	21:32	21:36	152
132	47 54.9915 S	103 00.0275 W	01-Feb-2008	20:14	20:17	162
134	48 56.4300 S	103 03.9510 W	02-Feb-2008	19:31	19:34	156
138	51 24.9965 S	102 59.9645 W	03-Feb-2008	19:23	19:26	167
140	52 34.8745 S	103 00.1495 W	04-Feb-2008	16:58	17:02	150
144	54 55.0110 S	102 59.8790 W	05-Feb-2008	20:03	20:06	150
147	56 40.0180 S	102 59.8600 W	06-Feb-2008	19:50	19:53	150
151	58 45.0555 S	102 59.9130 W	07-Feb-2008	21:17	21:21	140
153	59 45.0200 S	102 59.9560 W	08-Feb-2008	15:59	16:02	151
157	61 44.9960 S	102 59.9650 W	09-Feb-2008	18:26	18:29	151
161	63 44.9350 S	103 00.0690 W	10-Feb-2008	19:29	19:33	160

P18 Sta	MicroPro Cast Start Position Latitude	Longitude	UTC Date	Start Time	End Time	Depth (m)
163	64 45.1315 S	102 59.8315 W	11-Feb-2008	16:16	16:20	155
167	66 45.0070 S	102 59.8710 W	12-Feb-2008	19:33	19:37	154
169	67 45.0090 S	102 59.9400 W	13-Feb-2008	13:45	13:49	147
173	67 00.0280 S	107 15.0115 W	16-Feb-2008	15:22	15:25	155

On the core CTD we deploy a WetLabs UV fluorometer (Ex 370 nm, Em 460 nm), which stimulates and measures fluorescence of CDOM. We are evaluating the use of this instrument to supplement or enhance bottle CDOM measurements, as bottle samples often do not have the depth resolution needed to resolve the observed strong near-surface gradients in CDOM concentration, and on cruises such as this we are not able to sample CDOM on every station. Differences between the fluorescence and absorption profiles may reveal gradients in chemical composition of CDOM. The fluorometer has performed very well: problems with temperature compensation encountered on P16N have been corrected. Signal to noise ratios remain low for the open ocean areas that we are studying.

This fluorometer is ganged to a WetLabs C-star 660 nm 0.25 m pathlength beam transmissometer belonging to Dr. Wilford Gardner, TAMU. The transmissometer is used to gauge particle load in the water column, which can be calibrated to produce estimates of particulate carbon. Decline of the particle load with depth can then be related to POC flux, another element of the carbon system.

Both CDOM fluorometer and transmissometer were present on all cast taken with the primary 36 bottle CTD package. During the short periods during leg 1 and 2 when the 24 bottle CTD package was used, neither sensor was able to be attached. After the CTD wire problems on Station 153, the CDOM fluorometer was interfaced to the 24 bottle CTD package for the remaining station profiles. There was no suitable mounting location for the transmissometer, so it was not present for the rest of the CTD profiles.

Bottle Samples

CDOM is at present quantified by its light absorption properties. We are collecting samples of seawater for absorption spectroscopy on one deep ocean cast each day. CDOM is typically quantified as the absorption coefficient at a particular wavelength or wavelength range (we are using 325 nm). We determine CDOM at sea by measuring absorption spectra (280-730 nm) of 0.2μm filtrates using a liquid waveguide spectrophotometer through a 200 cm cell. A full profile of 60 ml samples were drawn from one mid-day CTD cast each day, into amber glass vials. Duplicate samples were collected at a rate of ca. 2 samples per cast. For Leg 1 RMS differences in absorption coefficient at 325 nm between the duplicate samples were just over 0.012 m^{-1}, which is ca. 9% of the average absorption coefficient at that wavelength. For Leg 2 RMS differences in absorption coefficient at 325 nm between the duplicate samples were 0.01 m^{-1}, which is ca. 12% of the average absorption coefficient at that wavelength.

Because of the connections to light availability and remote sensing, we collect ca. 270 ml bottle samples in the top 250 m for Chlorophyll a analysis. In addition we collect ca. 2 L surface samples from the ship's uncontaminated seawater system for complete pigment analysis (HPLC) and spectrophotometric particulate absorption (AP). The sampled filters are preserved in liquid Nitrogen and will be returned to UCSB for later analysis.

The Chlorophyll a samples are filtered, extracted in 90% acetone, and read on a Turner Designs 10-AU fluorometer. Determination is made of Chlorophyll a, the degradation product Phaeophytin a, and the sum of these two. Only Chlorophyll a concentrations are reported here.

We are sporadically collecting 60 ml samples for DOM characterization, including carbohydrate and neutral sugar analysis (CDOM2C), and large volume (ca. 2 L) samples for CDOM photolysis experiments (CDOM3C) to compare the distribution of these quantities to that of CDOM. These analyses and the photolysis experiment will be performed at UCSB. Additionally every third day we collect ca. 2 L samples for POC analysis to compare with transmissometer data. The sampled filters are preserved in liquid Nitrogen and will be analyzed ashore.

Leg 1 Problems

Both the MicroPro and SMSR require slowly flowing seawater for cooling. During Leg 1 seawater was not available on the fantail for the MicroPro; it was available on the bow for the SMSR. To attempt to compensate for this a stagnant fresh water cooling bath was set up for the MicroPro, with ice carried to it about half an hour before deployment. Various problems with the ship's icemaker made ice unavailable for about 5 days total. As the table indicates, we had problems deploying the MicroPro to 150 m. At the beginning of the cruise we achieved casts to 150 m at 2 out of 18 stations. On January 6 we were able to convince the Captain to have the bridge take the ship off autopilot during the eight minutes the MicroPro was in the water. Casts from Jan 6th on reached 150 m or deeper at all 11 stations. Station 46 was hindered by a strong undercurrent of ˜ 1 m/s.

Early on the morning of December 29 the walk-in -20 C freezer failed, it was fixed later that day. Our DOM characterization samples (CDOM2C) from station 10 were stored in there, we think they'll be fine as they were insulated in a cooler.

Our Barnstead NANOpure water system, which we use for CDOM spectrophotometry baselines, failed on January 1. We used Milli-Q water from the nutrient lab for the rest of the leg. Comparison tests were run on the spectrophotometer showing that Milli-Q is probably adequate. Results showed Barnstead water contains less CDOM than Optima Spectographic Reference Water, and Milli-Q water slightly more than Optima water.

CDOM absorption coefficient data was noisy, especially below 1500 m, on the order of 0.08 m^{-1} at 325 nm. The cause remains unknown.

Leg 2 Problems

The Barnstead NANOpure water system was repaired during the turn-around at Easter Island and provided stable CDOM baseline data for all of leg 2. The CDOM sample noise in the lower water column was significantly better during leg 2 than on leg 1. We thank all of the water sampling personnel who used gloves and silicone tubing thereby reducing CDOM contamination of the CTD sample bottle spigots.

A hose connected to the overboard outflow from the ship's uncontaminated sea water system was used to provide water flow for the cooling bath for the MicroPro. This allowed equilibration of the instrument to sea surface temperature prior to each optical cast. This will improve data quality during final processing back at UCSB. When air temperatures neared freezing, the cooling bath was emptied to avoid possible freezing.

When the CDOM fluorometer was moved to the 24 bottle rosette package on Station 154, that profile was significantly different than previous profiles. The fluorometer had not been cleaned during the rapid switch over from the 36 bottle rosette package. Subsequent profiles were less different, but there appears to be a difference in profile shape which persisted for the remainder of the cruise. The cause is unknown at this point. Comparison to discrete CDOM samples should clarify the problem.

3.14. Nutrient Measurements

Nutrient samples were collected from the Niskin bottles in acid-washed bottles after at least three seawater rinses, and sample analysis typically began within 1 hour of sample collection. Nutrients were analyzed with a continuous flow analyzer (CFA) using the standard and analysis protocols for the WOCE hydrographic program as set forth in the manual by L.I. Gordon, *et al.* [Gord93]. 5598 samples were taken at discrete depths and analyzed for phosphate (PO_4^{3-}), nitrate (NO_3^-), nitrite (NO_2^-) and orthosilicic acid (H_4SiO_4).

Nitrite was determined by diazotizing the sample with sulfanilamide and coupling with N-1 naphthyl ethylenediamine dihydrochloride to form an azo dye. The color produced is measured at 540 nm. Samples for nitrate analysis were passed through a cadmium column, which reduced nitrate to nitrite and the resulting nitrite concentration (i.e. the sum of nitrate + nitrite which is signified as N+N) was then determined as described above. Nitrate concentrations were determined from the difference of N+N and nitrite.

Phosphate was determined by reacting the sample with molybdic acid at a temperature of 55°C to form phosphomolybdic acid. This complex was subsequently reduced with hydrazine, and the absorbance of the resulting phosphomolybdous acid was measured at 820 nm.

Silicic acid was analyzed by reacting the sample with molybdate in an acidic solution to form molybdosilicic acid. The molybdosilicic acid was then reduced with $SnCl_2$ to form molybdenum blue. The absorbance of the molybdenum blue was measured at 820 nm.

A mixed stock standard consisting of silicic acid, phosphate and nitrate was prepared by dissolving high purity standard materials (KNO_3, KH_2PO_4 and Na_2SiF_6) in deionized water using a two step dilution for phosphate and nitrate. This standard was stored at room temperature. A nitrite stock standard was prepared about every 10 days by dissolving $NaNO_2$ in distilled water, and this standard was stored in the refrigerator. Working standards were freshly made at each station by diluting the stock solutions in low nutrient seawater. Mixed standards were verified against standards purchased from Ocean Scientific.

A typical analytical run consisted of distilled water blanks, standard blanks, working standards, a standard from the previous run, a deep sample from the previous run, samples, replicates, working standards, and standard and distilled water blanks. Replicates were usually run for the 3 deepest Niskin bottles from each cast, plus any samples with questionable peaks. The standard deviation of these replicates was used to estimate the overall precision of the method which was <1% full scale. During the cruise, pump tubes were changed four times, linearity was checked six times, and there were 19 measurements of the refractive index.

Table 3.14.0 Precision of Nutrient Measurements.

	Phosphate	Silicic Acid	Nitrate
Number of replicates	491	489	488
Average standard deviation (μM)	0.02	0.2	0.1
Percent deviation	0.9%	0.1%	0.2%

Temperatures in the ship's bioanalytical laboratory fluctuated with temperatures ranging from 17.2°C to 25.3°C with an average temperature of (20.9±1.9°C); however, temperatures were generally stable during an individual analytical run. On leg one, a 24-channel Ismatec pump failed and was replace with an identical spare pump. On leg 2, an Alpkem sampler using 35 ml polyethelene sample bottles failed and was replaced with a Westco CS9000 sampler that used 20 ml plastic sample bottles.

3.15. Silica-32 Samples

Water samples were collected at six stations for analysis of ^{32}Si ashore. The filters originally provided (Spritzenfilter PTFE 25 mm/0.2 micron) only produced a flow of a few drops per minute when connected by a ~50 cm length of tubing to the Niskin bottle spigots. This was not an adequate flow rate to allow filling the 50 cc plastic sample vials. As an alternate, a sampling system used by the RSMAS DOC group was used to collect the samples. This consisted of a ~50 cm length of silicone tubing with a filter holder on the end containing a 47 mm diameter GFF filter. The tubing was connected to the bottle spigot and a small vent near the filter opened to allow rapid initial flushing of the upper side of the filter. The vent was then closed and the water passing through the filter used to rinse (3 times) and fill the sample vials. A single GFF filter was used to collect 2 profiles on Leg 1 and another filter was used to collect 4 profiles on leg 2. The GFF filters were saved so they could be tested later for possible contamination problems.

3.16. ^{15}N and ^{18}O Analysis of Nitrate

^{15}N and ^{18}O samples were collected by Stacy Brown on leg 1 and Charles Farmer on leg 2 for analysis by Mark Altabet, School of Marine Science and Technology, University of Massachusetts, New Bedford MA *(maltabet@umassd.edu)*. A total of 1463 samples were collected from stations during the entire P18 cruise, with 418 being collected on leg 2. For information regarding availability of data, please contact Mark Altabet.

Sampling

All samples were collected directly from the Niskin bottles into 125 ml low density polyethylene (LDPE) bottles that were preloaded with dilute HCl as a preservative. Additionally, 300 bottles also contained an additional reagent (sulfanilic acid) to bind expected high levels of Nitrite. Generally the shallowest 20 depths were sampled in the upper 1200 meters of a cast except every 10 deg of latitude where all depths were sampled. Samples were stored at room temperature until they were returned to Mark Altabet's laboratory.

Analysis

Samples will be analyzed by Mark Altabet. For more information regarding the analyses, please contact Mark Altabet directly.

3.17. Salinity Analysis

Equipment and Techniques

A single Guildline Autosal Model 8400B salinometer (S/N 61668), located in the aft Hydro lab, was used for all salinity measurements. A second Guildline Autosal 8400B (S/N 68807, PMEL) was set up midway through the cruise as a backup, and was used to run several duplicate sample boxes. The salinometers were connected to computer interfaces for computer-aided measurement. Both Autosals' water bath temperatures were set to 24°C, which the Autosals are designed to automatically maintain. The laboratory's temperature was also set and maintained to just below 24°C, to help further stabilize reading values and improve accuracy.

Salinity analyses were performed after samples had equilibrated to laboratory temperature, usually within 12 to 24 hours after collection. The salinometers were standardized for each group of samples analyzed (usually 1-2 casts and up to 74 samples) using two bottles of standard seawater: one at the beginning and end of each set of measurements. The salinometer outputs were logged to a computer file by the interface software, which prompted the analyst to flush the instrument's cell and change samples when appropriate. For each sample, the salinometer cell was initially flushed at least 4 times before a set of conductivity ratio readings were taken.

Standards

IAPSO Standard Seawater Batch P-147 was used to standardize all casts.

Sampling and Data Processing

5708 salinity measurements were taken and approximately 200 vials of standard seawater (SSW) were used.

A duplicate sample was drawn for each cast in order to confirm sampling accuracy.

The salinity samples were deposited into 200 ml Kimax high-alumina borosilicate bottles, which were initially rinsed a minimum of three times with sample water prior to filling. The bottles were sealed with custom-made plastic insert thimbles and Nalgene screw caps. This assembly provides very low container dissolution and sample evaporation. Prior to sample collection, inserts were inspected for proper fit and loose inserts replaced to insure an airtight seal. Laboratory temperature was also monitored electronically throughout the cruise.

PSS-78 salinity [UNES81] was calculated for each sample from the measured conductivity ratios. The offset between the initial standard seawater value and its reference value was applied to each sample. Then the difference (if any) between the initial and final vials of standard seawater was applied to each sample as a linear function of elapsed run time. The corrected salinity data was then incorporated into the cruise database.

CTD salinities on P18-2007/8 started off 0.003 low compared to P18-1994 deep data, and bottle salinities 0.003-4 high over the duration of the cruise. A second Autosal was set up partway through the first leg to verify that the primary Autosal was working properly, and the replicates agreed well. Comparisons of I9N and P18 with historical data (both recent cruises used the same standard seawater (SSW) batch) suggested that corrections to the IAPSO standard seawater batch and salinity values for P18-1994 all point to bottle salinities from this cruise being within WOCE specs.

The latest IAPSO SSW comparison paper [Kawa06] recommends a +0.0020 correction to batch P-114 (used on P18-1997) and related salinity data, based on using recent batches with better accuracy as the "standards". The P18-2007/8 SSW batch P-147 was not available at the time the paper was written. However, batch P-147 was also used during I8S/I9N in 2007. After applying the Kawano *et al.* suggested +0.0006 correction for SSW batch P-126 to I9N-1995 data, I9N-2007 salinity data are +0.0005 to +0.001 higher than 1995 data. Personal communication with the author [Kawa07] confirmed that batch P-147 has been recently analyzed, and warrants a -0.0005 correction when compared with other recent standards.

If standard batch corrections were applied to P18-2007/8 and P18-1994 data, the residual deep salinity difference between the two P18 cruises (2007/8 minus 1994) would be ~0 to +0.001, suggesting that P18 bottle salinity data are within WOCE specifications of ±0.002.

Laboratory Temperature

The temperature in the salinometer laboratory varied from 22.5 to 23.5°C during the cruise. The air temperature change during any particular run varied from -0.5 to +0.5°C. The only exception was during the analysis of salinities for stations 168 and 169: the laboratory temperature did deviate from the ideal range due to Brown air conditioner failure, rising to just below 26°C.

3.18. Density Sampling

Density samples were taken approximately every 5 degrees of latitude on Leg 1 and at a higher resolution on Leg 2. (Stations 2, 8, 17, 26, 34, 44, 55, 67, 76, 84, 110, 120, 128, 134, 140, 149, 157, 165, and 173). Eighteen bottles were drawn from each cast of 36 and 24 Niskins. The samples were drawn through a teflon tube to the neck of 125 mL HDPE bottles. These samples will be analyzed for density and re-analyzed for salinity back in Miami.

4. Underway Measurements

The shipboard computing system (SCS) logs all data routinely acquired by the permanent shipboard sensors including TSG, rain, meteorological parameters, and ship speed and course. The data are logged at 30-second intervals and are available from the chief scientist.

Weather observations (ship position, cloud cover and type, visibility, wind speed and direction, sea state, wave height and direction, surface water temperature, atmospheric pressure, and wet and dry bulb air temperature) were recorded manually at hourly intervals by the bridge and during each hydrocast. Copies of these data log sheets are available from the Chief Scientist.

The following underway measurements were recorded at intervals of 30 seconds using the SCS. 'Output' is the file name of the stored data.

