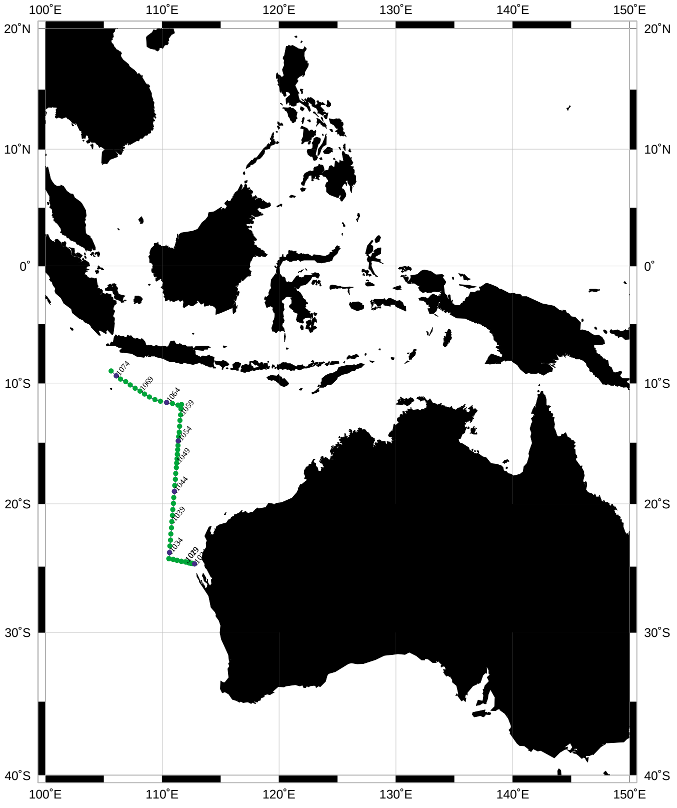


Station locations for i10

Produced from .sum file by WHPO-SIO

WHP Cruise Summary Information

WOCE section designation	**I10**
Expedition designation (EXPOCODE)	**316N145_13**
Chief Scientist(s) and their affiliation	**Nan Bray**
Dates	1995.11.11 - 1995.11.28
Ship	R/V Knorr
Ports of call	Dampier, Australia and Singapore
Number of stations	61
Geographic boundaries of the stations	8°59.94’ S 105°37.80’ E 112°46.18’ E 24°46.93’ S
Floats and drifters deployed	Nine ALACE floats
Moorings deployed or recovered	none

Contributing Authors

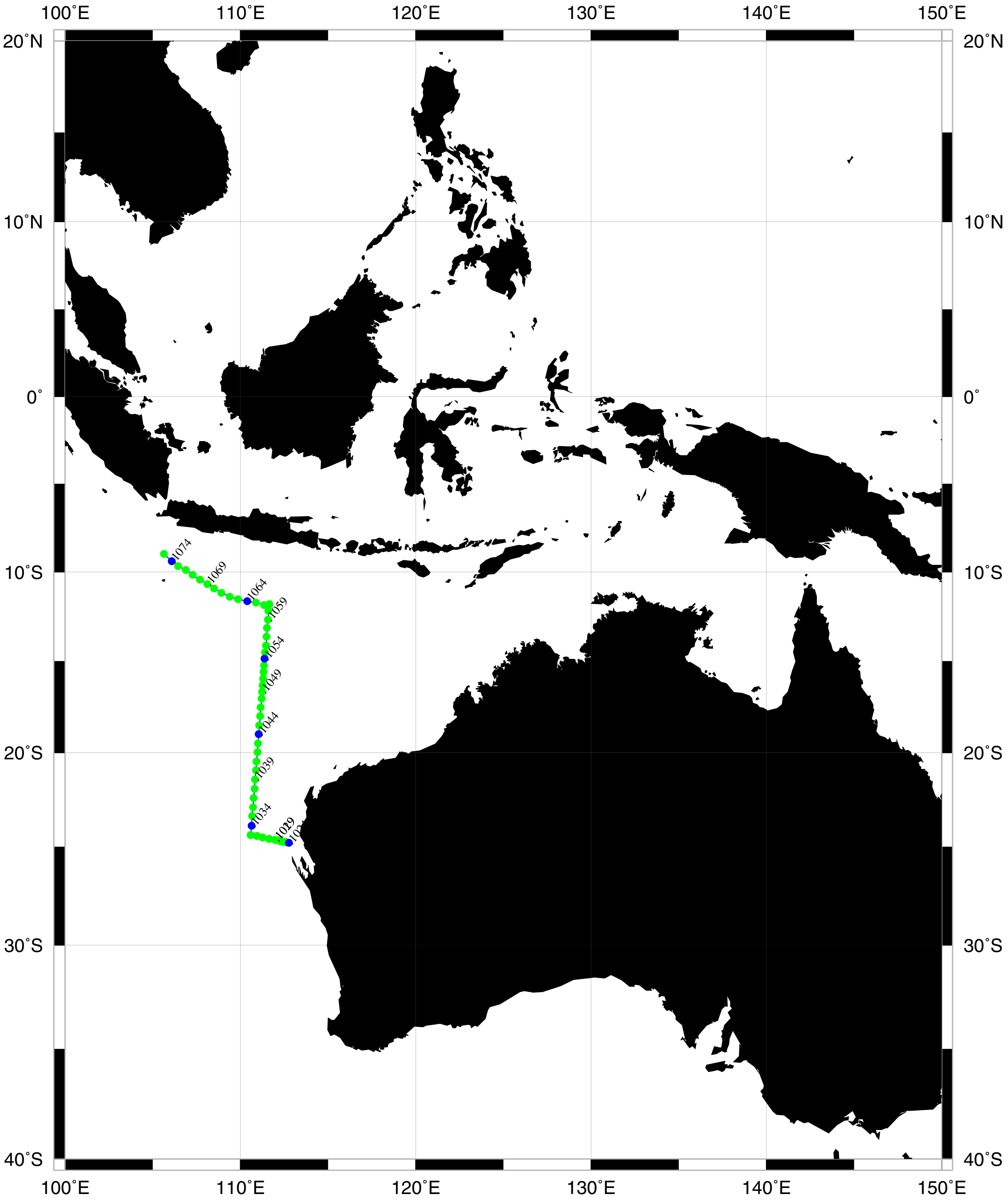
WHP Cruise and Data Information

Instructions: Click on any item to locate primary reference(s) or use navigation tools above.

Cruise Summary Information	**Hydrographic Measurements**
Description of scientific program	CTD - general
	CTD - pressure
Geographic boundaries of the survey	CTD - temperature
Cruise track (figure)	CTD - conductivity/salinity
Description of stations	CTD - dissolved oxygen
Description of parameters sampled	
Bottle depth distributions (figure)	Salinity
Floats and drifters deployed	Oxygen
	Nutrients
	CFCs
Principal Investigators for all measurements	Helium
Cruise Participants	Tritium
	Radiocarbon
Problems and goals not achieved	CO2 system parameters
Other incidents of note	Other parameters
Underway Data Information	**Acknowledgments**
Navigation	**References**
Bathymetry	
† Acoustic Doppler Current Profiler (ADCP)	**DQE Reports**
Thermosalinograph and related measurements	(none as of this update)
XBT and/or XCTD	CTD
Meteorological observations	S/O2/nutrients
	CFCs
	14C
	Data Status Notes

† for a complete ADCP report see: Chereskin, T.K. and Harris, C.L., "Shipboard Acoustic Doppler Current Profiling During the WOCE Indian Ocean Expedition: I10", SIO Reference No. 97-14, Dec 1997.

Station locations for I10



Produced from .sum file by WHPO-SIO

A. Cruise Narrative

1. Highlights

a.	WOCE designation:	**I10**
b.	Expedition designation:	**316N145_13**
c.	Chief Scientist:	**Nan Bray**
d.	Ship:	R/V Knorr, call sign KCEJ
e.	Ports of Call:	Dampier, Australia and Singapore
f.	Cruise Dates:	11 November 1995 to 28 November 1995

2. Cruise Summary Information

WOCE section I-10 runs from Shark Bay, Western Australia, to the Indonesian EEZ boundary, 120 nm south of Sunda Strait (the midpoint between Java and Christmas Island). As originally planned, the section was to coincide with the WOCE XBT section IX1 (Figure A2-1). Constraints imposed by the Indonesian government as part of the clearance agreement necessitated moving the endpoint of the section from Sunda Strait to central Java. Regretably, at the last moment the Indonesian government denied clearance to work in the EEZ, and we completed the section by taking stations along the EEZ boundary back to the longitude of the original section, (Figure A2-1). At the same time as the I-10 section, a high-density XBT/XCTD section was run by Meyers and Wjiffels of the Australian CSIRO. At the Shark Bay end of the I-10 hydrographic section, ten stations across the shelf and slope were occupied twice to resolve the Leeuwin Current.