Output: POSITION
Date, Time
Position (Latitude, Longitude)
Gyro (Degrees)
Speed over ground (SOG)
Course over ground (COG)

Output: TSG
Thermosalinograph (TSG):
  Temperature
  Conductivity
  Salinity
IMET SST
Fluoro-Val

Output: WIND
IMET Relative Wind Speed2
  Relative Wind Direction2
IMET True Wind Speed2
  True Wind Direction2

Output: WX-OBS
IMET Relative Humidity
  Temperature
  Shortwave
  Longwave
  Baro-Corrected Sea Level Pressure

Output: RAIN
IMET Rain1: Stb02
Rain2: Port02
Rain3: Stbd03
Precip (mm/hr)

4.1. Underway pCO2 System

During the CLIVAR P18 cruise, an automated underway pCO_2 system from AOML was situated in the Hydro Lab aboard the R/V Ronald H. Brown. This system has been collecting data on the Brown since 1999. The system runs on an hourly cycle during which 3 gas standards, 3 ambient air samples, and 8 headspace gas samples from the equilibrator are analyzed (see table 4.1.0). The standard gases used on this cruise were serial numbers CA6745 (289.06 ppm), CA5398 (370.90 ppm), and CA6352 (514.29 ppm). They were purchased from NOAA/ESRL in Boulder, CO and are directly traceable to the WMO scale.

Table 4.1.0 Hourly sampling cycle for the underway pCO_2 system (version 2.5).

Minutes after the Hour	Sample
4	Low standard
8	Mid standard
12	High standard
16.5	Water (= headspace of equilibrator)
21	Water
25.5	Water
30	Water
34	Air (marine air from the bow line)
38	Air
42	Air
46.5	Water
51	Water
55.5	Water
60	Water

The system uses an equilibrator based on a design by Weiss where surface seawater from the bow intake is equilibrated with headspace gas. The approximate volume of the equilibrator is 15 liters, about half of which is filled with seawater. The approximate flow rate through the equilibrator is 10 - 12 liters per minute.

The equilibrator headspace is circulated through a LI-COR® model 6251 non-dispersive infrared analyzer (IR) and then returned to the equilibrator. When ambient air or standard gas is analyzed the output of the LI-COR® sample cell is vented to the lab rather than the equilibrator. The system uses a KNF pump to draw air from the bow mast through 100 meters of 0.95 cm OD Dekoron® tubing at a rate of 6 - 8 liters per minute. A filter of glass wool at the intake prevents particles from entering the gas stream. Two glass condensors chilled to 1°C after the pumps remove water vapor from the headspace and air gas streams. A column of magnesium perchlorate downstream of the condensors removes any residual water vapor. Fifteen seconds before the end of each measurement phase (headspace, air, or standard gas), gas flow is stopped to allow the sample cell of the IR analyzer to reach ambient pressure and the measurements are taken 10 seconds after the gas flow is stopped.

A custom developed program running under LabVIEW controls the system and graphically displays the results. The program records the output and temperature of the LI-COR®, the water flow, the gas flows, the equilibrator temperature, the barometric pressure, the GPS position and the temperature and salinity from a Sea-Bird Micro TSG® located in the sink in the Hydro Lab in addition to several other sensors. It writes all of this data to the output file at the end of each measurement phase. The details of the instrumental design can be found in Wanninkhof and Thoning [Wann93], Ho *et al.* [Ho97], and Feely *et al.* [Feel98].

Coming out of San Diego, air values were running about 15 - 20 ppm higher than expected. Since the operator was also involved in collecting and analyzing discrete pCO_2 samples, minimal time was allotted to troubleshooting the problem. Eventually it was determined that the solenoid valve which stops the gas flow before measurements are recorded had failed and that standard gas flow was insufficient to flush out the sample cell of the IR analyzer, resulting in bad calibration curves. For these reasons, data before January 9th are not correct. Since gas flow of ambient air and headspace gas was adequate for the entire cruise, it may be possible to correct the data at a later date.

5. Drifter deployment

A total of twelve SVP drifters and five SVP-barometer drifters provided by the Global Drifter Program were deployed during the cruise. Ten SVP drifters were deployed during leg 1. Two SVP drifters and five SVP-barometer drifters were deployed during leg 2. The SVP-barometer drifters were those deployed at and south of ~50 S. On both legs of the cruise each drifter was removed from its plastic packaging immediately before deployment, and on leg 2 the magnet was also removed from the drifter just before deployment. During leg 1, drifters were deployed after the completion of the CTD station closest to the target deployment location, the ship re-positioned for the transit to the next station. Once the ship was re-positioned and began steaming at ~1 knot, the drifter was thrown off the fantail of the ship. On leg 2, some drifters were deployed from the fantail during steaming between stations to deploy them closer to the target deployment locations. The time and position of each drifter deployment was recorded and transmitted via e-mail to shaun.dolk@noaa.gov.

The following seventeen drifters were deployed:

Float ID	Date mm/dd/yy	Time (UTC) hh:mm	Latitude DD mm.mm N/S	Longitude DDD mm.mm E/W
71470	12/30/07	07:40	00 00.02 S	109 58.076 W
71467	01/01/08	05:36	03 00.94 S	110 00.00 W
71471	01/04/08	19:22	06 39.727 S	107 40.837 W
71468	01/06/08	11:31	09 09.982 S	104 10.424 W
71469	01/08/08	09:02	12 20.082 S	102 59.952 W
71466	01/09/08	22:51	15 15.025 S	103 00.024 W
71465	01/11/08	12:32	18 09.487 S	103 00.042 W
71464	01/13/08	04:34	21 05.043 S	102 57.993 W
71463	01/15/08	17:43	24 00.308 S	103 00.062 W
71462	01/16/08	10:33	26 55.019 S	103 00.007 W
71454	01/23/08	22:36	30 02.280 S	103 00.005 W
71456	01/25/08	05:08	32 50.984 S	103 00.003 W
70933	02/03/08	05:55	49 59.104 S	103 00.004 W
70937	02/05/08	06:05	54 02. S	102 59.837 W
70928	02/06/08	12:40	56 04.9 S	103 00.020 W
70929	02/09/08	07:00	60 58.862 S	103 00.000 W
70934	02/12/08	09:21	65 50.590 S	103 00.004 W

6. Argo Float Deployments

Twenty-four Webb Research Corporation APEX profiling CTD floats were launched during this cruise at the request of Argo PI Dr. Gregory C. Johnson of NOAA/PMEL. *(Gregory.C.Johnson@noaa.gov).*

Eight floats were launched during leg 1 and another sixteen during leg 2. These floats are part of the Argo array, a global network of > 3000 profiling floats. The floats are designed to sink to a depth of about 1000m. They then drift freely at depth for about 10 days before sinking to 2000m, and then immediately rising to the surface, collecting CTD data as they rise. Conductivity, temperature, and pressure (hence salinity) are measured and recorded at about 73 levels during each float ascent. At the surface, before the next dive begins, the acquired data are transmitted to shore via satellite, and location fixes for the floats are estimated by satellite. The typical life time of the floats in the water is ~4 years. Information on the floats deployed during this cruise and other PMEL floats can be found on the PMEL Argo float web pages *(http://floats.pmel.noaa.gov/).* All Argo float data are made publicly available on the web in real-time *(http://www.usgodae.org/argo/argo.html).*

All floats were checked in the ship's laboratory and started ~1-2 hours before deployment by passing a magnet over the 'reset' area of the float. Detailed logs of each float startup were kept and returned to PMEL. Each float was launched by carefully lowering it into the water using a hand-held line. Deployments were done after the completion of a hydrocast, immediately after the ship had turned to the course needed to proceed to the next station, and had begun steaming at ~1 kt. All floats were deployed successfully. Following each deployment, an e-mail was sent to pmel_floats@noaa.gov to report the float ID number, float reset time, exact float deployment time and location, closest CTD station number, and deployer name(s).

Argo float deployment information is summarized in the table below.

Float ID	Time(UTC) hh:mm	Date mm/dd/yy	Latitude DD mm.mmm N/S	Longitude DDD mm.mmm E/W
3508	08:27	12/18/07	22 29.808 N	111 00.058 W
3006	08:14	12/19/07	20 14.924 N	109 59.929 W
3403	07:43	12/30/07	00 00.012 S	109 58.001 W
3362	00:54	12/31/07	00 59.879 S	109 59.987 W
3507	05:00	01/12/08	19 20.034 S	103 00.073 W
3389	04:37	01/13/08	21 05.101 S	102 59.985 W
3347	02:39	01/14/08	22 50.063 S	103 00.010 W
3398	01:10	01/15/08	24 34.987 S	103 00.066 W
3392	20:36	01/23/08	29 49.992 S	102 59.946 W
3505	22:02	01/24/08	32 10.074 S	102 59.931 W
3509	17:32	01/25/08	33 54.791 S	102 59.849 W
3394	18:25	01/26/08	36 15.002 S	102 59.919 W
3361	14:07	01/27/08	38 00.293 S	102 59.462 W
3506	12:24	01/28/08	39 45.125 S	103 00.052 W
3395	18:05	01/29/08	42 04.958 S	103 00.056 W
3396	16:20	01/30/08	43 49.909 S	102 59.965 W
3390	21:47	01/31/08	46 10.096 S	102 59.788 W
3391	20:28	02/01/08	47 54.991 S	102 59.981 W
3359	03:01	02/03/08	49 40.054 S	102 59.799 W
3397	10:20	02/04/08	51 59.980 S	103 00.022 W
2398	05:44	02/05/08	53 44.981 S	102 59.924 W
3387	12:21	02/06/08	56 04.977 S	103 00.020 W
3386	10:41	02/07/08	57 45.007 S	102 59.960 W
3385	16:14	02/08/08	59 45.164 S	102 59.778 W

7. XBT Deployments

XBTs provided by Prof. Dean Roemmich of SIO were dropped during the cruise for purposes of evaluating fall rate errors in the equations used to convert the time elapsed since an XBT enters the water to depth. The goals of this study, designed by Dr. Gregory C. Johnson of NOAA/PMEL, are to assess possible variations in the XBT fall rate equation as a function of ship speed and to allow comparison of co-located XBT and CTD temperature-depth profiles.

The study design called for dropping three XBTs before and during arrival at selected CTD stations. The first XBT was dropped as the ship passed over the station location at cruising speed, typically 12 or 9 kts. After the full XBT trace was collected, the ship turned and headed back toward the station location. As the ship approached the station for the second time and slowed, with a heading adjusted to that for the CTD deployment, a second XBT was dropped. The third XBT was dropped as the CTD was being deployed. Sometimes failed XBTs or operator error resulted in deviations from this procedure. Most of the XBT's were Sippican "Deep Blue" models, but the XBT's with 7 digit S/Ns starting in '02' were Sippican "T4" models, vintage 1968. During leg 1 only the last five digits of probe serial numbers were recorded, and during leg 2 the last seven digits were recorded. Also, differences in use of the XBT acquisition program during leg 1 and 2 appears to have resulted in different files being archived for the drops. The XBT drop times and dates listed below are from the XBT acquisition computer, and generally agree to within about one minute of those recorded in the ship's log, when XBT drop times and locations were recorded in the log. The drop locations and ship speeds are extracted from ship's GPS data assuming that the computer times are correct.

The times and locations of the XBT drops are given below. Further information on this study can be obtained from Gregory C. Johnson *(Gregory.C.Johnson@noaa.gov).*

CTD Stn#	XBT S/N	Drop date mm/dd/yy	Time hh:mm	Latitude Deg Min N/S	Longitude Deg Min E/W	Speed Knots	Filename
11	14634	12/19/07	22:48	18 29.7000 N	110 00.0047 W	12.4	X071219N01.txt
11	14635	12/19/07	22:52	18 29.1794 N	109 59.8669 W	6.3	X071219N02.txt
11	14636	12/19/07	23:08	18 29.9012 N	110 00.0079 W	0.3	X071219N03.txt
15	14631	12/20/07	22:37	16 09.8732 N	110 00.0037 W	8.7	X071220N01.txt
15	14632	12/20/07	22:54	16 09.9845 N	109 59.9942 W	0.4	X071220N02.txt
15	14633	12/20/07	23:06	16 09.9857 N	109 59.9948 W	0.3	X071220N03.txt
18	14625	12/21/07	19:29	14 24.8437 N	110 00.0051 W	7.0	X071221N01.txt
18	14626	12/21/07	19:48	14 24.9921 N	110 00.0159 W	0.3	X071221N02.txt
18	14627	12/21/07	20:03	14 24.9956 N	110 00.0126 W	0.4	X071221N03.txt
18	14628	12/21/07	20:06	14 24.9965 N	110 00.0101 W	0.6	X071221N04.txt
22	14629	12/23/07	00:41	12 04.7305 N	110 00.0050 W	9.0	X071223N01.txt
22	14630	12/23/07	00:56	12 05.0072 N	109 59.9948 W	0.3	X071223N02.txt
22	19989	12/23/07	01:01	12 05.0054 N	109 59.9904 W	0.2	X071223N03.txt
24	19990	12/24/07	15:48	08 34.7522 N	110 00.0022 W	11.8	X071224N01.txt
24	19991	12/24/07	16:05	08 35.0425 N	110 00.0281 W	2.5	X071224N02.txt
24	19992	12/24/07	16:10	08 35.0804 N	109 59.9805 W	0.3	X071224N03.txt
32	19993	12/25/07	20:49	06 14.8607 N	110 00.0039 W	11.5	X071225N01.txt
32	19994	12/25/07	20:57	06 14.6250 N	109 59.6333 W	6.2	X071225N02.txt
32	19995	12/25/07	21:03	06 14.9711 N	109 59.9498 W	2.2	X071225N03.txt
36	19996	12/26/07	22:58	03 59.7614 N	110 00.0031 W	11.9	X071226N01.txt
36	19997	12/26/07	23:13	04 00.0253 N	109 59.9882 W	0.2	X071226N02.txt
36	19997	12/26/07	23:18	04 00.0248 N	109 59.9877 W	0.2	X071226N03.txt
41	19999	12/28/07	23:51	01 29.7930 N	109 59.9975 W	7.8	X071228N01.txt
41	20000	12/29/07	00:05	01 29.9406 N	110 00.1123 W	4.0	X071229N01.txt
41	19893	12/29/07	00:11	01 30.0020 N	110 00.0430 W	1.0	X071229N02.txt
46	19894	12/30/07	15:30	00 40.1192 S	110 00.0028 W	9.2	X071230N01.txt
46	19895	12/30/07	15:49	00 40.0287 S	110 00.0758 W	0.6	X071230N02.txt
46	19896	12/30/07	16:05	00 40.0480 S	110 00.1525 W	1.2	X071230N03.txt
50	19897	12/31/07	19:19	02 30.1821 S	110 00.0033 W	7.3	X071231N01.txt
50	19898	12/31/07	19:35	02 29.9804 S	109 59.9900 W	0.9	X071231N02.txt
50	19899	12/31/07	19:54	02 29.9160 S	110 00.0014 W	0.5	X071231N03.txt
53	19900	01/01/08	14:08	04 00.1936 S	110 00.0037 W	11.3	X080101N01.txt
53	19901	01/01/08	14:27	03 59.9797 S	110 00.1285 W	0.4	X080101N02.txt
53	19902	01/01/08	14:37	03 59.9778 S	110 00.1297 W	0.3	X080101N03.txt
59	19903	01/04/08	15:55	06 40.1056 S	107 40.3893 W	12	X080104N01.txt
59	19904	01/04/08	16:09	06 39.9263 S	107 40.7150 W	0.1	X080104N02.txt
59	19749	01/04/08	16:17	06 39.9285 S	107 40.7142 W	0.4	X080104N03.txt
66	19750	01/06/08	15:10	09 35.0943 S	103 35.0708 W	11.8	X080106N01.txt
66	19751	01/06/08	15:23	09 34.9551 S	103 35.2601 W	1.9	X080106N02.txt
66	19752	01/06/08	15:32	09 34.9350 S	103 35.2700 W	0.4	X080106N03.txt
70	19753	01/07/08	22:06	11 45.1775 S	103 00.0055 W	8.9	X080107N01.txt
70	19754	01/07/08	22:18	11 44.9911 S	103 00.0332 W	0.4	X080107N02.txt
70	19755	01/07/08	22:24	11 44.9928 S	103 00.0361 W	0.3	X080107N03.txt
101	0111111	01/23/08	17:31	29 49.9917 S	102 59.9273 W	1.0	P180712r_008.SRP
102	0019758	01/23/08	23:35	30 25.2092 S	103 00.0036 W	11.9	P180712r_009.SRP
102	0019760	01/23/08	23:46	30 25.1544 S	102 59.8634 W	6.5	P180712r_010.SRP
102	0019756	01/23/08	23:53	30 24.9909 S	103 00.0335 W	0.4	P180712r_011.SRP
103	0020001	01/24/08	05:50	31 00.3517 S	103 00.0044 W	11.5	P180712r_012.SRP
103	0020002	01/24/08	06:00	30 59.9979 S	103 00.0173 W	0.6	P180712r_013.SRP
103	0102003	01/24/08	06:05	30 59.9964 S	103 00.0162 W	0.5	P180712r_014.SRP
104	0020004	01/24/08	12:06	31 35.1922 S	103 00.0037 W	12.0	P180712r_015.SRP
104	0020006	01/24/08	12:22	31 35.0216 S	102 59.9965 W	3.6	P180712r_016.SRP
104	0020007	01/24/08	12:30	31 34.9556 S	103 00.0300 W	0.4	P180712r_017.SRP
105	0020011	01/24/08	18:43	32 10.5664 S	103 00.0037 W	11.6	P180712r_018.SRP
105	0020011	01/24/08	18:59	32 10.0135 S	102 59.9669 W	0.4	P180712r_019.SRP
105	0209875	01/24/08	19:03	32 10.0110 S	102 59.9671 W	0.4	P180712r_020.SRP
106	0019805	01/25/08	01:18	32 45.4658 S	102 59.9982 W	10.4	P180712r_021.SRP
106	0020010	01/25/08	01:32	32 44.9254 S	102 59.9730 W	0.3	P180712r_022.SRP
107	0209881	01/25/08	07:55	33 20.0551 S	103 00.0631 W	0.4	P180712r_023.SRP
108	0019799	01/25/08	14:03	33 55.3152 S	103 00.0037 W	11.7	P180712r_024.SRP
108	0019800	01/25/08	14:16	33 54.9003 S	102 59.9717 W	4.1	P180712r_025.SRP
108	0209884	01/25/08	14:29	33 54.8183 S	102 59.8607 W	0.6	P180712r_026.SRP