There were a total of 61 small volume stations occupied during I-10. On all stations, CTDO2 and nutrients were measured, and lowered ADCP velocity data were taken. In addition, CO2, alkalinity, C14, radium-228, CFCs and 3He/3H were sampled at most stations. Rosette casts at 57 stations were made to within 10 meters of the bottom. The other four casts (above the Java Trench) were made to the maximum CTD and LADCP depth rating of 6000 meters (Figure A2-2). The CTD and tracer measurements are described more fully in Section C below. Underway measurements of sea surface temperature and salinity, meteorological variables and pCO2 were also made.

Direct measurements of ocean velocity were taken on I-10, using two acoustic Doppler current profiler (ADCP) systems and accurate navigation data. The two systems are the hull-mounted ADCP and a lowered ADCP mounted on the rosette with the CTD. The purpose of the observations was to document the upper ocean horizontal velocity structure along the cruise track, and to measure vertical profiles of the horizontal velocity components at the individual hydrographic stations. The observations provide absolute velocity estimates including the ageostrophic component of the flow. Underway near-surface velocities from the hull-mounted ADCP are shown in Figure A2-3. Figure A2-4 shows the zonal flow from 25 S to 12 S, between Australia and Indonesia, from the lowered ADCP.

Nine ALACE floats were released at locations denoted by diamonds in Figure A2-1.

3. List of Principal Investigators

PI	Measurement	Institution	email
Nan Bray	CTD/O2/Nutrients	SIO	nbray@ucsd
John Toole	CTD/O2/Nutrients	WHOI	jtoole@whoi
Rana Fine	CFCs	RSMAS	rfine@rsmas.miami.edu
Teri Chereskin	ADCP/LADCP	SIO	tchereskin@ucsd
Russ Davis	ALACE floats	SIO	redavis@ucsd
William Jenkins	3He/3H	WHOI	wjenkins@whoi
Robert Key	CO2,alkalinity	Princeton	key@geo.Princeton
Chris Sabine			sabine@geo.Princeton
Jorge Sarmiento			jls@geo.Princeton
Robert Key	radium-228,C14	Princeton	key@geo.Princeton

4. Scientific Program and Methods

a. Cruise Scientific Objectives

The eastern boundary of the Indian Ocean, unlike other oceans, is "leaky", in the sense that a substantial transport of mass, heat and freshwater enters the basin from the Pacific through passages in the Indonesian Archipelago. This transport (or "throughflow" as it is often called) has a major impact on the distribution of properties in the Indian Ocean, and is a key element in the global thermohaline circulation. Because the throughflow occurs at low latitude and is surface-intensified, it carries water that is quite warm and extremely fresh into the upper Indian Ocean [Sharma, 1972]. Thus even small net transports of throughflow water can have significant impact on the heat and freshwater budgets of the Indian Ocean. Because the throughflow occurs in the upper ocean, it is modulated strongly by seasonal and semi-annual variations in the wind: the Indian Ocean monsoons, making difficult the estimation of average net transport. Evidence from repeat XBT data [Meyers et al, 1993] suggest that the seasonal/semi-annual variance of upper-ocean transport is comparable to the mean estimated over decadal time-scale. Comparatively little is understood about the deeper circulation in this area.

The observational challenge for this region is to quantify the mass, heat, freshwater and related property transports through the Indonesian Archipelago, with estimates of their variability. Section I-10 was drawn to run between the coast of Australia and the coast of Sumatra, thereby encompassing the Archipelago throughflow sources (the major passages lie east of the sampling line) and any flow over the Australian shelf. To address the variability issue, the planned section was aligned with WOCE XBT section IX1, which was occupied more than 100 times over the last decade [Meyers et al., 1993]. This hydrographic section was further occupied by the Australians in April and September of 1995 (IR6), making a total of three occupations in different seasons during the Indian Ocean WOCE Expedition [Cresswell et al, 1995, Wijffels et al., 1995]. Lastly in conjunction with each of the hydrographic sections, a high-density VOS sampling cruise was conducted.

Historically, the maximum throughflow occurs during northern summer, the period of the South Monsoon which has an easterly component in this part of the Indian Ocean. One explanation for this maximum is that coastal upwelling along the south coast of Java, resulting from the monsoon winds, induces a drop in sea level on the Indian Ocean side of the Archipelago, and a corresponding enhancement of the large-scale pressure gradient that supports the throughflow [Wyrtki, 1987]. At the same time of year, the alongshore coastal current generated by that upwelling opposes the eastward-flowing South Java Current (SJC), resulting in a seasonal minimum in SJC transport. Recent data in this region [Fieux, et al., 1994; Fieux; et al.,submitted] are available from a low resolution section in August of 1989, and a higher resolution survey in February of 1992. With this coverage, there will be at least one cruise in each season, and two during the maximum throughflow period in August/September, in the period 1989-1995.

b. Cruise Summary

The I-10 cruise embarked in the port of Dampier, Australia, on the 11th of November. After conducting a test station off Northwest Cape, we steamed to the offshore station in the Leewin Current section off Shark Bay. Two occupations of a cross-shelf section were made, the first Sta 1015-1024, worked towards shallow water; the second occupation ran back out towards deep water with Sta 1033 at the site of Sta 1015. We then headed more or less north, diverging from the VOS XBT and Australian repeat sections to intersect the Indonesian EEZ at a point specified by the Indonesian Military Security, who objected to our original cruise track that approached quite close to Sunda Strait. We maintained a station separation of about 55 km along that part of the section, except near the water mass boundary usually found near 15 S, where stations were spaced 40 km apart (centered on station 1052). By the time we reached the edge of the EEZ (station 1061), we had been notified that Indonesian clearance had been denied, and altered the track to follow the EEZ boundary back to the original cruise track. This segment of the sampling line, a re-occupation of stations taken by the Australians in September of 1995, ran obliquely through the South Equatorial Current and the southern end of the Java Current (Fig A2-2). We finished station work with Sta 1075 on the original cruise track, about 120 nm south of Sunda Strait. [The station fell at the edge of the EEZ boundary between Christmas Is (Australia) and the Java coast.]

As can be seen in the vertical section plots (Figures A4-1 to A4-11), the section resolved the shallow Leewin Current, with a surprisingly strong, subsurface northward counterflow over the slope off Western Australia. Waters of the Subtropical Gyre dominate the southern part of the section, while waters with Indonesian throughflow characteristics occupied the upper ocean north of about 15 S. A particularly strong westward current carrying waters with throughflow characteristics was observed along the boundary of the Indonesian EEZ, and was resolved by the lowered ADCP measurements. Along the majority of the track, the CTD geostrophic velocity and LADCP velocity compare favorably. Along the EEZ boundary, the CTD section was more or less parallel to the strong current, and there we will have to rely upon the LADCP measurements to provide transport estimates, though the properties were of course well-identified by the CTD section.

The quality of the CTD and bottle data from the section is excellent. Salinity differences in the deep water between the CTD and the salinometer were routinely 1 or 2 ppm. Oxygen and nutrient data were similarly of excellent quality, with very few mis-trips or other problems with the bottle data. The ODF operation was extremely smooth and competent, and the preliminary data look really good. The only exception is that we had trouble with the oxygen sensor on the CTD, as described below.

The CFC concentrations in the thermocline go through a major transition. Highest concentrations of 3.5 pM/kg were observed in the subtropical gyre waters at the southern end of the leg, intermediate concentrations in the throughflow waters, and then lowest concentrations equatorward of the throughflow waters at the northwestern end of the leg. The strongest gradient is across the transition between the subtropical gyre and throughflow waters. The average concentrations were 510 pptr CFC-12 and 267 pptr CFC-11.

c. Interlaboratory calibrations: none.

d. Vertical sections: Figures A4-1 to A4-11.