CTD Stn#	XBT S/N	Drop date mm/dd/yy	Time hh:mm	Latitude Deg Min N/S	Longitude Deg Min E/W	Speed Knots	Filename
109	0019806	01/25/08	20:46	34 29.9995 S	103 00.0051 W	11.3	P180712r_027.SRP
109	0019807	01/25/08	20:58	34 29.9260 S	102 59.9913 W	5.5	P180712r_028.SRP
109	0209885	01/25/08	21:07	34 29.6382 S	103 00.1097 W	0.4	P180712r_029.SRP
110	0019801	01/26/08	03:03	35 05.1816 S	103 00.0040 W	12.0	P180712r_030.SRP
110	0019802	01/26/08	03:16	35 05.0487 S	103 00.0410 W	0.9	P180712r_031.SRP
110	0209882	01/26/08	03:21	35 05.0490 S	103 00.0410 W	0.7	P180712r_032.SRP
111	0019803	01/26/08	09:15	35 40.4052 S	103 00.0041 W	11.4	P180712r_033.SRP
111	0019804	01/26/08	09:30	35 40.0522 S	102 59.9582 W	5.5	P180712r_034.SRP
111	0209879	01/26/08	09:38	35 39.9882 S	103 00.0341 W	0.6	P180712r_035.SRP
112	0014820	01/26/08	15:50	36 15.0043 S	102 59.9888 W	2.7	P180712r_036.SRP
113	0014824	01/26/08	21:27	36 50.3723 S	103 00.0021 W	11.6	P180712r_037.SRP
113	0014828	01/26/08	21:43	36 50.0044 S	102 59.9961 W	0.7	P180712r_038.SRP
113	0209886	01/26/08	21:47	36 50.0064 S	103 00.0005 W	0.6	P180712r_039.SRP
114	0014823	01/27/08	03:57	37 25.3091 S	103 00.0043 W	11.8	P180712r_040.SRP
114	0014827	01/27/08	04:10	37 25.0469 S	102 59.9686 W	0.8	P180712r_041.SRP
115	0014818	01/27/08	10:16	38 00.2958 S	103 00.0047 W	12.1	P180712r_042.SRP
115	0014819	01/27/08	10:29	38 00.0772 S	102 59.9520 W	6.4	P180712r_043.SRP
115	0209880	01/27/08	10:47	38 00.0423 S	103 00.0119 W	0.6	P180712r_044.SRP
116	0014822	01/27/08	17:12	38 35.5659 S	103 00.0036 W	11.8	P180712r_045.SRP
116	0014817	01/27/08	17:25	38 35.0056 S	102 59.9571 W	0.5	P180712r_046.SRP
116	0209883	01/27/08	17:28	38 35.0066 S	102 59.9625 W	0.6	P180712r_047.SRP

8. TAO Buoy Operations

Visits were made to the following 8 sites to service TAO buoys. The positions shown are nominal.

Table 8.0 TAO Buoy Sites Visited

Nominal Latitude	Nominal Longitude	Activity at Buoy Site
8°N	110°W	ATLAS Service SSC/ wind
5°N	110°W	ATLAS Visit
2°N	110°W	ATLAS Recover/Deploy (1 yr Threshold)
0°	110°W	ADCP Recover/Deploy (1 yr Threshold)
0°	110°W	ATLAS Service AT/RH, SSC
2°S	110°W	ATLAS Service Wind, AT/RH
5°S	110°W	ATLAS Deploy
8°S	110°W	ATLAS Deploy

All but the 5°N 110°W and 8°S 110°W buoy site were located close to the P18 section and the deep CTD casts made as part of the P18 line was used as the reference stations for the buoys. The 8°S 110°W required a steam of about 12 hrs each way from the P18 line. A separate CTD cast (997) to approximately 1000 meters depth was made about 1 mile away from the buoy site.

Details on TAO Buoy activities during P18 are available at *http://ndbc.noaa.gov.*

9. Appendix: Bottle Data Quality Code Summary and Comments

This section contains WOCE quality codes [Joyc94] used during this cruise, and remarks regarding bottle data.

Table 9.0 P18 Water Sample Quality Code Summary

Property	1	2	3	4	5	6	7	8	9	Total
Bottle	0	5533	25	71	0	0	0	0	2	5631
$^{13}C/^{14}C$	489	0	0	0	0	0	0	0	0	489
CDOM Abs.@325nm	0	1359	61	0	250	0	0	0	0	1670
CDOM Abs.@340nm	0	1344	74	2	250	0	0	0	0	1670
CDOM Abs.@380nm	0	1235	96	89	250	0	0	0	0	1670
CDOM Abs.@412nm	0	1131	108	181	250	0	0	0	0	1670
CDOM Abs.@443nm	0	622	360	438	250	0	0	0	0	1670
CDOM Abs.@490nm	0	300	163	957	250	0	0	0	0	1670
CDOM Abs.@555nm	0	235	29	1156	250	0	0	0	0	1670
CDOM2c	60	0	0	0	0	0	0	0	0	60
CDOM3c	18	0	0	0	0	0	0	0	0	18
CDOM $S_{\log}$	0	675	598	108	289	0	0	0	0	1670
CDOM S_{nlf}	0	776	489	116	289	0	0	0	0	1670
Chlorophyll a	0	532	0	0	5	0	0	0	0	537
POC	42	0	0	0	0	0	0	0	0	42
CFC-11	0	2874	53	17	29	163	0	0	1	3137
CFC-12	0	2878	47	18	29	164	0	0	1	3137
CCl_4	0	7	7	3095	27	0	0	0	1	3137
SF_6	0	2760	60	16	29	152	0	0	1	3018
Density	331	0	0	0	0	0	0	0	0	331
DIC	0	4116	11	15	8	531	0	0	3	4684
DOC	2796	0	0	0	0	0	0	0	0	2796
^{3}He	703	1	0	0	1	0	0	0	0	705
Tritium	641	0	0	0	0	0	0	0	0	641
$^{15}N/^{18}O$	1517	0	0	0	0	0	0	0	0	1517
Nitrate	0	5271	5	31	40	227	0	0	1	5575
Nitrite	0	5241	36	65	4	228	0	0	1	5575
Phosphate	0	5304	4	32	4	230	0	0	1	5575
Silicic Acid	0	5305	4	32	4	229	0	0	1	5575
ONAR	163	0	0	0	0	0	0	0	0	163
O_2	0	5422	108	34	15	0	0	0	1	5580
pCO_2	0	1046	132	4	0	91	0	0	0	1273
pH	0	3926	54	28	18	477	0	0	1	4504
Salinity	0	5423	123	33	5	0	0	0	1	5585
^{32}Si	88	0	0	0	0	0	0	0	0	88
Total Alkalinity	0	3482	166	102	135	346	0	0	2	4233

Comments from the Sample Logs and the results of STS/ODF's investigations are included in this report. Units used in these comments are degrees Celsius for temperature, PSS-78 salinity, and micromoles/kg for oxygen and nutrient data. The sample number is the cast number times 100 plus the bottle number.

Table 9.1 P18 Bottle Quality Codes and Comments

Station /Cast	Sample No.	Property	Quality Code	Comment
1/1	112	O2	2	O2 value 5-10% high vs CTDO2 on Stas.1, 15-18, 20% on Sta.21 (in min.): 2 rosettes/Niskins, same O2 flask 13. Replicate sample from Flask 14 ok, use O2 value from flask 14. Code acceptable.
2/1	103	Bottle	3	Leak from bottom endcap.
4/1	111	Nitrite	5	Nutrient sampler bottle empty, sample lost.
4/1	111	Nitrate	5	Nutrient sampler bottle empty, sample lost.
4/1	111	Phosphate	5	Nutrient sampler bottle empty, sample lost.
4/1	111	Silicate	5	Nutrient sampler bottle empty, sample lost.
4/1	124	Bottle	3	Leaked from endcap, due to tie-down strap.
4/1	124	O2	9	O2 not sampled due to endcap leak.
6/1	121	O2	5	Program error during titration, O2 sample lost.
6/1	122	CTDS2	3	CTDT2/C2 drifts/spikes at trip, code CTDS2 questionable.
6/1	122	CTDT2	3	CTDT2/C2 drift/spike at trip, code CTDT2 questionable.
7/1	ALL		-	End standard for Stations 7-8 Salt Analysis appears high. Salinity-CTDS differences abnormally low; used start standard for station 9, 40 minutes later, as new end standard. Salinity is now acceptable.
7/1	101	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	101	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	102	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	102	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	103	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	103	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	104	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	104	Salinity	3	Salinity high vs CTDS, code questionable.
7/1	104	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	105	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	105	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	106	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	106	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	107	pCO2	2	pCO2 sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	107	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	107	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	108	DIC	2	DIC sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	108	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	108	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	109	DIC	2	DIC sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	109	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	109	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	110	DIC	2	DIC sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	110	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	110	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	111	DIC	2	DIC sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	111	O2	2	O2 sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	111	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	111	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	112	DIC	2	DIC sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	112	O2	2	O2 sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	112	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	112	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.

Station /Cast	Sample No.	Property	Quality Code	Comment
7/1	113	DIC	2	DIC sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	113	O2	2	O2 sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	113	pH	2	pH sampling delayed 20-30 mins. for boom retraction problem/repair.
7/1	113	TAlk	2	TALK sampling delayed 20-30 mins. for boom retraction problem/repair.
8/1	ALL		-	End standard for Stations 7-8 Salt Analysis appears high. Salinity-CTDS differences abnormally low; used start standard for station 9, 40 minutes later, as new end standard. Salinity is now acceptable.
8/1	103	Bottle	3	Bottom endcap leaking, closed vent between samples to preserve water.
8/1	122	Bottle	2	Niskin ran out of water as last sampler finished.
9/1	101	Bottle	3	Leaks at bottom seal.
9/1	103	Bottle	3	Leaks at bottom seal.
9/1	107	Salinity	3	Salinity low vs CTDS, code questionable.
12/1	113	Bottle	2	3He sampler tube leaked, sample lost (code 5).
12/1	124	Bottle	4	O2 draw Temp same as 500db bottle; lower lanyard unclipped, upper lanyard wrapped around rosette. No samples drawn after DIC. Code as mis-trip.
12/1	124	O2	9	Sample drawn, but discarded after it was determined bottle probably mis-tripped.
13/1	101	Bottle	2	Bottom cap leaks a little.
13/1	101	pH	2	pH cell 1 broken, duplicate drawn in cell 25.
13/1	109	O2	3	O2 value 2 umol/kg high vs CTDO2, Nutrients/Salinity ok. Code questionable.
14/1	101	Bottle	3	Bottom cap leaks (slow).
14/1	102	Bottle	2	Spigot pin missing.
14/1	120	O2	2	O2 Draw Temp not recorded, sample cop did not hear the reading. Use 18 deg.C, based on CTD in situ Temps and draw Ts of nearby niskins.
14/1	124	Bottle	2	Niskin opened/sampled before gases sampled; gases did not sample immediately afterward.
15/1	101	Salinity	3	Salinity value high vs CTDS. Code questionable.
15/1	102	Salinity	3	Salinity value high vs CTDS. Code questionable.
15/1	103	Bottle	3	Leaking from bottom cap. No samples taken.
15/1	104	Bottle	4	O2 Draw Temp 15 deg.C higher than expected; salinity low, nutrients not drawn. Code as mis-trip.
15/1	104	O2	4	O2 value + Draw Temp indicate water from thermocline, not 2900+db; bottle mis-tripped. Code bad.
15/1	104	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
15/1	105	Bottle	4	O2 Draw Temp 4 deg.C higher than expected, salinity low, nutrients not drawn. Code as mis-trip.
15/1	105	O2	4	O2 value + Draw Temp indicate water from O2 min, not 2700+db; bottle mis-tripped. Code bad.
15/1	105	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
15/1	108	Bottle	4	O2 Draw Temp 3 deg.C higher than expected, salinity low, nutrients not drawn. Code as mis-trip.
15/1	108	O2	4	O2 value + Draw Temp indicate water from O2 min, not 2100+db; bottle mis-tripped. Code bad.
15/1	108	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
15/1	110	Bottle	4	O2 Draw Temp 19 deg.C higher than expected, salinity low, nutrients not drawn. Code as mis-trip.
15/1	110	O2	4	O2 value + Draw Temp indicate water from surface, not 1700+db; bottle mis-tripped. Code bad.
15/1	110	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
15/1	112	O2	3	O2 value 5-10% high on Stas.1, 15-18, 20% on Sta.21 (in min.): 2 rosettes/Niskins, same O2 flask 13. Replicate test on Sta 26 was also high, removed flask 13 from sampling lineup. Code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
15/1	115	Bottle	3	Leaking from bottom cap.
15/1	115	O2	3	O2 value +3.3umol/kg compared to CTDO2, salinity ok, no nutrients drawn. Leaking may have affected gas samples: Code questionable.
15/1	119	Bottle	4	Niskin did not trip, no samples.
15/1	122	Bottle	3	Leaking from bottom cap.
15/1	124	CTDS2	4	CTD-C2 sensor cut out, value bad/lost.
15/1	125	CTDS2	4	CTD-C2 sensor cut out, value bad/lost.
15/1	126	CTDS2	4	CTD-C2 sensor cut out, value bad/lost.
15/1	127	Bottle	3	Niskin not air-tight: vent ok, possibly top cap? Only DON, salinity sampled.
15/1	128	Bottle	3	Leaking from bottom cap, no water to sample.
15/1	135	Bottle	3	Leaking from bottom cap, almost no water to sample. Only DON, salinity sampled.
16/1	ALL		-	altimeter erratic: stop approx. 30m above bottom. Used 31.5m height above bottom at btl.1 (from SBE raw/hex data).
16/1	101	Bottle	3	Leaking (drip) from bottom cap.
16/1	101	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	102	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	103	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	104	Bottle	4	O2 Draw Temp only 1 deg.C higher than expected. O2/SiO3 low; NO3/PO4 high. Code as mis-trip.
16/1	104	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	104	Nitrate	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
16/1	104	O2	4	O2 value indicates water from approx. 1300db, not 3000db; O2 Draw Temp is only 1 deg.C high (1300db is 2 deg.C warmer than 3000db). Bottle mis-tripped, Code bad.
16/1	104	Phosphate	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
16/1	104	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
16/1	104	Silicate	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
16/1	105	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	106	Bottle	3	Leaking (drip) from bottom cap.
16/1	106	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	107	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	107	Salinity	3	Salinity value high vs CTDS. Code questionable.
16/1	108	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	108	Salinity	3	Salinity value high vs CTDS. Code questionable.
16/1	109	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	110	Bottle	4	O2 Draw Temp 11-12 deg.C higher than expected, samples drawn anyways. O2 low, nutrients low. Code as mis-trip.
16/1	110	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	110	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
16/1	110	O2	4	O2 value + Draw Temp indicate water from thermocline/above 100db, not 1800db.
16/1	110	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
16/1	110	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
16/1	110	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
16/1	111	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	112	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	112	O2	3	O2 value 5-10% high vs CTDO2 on Stas.1, 15-18, 20% on Sta.21 (in min.): 2 rosettes/Niskins, same O2 flask 13. Replicate test on Sta 26 was also high, removed flask 13 from sampling lineup. Code questionable.
16/1	113	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	114	Bottle	2	Niskin missing safety pin on collar.
16/1	114	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	115	Nitrite	4	Bubble in nitrite flowcell. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
16/1	116	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	117	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	118	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	119	Bottle	4	O2 Draw Temp 9-10 deg.C higher than expected, samples drawn anyways. O2 high, nutrients low. Code as mis-trip.
16/1	119	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	119	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
16/1	119	O2	4	O2 value + Draw Temp indicate water from thermocline/above 100db, not 700db. Code bad.
16/1	119	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
16/1	119	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
16/1	119	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
16/1	120	CTDS2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	120	CTDT2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	120	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	121	CTDS2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	121	CTDT2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	121	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	122	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	123	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	124	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	125	CTDS2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	125	CTDT2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	125	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	126	CTDS2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	126	CTDT2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	126	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	127	CTDS2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	127	CTDT2	4	CTD-T2 sensor cut out, value bad/lost.
16/1	127	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	128	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	128	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	128	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	129	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	129	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	129	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	130	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	130	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	130	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	131	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	131	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	131	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	132	Bottle	2	Spigot easy to open.
16/1	132	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	132	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	132	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	133	Bottle	2	Spigot easy to open.
16/1	133	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	133	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	133	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	134	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.

Station /Cast	Sample No.	Property	Quality Code	Comment
16/1	134	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	134	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	135	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	135	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	135	Nitrite	4	Bubble in nitrite flowcell. Code bad.
16/1	136	CTDS2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	136	CTDT2	4	CTD-T2 and CTD-C2 sensors cut out, value bad/lost.
16/1	136	Nitrite	4	Bubble in nitrite flowcell. Code bad.
17/1	101	Bottle	3	Slow leak from bottom cap; bottom cap O-ring replaced after sampling.
17/1	104	Bottle	4	O2 Draw Temp 15 deg.C higher than expected; Code as mis-trip. All samples discarded. Niskin height and lanyard length adjusted after sampling to improve tension.
17/1	110	Bottle	4	Niskin did not close, lanyard not released by carousel. Niskin height and lanyard length adjusted after sampling to improve tension.
17/1	112	O2	3	O2 value 5-10% high vs. CTDO2 on Stas.1, 15-18, 20% on Sta.21 (in min.): 2 rosettes/Niskins, same O2 flask 13. Replicate test on Sta 26 was also high, removed flask 13 from sampling lineup. Code questionable.
17/1	119	Bottle	2	Niskin height and lanyard length adjusted after sampling to improve tension.
17/1	132	Bottle	2	Spigot is very loose.
17/1	135	Bottle	2	Spigot is loose.
18/1	106	Bottle	4	O2/SiO3/Salinity low, PO4/NO3 high. Code as mis-trip.
18/1	106	Nitrite	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	106	Nitrate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	106	O2	4	O2 value 30 umol/kg low, same as water near 2200db, not 3150db; O2 Draw Temp ok; bottle mis-tripped. Code bad.
18/1	106	Phosphate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	106	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
18/1	106	Silicate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	109	Bottle	3	Leaky, only salt sampled: salinity ok.
18/1	110	Bottle	4	O2/SiO3/Salinity slightly low, PO4/NO3/O2 Draw Temp slightly high. Code as mis-trip.
18/1	110	Nitrite	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	110	Nitrate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	110	O2	4	O2 value 10 umol/kg low, same as water near 2100db, not 2300+db; O2 Draw Temp slightly high; bottle mis-tripped. Code bad.
18/1	110	Phosphate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	110	Salinity	4	Salinity slightly low; bottle mis-tripped. Code bad.
18/1	110	Silicate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
18/1	112	Bottle	2	Niskin spigot pushed in.
18/1	112	O2	3	O2 value 5-10% high vs. CTDO2 on Stas.1, 15-18, 20% on Sta.21 (in min.): 2 rosettes/Niskins, same O2 flask 13. Replicate test on Sta 26 was also high, removed flask 13 from sampling lineup. Code questionable.
18/1	118	Bottle	4	O2 Draw Temp 5 deg.C higher than expected; O2 slightly low, Salinity high, nutrients low. Code as mis-trip.
18/1	118	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
18/1	118	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
18/1	118	O2	4	O2 value 3 umol/kg low, near O2 minimum; nutrients low. Draw Temp from 500db shallower, also in O2 min, bottle mis-tripped. Code bad.
18/1	118	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
18/1	118	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
18/1	118	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
18/1	131	Salinity	2	Salt sampler bottle 931 did not have seal.
19/1	101	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	102	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	103	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	104	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	105	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	106	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	106	O2	5	Program error during titration, O2 sample lost.
19/1	107	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	107	O2	2	Sample sat [open] awhile before titrating, while trying to get program running again.
19/1	108	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	109	CTDS2	3	CTDC2 noise/spiking/offsets on upcast, signal returned at deeper bottle stops. Secondary pump changed after cast. Code CTDS2 questionable.
19/1	110	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	111	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	112	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	113	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	114	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	115	CTDS2	4	Severe CTDC2 noise/spiking/offsets on upcast, near-bottom to 320db. Secondary pump changed after cast. Code CTDS2 bad.
19/1	122	CTDS2	3	CTDT2/C2 sensors noisier in high gradient, probably from secondary pump problems (changed after cast). Code questionable.
19/1	122	CTDT2	4	CTDT2/C2 sensors noisier in high gradient, probably from secondary pump problems (changed after cast). Code questionable.
20/1	106	Bottle	2	Spigot dripping.
20/1	107	Bottle	2	Spigot dripping.
20/1	112	CTDS1	4	CTDC1 sensor offset low/noisy 670-350db upcast. CTD primary pump problems started here. Code bad.
20/1	113	Bottle	2	Spigot dripping.
20/1	113	CTDS1	4	CTDC1 sensor offset low/noisy 670-350db upcast. CTD primary pump problems started here. Code bad.
20/1	114	CTDS1	4	CTDC1 sensor offset low/noisy 670-350db upcast. CTD primary pump problems started here. Code bad.
20/1	115	CTDS1	4	CTDC1 sensor offset low/noisy 670-350db upcast. CTD primary pump problems started here. Code bad.
20/1	123	Salinity	2	Salt bottle 123: no label.
21/1	101	CTDO	4	CTDO2 value 13.5 umol/kg low vs O2, signal drops during bottom approach because of primary pump problems. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
21/1	101	CTDS1	3	CTDC1 sensor somewhat noisy starting 3600db upcast, offset 2480-2280db, very noisy/low 2100-377db, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
21/1	102	CTDS1	3	CTDC1 sensor somewhat noisy starting 3600db upcast, offset 2480-2280db, very noisy/low 2100-377db, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
21/1	103	CTDS1	3	CTDC1 sensor somewhat noisy starting 3600db upcast, offset 2480-2280db, very noisy/low 2100-377db, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
21/1	104	CTDS1	3	CTDC1 sensor somewhat noisy starting 3600db upcast, offset 2480-2280db, very noisy/low 2100-377db, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
21/1	105	CTDS1	3	CTDC1 sensor somewhat noisy starting 3600db upcast, offset 2480-2280db, very noisy/low 2100-377db, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
21/1	106	CTDS1	3	CTDC1 sensor somewhat noisy starting 3600db upcast, offset 2480-2280db, very noisy/low 2100-377db, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
21/1	107	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	108	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	109	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	110	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	111	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	112	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	112	O2	3	O2 value 5-10% high vs CTDO2 on Stas.1, 15-18; 20% on Sta.21 (in min.): 2 rosettes/Niskins, same O2 flask 13. Replicate test on Sta 26 was also high, removed flask 13 from sampling lineup. Code questionable.
21/1	113	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	114	CTDS1	4	CTDC1 sensor very noisy 2100-377db, ok starting 375db trip (niskin 15). CTD primary pump problems. Code bad.
21/1	114	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
21/1	122	CTDS1	3	CTDT1/C1 sensors noisier in high gradient, probably from primary pump problems. Code questionable.
21/1	122	CTDT1	4	CTDT1/C1 sensors noisier in high gradient, probably from primary pump problems. Code questionable.
22/1	ALL		-	Raining during sampling.
22/1	102	Salinity	3	Salinity value high vs CTDS, same as salt from niskin 1. Code questionable.
22/1	111	Salinity	3	Salinity value low vs CTDS. Code questionable.
22/1	118	Bottle	2	Niskin top lid opened while checking niskin 19, sampled first/out of order: lower O2 Draw Temp ok.
22/1	119	Bottle	4	Niskin did not trip
22/1	120	Bottle	4	O2 Draw Temp 2-3 deg.C higher than expected, samples drawn anyways. O2 high, nutrients/salinity low. Code as mis-trip.
22/1	120	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
22/1	120	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
22/1	120	O2	4	high O2 value + Draw Temp indicate water from surface, not 600db. Code bad.
22/1	120	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
22/1	120	Salinity	4	Salinity low; bottle mis-tripped. Code bad.
22/1	120	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
22/1	122	O2	5	Sample discarded before analyzing. Code sample lost.
22/1	132	Bottle	2	Leaking from spigot during sampling.
22/1	136	Bottle	2	Ran out of water as last sampler finished.
23/1	104	Bottle	4	O2/Salinity/SiO3 low, NO3/PO4 high, O2 Draw Temp ok. Data indicate bottle tripped near 2070db. Code as mis-trip.
23/1	104	Nitrite	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
23/1	104	Nitrate	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
23/1	104	O2	4	O2/SiO3 low; NO3/PO4 high; O2 Draw Temp ok; bottle mis-tripped. Code bad.
23/1	104	Phosphate	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
23/1	104	Salinity	4	Salinity 0.017 low, bottle mis-tripped. Code bad.
23/1	104	Silicate	4	SiO3 low, NO3/PO4 high; bottle mis-tripped. Code bad.
23/1	106	O2	3	O2 value 2 umol/kg high vs. CTDO2. O2 Draw Temp ok. Code questionable.
23/1	122	Bottle	4	Niskin did not trip.
24/1	101	O2	3	O2 value 2 umol/kg low vs CTDO2 and nearby casts. Code questionable.
24/1	111	O2	3	O2 value 7 umol/kg high vs CTDO2. Flask 52 O2 values 10-12% high for 5/7 casts from stas.24-42, flask 52 replicate on sta.46 was 11% high; not used again. Code questionable.
24/1	114	O2	3	O2 value 16 umol/kg low. Code questionable.
24/1	118	Bottle	4	O2 Draw Temp 14 deg.C higher than expected. O2 high, nutrients low. Code as mis-trip.
24/1	118	DIC	9	Not sampled due to high O2 Draw Temp; sampler number and checkmark on sample log, crossed off later.
24/1	118	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
24/1	118	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
24/1	118	O2	4	O2 value + Draw Temp indicate water from thermocline/near-surface, not 870db. Code bad.
24/1	118	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
24/1	118	Salinity	4	Salinity -0.075 low vs both CTDS values, bottle mis-tripped. Code bad.
24/1	118	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
24/1	118	TAlk	9	Apparently not sampled due to high O2 Draw Temp; sampler number and checkmark are on sample log.
24/1	129	Salinity	5	Salt bottle cracked, broke with Autosal pressure. Sample lost.
25/1	116	Bottle	2	Possible slow leak.
26/1	109	Bottle	2	"Leak air and bottom cap"
26/1	116	Bottle	2	Leak bottom cap.
26/1	130	DIC	9	Apparently not sampled; sampler number and checkmark on sample log, crossed off later.
26/1	130	O2	2	Extra chemicals added during fixing, but O2 value agrees with CTDO2. Code acceptable.
26/1	136	O2	2	O2 value 22 umol/kg low vs downcast CTDO2 at surface; drop in upcast CTDO2 even lower, value ok?
27/1	102	O2	3	O2 value 4 umol/kg low vs CTDO2. Draw Temp ok, nutrients ok. Code questionable.
27/1	104	Bottle	2	Bottom cap leaks.
27/1	106	O2	3	O2 value 2.5 umol/kg high vs CTDO2. Draw Temp ok, nutrients ok. Code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
27/1	109	O2	3	O2 value 2 umol/kg high vs CTDO2. Draw Temp ok, nutrients ok. Code questionable.
27/1	109	TAlk	5	Sample log shows sample drawn, but never analyzed. Code sample lost.
27/1	110	CTDS1	4	CTDC1 sensor offsets low, 2360-2030db; probably sensor fouling. Code bad.
27/1	111	CTDS1	4	CTDC1 sensor offsets low, 2360-2030db; probably sensor fouling. Code bad.
27/1	116	O2	3	O2 value 4 umol/kg low vs CTDO2. Draw Temp ok, nutrients ok. Code questionable.
27/1	119	Bottle	4	O2 Draw Temp 3 deg.C higher than expected; O2/nutrients low, Salinity high. DIC sample discarded, drawn from niskin 20 instead. Code as mis-trip.
27/1	119	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
27/1	119	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
27/1	119	O2	4	Low O2 value + Draw Temp indicate water from near 300db, not 750db. Code bad.
27/1	119	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
27/1	119	Salinity	4	Salinity high, bottle mis-tripped. Code bad.
27/1	119	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
27/1	121	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	122	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	123	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	124	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	125	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	126	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	127	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	128	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	129	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	130	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	131	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	132	Bottle	2	Bottom cap leaks with vent open.
27/1	132	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	133	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	134	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	135	Bottle	2	Bottom cap leaks with vent open.
27/1	135	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
27/1	136	CTDS1	4	CTDC1 sensor offsets low, 570-125db; probably sensor fouling. Code bad.
28/1	104	Bottle	2	Leaking from bottom cap.
28/1	105	O2	5	Program error during titration, O2 sample lost.
28/1	111	O2	3	O2 value 8 umol/kg high vs CTDO2. Flask 52 O2 values 10-12% high for 5/7 casts from stas.24-42, flask 52 replicate on sta.46 was 11% high; not used again. Code questionable.
28/1	119	Bottle	4	Niskin did not trip.
28/1	133	Bottle	2	Leaking from bottom cap.
28/1	136	O2	3	O2 value 10 umol/kg low vs CTDO2 at surface. Code questionable.
29/2	206	O2	3	O2 value 3 umol/kg high vs CTDO2. Code questionable.
29/2	209	O2	3	O2 value 3 umol/kg high vs CTDO2. Code questionable.
29/2	211	O2	3	O2 value 3.5 umol/kg low vs CTDO2. Code questionable.
29/2	222	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	223	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	224	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	225	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.

Station /Cast	Sample No.	Property	Quality Code	Comment
29/2	226	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	227	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	228	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	229	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	230	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	231	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	232	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	233	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	234	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	235	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
29/2	236	Bottle	4	Niskins 22-36 did not close. Carousel apparently reset itself to trip position 1 after trip 21.
30/1	ALL		-	Started to drizzle, stopped, resumed during sampling.
30/1	101	Bottle	2	Niskin 1 lanyard tangled around niskin 23 hose clamp, yet both caps closed.
30/1	101	CTDO	3	CTDO2 signal drop at cast bottom, likely combination of pump1 problem and slowdown at bottom approach.
30/1	101	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	101	O2	3	O2 value 6 umol/kg low on Theta/O2 profile; CTDO2 drops at bottom, but probably caused by CTD pump problems and winch slowdown near bottom. No nearby casts as deep. Code questionable.
30/1	102	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	103	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	104	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	105	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	106	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	107	CTDS1	3	CTDC1 sensor noisy 3720-2830db upcast, often shifts back during bottle stops. CTD primary pump problems. Code questionable.
30/1	108	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
30/1	109	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
30/1	110	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
30/1	111	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
30/1	112	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
30/1	113	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
30/1	114	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
30/1	115	CTDS1	4	CTDC1 sensor very noisy/low 2500-300db, ok starting 300db. CTD primary pump problems. Code bad.
31/1	101	CTDO	3	CTDO2 signal drop at cast bottom, likely combination of pump1 problem and slowdown at bottom approach.
31/1	101	CTDS1	3	CTDC1 sensor noisy 3200-2000db upcast, CTD primary pump problems. Code questionable.
31/1	101	O2	3	O2 value 3 umol/kg low on Theta/O2 profile; Small CTDO2 drop in bottom 6db probably caused by CTD pump problems and winch slowdown near bottom. Code questionable.
31/1	102	CTDS1	3	CTDC1 sensor noisy 3200-2000db upcast, CTD primary pump problems. Code questionable.
31/1	103	CTDS1	3	CTDC1 sensor noisy 3200-2000db upcast, CTD primary pump problems. Code questionable.
31/1	104	CTDS1	3	CTDC1 sensor noisy 3200-2000db upcast, CTD primary pump problems. Code questionable.
31/1	105	CTDS1	3	CTDC1 sensor noisy 3200-2000db upcast, CTD primary pump problems. Code questionable.
31/1	106	CTDS1	3	CTDC1 sensor noisy 3200-2000db upcast, CTD primary pump problems. Code questionable.
31/1	106	O2	3	O2 value 7 umol/kg low vs CTD; O2 Draw Temp and nutrients ok. Code questionable.
31/1	107	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	108	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	109	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	110	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	111	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	112	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	113	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	114	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	115	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	116	CTDS1	4	CTDC1 sensor very noisy 2000-270db upcast, CTD primary pump problems. Code bad.
31/1	122	CTDO	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
31/1	122	CTDPRS	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.