5. Major Problems and Goals Not Achieved.

The major objective not achieved was measurement within the Indonesian EEZ--specifically, resolution of the energetic Soouth Java Current. In a last minute reversal, the Indonesian goverment denied clearance for us to enter the EEZ to pick up the observers they required us to have on board while working in the EEZ. Although this denial was subsequently deemed illegal by the US Embassy, at the time it was issued we had no alternative but to alter our course to remain outside the EEZ. We had previously altered the original station plan according to requirements from the Indonesian government. Thus we ended up with a "Z" shaped section (see Figure A2-1), with the top leg of the Z adjacent to the EEZ boundary between Indonesia and Australia's Christmas Island. The Australians occupied the same stations along the EEZ when they were denied clearance by the Indonesians in September. The last station on I-10 (1075) is on the original cruise track line, as are the southernmost stations that cross the Leeuwin Current.

Although we could not sample the SJC as we intended, there are some compensating measurements: a high-density XBT/XCTD section was run only days before I-10 reached the area, and on that cruise XCTDs were dropped in the region of the SJC. Also, even though the CTD stations along the EEZ boundary are roughly parallel to the axis of flow, and therefore ill-suited to determine the current by geostrophy, the lowered ADCP worked well and gave us both components of velocity throughout the water column. By the end of the section, we were within about 120 nm of the south coast of Java, since the EEZ from Christmas Is. splits the distance between Java and Christmas. We believe we may have sampled the outer edge of the SJC toward the end of the section. We also deployed ALACE floats along the top of the "Z", and those should give us a time-integrated measure of the intermediate level flow along the boundary.

Our second significant problem was that the oxygen sensors on the CTD were not particularly reliable: we went through three sensors over the course of the cruise. All three failed due to apparent pressure effects, and there are several stations with incomplete and/or uncalibratible CTD-oxygen data. To some extent, this lack is offset by the excellent bottle O2 data set (see Figure A4-7). The sensor problem seems to be one of manufacture quality control, and should be addressed before future cruises.

6. Other Incidents of Note:

The Thanksgiving holiday was celebrated mid-cruise. Thanks to the exceptional efforts of Steward Mitch Barros, Robin Love Nay and Ju Ju Fernandes and a host of volunteers, a veritable feast was created and enjoyed by all aboard.

7. List of Cruise Participants

Name	Title	Affiliation	Duties
Nan Bray	Assoc Res Oceanographer	SIO	Chief Scientist
John Toole	Assoc Scientist	WHOI	Co-PI/Btl Data/Rosette
Mulia Purba	Assoc Professor	Indonesia	Co-PI/Sample Cop
Carl W. Mattson	Pr Electronic Tech	STS/ODF	TIC/Watch Leader/ET/Rosette
John Boaz	Marine Tech	STS/ODF	Watch Leader/O2/Rosette/Btl data
Stacey R. Morgan	SRA	STS/ODF	Nutrients
Ron Patrick	SRA	STS/ODF	Nutrients
Craig M. Hallman	SRA	STS/ODF	Oxygen/Salt/Rosette
Kristin Sanborn	SRA	STS/ODF	Bottle data/Oxygen
Frank Delahoyde	Pr Programmer	STS/ODF	CTD data Processing
Woody Sutherland	Manager	STS	Salt/Rosette
Werner Morawitz	Postdoc Investigator	SIO	CTD Console/Rosette
Joanna Muench	Postdoc Investigator	WHOI	CTD Console/Rosette
Susan Hautala	Assist Prof	UW	Ctd Console/Rosette
Spicer Conant	SRA	SIO	Salt/Rosette
Teresa Chereskin	Assoc Res Oceanographer	SIO	LADCP/ADCP
Chris Sabine	Research Staff	Princeton	TCO2/Alkalinity
Marion Markham	Lab Assist	Princeton	TCO2/Alkalinity
Sue Boehme	Postdoc Fellow	Rutgers	TCO2/Alkalinity
Gerard Mcdonald	Sr Res Assist	Princeton	TCO2/Alkalinity
Tonalee Key	Tech Staff	Princeton/OTL	C14/Ra-228
Kevin F. Sullivan	Marine Tech Spec	RSMAS	CFC
Jorina Waworuntu	Grad student	RSMAS	CFC
Dempsey Lott	Research Specialist	WHOI	He/Tr
Joshua Curtice	Research Specialist	WHOI	He/Tr
Mike Thatcher	SSSG Tech	WHOI	Res Tech
Ahmad Najid	Scientist	Indonesia	Observer
I. Nyoman M. Naith	Student	U Indonesia	Sampling
Yuli Naulita	Student	U Indonesia	Sampling

B. Underway Measurements

1. Navigation and bathymetry

A Trimble P-code receiver was used for navigation and was recorded once per second for the entire cruise. Precision code (P-code) GPS was available from 11-18 November. P-code was lost on 19 November, when the new codes (unavailable for this cruise) went into effect. Standard GPS was recorded for the remainder of the cruise. The Ashtech receiver uses a four antennae array to measure position and attitude. The heading estimate was used with the gyro to provide a heading correction for the ADCP ensembles. The Ashtech data was stored by the ADCP user-exit program along with the ADCP data.

Underway bathymetry was logged manually from the ship's 12 khz Raytheon PDR at five-minute intervals, then merged with the navigation data.

2. ADCP

The hull-mounted ADCP is part of the ship's equipment aboard the KNORR. The ADCP is a 150 kHz unit manufactured by RD Instruments. The instrument pings about once per second, and for most of the cruise the data were stored as 3-minute averages or ensembles. A user-exit program, ue4, receives and stores both the GPS navigation data from the ship's Trimble receiver and the Ashtech GPS receiver headings along with the ADCP data. The GPS data are used to determine the velocity of the ship for the purposes of the ADCP processing. The ship gyro is providing heading information for vector averaging the ADCP data over the 3-minute ensembles. The user-exit program calculates and stores the heading offset based on the difference between the heading determination from the Ashtech receiver and from the ship's gyrocompass. The ADCP transducer is mounted at a depth of about 5 meters below the waterline of the ship.

As setup parameters, we used a blanking interval of 4 meters, a vertical pulse length of 8 meters, and a vertical bin size of 8 meters. A 3 minute sampling interval was used for the entire cruise. Bottom tracking was activated during the shallow water transits near the Australian coast. For the processing of the ADCP data aboard ship, we used a rotation amplitude of 1.007, a rotation angle of -0.5 degrees (added to the gyro minus GPS heading), and a time filter width of 0.0208 days (30 minutes). Final editing and calibration of the ADCP data has not yet been done. For example, some spikes due to pinging off the CTD wire or rosette on station are still present in the data.

A complete set of preliminary plots was generated during the cruise. The plots consist of: vector plots with velocity averaged over several depth intervals, and over one hour in time; and contour plots of u (positive east) and v (positive north) typically averaged over 0.1 degree of longitude or latitude, depending on the track. The velocity was measured from a depth of 21 meters to a depth of about 300 meters, typically, during the first part of the cruise.

3. Thermosalinograph and undissolved O2 etc.

Thermosalinograph data were collected underway, and were logged as part of the IMET data (see section C5 below). In addition, the pCO2 of the air and surface water were analyzed along the cruise track with an automated system. (See also Section C4.) Alternate readings of air pumped from the bow and air equilibrated with surface water supplied from the ship's uncontaminated seawater supply were made using a non-dispersive infrared analyzer. Together with the ship's navigational and IMET data, these pCO2 measurements will be used to calculate the flux of CO2 along the cruise track.

4. XBT and XCTD: none

5. Meteorological observations

The following IMET sensors were installed and in use during I10.

Type	Serial Number	Label
Air Temperature	119	TMP
Barometric Pressure	118	BPR
Precipitation	113	PRC
Relative Humidity	115	HRH
Sea Surface Temperature	Falmouth Scientific:	OCM-TH-212
Short Wave Radiation	105	SWR
Wind Speed and Direction	002	WND

The data were logged to ASCII text files, one per day. The files are named YYMMDD.dat, where YYM MDD is the year, month, and day which is covered in the file. Logging began on November 11 at 01:03 UTC, and ended on November 25 at 00:50 UTC.

The following data items were recorded once per minute during this cruise:

Item # & Name	Description
003| CTIME	Computer time
009| GYRO	Ship's heading (Gyro syncro)
021| SPDLOG	Ship's speed (EDO Speedlog)
024| SSCND	Sea surface conductivity (mmho/cm)
025| SSTMP	Sea surface temperature (C)
029| GP20P_TP	Port GPS 200 time & position
034| GP20S_TP	Stbd GPS 200 time & position
036| GPS_COG	GPS course over ground
039| GPS_SOG	GPS speed over ground
040| GPS_TP	GPS time & position
042| IMET_AIR	Air temperature (degrees C)
043| IMET_BPR	Barometric pressure (millibars)
045| IMET_HUM	Relative humidity (percent)
048| IMET_PRC	Precipitation (millimeters)
050| IMET_SWR	Short wave radiation (watts/sq m)
051| IMET_WNC	Compass reading (degrees) [NOT IN USE]
052| IMET_WND	Wind direction (ship relative)
053| IMET_WNS	Wind speed (m/s, ship relative)

Known Problems

The IMET_WND - There is a faulty board in the wind sensor. As a result the wind speed will occasionally jump to an unreasonably high value, such as 100+ meters per second for a period of about one minute. At these times, the compass (WNC) will often register a fictitious reading (it should read 0.0 as it has been disconnected) and wind direction (WND) will sometimes log a "?" character. Data logged from this instrument was only 92% reliable for this cruise. There is a new wind sensor being shipped to Singapore which will be installed during the port stop.

P-Code GPS (GPS_TP): The ship lost it's P-Code on November 18, at 23:58 UTC. This was due to the Military's change of encryption codes for the device. A valid KYK keying device is waiting for the ship in Singapore.

There were a few gaps in the data during the cruise. Any gap longer than 15 minutes while under way, and any gap longer than one hour while on station are listed below, with a short explanation of each. If only a subset of the data items are missing for the period indicated, the missing items will be listed along with the notes. In the table below OS stands for on station, and UW stands for under way.

Date	Start	Stop	Length	UW/OS	Notes (Including data affected)
11/16	05:04	06:51	01:46	OS	WNC, WND, WNS-Instrument out of sync needed power cycling
11/17	05:29	05:50	00:21	UW	*ALL Sensors* Data logging computer failed
	05:59	06:48	00:49	UW	SSCND, SSTMP, AIR, BPR, HUM, PRC, SWR,
					WNC, WND, WNS - Power Supply Failure
	07:13	08:05	00:59	OS	AIR- Instrument out of sync needed power cycling
11/19	20:44	23:05	02:21	Both	WNC, WND, WNS-Instrument out of sync needed power cycling

6. Atmospheric Chemistry: none

3. CFCs

Two chlorofluorocarbons (CFC-11 and CFC-12) were measured on WOCE leg I10 by Kevin Sullivan and Jorina Waworuntu of the University of Miami. The shipboard measurement of the two CFCs was done using the University of Miami analytical system, by an established procedure (Bullister and Weiss, 1988). Analytical blanks for CFC-11 and CFC-12 were close to zero. At two stations bottles were tripped in a different order to test for bottle blanks. Bottle blanks ranged 0.002-0.004 pM/kg, and were not applied to the preliminary data. Stations 1019-1024 at the beginning of the cruise were not sampled because of a problem with the analytical system. Nine hundred and nineteen samples were collected and analyzed at 53 of the 60 stations. Approximately 20 samples were analyzed at each station normally above 2000 m. Blank levels of CFCs were usually reached by 1500 m. Eleven replicate water samples were drawn. The average standard deviations of these replicates were 0.0018 pM CFC-12/kg and 0.0013 pM CFC-11/kg. The I10 CFC-11 and CFC-12 data well exceed WOCE analytical standards. In addition to water analyses, marine airs were analyzed. The average concentrations were 510 pptr CFC-12 and 267 pptr CFC-11.

4. CO2 and Alkalinity

As part of a global survey of carbon dioxide in the oceans sponsored by the Department of Energy, the Princeton University Ocean Tracers Lab (OTL) was responsible for making inorganic carbon measurements on WOCE line I10. In addition to the contribution to the current global carbon inventory estimate, we expect to use the data from this line together with our data from the far western Pacific and WOCE line I-9N to evaluate the carbon transport associated with the Indonesian through-flow and the influence this area has on the alkalinity budgets of the Pacific and Indian Oceans. Four members of the OTL- CO2 group participated in the cruise: Christopher Sabine, Susan Boehme, Gerard McDonald, and Marian Markham. Discrete samples were collected and analyzed for total carbon dioxide (TCO2) and total alkalinity (TA). Carbon dioxide partial pressure (pCO2) was measured quasi-continuously in the air and surface water throughout the cruise.

Samples for TCO2 were collected in 300 ml borosilicate bottles and analyzed using two SOMMA-coulometer systems following the methods of Johnson et al. (1985; 1987). TA samples were collected in 500 ml borosilicate bottles and analyzed with two closed cell titration systems using methods similar to those described by Bradshaw et al. (1981). Evaluation of the titration results were made using the non-linear least-squares approach described by Dickson (1981) and by Johansson & Wedborg (1982).

No major problems were encountered on the cruise. By sending four analysts and running multiple systems, we were able to analyze 936 (>50% of total) samples for both TCO2 and TA. This is more than a 50% increase over the typical coverage for the Pacific WOCE legs. Full profiles were collected at 33 stations. Samples were collected from the surface niskin of 20 additional stations to get maximum coverage in the surface waters. Duplicate samples were drawn and analyzed from approximately 8% of the niskins to evaluate sampling and analytical precision. Duplicate 500 ml samples were also drawn from one surface and one deep niskin at 5 stations distributed along the cruise track. These samples will be shipped to Scripps for TCO2 analysis by C. D. Keeling as part of the standard CO2 QA/QC program for WOCE legs.

5. C14

The Princeton University Ocean Tracers Lab (OTL) was responsible for collecting samples for carbon 14 analysis on WOCE line I10. The data from this line together with data from the far western Pacific and other WOCE Indian Ocean lines will be used to characterize the water masses in the Indonesian through-flow. One member of the OTL group participated in the cruise: Tonalee Key. One hundred twenty eight samples were collected at 6 stations on this line. Full water profiles were collected at two stations, shallow profiles, 1700m or less, were collected at 4 stations. The samples will be analyzed at a later date in the land based Atomic Mass Spectrometry lab at Woods Hole Oceanographic Institution.

6. 3He/3H

A total of 216 tritium and 384 helium samples were collected during I-10. Helium samples, taken at depth between 1 and 6400 m, were extracted for helium isotopes using WHOI's shipboard sample processing system within 12 hours of acquisition. The isotope ratio measurements will be made by mass spectrometer at the WHOI facility. The tritium samples, taken at depths between 1 and 1500 m, were degassed using the WHOI shipboard sea water degassing system and stored in 1000 ml aluminum silicate glass vessels for subsequent tritium determination by mass spectrometric measurement of the decay product 3He at the WHOI facility.