Station /Cast	Sample No.	Property	Quality Code	Comment
31/1	122	CTDS1	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
31/1	122	CTDS2	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
31/1	122	CTDT1	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
31/1	122	CTDT2	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
31/1	124	O2	2	O2 value 18 umol/kg low vs downcast CTDO2 at surface; drop in upcast CTDO2 matches, value ok?
32/1	106	Bottle	2	Leak bottom cap.
33/1	101	O2	3	O2 value 6 umol/kg low vs CTDO2, O2 Draw Temp and nutrients ok. O2 analyst noted nothing unusual. Code questionable.
33/1	102	O2	3	O2 value 14 umol/kg low vs CTDO2, O2 Draw Temp and nutrients ok. O2 analyst noted nothing unusual. Code questionable.
33/1	104	O2	3	O2 value 9 umol/kg low vs CTDO2, O2 Draw Temp and nutrients ok. O2 analyst noted nothing unusual. Code questionable.
33/1	109	O2	3	O2 value 20+ umol/kg low vs CTDO2, O2 Draw Temp and nutrients ok. O2 analyst noted nothing unusual. Code questionable.
33/1	111	O2	3	O2 value 10 umol/kg low vs CTDO2, O2 Draw Temp and nutrients ok. O2 analyst noted nothing unusual. Code questionable.
33/1	115	Bottle	2	Spigot changed after sampling.
33/1	132	Bottle	2	Spigot changed after sampling.
33/1	133	Bottle	4	Bottle did not trip.
33/1	134	Bottle	2	Spigot changed after sampling.
33/1	136	O2	2	O2 value 18 umol/kg low vs downcast CTDO2 at surface; drop in upcast CTDO2 matches, value ok?
34/1	104	Bottle	2	bottom cap leaks after vent opened.
34/1	113	Salinity	2	salinity bottle 613 cracked - not used; substituted bottle 06.
34/1	116	O2	3	O2 value 11.5 umol/kg low vs CTDO2, O2 Draw Temp ok. Code questionable.
34/1	133	O2	3	O2 value 7.5 umol/kg low vs CTDO2, O2 Draw Temp ok. Code questionable.
34/1	135	O2	3	O2 value 25 umol/kg low vs CTDO2, O2 Draw Temp ok. Code questionable.
35/1	101	Bottle	2	Spigot changed for a new one after sampling.
35/1	101	Salinity	3	Salinity low vs CTDS, code questionable.
35/1	106	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
35/1	109	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
35/1	133	Bottle	9	Cap caught on lanyard - no water.
36/1	116	Bottle	2	Leaks from bottom cap.
36/1	133	Bottle	2	Leaks from bottom cap (drip).
36/1	135	Bottle	2	Vents left open
36/1	136	Bottle	2	Vents left open
37/1	101	Salinity	3	Salinity low vs CTDS, code questionable.
37/1	111	O2	3	O2 value 10 umol/kg high vs CTDO2. Flask 52 O2 values 10-12% high for 5/7 casts from stas.24-42, flask 52 replicate on sta.46 was 11% high; not used again. Code questionable.
38/1	101	O2	3	O2 15 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
38/1	103	O2	3	O2 15 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
38/1	105	O2	3	O2 8 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
38/1	107	O2	3	O2 4 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
38/1	110	Bottle	4	O2/SiO3 low, PO4/NO3 high; Salinity/O2 Draw Temp ok. Code as mis-trip.
38/1	110	Nitrite	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
38/1	110	Nitrate	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
38/1	110	O2	4	O2 10 umol/kg low vs CTD, O2 Draw Temp ok; nutrients also bad, bottle mis-tripped. Code bad.
38/1	110	Phosphate	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
38/1	110	Salinity	2	Salinity ok, despite probable mis-trip. Code acceptable.
38/1	110	Silicate	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
38/1	119	Bottle	2	Leaks from stopcock.
38/1	134	O2	3	O2 6 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
38/1	136	O2	3	O2 28 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
39/1	101	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	102	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	103	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	104	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	104	O2	3	O2 value 5 umol/kg low vs CTD, O2 Draw Temp ok. Code questionable.
39/1	105	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	106	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	107	CTDS1	3	CTDC1 sensor noisy most of upcast until surface mixed layer, offset back during bottle stops first 7 niskins; sea"slime" on rosette near sensors after cast. Code questionable.
39/1	108	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	109	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	110	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	111	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	112	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	113	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	114	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	115	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	116	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	117	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
39/1	118	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	119	Bottle	4	O2 Draw Temp 4 deg.C higher than expected, O2/nutrients low, salinity high. Code as mis-trip.
39/1	119	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	119	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
39/1	119	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
39/1	119	O2	4	O2 value low, O2 Draw Temp high; bottle mis-tripped. Code bad.
39/1	119	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
39/1	119	Salinity	4	Salinity 0.3 high, bottle mis-tripped. Code bad.
39/1	119	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
39/1	120	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	121	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	122	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	123	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	124	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	125	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	126	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	127	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	128	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	129	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	130	CTDO	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
39/1	130	CTDPRS	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
39/1	130	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	130	CTDS2	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
39/1	130	CTDT1	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
39/1	130	CTDT2	2	Trip not flagged by SeaSoft, missing in .bl file; estimated trip time to generate CTD info for trip.
39/1	131	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	132	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.
39/1	133	Bottle	9	Niskin did not close: lanyard of niskin 32 tangled on bottom cap of niskin 33.
39/1	133	CTDS1	4	CTDC1 sensor noisy most of upcast until surface mixed layer; sea"slime" on rosette near sensors after cast. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
40/1	108	pH	2	pH cell 8 broken, sample retaken with cell 42.
40/1	111	O2	3	O2 value 11 umol/kg high vs CTDO2. Flask 52 O2 value 10-12% high for 5/7 casts from stas.24-42, flask 52 replicate on sta.46 was 11% high; not used again. Code questionable.
40/1	112	CTDO	3	CTD pumps off 1 min. at 1587-1648db after signal cut-out, CTDO2 signal low
40/1	118	Bottle	4	O2 Draw Temp 14 deg.C higher than expected: O2 high, nutrients low: near-surface values. Code as mis-trip.
40/1	118	DIC	9	Not sampled due to high O2 Draw Temp; sampler number on sample log crossed off later.
40/1	118	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
40/1	118	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
40/1	118	O2	4	O2 value high; bottle mis-tripped. Code bad.
40/1	118	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
40/1	118	Salinity	4	Salinity low, bottle mis-tripped. Code bad.
40/1	118	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
40/1	136	Bottle	2	Ran out of water during tritium sample, bubbles went into tritium sample bottle (sampled with flag).
40/1	136	Salinity	9	No water left to take salt sample.
41/1	112	CTDO	3	CTD pumps off 1 min. at 1433-1496db after signal cut-out, CTDO2 signal low
41/1	112	O2	2	O2 value appears to be a bit high, but matches upcast CTDO2. Code acceptable.
41/1	112	Salinity	3	Salinity value high vs CTDS. Code questionable.
42/1	101	Bottle	2	Winch level-wind problems, 30-min. delay and yoyo back down from 3140 to 3277db after tripping Niskins 1-4; yoyo went deeper than Niskin 4 only.
42/1	101	pCO2	2	pCO2 sampling started late (CFC at niskin 14, TALK at niskin 11).
42/1	102	Bottle	2	Winch level-wind problems, 30-min. delay and yoyo back down from 3140 to 3277db after tripping Niskins 1-4; yoyo went deeper than Niskin 4 only.
42/1	103	Bottle	2	Winch level-wind problems, 30-min. delay and yoyo back down from 3140 to 3277db after tripping Niskins 1-4; yoyo went deeper than Niskin 4 only.
42/1	103	pCO2	2	pCO2 sampling started late (CFC at niskin 14, TALK at niskin 11).
42/1	103	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
42/1	104	Bottle	2	Winch level-wind problems, 30-min. delay and yoyo back down from 3140 to 3277db after tripping Niskins 1-4; yoyo went deeper than Niskin 4 only.
42/1	104	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
42/1	105	pCO2	2	pCO2 sampling started late (CFC at niskin 14, TALK at niskin 11).
42/1	107	pCO2	2	pCO2 sampling started late (CFC at niskin 14, TALK at niskin 11).
42/1	109	pCO2	2	pCO2 sampling started late (CFC at niskin 14, TALK at niskin 11).
42/1	111	O2	3	O2 value 11 umol/kg high vs CTDO2. Flask 52 O2 value 10-12% high for 5/7 casts from stas.24-42, flask 52 replicate on sta.46 was 11% high, not used again. Code questionable.
42/1	112	pCO2	2	pCO2 sampling started late (CFC at niskin 14, TALK at niskin 11).
42/1	119	Bottle	4	Niskin did not trip.
43/1	112	Bottle	4	O2 Draw Temp ok; O2/Salinity high. Code as mis-trip.
43/1	112	O2	3	O2 value 5 umol/kg high vs CTDO2. Code questionable.
43/1	112	Salinity	3	Salinity high vs CTDS. Code questionable.
43/1	113	Salinity	3	Salinity value high vs CTDS. Code questionable.
43/1	118	Bottle	2	Niskin height adjusted, lower lanyards knotted after sampling.
43/1	119	Bottle	2	Niskin height adjusted, lower lanyards knotted after sampling.
43/1	128	TAlk	9	Sample log says TAlk sampler 11 drawn from niskin 28, but value reported for 27. Other CO2 samples drawn from 28, probably this one was as well. Code niskin 28 as not sampled.
43/1	129	O2	5	Program error during titration, O2 sample lost.

Station /Cast	Sample No.	Property	Quality Code	Comment
44/1	106	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
44/1	109	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
44/1	128	DIC	2	replicate B40 taken at end of sampling (B28 might have been drawn from niskin 29).
45/1	104	Salinity	3	Salinity value high vs CTDS, code questionable.
45/1	114	CTDO	3	CTD pumps off 3 mins. at 1120-1309db after 3 back-to-back signal cut-outs, CTDO2 signal low
45/1	115	CTDO	3	CTD pumps off 3 mins. at 1120-1309db after 3 back-to-back signal cut-outs, CTDO2 signal low
45/1	116	Bottle	2	Leaks at bottom cap.
46/1	133	Bottle	2	Small leak from bottom cap.
47/1	106	Bottle	2	Leaks from bottom cap, replaced O-ring with Buna-N after cast.
47/1	106	O2	3	O2 value 5 umol/kg high vs CTDO2, code questionable.
47/1	109	O2	3	O2 value 3 umol/kg high vs CTDO2, code questionable.
47/1	120	pH	9	Apparently pH not sampled: sampler number written on sample log, but not checked off.
47/1	134	O2	5	Program error during titration, O2 sample lost.
48/1	101	Salinity	2	extra samples Z1-Z4 drawn for backup autosal test/cross-calibration.
48/1	105	Bottle	2	air vent unscrewed/dropped into ocean, replaced during O2 sampling.
48/1	105	O2	3	O2 value 3 umol/kg high vs CTDO2, code questionable.
48/1	115	CTDO	3	CTD pumps off 1 min. at 1142-1204db after signal cut-out, CTDO2 signal low.
49/1	101	Salinity	3	Salinity low vs CTDS, code questionable.
49/1	105	Bottle	4	O2 Draw Temp 1 deg.C high. O2/Salinity/SiO3 low, PO4/NO3 high. Code as mis-trip.
49/1	105	Nitrite	4	SiO3 slightly low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	105	Nitrate	4	SiO3 slightly low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	105	O2	3	O2 value 23 umol/kg low vs CTDO2, O2 Draw Temp 1 deg.C high; bottle mis-tripped. Code questionable.
49/1	105	Phosphate	4	SiO3 slightly low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	105	Salinity	3	Salinity low vs CTDS; bottle mis-tripped. Code questionable.
49/1	105	Silicate	4	SiO3 slightly low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	106	Bottle	4	O2 Draw Temp 1 deg.C high. O2/Salinity/SiO3 low, PO4/NO3 high. Code as mis-trip.
49/1	106	Nitrite	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	106	Nitrate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	106	O2	3	O2 value 47 umol/kg low vs CTDO2, O2 Draw Temp 1 deg.C high; bottle mis-tripped. Code questionable.
49/1	106	Phosphate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	106	Salinity	3	Salinity low vs CTDS; bottle mis-tripped. Code questionable.
49/1	106	Silicate	4	SiO3 low, PO4/NO3 high; bottle mis-tripped. Code bad.
49/1	116	Bottle	2	C14 bottle 4379 has cap 4479
49/1	118	Bottle	4	Niskin did not close.
50/1	107	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
50/1	110	Bottle	2	Niskins 10-12 sampled first, then 1-9, to facilitate maintenance on niskins. O2 Draw Temps lower than surrounding bottles, ok.
50/1	110	Nitrite	9	Nutrients not drawn before water dumped from niskin.
50/1	110	Nitrate	9	Nutrients not drawn before water dumped from niskin.
50/1	110	Phosphate	9	Nutrients not drawn before water dumped from niskin.
50/1	110	Silicate	9	Nutrients not drawn before water dumped from niskin.
50/1	111	Bottle	2	Niskins 10-12 sampled first, then 1-9, to facilitate maintenance on niskins. O2 Draw Temps lower than surrounding bottles, ok.

Station /Cast	Sample No.	Property	Quality Code	Comment
50/1	112	Bottle	2	Niskins 10-12 sampled first, then 1-9, to facilitate maintenance on niskins. O2 Draw Temps lower than surrounding bottles, ok.
50/1	115	O2	3	CTD pumps off 1 min. at 1202-1225db after signal cut-out, CTDO2 signal low.
50/1	116	Bottle	2	Slightly leaking from bottom.
50/1	124	Bottle	4	Niskin 24 did not close.
50/1	127	Nitrite	5	Nutrient sample spilled, code sample lost.
50/1	127	Nitrate	5	Nutrient sample spilled, code sample lost.
50/1	127	Phosphate	5	Nutrient sample spilled, code sample lost.
50/1	127	Silicate	5	Nutrient sample spilled, code sample lost.
50/1	135	Bottle	2	Small leak from [no details].
51/1	ALL		-	Air vents cap changed on all bottles.
51/1	101	CTDO	3	CTDO2 signal drop at cast bottom, likely combination of pump1 problem and slowdown at bottom approach. Bottle O2 value matches Theta/O2 profile.
51/1	101	CTDS1	3	CTDC1 sensor noisy most of upcast, offsets back at most deeper bottle stops. CTD primary pump problems. Code questionable.
51/1	102	CTDS1	3	CTDC1 sensor noisy most of upcast, offsets back at most deeper bottle stops. CTD primary pump problems. Code questionable.
51/1	103	CTDS1	4	CTDC1 sensor noisy most of upcast, offsets back at most deeper bottle stops. CTD primary pump problems. Code bad.
51/1	103	Salinity	3	Salinity value low vs CTDS, code questionable.
51/1	104	CTDS1	3	CTDC1 sensor noisy most of upcast, offsets back at most deeper bottle stops. CTD primary pump problems. Code questionable.
51/1	104	Salinity	3	Salinity value high vs CTDS, code questionable.
51/1	105	CTDS1	3	CTDC1 sensor noisy most of upcast, offsets back at most deeper bottle stops. CTD primary pump problems. Code questionable.
51/1	106	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	107	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	108	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	109	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	110	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	111	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	112	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	113	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	114	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	115	CTDS1	4	CTDC1 sensor very noisy 2300-277db upcast, back to normal at 275db/niskin 116 bottle stop. CTD primary pump problems. Code bad.
51/1	115	CTDT1	3	CTDT1 sensor noisier in high gradient, probably from primary pump problems. Code questionable.
51/1	124	Bottle	4	Niskin did not trip.
52/1	ALL		-	LADCP and battery pack attached to 24-plc. rosette after cast. Altimeter spiky at bottom, estim. 15-18m; used 15.5m height above bottom at btl.1 (from SBE raw/hex data).