List of Figures

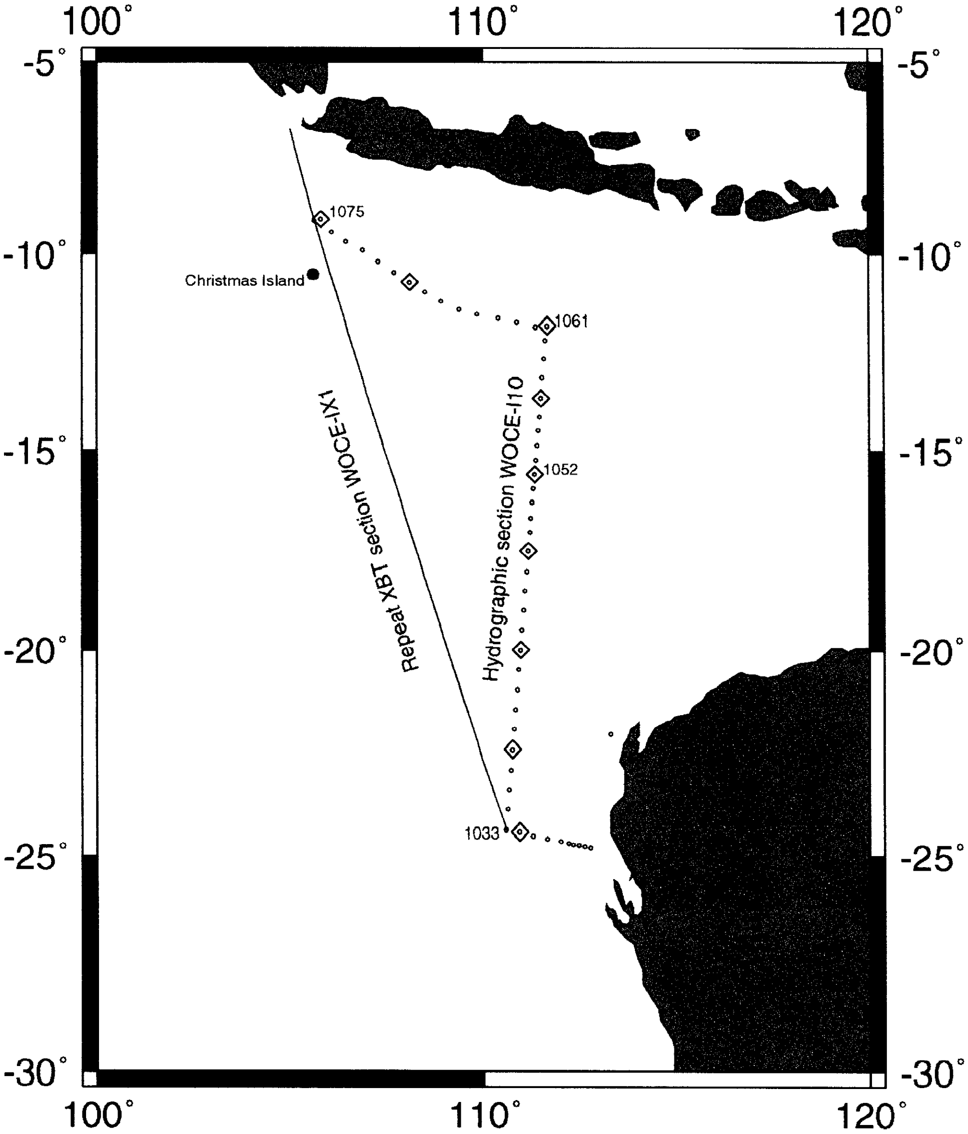


Figure A2-1 Cruise Track. Dots are CTD/O2/nutrient/LADCP stations. Diamonds identify ALACE deployment locations.

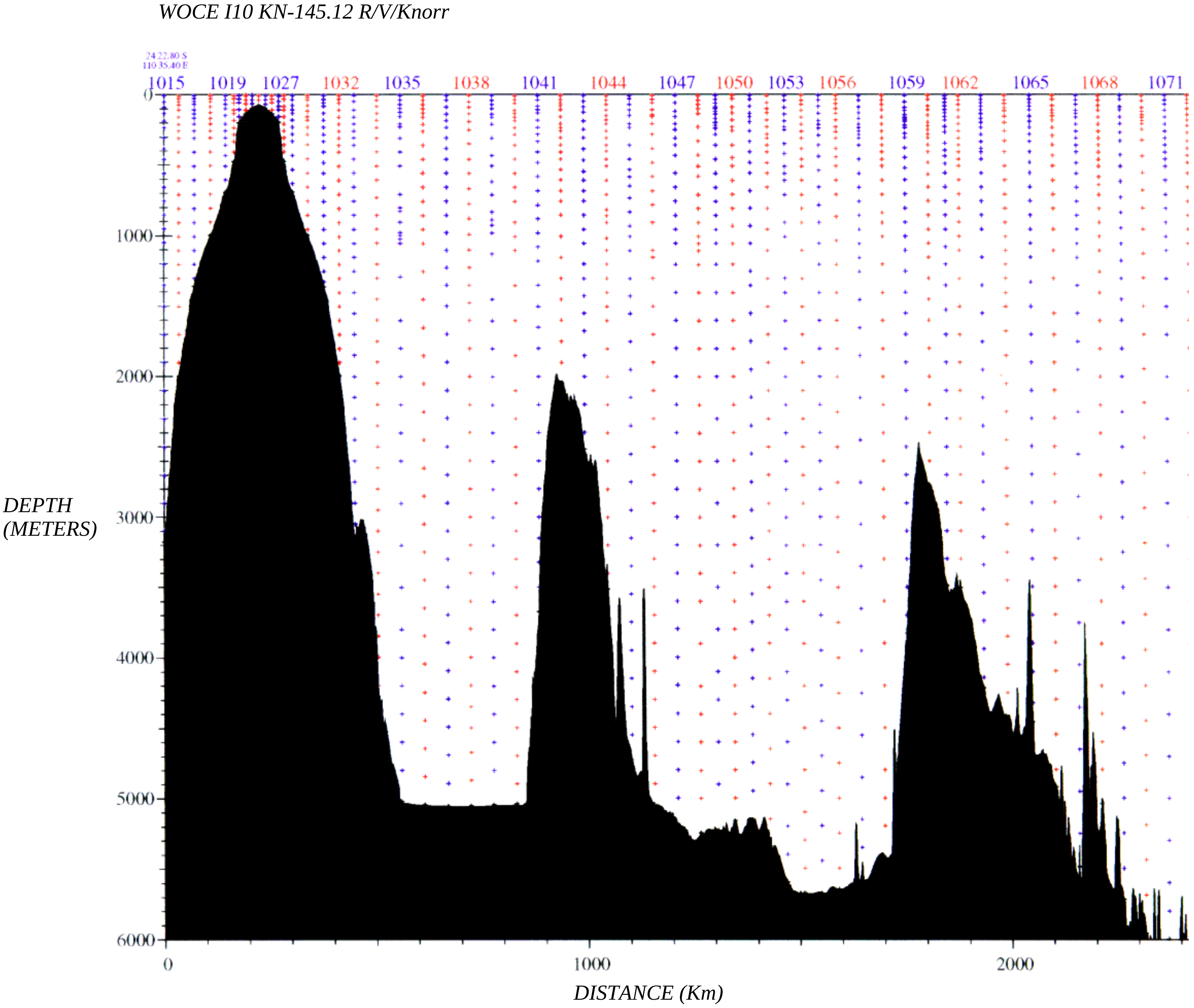


Figure A2-2 Rosette bottle trips along the I10

Mon Nov 27 04:30:33 1995
Cheres'