Station /Cast	Sample No.	Property	Quality Code	Comment
52/1	101	O2	3	O2 value 7 umol/kg low vs CTDO2, Code questionable.
52/1	102	O2	3	O2 value 7 umol/kg low vs CTDO2, Code questionable.
52/1	111	O2	3	O2 value 7 umol/kg low vs CTDO2, Code questionable.
52/1	113	Bottle	2	Spigot drips.
53/1	101	O2	3	O2 value 6 umol/kg low vs CTDO2, Code questionable.
53/1	107	O2	3	O2 value 2 umol/kg high vs CTDO2, Code questionable.
54/1	116	Bottle	2	Small leak.
55/1	ALL		-	Deck lights out during sampling. No reading from altimeter, poor pinger return; approx. 20-40m off at cast bottom. Used 36.5m height above bottom at btl.1 (from SBE raw/hex data).
55/1	107	O2	3	O2 value 3 umol/kg high vs CTDO2, code questionable.
55/1	110	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
55/1	116	Bottle	2	Small leak from bottom cap.
55/1	134	O2	2	O2 draw temperature corrected from 23.9 to 22.9.
55/1	136	O2	3	O2 value 5 umol/kg high vs nearby casts and other near-surface bottles within cast. Code questionable.
56/1	ALL		-	Extra set of salts taken for an experiment, using Sal box 1000.
56/1	106	Salinity	3	Salinity value high vs CTDS. Code questionable.
56/1	110	Salinity	3	Salinity value high vs CTDS, matches salt from niskin 9. Code questionable.
56/1	111	Salinity	3	Salinity value high vs CTDS, matches salt from niskin 9. Code questionable.
56/1	115	Salinity	3	Salinity value low vs CTDS. Code questionable.
56/1	127	pH	5	pH sample logged/checked off as sampled, but never analyzed. Code lost.
56/1	129	Nitrite	5	Nutrient sample spilled, code sample lost.
56/1	129	Nitrate	5	Nutrient sample spilled, code sample lost.
56/1	129	Phosphate	5	Nutrient sample spilled, code sample lost.
56/1	129	Silicate	5	Nutrient sample spilled, code sample lost.
57/1	123	Bottle	2	Leaks from the bottom.
57/1	127	he	5	Sample tube leaked, sample lost.
58/1	ALL		-	altimeter unreliable 100m dab to bottom, 10-12m off? Used 14m height above bottom at btl.1 (from SBE raw/hex data).
59/1	102	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	103	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	104	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	106	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	107	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	107	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
59/1	108	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	108	Salinity	3	Salinity high vs CTDS, code questionable.
59/1	109	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	110	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	110	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
59/1	111	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	112	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	113	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	113	Salinity	3	Salinity high vs CTDS, code questionable.
59/1	114	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	114	Salinity	3	Salinity high vs CTDS, code questionable.
59/1	115	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	116	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	117	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	118	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
59/1	119	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	120	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	121	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	122	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	123	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	124	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	125	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	126	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	127	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	128	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	129	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	130	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	131	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	132	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	133	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	134	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	135	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	136	Nitrite	3	Nitrite values high, bubble caught in system. Code questionable.
59/1	136	O2	3	O2 value 4 umol/kg high vs CTDO2 and nearby surface bottles, code questionable.
60/1	ALL		-	altimeter kicked in only after already stopped, approx. 15m off bottom. Used 19m height above bottom at btl.1 (from SBE raw/hex data).
61/1	ALL		-	Spigots changed on "some" bottles; a wave splashed on deck while collecting TALK and pH samples from outboard bottles (perhaps niskins 9-12?)
62/1	101	Salinity	3	Salinity low vs CTDS, code questionable.
62/1	106	Salinity	2	salt bottle 606 broken, new bottle labeled 606 also.
63/1	134	O2	5	Sensor not immersed before starting titration. Code sample lost.
64/1	116	Bottle	2	Leak from bottom cap.
64/1	136	O2	2	O2 value was 2.5 umol/kg high: flask typo, fixed. Code acceptable.
65/1	104	O2	5	Lost sample due to computer error.
65/1	106	Salinity	3	Salinity high vs CTDS, code questionable.
65/1	116	Bottle	2	O2 draw temperature corrected from 9.8 to 8.8. O2, Salinity and Silicate indicate probable mis-trip, possibly original draw T was right. Code as mis-trip.
65/1	116	Nitrite	3	Bottle apparently mis-tripped. Code bad.
65/1	116	Nitrate	3	Nitrate seems ok, but bottle apparently mis-tripped. Code bad.
65/1	116	O2	3	O2 value 34 umol/kg low vs CTDO2, bottle apparently mis-tripped. Code questionable.
65/1	116	Phosphate	3	Phosphate slightly low, bottle apparently mis-tripped. Code questionable.
65/1	116	Salinity	3	Salinity high vs CTDS, bottle apparently mis-tripped. Code questionable.
65/1	116	Silicate	3	Silicate low, bottle apparently mis-tripped. Code questionable.
65/1	118	O2	3	O2 value 14 umol/kg low vs CTDO2. Code questionable.
66/1	101	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	102	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	103	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	104	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	105	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
66/1	106	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	107	Bottle	3	Leaking from bottom cap. Samples for all gases taken despite the leaking. High O2 value, Code as leaking.
66/1	107	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	107	O2	4	O2 value 6 umol/kg high vs CTDO2. Bottle leaking. Code bad.
66/1	108	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	109	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	110	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	111	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	111	O2	2	O2 sample taken after quadruplicate He sampling.
66/1	112	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	113	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	114	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	115	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	116	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	117	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	118	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	119	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	120	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	121	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	122	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	123	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	124	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	125	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	126	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	127	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	128	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
66/1	129	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	130	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	131	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	132	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	133	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	134	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	135	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
66/1	136	CTDS2	4	CTDC2 sensor dying, large offset at bottom, drifts back to "ok" by 500db. Code CTDS2 bad.
67/1	ALL		-	styrofoam cups went down with CTD, attached to bottom rung
67/1	117	he	2	Helium taken after oxygen
67/1	129	Salinity	5	Salinity bottle 129 empty in box. Code sample lost.
68/1	106	Bottle	4	O2 Draw Temp slightly elevated; O2 lost, SiO3 low, PO4/NO3 high. Code as mis-trip.
68/1	106	Nitrite	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
68/1	106	Nitrate	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
68/1	106	O2	5	Instrument error, oxygen reading was 511k. Code sample lost.
68/1	106	Phosphate	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
68/1	106	Salinity	4	Salinity low, bottle mis-tripped. Code bad.
68/1	106	Silicate	4	SiO3 low, PO4/NO3 high, bottle mis-tripped. Code bad.
68/1	133	O2	3	O2 value 10 umol/kg high vs CTDO2 and nearby oxygen values. Code questionable.
69/1	106	Bottle	4	O2 Draw Temp 0.5 deg.C high; O2/Salt/SiO3 low, PO4/NO3 high. Code as mis-trip.
69/1	106	Nitrite	4	SiO3 low, PO4/NO3 high. Bottle mis-tripped, code bad.
69/1	106	Nitrate	4	SiO3 low, PO4/NO3 high. Bottle mis-tripped, code bad.
69/1	106	O2	4	Oxygen value 25 umol/kg low vs CTDO2. O2 Draw Temp 0.5 deg.C high. Bottle mis-tripped, code bad.
69/1	106	Phosphate	4	SiO3 low, PO4/NO3 high. Bottle mis-tripped, code bad.
69/1	106	Salinity	4	Salinity low vs CTDS. Bottle mis-tripped, code bad.
69/1	106	Silicate	4	SiO3 low, PO4/NO3 high. Bottle mis-tripped, code bad.
69/1	110	Salinity	3	Salinity slightly high vs CTDS, code questionable.
69/1	113	Salinity	3	Salinity slightly high vs CTDS, code questionable.
69/1	118	Bottle	4	Did not trip.
69/1	119	Salinity	3	Salinity high vs CTDS, code questionable.
70/1	122	O2	5	Sensor not immersed before starting titration. Code sample lost.
70/1	126	O2	5	Sensor not immersed before starting titration. Code sample lost.
71/1	ALL		-	Drizzle during sampling. DOC/DON started sampling last.
71/1	101	Salinity	3	Salinity slightly low, code questionable.
71/1	112	Bottle	2	DIC sample bottle B12 broken. Sample re-drawn in A12.
71/1	135	Bottle	2	Bottle drips at bottom cap.
72/1	113	Salinity	3	Salinity slightly high, code questionable.
72/1	135	Bottle	2	Spigot leaks when open.
73/1	ALL		-	All CDOM sampled immediately after oxygen (vs after nutrients) due to possible CDOM sample contamination.
73/1	101	Salinity	3	Salinity slightly low, code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
73/1	102	Salinity	3	Salinity slightly high, code questionable.
73/1	104	Bottle	2	Leaking from bottom.
73/1	106	Salinity	3	Salinity slightly high, code questionable.
73/1	108	Bottle	2	3He sampled immediately after cast on deck, quadruplicate sample.
73/1	108	O2	2	Oxygen sampled in usual sequence, after quad. 3He samples. O2 Draw Temp. higher/ok.
73/1	118	Bottle	4	Did not close, no water. Code as mis-trip.
74/1	107	O2	3	Oxygen value 12 umol/kg high vs CTDO2. O2 Draw Temp ok, since cfc drawn first. Nutrients ok. Code questionable.
74/1	118	Bottle	4	Bottle did not trip. Code as mis-trip.
75/1	108	Salinity	3	Salinity slightly high, code questionable.
75/1	118	Bottle	4	O2 Draw Temp 12 deg.C higher than expected. O2/Salinity/NO2 very high, Other nutrients very low. Code as mis-trip.
75/1	118	Nitrite	4	Nitrite very high, bottle mis-tripped. Code bad.
75/1	118	Nitrate	4	Silicate/Phosphate/Nitrate very low, bottle mis-tripped. Code bad.
75/1	118	O2	4	O2 value from near 200db, draw Temp 12 deg.C high. Bottle mis-tripped. Code bad.
75/1	118	Phosphate	4	Silicate/Phosphate/Nitrate very low, bottle mis-tripped. Code bad.
75/1	118	Salinity	4	Salinity very high vs CTDS, bottle mis-tripped. Code bad.
75/1	118	Silicate	4	Silicate/Phosphate/Nitrate very low, bottle mis-tripped. Code bad.
75/1	136	Salinity	2	Started to drizzle at salt 936 (rained afterwards).
76/1	ALL		-	replicate cdom sampled with freon polycarbonate tip for comparison. Replicate salts drawn.
76/1	118	Bottle	4	Bottle did not close. Code as mis-trip.
76/1	123	O2	3	O2 value 13 umol/kg low vs CTDO2. Code questionable.
76/1	123	Salinity	3	Salinity value high vs CTDS, code questionable.
76/1	128	O2	3	O2 value 8.5 umol/kg high vs CTDO2. Code questionable.
77/1	111	Salinity	2	Salt flask broken. Sample retaken in a new flask.
77/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92: same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Code questionable.
77/1	131	O2	2	O2 value matches feature in down+up CTDO2. Code acceptable.
78/1	ALL		-	altimeter rdg. disappeared 110m off bottom; dab estim. as 15-20m by pinger. Used 30.5m height above bottom at btl.1 (from SBE raw/hex data).
78/1	125	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	126	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	127	pH	2	pH sample from niskin 27 was drawn after niskin 36 drawn.
78/1	127	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92: same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Code questionable.
78/1	128	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	129	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	130	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	131	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	132	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	133	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	134	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	135	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
78/1	136	Salinity	2	Started to drizzle 2/3 of the way through sampling (˜bottle 25)
79/1	108	Bottle	4	O2 Draw Temp 12 deg.C higher than expected. O2/Salinity/NO2 high, other nutrients low. Code as mis-trip.

Station /Cast	Sample No.	Property	Quality Code	Comment
79/1	108	Nitrite	4	Nitrite very high, bottle mis-tripped. Code bad.
79/1	108	Nitrate	4	Silicate/Phosphate/Nitrate very low, bottle mis-tripped. Code bad.
79/1	108	O2	4	O2 value from near-surface, draw Temp 12 deg.C high. Bottle mis-tripped. Code bad.
79/1	108	Phosphate	4	Silicate/Phosphate/Nitrate very low, bottle mis-tripped. Code bad.
79/1	108	Salinity	4	Salinity value very high, Bottle mis-tripped. Code bad.
79/1	108	Silicate	4	Silicate/Phosphate/Nitrate very low, bottle mis-tripped. Code bad.
79/1	110	O2	5	Titration system crashed 3x, lost samples.
79/1	111	O2	5	Titration system crashed 3x, lost samples.
79/1	112	O2	5	Titration system crashed 3x, lost samples.
79/1	128	O2	3	O2 value 5.5 umol/kg high vs CTDO2. Code questionable.
80/1	ALL		-	Salts sampled before nutrients.
80/1	101	Salinity	3	Salinity slightly low vs CTDS, code questionable.
80/1	110	Bottle	4	O2, O2 Draw Temp and nutrients match values from bottle 11. Code as mis-trip.
80/1	110	Nitrite	4	Nutrients match values from bottle 11, bottle mis-tripped. Code bad.
80/1	110	Nitrate	4	Nutrients match values from bottle 11, bottle mis-tripped. Code bad.
80/1	110	O2	4	O2 value 12 umol/kg low vs CTDO2, matches value from bottle 11; bottle mis-tripped. Code bad.
80/1	110	Phosphate	4	Nutrients match values from bottle 11, bottle mis-tripped. Code bad.
80/1	110	Salinity	4	Salinity low, matches value from bottle 11; bottle mis-tripped. Code bad.
80/1	110	Silicate	4	Nutrients match values from bottle 11, bottle mis-tripped. Code bad.
80/1	119	DIC	5	Sample lost - sampler bottle broken.
80/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92: same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Code questionable.
81/1	114	Bottle	2	Bottom cap drips.
81/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92, same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Code questionable.
82/1	101	Salinity	3	Salinity slightly low vs CTDS. Code questionable.
82/1	108	Bottle	4	O2 Draw Temp 0.5 deg.C high; O2/Salinity low, Nutrients slightly low. Code as mis-trip.
82/1	108	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	108	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	108	O2	4	O2 value 3.5 umol/kg low vs CTDO2, O2 Draw Temp 0.5 deg.C high vs. nearby bottles. Bottle mis-tripped, Code bad.
82/1	108	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	108	Salinity	4	Salinity low vs CTDS, bottle mis-tripped. Code bad.
82/1	108	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	118	Bottle	4	O2 Draw Temp 0.5-1.0 deg.C high; O2/Salinity/Nutrients low. Code as mis-trip.
82/1	118	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	118	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	118	O2	4	O2 value 2.5 umol/kg low vs CTDO2, O2 Draw Temp high; bottle mis-tripped. Code bad.
82/1	118	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	118	Salinity	4	Salinity low vs CTDS, bottle mis-tripped. Code bad.
82/1	118	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
82/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92: same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Code questionable.
83/1	108	O2	2	A quadruplicate sample of He was taken before oxygen.

Station /Cast	Sample No.	Property	Quality Code	Comment
83/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92: same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Code questionable.
84/1	116	Bottle	4	O2/O2 Draw Temp ok, but Nutrients/Salinity fit profiles 50+db shallower. Bottle apparently mis-tripped, code as mis-trip.
84/1	116	Nitrite	4	Nutrients slightly low, bottle apparently mis-tripped. Code bad.
84/1	116	Nitrate	4	Nutrients slightly low, bottle apparently mis-tripped. Code bad.
84/1	116	O2	4	O2 value ok vs CTDO2, O2 Draw Temp ok. O2 similar in area where bottle apparently mis-tripped, code questionable.
84/1	116	Phosphate	4	Nutrients slightly low, bottle apparently mis-tripped. Code bad.
84/1	116	Salinity	4	Salinity value low vs CTDS, bottle apparently mis-tripped. Code questionable.
84/1	116	Silicate	4	Nutrients slightly low, bottle apparently mis-tripped. Code bad.
84/1	128	Bottle	3	Bottle 28 leaking with air valve closed. Rapid leak. Top cap O-ring replaced with Viton. O2 sampled anyways.
85/1	ALL		-	Samples drawn from Niskin 19 first, then back to typical order until ONAR ready to draw another sample.
85/1	107	Salinity	3	Salinity slightly high, code questionable.
85/1	118	Bottle	4	O2 Draw Temp 2-2.5 deg.C higher than expected; O2 value ok, Nutrients/Salinity low, could have tripped around 500db. Code as mis-trip.
85/1	118	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
85/1	118	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
85/1	118	O2	4	O2 value ok, but bottle mis-tripped. Code bad.
85/1	118	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
85/1	118	Salinity	4	Salinity low vs CTDS, bottle mis-tripped. Code bad.
85/1	118	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
85/1	127	O2	2	O2 value 5 umol/kg high vs CTDO2, but matches upcast feature. Code acceptable.
85/1	128	O2	3	O2 value 10 umol/kg high vs CTDO2. Code questionable.
86/1	ALL		-	Styrofoam cups down with cast.
87/1	128	O2	3	O2 value 9 umol/kg high vs CTDO2, code questionable.
87/1	129	Bottle	3	Bottle 29 leaking from the bottom. O2 sample taken anyways.
88/1	101	Salinity	3	Salinity slightly low vs CTDS, code questionable.
88/1	106	O2	3	Oxygen 2 umol/kg low vs CTDO2, code questionable.
88/1	106	Salinity	3	Salinity low vs CTDS, code questionable.
88/1	119	Bottle	2	Spigot changed after cast.
88/1	124	O2	3	O2 value 50 umol/kg low vs CTDO2, code questionable.
88/1	127	Bottle	3	Upper end cap leak, no samples taken. Spigot changed after cast.
88/1	129	Bottle	2	Bottom cap o-ring replaced before cast.
89/1	ALL		-	End standard for Stations 89-90 Salt Analysis appears high. Salinity-CTDS differences abnormally low; re-updated without an end standard/no drift. Salinity is now acceptable.
89/1	107	Bottle	2	Niskin fired on-the-fly at 25 m/min, samples may not be accurate.
89/1	124	Bottle	4	O2 Draw Temp 8+ deg.C high; O2/Nutrients/Salinity from near-surface mixed layer. Code as mis-trip.
89/1	124	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
89/1	124	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
89/1	124	O2	4	O2 value high vs CTDO2, O2 Draw Temp high bottle mis-tripped. Code bad.
89/1	124	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
89/1	124	Salinity	4	Salinity high vs CTDS, bottle mis-tripped. Code bad.
89/1	124	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
89/1	128	O2	3	O2 value 10 umol/kg high vs CTDO2, code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
90/1	ALL		-	End standard for Stations 89-90 Salt Analysis appears high. Salinity-CTDS differences abnormally low; re-updated without an end standard/no drift. Salinity is now acceptable.
90/1	118	Bottle	4	O2 Draw Temp 4+ deg.C high; O2/Salinity high, Nutrients low - tripped near 370db. Code as mis-trip.
90/1	118	Nitrite	4	Nutrients low, bottle mis-tripped. Code bad.
90/1	118	Nitrate	4	Nutrients low, bottle mis-tripped. Code bad.
90/1	118	O2	4	O2 value high vs CTDO2, O2 Draw Temp high, bottle mis-tripped. Code bad.
90/1	118	Phosphate	4	Nutrients low, bottle mis-tripped. Code bad.
90/1	118	Salinity	4	Salinity high vs CTDS, bottle mis-tripped. Code bad.
90/1	118	Silicate	4	Nutrients low, bottle mis-tripped. Code bad.
90/1	119	pCO2	2	pCO2 sample 7 retaken at btl 19, skipped 18.
91/1	ALL		-	Samples drawn from Niskin 19 first, then back to typical order until ONAR ready to draw another sample.
91/1	101	O2	3	O2 value 2 umol/kg high vs CTDO2, O2 Draw Temp ok. Code questionable.
91/1	104	O2	3	O2 value 16 umol/kg low vs CTDO2, code questionable.
91/1	110	Salinity	3	Salinity value high vs CTDS, code questionable.
91/1	118	Bottle	2	small tygon tubing piece placed on pylon trigger pin before cast.
91/1	124	Bottle	2	small tygon tubing piece placed on pylon trigger pin before cast.
92/1	106	Bottle	4	O2/Silicate/Salinity low, Nitrate slightly low. Phosphate ok, O2 Draw Temp ok. Code as possible mis-trip.
92/1	106	Nitrite	3	Nutrients a bit off, bottle may have mis-tripped. Code questionable.
92/1	106	Nitrate	3	Nitrate slightly low, bottle may have mis-tripped. Code questionable.
92/1	106	O2	3	O2 value 1.5 umol/kg low vs CTDO2, O2 Draw Temp ok; bottle may have mis-tripped. Code questionable.
92/1	106	Phosphate	3	Phosphate seems ok, bottle may have mis-tripped. Code questionable.
92/1	106	Salinity	3	Salinity value low vs CTDS, bottle may have mis-tripped. Code questionable.
92/1	106	Silicate	3	Silicate slightly low, bottle may have mis-tripped. Code questionable.
92/1	128	O2	3	O2 value 3-5% high vs CTDO2/nearby mixed-layer bottles on Stas.77-78,80-83,92: same O2 flask 28. Replicate test on Sta 84: flask 28 was 4.1% high, removed flask 28 from sampling lineup. Accidentally added back in this one cast. Code questionable.
93/1	103	O2	3	O2 value 9 umol/kg high vs CTDO2. O2 Analyst: Only two points recorded before titrator found endpoint, program error. Code bad.
93/1	104	O2	3	O2 value 13 umol/kg high vs CTDO2. O2 Analyst: Only two points recorded before titrator found endpoint, program error. Code bad.
93/1	121	O2	3	O2 value 2 umol/kg high vs CTDO2. O2 Analyst: Only two points recorded before titrator found endpoint, program error. Code bad.
93/1	124	O2	3	O2 value 17.5 umol/kg low vs CTDO2. Analyst hit wrong button: extra thio added to sample before analysis. Code bad.
93/1	127	O2	3	O2 value 18 umol/kg high vs CTDO2. O2 Analyst: Only two points recorded before titrator found endpoint, program error. Code bad.
93/1	128	O2	3	O2 value 3.5 umol/kg high vs CTDO2. O2 Analyst: Only two points recorded before titrator found endpoint, program error. Code bad.
94/1	106	Bottle	4	O2 Draw Temp 0.5+ deg.C high; O2/Salinity/SIO3 low, PO4/NO3 high. Code as mis-trip.
94/1	106	Nitrite	4	Nutrients show bottle mis-tripped. Code bad.
94/1	106	Nitrate	4	PO4/NO3 high, bottle mis-tripped. Code bad.
94/1	106	O2	4	O2 value 23 umol/kg low vs CTDO2, O2 Draw Temp slightly high, bottle mis-tripped. Code bad.
94/1	106	Phosphate	4	PO4/NO3 high, bottle mis-tripped. Code bad.
94/1	106	Salinity	4	Salinity low vs CTDS, bottle mis-tripped. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
94/1	106	Silicate	4	SIO3 low, bottle mis-tripped. Code bad.
94/1	123	O2	3	O2 value 7 umol/kg high vs CTDO2, code questionable.
94/1	129	O2	3	O2 value 10 umol/kg high, code questionable.
95/1	103	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
95/1	105	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
95/1	106	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
95/1	107	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
96/1	104	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
96/1	120	Salinity	5	Salt bottle had a small crack, exploded when Autosal applied pressure. Code sample lost.
96/1	134	Bottle	2	Spigot leaks when vent opened. Top cap o-ring replaced but the spigot still leaks.
98/1	104	O2	3	O2 value 5 umol/kg low vs CTDO2. Analyst: "sample had unusual color". Code questionable.
98/2	208	Bottle	2	Bottle flows without opening valve.
98/2	216	Salinity	3	Salinity value slightly low vs CTDS. Code questionable.
98/2	218	Bottle	4	Bottle did not close.
98/2	235	Bottle	2	Leaking from bottom endcap with valve open.
99/1	108	Bottle	2	Top valve open.
99/1	118	Nitrate	3	Nutrient values for 18/19 appear to be switched, code questionable.
99/1	118	Phosphate	3	Nutrient values for 18/19 appear to be switched, code questionable.
99/1	118	Silicate	3	Nutrient values for 18/19 appear to be switched, code questionable.
99/1	119	Nitrate	3	Nutrient values for 18/19 appear to be switched, code questionable.
99/1	119	Phosphate	3	Nutrient values for 18/19 appear to be switched, code questionable.
99/1	119	Silicate	3	Nutrient values for 18/19 appear to be switched, code questionable.
100/1	104	ccl4	9	80% certain CFC sample 613 drawn from niskin 7, and niskin 4 not sampled.
100/1	104	cfc11	9	80% certain CFC sample 613 drawn from niskin 7, and niskin 4 not sampled.
100/1	104	cfc12	9	80% certain CFC sample 613 drawn from niskin 7, and niskin 4 not sampled.
100/1	107	ccl4	2	80% certain CFC sample 613 drawn from niskin 7, and niskin 4 not sampled.
100/1	107	cfc11	2	80% certain CFC sample 613 drawn from niskin 7, and niskin 4 not sampled.
100/1	107	cfc12	2	80% certain CFC sample 613 drawn from niskin 7, and niskin 4 not sampled.
101/1	ALL		-	Bottom depth recorded at first bottle trip was CTD depth, not seabeam. Use CTD + altimeter = (3322+13) = 3335m.
101/1	102	O2	2	Flask 2 possibly mis-sampled; re-sampled with 37 and 40 (rep).
101/1	108	Bottle	2	Leaks with valve closed: O-ring
101/1	108	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
102/1	101	Bottle	3	Salinity high, Nutrients low, but do not match any other single depth. Apparently bottle leaked. Code as leaking.
102/1	101	Nitrite	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
102/1	101	Nitrate	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
102/1	101	O2	4	O2 value slightly low, Salinity high, Nutrients low, apparently bottle leaked. Code bad.
102/1	101	Phosphate	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
102/1	101	Salinity	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
102/1	101	Silicate	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
102/1	129	Bottle	3	Leaking: lanyard between top endcap and bottle. Not sampled
103/1	104	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
103/1	106	Bottle	4	O2 Draw Temp in line, but O2/SIO3 low, PO4/NO3 high: from near 1140db. Code as mis-trip.
103/1	106	Nitrite	4	Nutrients show bottle mis-tripped. Code bad.
103/1	106	Nitrate	4	PO4/NO3 high, bottle mis-tripped. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
103/1	106	O2	4	O2 value 12 umol/kg low vs CTDO2, O2 Draw Temp ok, bottle mis-tripped. Code bad.
103/1	106	Phosphate	4	PO4/NO3 high, bottle mis-tripped. Code bad.
103/1	106	Salinity	4	Salinity value very low vs CTDS, bottle mis-tripped. Code bad.
103/1	106	Silicate	4	SIO3 low, bottle mis-tripped. Code bad.
103/1	107	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
103/1	110	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
103/1	115	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
103/1	117	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
103/1	118	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
103/1	120	Salinity	3	Salinity slightly high vs CTDS. Code questionable.
104/1	134	ccl4	9	Sample log shows same CFC syringe for niskins 27, 34; niskin 34 not sampled for cfc.
104/1	134	cfc11	9	Sample log shows same CFC syringe for niskins 27, 34; niskin 34 not sampled for cfc.
104/1	134	cfc12	9	Sample log shows same CFC syringe for niskins 27, 34; niskin 34 not sampled for cfc.
104/1	134	sf6	9	Sample log shows same CFC syringe for niskins 27, 34; niskin 34 not sampled for cfc.
105/1	ALL		-	Raining during sampling; bottom depth recorded at first bottle trip was from CTD display, not seabeam. Use CTD + altimeter = (3571+39) = 3610m.
105/1	103	O2	3	O2 value 1.5 umol/kg high vs CTDO2, code questionable.
105/1	114	Salinity	3	Salinity value slightly low vs CTDS. Code questionable.
106/1	101	Bottle	3	Salinity high, Nutrients low, but do not match any other single depth. Apparently bottle leaked. Code as leaking.
106/1	101	Nitrite	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
106/1	101	Nitrate	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
106/1	101	O2	4	O2 value slightly low, Salinity high, Nutrients low, apparently bottle leaked. Code bad.
106/1	101	Phosphate	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
106/1	101	Salinity	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
106/1	101	Silicate	4	Salinity high, Nutrients low, apparently bottle leaked. Code bad.
106/1	119	Bottle	4	Bottle did not close.
106/1	136	Bottle	4	Bottle did not close.
108/1	104	Bottle	2	bottom cap leaky.
111/1	112	Salinity	3	Salinity value high vs CTDS. Code questionable.
112/1	110	Bottle	2	Leaking from vent O-ring.
113/1	ALL		-	XBT wire on the rosette frame.
114/1	ALL		-	XBT wire on the frame.
114/1	108	O2	3	O2 value 22 umol/kg high vs CTDO2; O2 Draw Temp, nutrients ok. Code questionable.
114/1	114	Salinity	3	Salinity value slightly low vs CTDS, code questionable.
114/1	119	Bottle	2	Valve was not closed, no CFC drawn.
115/1	113	O2	3	O2 value 2.5 umol/kg high vs CTDO2, code questionable.
116/1	101	O2	3	O2 value 1.35 umol/kg low vs CTDO2, code questionable.
116/1	101	Salinity	3	Salinity value slightly low vs CTDS, code questionable.
118/1	118	Bottle	4	O2 Draw Temp ok, but O2/Nuts match niskin 19 data. Code as mis-trip.
118/1	118	Nitrite	4	Nutrients match niskin 19 values, bottle mis-tripped. Code bad.
118/1	118	Nitrate	4	Nutrients match niskin 19 values, bottle mis-tripped. Code bad.
118/1	118	O2	4	O2 value 13 umol/kg low vs CTDO2, O2 Draw Temp ok. Matches niskin 19 data, bottle mis-tripped. Code bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
118/1	118	Phosphate	4	Nutrients match niskin 19 values, bottle mis-tripped. Code bad.
118/1	118	Salinity	4	Salinity value low vs CTDS, bottle mis-tripped. Code bad.
118/1	118	Silicate	4	Nutrients match niskin 19 values, bottle mis-tripped. Code bad.
122/1	111	Salinity	5	Bottle 411 broken prior to analysis, code sample lost.
122/1	114	Salinity	3	Salinity value +0.11 vs CTDS, matches value from bottle 12; suspect mis-sampled. Code questionable.
123/1	112	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
124/1	120	O2	3	O2 value 6 umol/kg low vs CTDO2, code questionable.
126/1	ALL		-	light mist during sampling.
127/1	101	O2	3	O2 value 2 umol/kg low vs CTDO2, code questionable.
127/1	118	Bottle	2	Broken nipple, replaced.
127/1	133	Bottle	2	Nipple replaced.
128/1	102	Salinity	3	Salinity value slightly low vs CTDS. Code questionable.
128/1	105	Salinity	3	Salinity value slightly low vs CTDS. Code questionable.
128/1	114	Salinity	3	Salinity value slightly low vs CTDS. Code questionable.
128/1	117	Salinity	3	Salinity value high vs CTDS. Code questionable.
129/1	105	O2	3	O2 value 2 umol/kg high vs CTDO2, code questionable.
130/1	101	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	101	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	102	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	102	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	103	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	103	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	104	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	104	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	105	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	105	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	106	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	106	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	107	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	107	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	108	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	108	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	109	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	109	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	109	O2	3	O2 value 3 umol/kg low vs CTDO2. Code questionable.
130/1	110	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	110	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	111	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	111	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	112	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	112	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	113	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	113	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	114	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	114	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	115	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	115	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	116	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	116	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	117	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.

Station /Cast	Sample No.	Property	Quality Code	Comment
130/1	117	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	118	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	118	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	119	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	119	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	120	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	120	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	121	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	121	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	122	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	122	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	123	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	123	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	124	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	124	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	125	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	125	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	126	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	126	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	127	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	127	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	128	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	128	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	129	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	129	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	130	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	130	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	131	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	131	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	132	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	132	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	133	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	133	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	134	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	134	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	135	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	135	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
130/1	136	CTDS2	4	Bio-fouling on CTDT2 sensor, code CTDS2 bad.
130/1	136	CTDT2	4	Bio-fouling on CTDT2 sensor, code CTDT2 bad.
131/1	101	Salinity	3	Salinity value slightly low vs CTDS, code questionable.
131/1	114	O2	3	O2 value 15 umol/kg low vs CTDO2, O2 Draw Temp ok. Code questionable.
131/1	118	Bottle	4	O2 Draw Temp 2+ deg.C higher than expected; O2/nutrients indicate tripped near 100db/O2+NO2 max. Code as mis-trip.
131/1	118	Nitrite	4	Nitrite high, bottle mis-tripped. Code bad.
131/1	118	O2	4	O2 value 75+ umol/kg high vs CTDO2, O2 Draw Temp 2+ deg.C high: bottle mis-tripped. Code bad.
131/1	118	Phosphate	4	SIO3/PO4 low, bottle mis-tripped. Code bad.
131/1	118	Salinity	4	Salinity value low vs CTDS, bottle mis-tripped. Code bad.
131/1	118	Silicate	4	SiO3/PO4 low, bottle mis-tripped. Code bad.
132/1	101	Salinity	3	Salinity value high vs CTDs, code questionable.
132/1	103	Salinity	3	Salinity value slightly high vs CTDs, code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
133/1	109	Bottle	2	Leaks with valve closed.
134/1	111	Bottle	2	Leaks with valve closed. (O-ring found missing after sta.140, replaced.)
135/1	122	Bottle	2	No trip recorded in .bl file for btl.22; re-tripped. Possible that bottles 22/23 both tripped at 42db, 24 at 20db, and no surface sample.
135/1	123	Bottle	2	No trip recorded in .bl file for btl.22; re-tripped. Possible that bottles 22/23 both tripped at 42db, 24 at 20db, and no surface sample.
135/1	124	Bottle	2	No trip recorded in .bl file for btl.22; re-tripped. Possible that bottles 22/23 both tripped at 42db, 24 at 20db, and no surface sample.
138/1	111	Bottle	2	Leaks with valve closed. (O-ring found missing after sta.140, replaced.)
140/1	107	Salinity	3	Salinity value high vs CTDS, code questionable.
140/1	111	Bottle	2	Leaks with valve closed: missing O-ring on top endcap, replaced after cast.
142/1	ALL		-	Changed batteries/tested O2 Thermistor after sampling.
142/1	108	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
142/1	110	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
142/1	111	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
142/1	112	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
142/1	113	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
142/1	114	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
142/1	115	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
142/1	116	O2	2	O2 Draw Temp appears 2-4 deg.C low, interpolated new value from bottles 9/17 based on fairly consistent slope for CTD Temps in this range.
144/1	129	Salinity	5	Computer malfunction (laptop froze up), code sample lost.
145/1	121	Bottle	3	Lanyard caught in top endcap, not sampled.
145/1	122	Bottle	4	Did not trip.
145/1	126	O2	2	O2 value -4 umol/kg vs downcast CTDO2, matches upcast. Code acceptable.
145/1	135	Bottle	3	Valve was open, most gases not sampled. Code as leaking.
145/1	135	O2	3	O2 value -5.5 umol/kg vs CTDO2, valve open. Code questionable.
145/1	136	Bottle	2	Valve was open, some gases not sampled.
146/1	109	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
146/1	119	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
147/1	134	O2	3	O2 value 3 umol/kg high vs CTDO2, code questionable.
148/1	107	Salinity	3	Salinity value high vs CTDS. Code questionable.
148/1	118	Salinity	3	Salinity value low vs CTDS. Code questionable.
150/1	119	Bottle	2	Spring broke off while cocking rosette, fixed before cast. Niskin has "nicropress" fitting inside bottle on this cast.
150/1	125	Bottle	2	Drains without valve open.
151/1	107	Salinity	3	Salinity value slightly high vs CTDO2, code questionable.
151/1	114	Salinity	3	Salinity value slightly high vs CTDO2, code questionable.
151/1	126	O2	2	O2 value -11 umol/kg vs downcast CTDO2, but matches upcast feature. Code acceptable.
152/1	130	Salinity	2	Salt bottles 530,534,535 out of order in Salt Box 500 at analysis time; sample log says niskin/salt bottle numbers same order. 530 clearly goes with Niskin 30; Niskin 33-36 salinity/CTDS all similar with low differences. Use sample log assignment, code acceptable.

Station /Cast	Sample No.	Property	Quality Code	Comment
152/1	131	Salinity	2	Salt bottles 530,534,535 out of order in Salt Box 500 at analysis time; sample log says niskin/salt bottle numbers same order. 530 clearly goes with Niskin 30; Niskin 33-36 salinity/CTDS all similar with low differences. Use sample log assignment, code acceptable.
152/1	132	Salinity	2	Salt bottles 530,534,535 out of order in Salt Box 500 at analysis time; sample log says niskin/salt bottle numbers same order. 530 clearly goes with Niskin 30; Niskin 33-36 salinity/CTDS all similar with low differences. Use sample log assignment, code acceptable.
152/1	133	Salinity	2	Salt bottles 530,534,535 out of order in Salt Box 500 at analysis time; sample log says niskin/salt bottle numbers same order. 530 clearly goes with Niskin 30; Niskin 33-36 salinity/CTDS all similar with low differences. Use sample log assignment, code acceptable.
152/1	134	Salinity	2	Salt bottles 530,534,535 out of order in Salt Box 500 at analysis time; sample log says niskin/salt bottle numbers same order. 530 clearly goes with Niskin 30; Niskin 33-36 salinity/CTDS all similar with low differences. Use sample log assignment, code acceptable.
152/1	135	Salinity	2	Salt bottles 530,534,535 out of order in Salt Box 500 at analysis time; sample log says niskin/salt bottle numbers same order. 530 clearly goes with Niskin 30; Niskin 33-36 salinity/CTDS all similar with low differences. Use sample log assignment, code acceptable.
153/1	104	O2	3	O2 value 1.5 umol/kg high vs CTDO2. Code questionable.
154/1	ALL		-	Light rain during start of sampling.
154/1	103	Salinity	3	Salinity slightly high vs CTDS, code questionable.
154/1	110	Salinity	3	Salinity slightly high vs CTDS, code questionable.
156/1	118	Bottle	2	"Niskin 18 very stiff"
156/1	124	CTDO	3	Surface CTDO2 3 umol/kg low, slow to equilibrate at top of yoyo; code questionable.
157/1	ALL		-	slight drizzle on deck.
158/1	122	Bottle	2	Filtered nuts on 122-124.
158/1	123	Bottle	2	Filtered nuts on 122-124.
158/1	124	Bottle	2	Filtered nuts on 122-124.
159/1	110	Salinity	3	Salinity slightly high vs CTDS, code questionable.
159/1	122	Bottle	2	Filtered nuts on 122-124.
159/1	123	Bottle	2	Filtered nuts on 122-124.
159/1	124	Bottle	2	Filtered nuts on 122-124.
160/1	111	Salinity	3	Salinity slightly high vs CTDS, code questionable.
160/1	119	Salinity	3	Salinity high vs CTDS, code questionable.
161/1	ALL		-	Snowing during sampling.
161/1	111	Salinity	3	Salinity slightly high vs CTDS, code questionable.
162/1	103	Bottle	2	Bottle fired 2x with software, 1x with DU: confirmed only after firing with DU.
162/1	104	Bottle	2	Bottles fired 1x with software, 1x with DU: confirmed only after firing with DU.
162/1	105	Bottle	2	Bottles fired 1x with software, 1x with DU: confirmed only after firing with DU.
162/1	106	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	107	Bottle	2	Did not confirm; CTD trip data extracted from 40 seconds after stopping at trip level.
162/1	108	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	109	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	110	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	111	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	112	Bottle	2	Did not confirm; recovered using scan marked at time of firing.
162/1	113	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	114	Bottle	2	Did not confirm; recovered using scan marked at time of firing.