VM-ADCP: KN9511 WHP I10

Nov 11-24, 1995

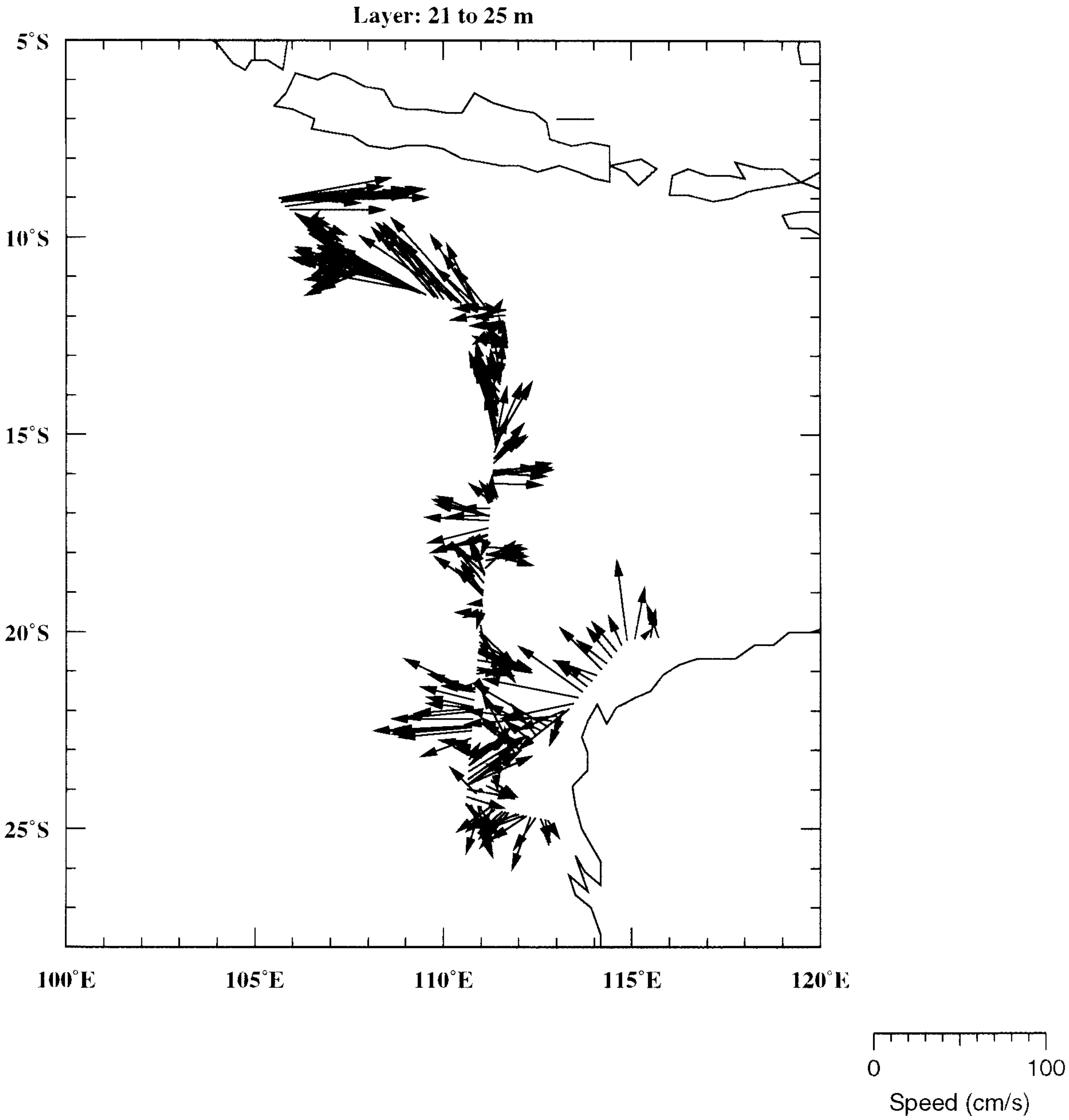


Figure A2-3 Underway ADCP velocity near the surface.

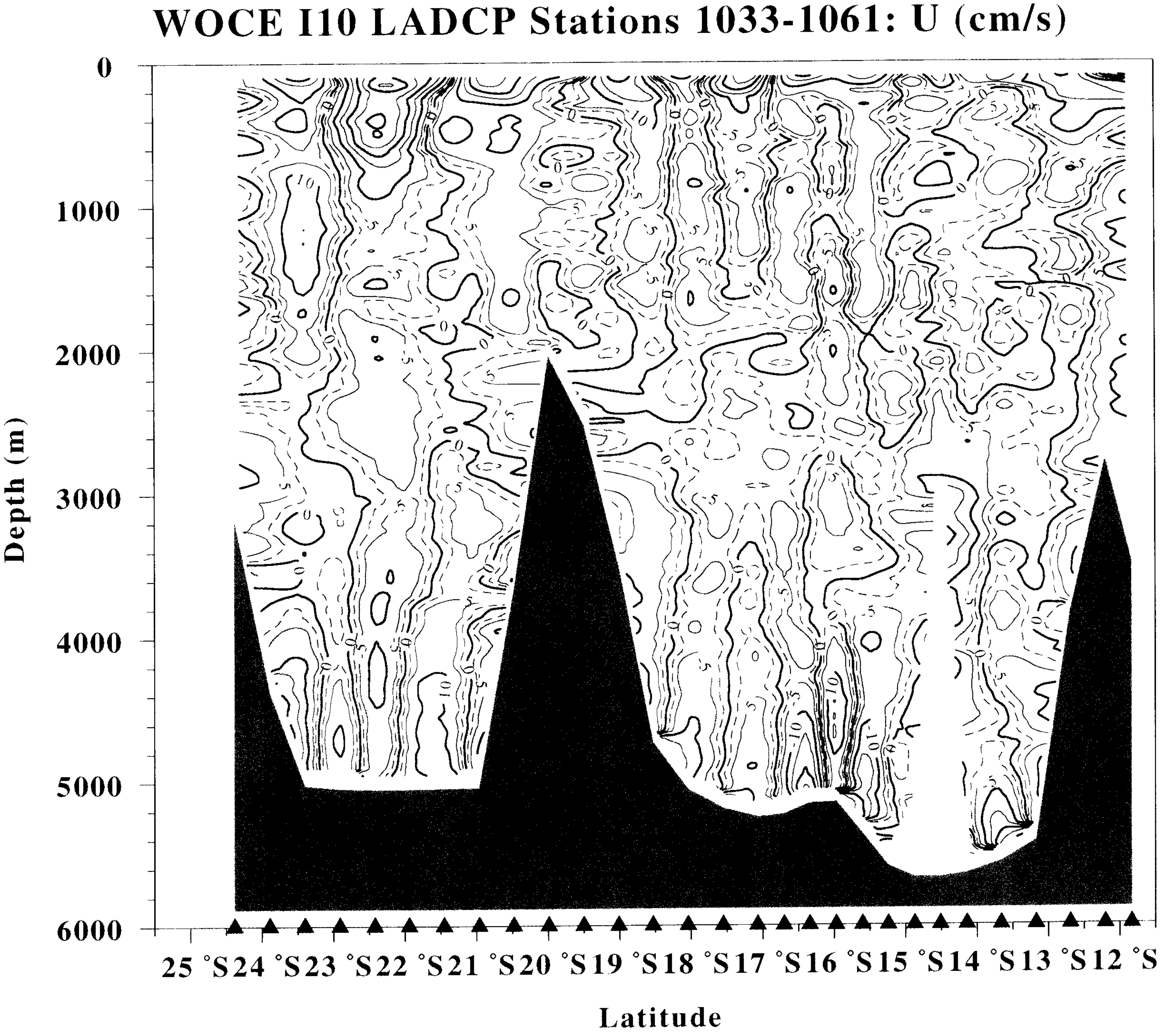


Figure A2-4a Zonal velocity from LADCP profiles along the entire section.

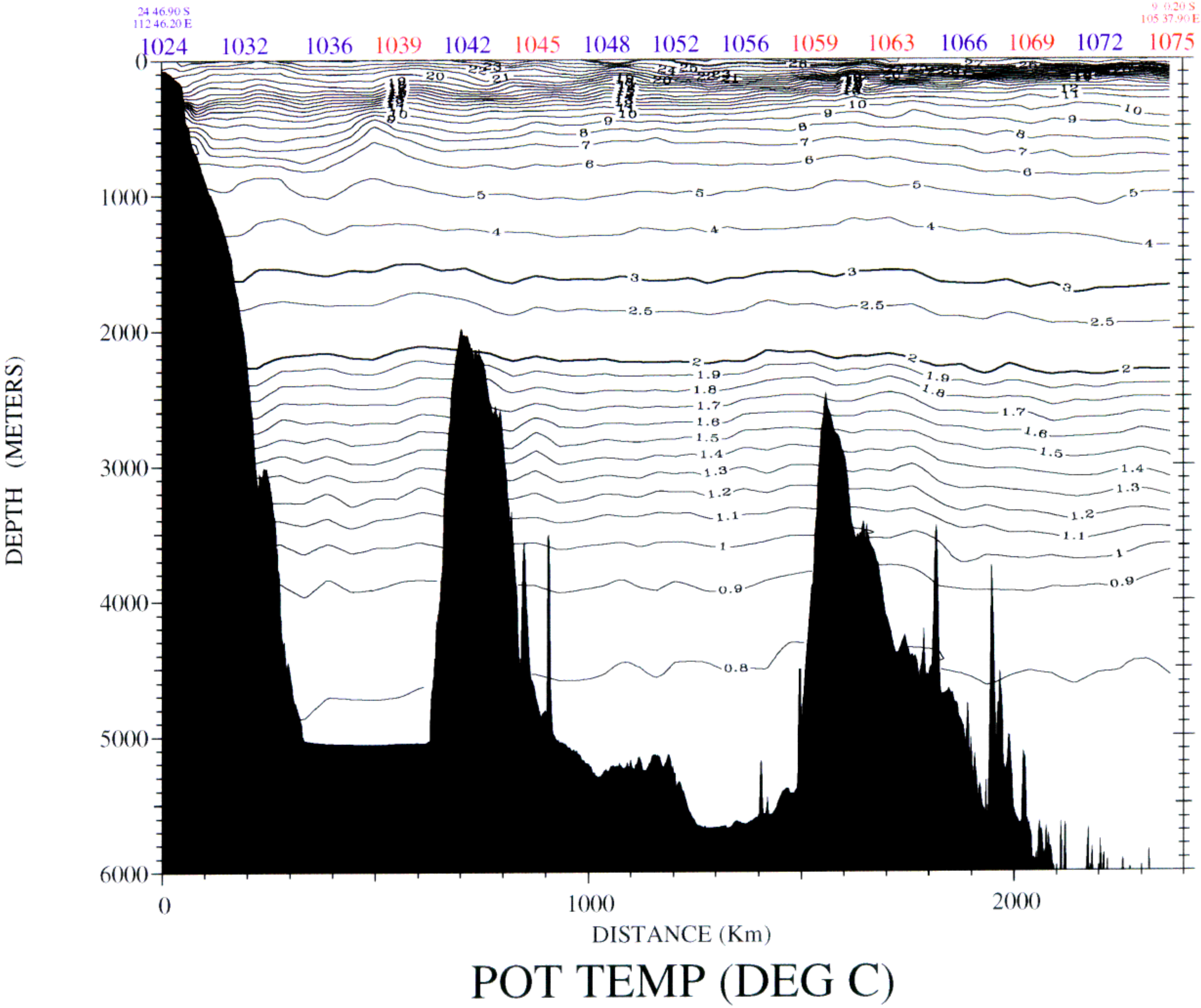


Figure A4-1. Vertical section of potential temperature for the entire section South is on the left side of the figure.

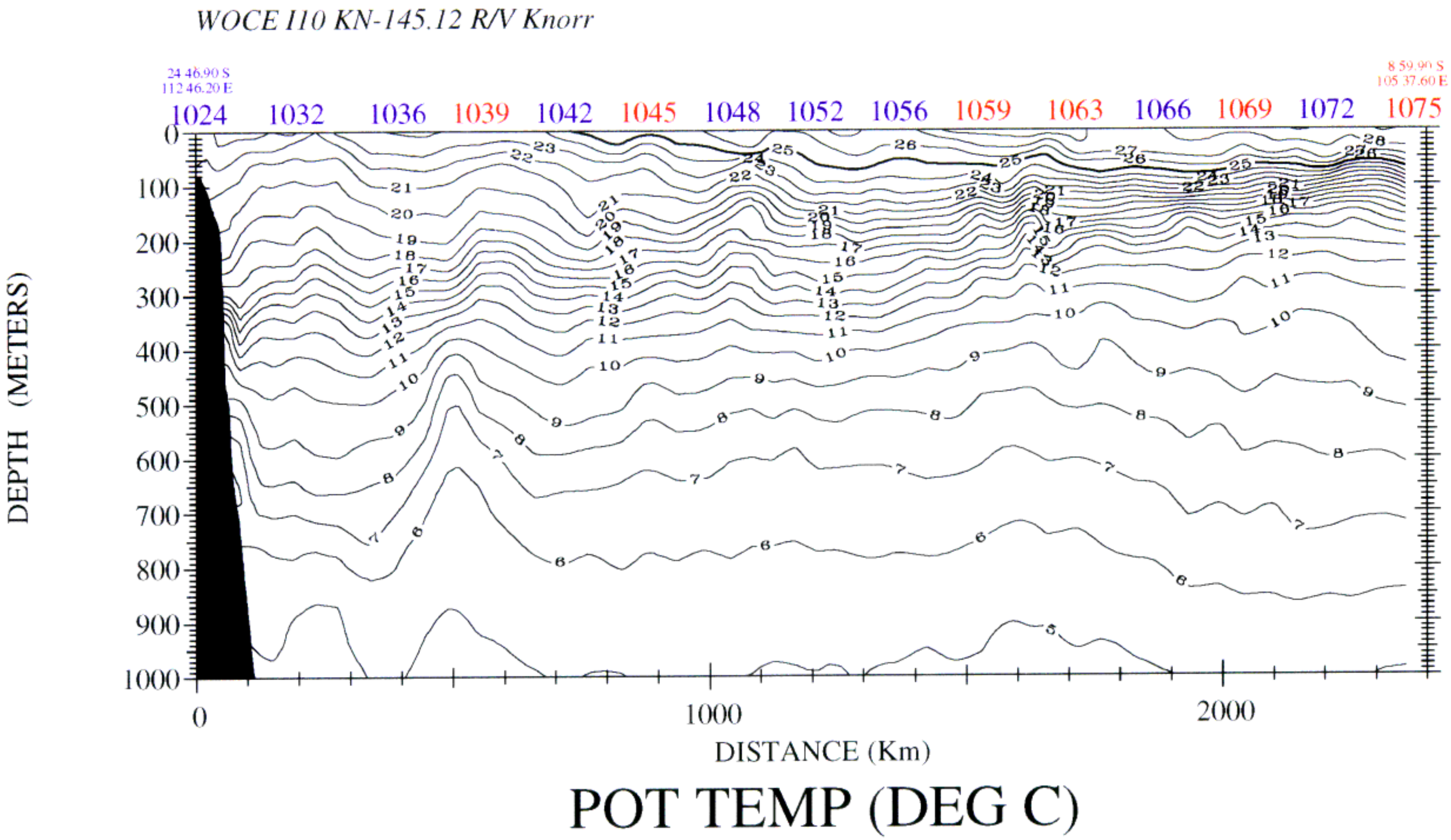


Figure A4-2. Potential temperature in the top 1000m.

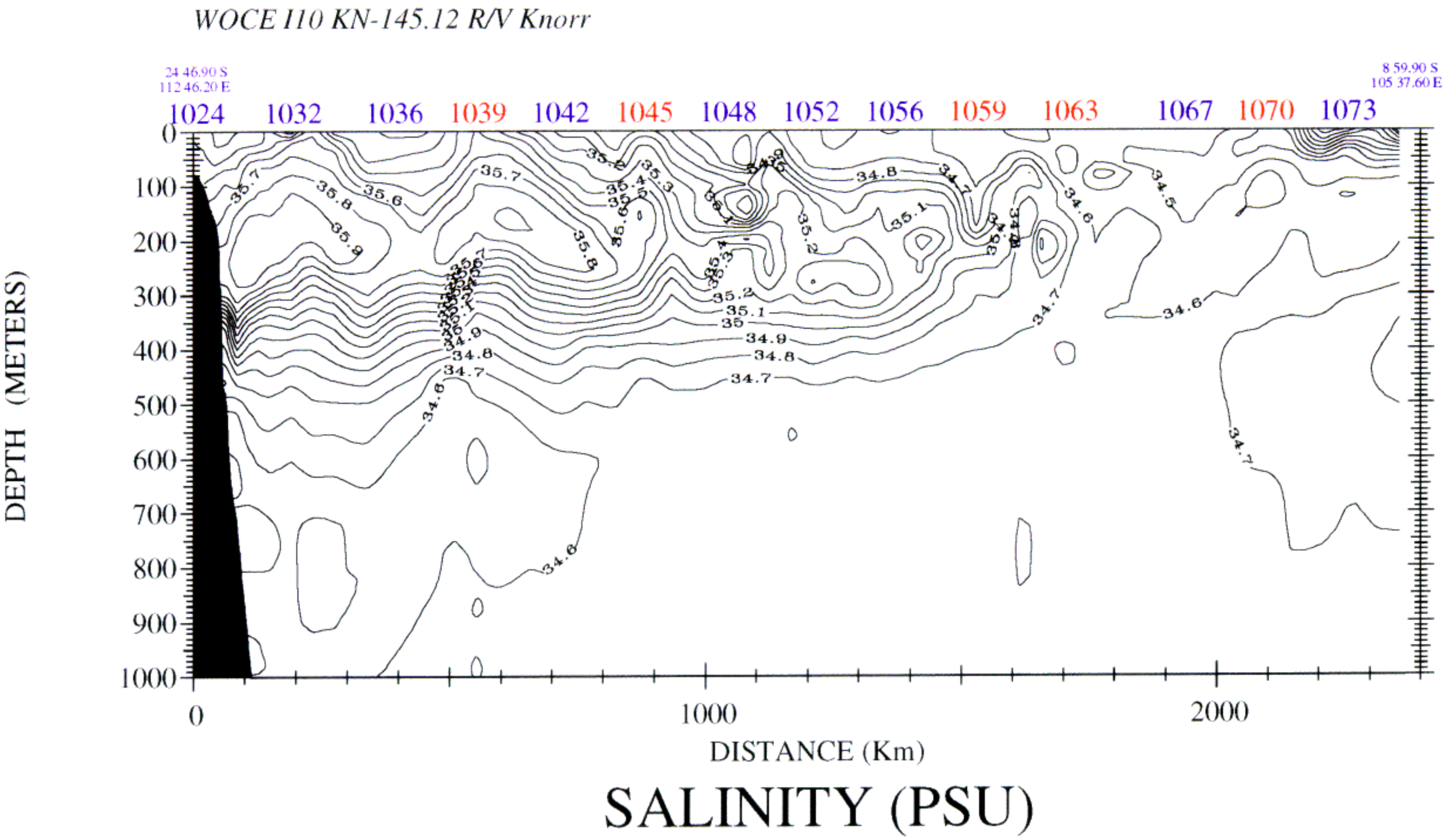


Figure A4-3. Salinity in the top 1000m.