Station /Cast	Sample No.	Property	Quality Code	Comment
162/1	115	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	116	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	117	Bottle	2	Did not confirm; recovered using scan marked at time of firing.
162/1	118	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	119	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	120	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	121	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	122	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	123	Bottle	2	Bottle fired from DU only, confirmed on screen.
162/1	124	Bottle	2	Bottle fired from DU only, confirmed on screen.
164/1	122	Bottle	2	Filtered nuts on 122-124.
164/1	123	Bottle	2	Filtered nuts on 122-124.
164/1	124	Bottle	2	Filtered nuts on 122-124.
165/1	121	Salinity	3	Salinity low vs CTDS, code questionable.
166/1	ALL		-	Snowing on station. Air T is 2.4 deg. C.
166/1	101	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
166/1	102	Salinity	3	Salinity value slightly high vs CTDS. Code questionable.
166/1	121	Salinity	3	Salinity low vs CTDS, code questionable.
167/1	122	Bottle	2	Filtered nuts on 122-124.
167/1	123	Bottle	2	Filtered nuts on 122-124.
167/1	124	Bottle	2	Filtered nuts on 122-124.
168/1	101	Salinity	3	Salinity slightly high vs CTDS, code questionable.
168/1	110	Salinity	3	Salinity slightly high vs CTDS, code questionable.
168/1	115	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	116	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	117	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	118	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	119	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	120	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	121	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
168/1	122	Bottle	2	Filtered nuts on 122-124.
168/1	122	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	123	Bottle	2	Filtered nuts on 122-124.
168/1	123	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
168/1	124	Bottle	2	Filtered nuts on 122-124.
168/1	124	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Code bottles 15-24 (after 2-hour time delay during run) questionable.
169/1	101	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	102	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	103	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	104	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	105	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	106	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	107	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	108	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	109	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.

Station /Cast	Sample No.	Property	Quality Code	Comment
169/1	110	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	111	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	112	Salinity	3	Room T ran over 24C bath Temp for 9 hours, as much as 25.5C, during end of sta.168/all of sta.169 run. Mid-run duplicate salts are 0.004 lower than start-/end-run values; end standard only +0.001 drift. Deepest 12 salinity values appear 0.003 lower on station 169 vs nearby casts, code questionable.
169/1	122	Salinity	3	Salinity high vs CTDS, mid-gradient and CTDS also noisy. Code questionable.
170/1	105	Salinity	3	Salinity slightly high vs CTDS, code questionable.
170/1	106	Salinity	3	Salinity slightly high vs CTDS, code questionable.
171/1	101	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	102	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	103	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	104	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	105	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	106	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	107	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	108	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	109	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.

Station /Cast	Sample No.	Property	Quality Code	Comment
171/1	110	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	111	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	112	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	113	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	114	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	115	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	116	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	117	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	118	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	119	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	120	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	121	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.

Station /Cast	Sample No.	Property	Quality Code	Comment
171/1	122	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	123	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
171/1	124	O2	2	Standard Temp. 3 deg.C higher than usual during this run: room T rose several deg.C due to A/C tripping off. Dropping standard T by 3 deg.C only accounts for 20% of the difference. O2 values below minimum avg. 1.0 umol/kg low vs nearby casts, but within 0.5-1%. Coded acceptable.
172/1	105	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
172/1	108	O2	3	O2 value 1.5 umol/kg low vs CTDO2, code questionable.
172/1	108	Salinity	3	Salinity value slightly high vs CTDS, code questionable.
172/1	111	Bottle	2	He sampled after o2 on this bottle.
173/1	ALL		-	snowing during sampling. Meter wheel read -85 on deck/cast end: Survey Tech says it WAS zeroed at cast start. Winch max. wireout 65m less than max. cast depth, even after applying slope correction factor.
173/1	124	Salinity	2	salt bottle only half full - no more water in niskin.
174/1	ALL		-	light drizzle while sampling
996/1	101	Salinity	5	Code samples as lost.
996/1	102	Salinity	5	Code samples as lost.
996/1	103	Salinity	5	Code samples as lost.
998/1	101	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	102	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	103	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	104	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	105	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	106	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	107	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	108	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	109	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	110	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	111	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	112	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	113	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.

Station /Cast	Sample No.	Property	Quality Code	Comment
998/1	114	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.
998/1	115	Bottle	3	Rosette returned from 543db upcast to 2927db (deeper than first max. pressure) to fix level wind problem; bottles may have leaked.

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CCHDO Data Processing Notes

Date	Contact	Data Type	Action	Summary
2007-11-28	Diggs	Cruise Report	Website Update	PDF doc. online and cruise entered
2007-12-15	Diggs	EXPO	Website Update	Expocode changed due to new dep. date
	According to Mary's first message, your departure time is 0215 Saturday December 15, 2007 GMT. Based on this information new expocode for P18 2007: 33RO20071215.			
2008-02-25	Johnson,G	CTD/BTL	Submitted	SALNTY/OXYGN
	Near the end of the 2007/2008 reoccupation of WOCE Section P18, with some helpful input from Mary Johnson and Alex Orsi, Kristy McTaggart and I decided to adjust some station groupings for preliminary CTD/O2 conductivity calibrations using bottle salts. We finished this work too late to get them integrated into the shipboard preliminary data package that Mary distributed on the ship and is bringing back to SIO, but not too late to send them to you before leaving Punta Arenas. I am attaching these new preliminary CTD/O2 profiles and CTD/O2 values at bottle stops (all the CTD/O2 stations and a bottle file with CTD/O2 and some other values in WOCE format) as a gzipped tar file. I think this version of the calibration is enough of an improvement over the values we gave Mary that the CTD/O2 profiles in this file, along with the CTD/O2 values at bottle stops, should be what are posted on the web for preliminary distribution. I hope this does not cause too much inconvenience. If you have any questions, please let me know. Kristy is on vacation for a few weeks, but I should be back in the office this Thursday, if all goes well.			
2008-02-29	Johnson,G	BTL/SUM	Submitted	use CTD/O2 values submitted 2/25/08
	The sum and sea files that Mary made during the cruise are attached. You may make the data public on the website. Again, the CTD/O2 values in the sea file attached should be replaced with those in the sea file that I sent you a few days ago.			
2008-03-12	Diggs	SUM/DOC	Data Update	ODF Sumfile and PDF Report online
	The SUMfile from ODF (M. Johnson) as well as the PDF documenation file are now online. New cruise track maps are also available online, made from SUMfile. Prelim-inary cruise tracks removed.			
2008-04-08	Johnson,G	CTD	Data Update	Ctdprs, ctdtmp, ctdsal, ctdoxy
	the values for CTDPRS, CTDTMP, CTDSAL, and CTDOXY from the attached file, p18_allo.sea, should be substituted into Mary's bottle file.			
2008-07-02	Johnson,M	ALKALI	Data Update	fixed coding error, CFC redundancies
	I updated the one last TALK code for station 43-127, and re-created the 3 data files for P18. CFC redundancies resolved as analyst resubmitted the data to me with only one value reported per bottle.			
2008-07-17	Kappa	Cruise Report	Website Update	New PDF & Text docs online
	• Created text doc • Added Data Processing Notes to pdf and txt docs • Added links to tables and figures in pdf doc • Added CCHDO station track to pdf doc			
2008-08-14	McTaggart	CTD	Submitted	Data are Final
	Attached is our short version of the final P18 .sea file with final calibrations applied to CTD temperature, salinity, and oxygen. It includes only STNNBR, CASTNO, SAMPNO, BTLNBR*, CTDRAW, CTDPRS, CTDTMP, CTDSAL*, CTDOXY*, THETA, SALNTY*, and QUALT1(1-4*). Basically, the header followed by the first 11 columns and then an abbreviated flag string.			
2008-08-15	Johnson,G	CTD	Submitted	Data are Final
	This week Kristy has given Steve Diggs at CCHDO the final CTD data and CTD values of pr, te, sa, & ox at bottle stops, so they should merge those instead of the revised ones we provided at the end of the cruise.			

CCHDO Data Processing Notes

Date	Contact	Data Type	Action	Summary
2008-09-09	Muus	BTL-CTD	Website Update	CTD trip data in bottle file

Notes on p18_2007 CTD trip data merge Sept 8, 2008/dm
ORIGINAL data files:
woce format bottle data file "p18.sea" from
/data/co2clivar/pacific/p18/p18_33RO20071215/original/20080819_Johnson-Mary_update
woce format summary file from "p18.sum" from
/data/co2clivar/pacific/p18/p18_33RO20071215/original/20080819_Johnson-Mary_update
(This summary file has EXPOCODE on stations from Jan 21, 2008, to end of cruise changed from 33RO20080121 to 33RO20071215)
NEW data file:
CTD trip data file "p18_cchdo.sea" from Kristy McTaggart, NOAA,August 14, 2008, email

1) Deleted from odf woce format file p18.sea:
   STNNBR CASTNO SAMPNO all data
   46 1 -9 -9
   52 1 -9 -9
   55 1 -9 -9
   71 1 -9 -9
   167 1 -9 -9
2) PH parameter mnemonic changed to PH_SWS
   PH_SCALE deleted
   PH_TMP changed to PH_TEMP
   per Jim Swift August 22, 2008 email re "Revised Guidelines for pH"
3) CDOM changed to CDOM325
   CDMSLOG changed to CDOMSL because CDMSLOG not on hyd_to_exchange.pl parameter list.
   CDMSNLF changed to CDOMSN " CDMSNLF "
   Following CDOM values significantly higher than adjacent values but with Q flags = "2"s.
   Sta 46 Ca 1 Smp 32 ctdp 60.2db All CDOM values
   82 1 30 132.3db CDOM325, CDOM340, CDOM380 & CDOM412 only.
4) SF6 Sta 149 Ca 1 Sample 30 11.5 high. Quality flag 6. Left as is for now
   Sta 173 Ca 1 Sample 15 -194.378 changed to -9.000. Quality flag 3 changed to 5
   Added John Bullister as SF6 P.I. per Bullister email Aug 20, 2008. Email also says further SF6 updates are expected.
5) Following parameters are included but are not described in CCHDO parameter list.
   All have missing value indicators and quality flags 9 or 1:
   CDOM2C
   CDOM3C
   DELSI30
   DELSITY
   N15-N2
   N2 (AZOTE?)
   O18-O2 (O18O16)

Date	Contact	Data Type	Action	Summary
2008-09-10	Muus	BTL	Website Update	Data citations added

Data citation comments added to P18_2007 Exchange bottle file.

CCHDO Data Processing Notes

<table>
<tr><th>Date</th><th>Contact</th><th>Data Type</th><th>Action</th><th>Summary</th></tr>
<tr><td>2008-10-14</td><td>Nelson</td><td>CDOM</td><td>Submitted</td><td>Supersede reported at-sea data</td></tr>
<tr><td></td><td colspan="4">Parameters reported:
CDOM325 [1/M] Absorption coefficient of CDOM at 325 nm
CDOM340 [1/M] Absorption coefficient of CDOM at 340 nm
CDOM380 [1/M] Absorption coefficient of CDOM at 380 nm
CDOM412 [1/M] Absorption coefficient of CDOM at 412 nm
SLOG [1/NM] Log spectral slope of absorption spectrum (320-400 nm) computed by linear regression of log-transformed data
SNLF [1/NM] Log spectral slope of absorption spectrum (320-400 nm) computed by non-linear curve fit
These spectroscopic data have been recalibrated based on the UCSB Ultrapath calibration 7a, 2008. They supersede data reported at-sea on the P18 expedition.</td></tr>
<tr><td>2008-11-10</td><td>Kozyr</td><td>BTL</td><td>Submitted</td><td>FINAL data submitted, not yet online</td></tr>
<tr><td></td><td colspan="4">Action: Merge Data, Place Online
Notes: here are the final DIC (TCO2), TALK, DOC, and TDN data for the merge into the hydro file.</td></tr>
<tr><td>2008-11-11</td><td>Key</td><td>CFCs</td><td>Data Status</td><td>DATA ARE PRELIMINARY</td></tr>
<tr><td>2008-11-12</td><td>Bullister</td><td>CFCs</td><td>Submitted</td><td>FINAL data submitted, not yet online</td></tr>
<tr><td></td><td colspan="4">I just uploaded a file of the CLIVAR P18 final CFC-11, CFC-12, carbon tetrachloride and sulfur hexafluoride data to the CCHDO website.</td></tr>
<tr><td>2008-11-18</td><td>Kozyr</td><td>CO2</td><td>Submitted</td><td>FINAL data submitted, not yet online</td></tr>
<tr><td></td><td colspan="4">Action: Merge Data, Place Online
Notes: Here are the final and public TCO2, TALK, pH, DOC, and TDN data. Please, discard a previous submission of these parameters. I will receive the discrete pCO2 measurements soon from Rik Wanninkhof and will send you the numbers separately. Please, let me know when you done with merging these parameters.</td></tr>
<tr><td>2008-11-21</td><td>Mordy</td><td>NUTs</td><td>Submitted</td><td>Released by PI</td></tr>
<tr><td></td><td colspan="4">Action: Merge Data, Place Online, Updated Parameters</td></tr>
<tr><td>2009-05-14</td><td>Muus</td><td>BTL</td><td>Website Update</td><td>CO2/CFC/SF6/NUTs/CDOM online</td></tr>
<tr><td></td><td colspan="4">Notes on P18_2007 merge Mar-May,2009/dm (EXPOCODE 33RO20071215):
WOCE format (20080925CCHDODM) and EXCHANGE format (20080925dm) bottle files have been modified.
1) Carbon data merged from file p18_2007_DIC_TALK_PH_DOC_TDN_2008 received from Alex Kozyr, ORNL, on Nov 18, 2008
[TCARBN, ALKALI,PH_SWS,DOC,TDN] (TDN is new parameter)
2) CFC data merged from file CLIVAR_P18_CFCS_SF6_sentto_CCHDO_12Nov2008.txt received from John Bullister, PMEL, on Nov 11, 2008
CFC-11, CFC-12, CCL4 & SF6 all reported to 4 decimal places in data file.
CCHDO precision for CFCs & CCL4 is 3 places so data were merged to 3 places.
CCHDO precision for SF6 not specified so SF6 data merged to 4 places. Previous cruises had SF6 data to 2 places. Left as is for now.
3) Nutrient data merged from file P18_Nutrients_umol-kg.txt received from Calvin Mordy, PMEL, on Nov 21, 2008
PHSPHT, SILCAT, NITRAT, NITRIT]
4) CDOM data merged from file ucsb_cdom_p18_s7a_20090130.txt received from Norman Nelson, UCSB, on Feb 2, 2009
[CDOM325, CDOM340, CDOM380, CDOM412, CDOM443, CDOM490, CDOM555, CDOMSL, CDOMSN] p(CDOM2C & CDOM3c were in original bottle file with all missingdata; no new data received.)</td></tr>
</table>

CCHDO Data Processing Notes

Date	Contact	Data Type	Action	Summary
	- About 50 sampling levels had CDOMs in shipboard data set butnot in the Feb 2, 2009, file. - I replaced the ones I could find with -9s and Quality Flags 5per Norm Nelson message April 8,2009. 5) The Exchange format file, p18_33RO20071215_hy1.csv, was checkedwith Java Ocean Atlas. The WOCE format file, p18_33RO20071215hy.txt, was checked with thenew WOCE to Exchange format program. 6) No data have been received yet for the following parameters: TRITUM, HELIUM, DELHE3, DELC14, DELC13, O18-O2, ARGON, DON, CDOM2C, CDOM3C, POC, DENSITY, DELSI30, N2 and N15-N2 Expect no data for DON since it is derived from TDN, NITRAT and NITRIT per Craig Carlson, UCSB, msg of April 8, 2009. 7) Expect updated PCO2 soon from AOML.			
2009-05-15	Quay	C13/C14	Collected	Not yet analyzed
	The seawater samples that John collected on P18 for 13C and 14C analyses are in my lab. Since I don't have funding for the 13C (or 14C) analyses on this cruise, the sample processing has a lower priority and will happen slowly. Thus, there are no 13C or 14C data to report at this time.			
2009-06-09	Diggs	CTD	Website Update	NetCDF CTD files online
2009-06-18	Kappa	Cruise Report	Website Update	PDF & Text files updated/online
	• Changed PI for C13/C14 to Paul Quay • Updated Data Processing Notes			
2010-07-14	Kozyr	FCO2	to go online	
	Action: Merge Data Alex Kozyr submitted these FCO2 updates by email. From his email: here is attached the final and public FCO2 data we received from Rik Wanninkhof (AOML) for cruise 33RO20071215 P18_2007. Please, merge the data and let me know when merging is done. Please, note that the header for this parameter it FCO2, not PCO2 as it is now in the .hy file online (per Rik) with FCO2_TMP and FCO2_FLAG_W columns.			
2010-07-29	Fields	FCO2	Exchange/NetCDF files online	
	FC02 was submitted by Alex Kozyr by email on July 14. I merged the FCO2, FCO2_TMP, and FCO2_FLAG_W columns into the current file without issue. After merging I created a netcdf bottle file as well. The new exchange bottle file and netcdf bottle file are now online.			
2010-09-13	Berys	BTL	Citations added	
	File: p18_33RO20071215_hy1.csv datestamp: 20100913CCHDOSIOCBG original moved to: original/p18_33RO20071215_rplcd_20100913_hy1.csv Citations added by A. Barna Formatted using copy_exchange_bot.rb (J. Fields) working directory: original/2010.09.13_P18_citation_CBG/			
2010-11-17	Kozyr	pH	to go online	
	Action: Place Online, Updated Parameters			
	Notes: revised pH_SWS, PH_TEMP, and PH_FLAG_W data sent by Frank Millero at RSMA			

CCHDO Data Processing Notes

Date	Contact	Data Type	Action	Summary
2011-04-25	Berys	pH		Available under 'Files as received'
	File p18_2007_PH_20101116_25C.csv containing pH data, submitted by Alex Kozyr on 2010-11-17, available under 'Files as received', unprocessed by CCHDO.			
2011-05-02	Bullister	Documentation	CFC report submitted	
	I noticed that the CFC section (3.3) of the cruise report at the website has not been updated. Please replace it with the attached file.			
2011-05-03	Kappa	Documentation	New CFC report online	
	Bullister's CFC report of 2011-05-02 has been merged into the text and pdf versions of the online cruise reports.			