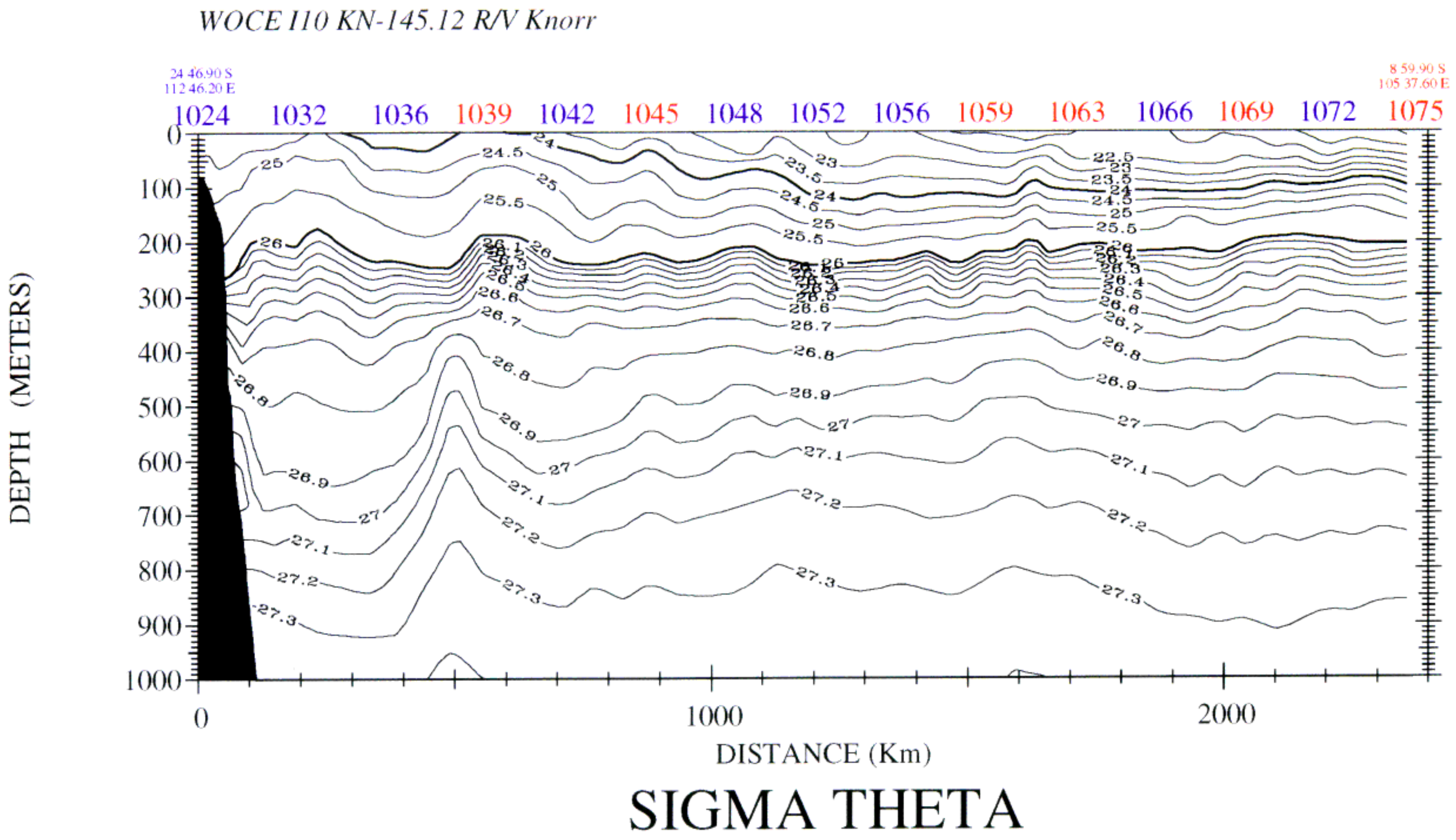


Figure A4-4. Density (sigma theta) in the top 1000m.

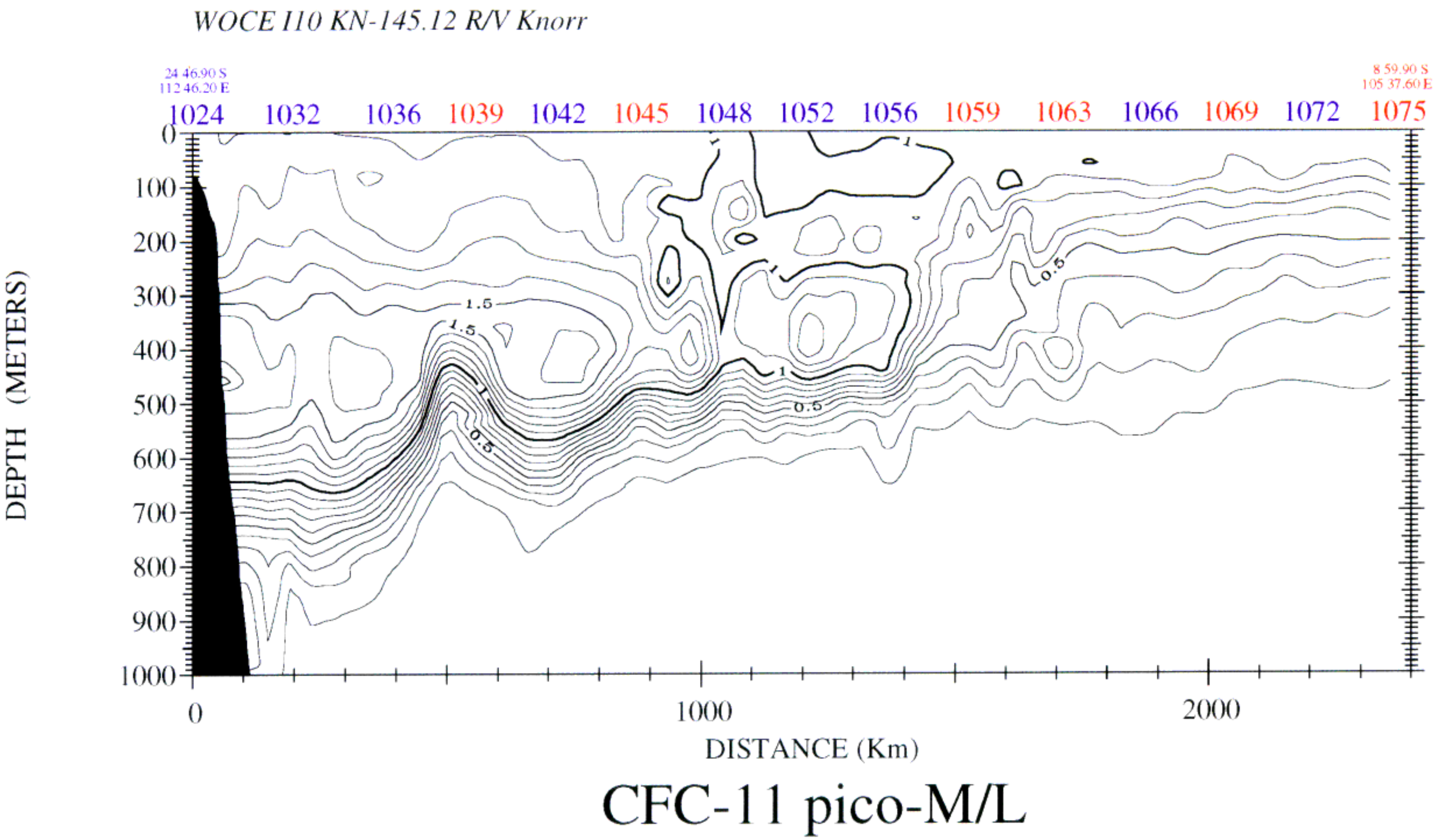


Figure A4-5. CFC-11 in the top 1000m.

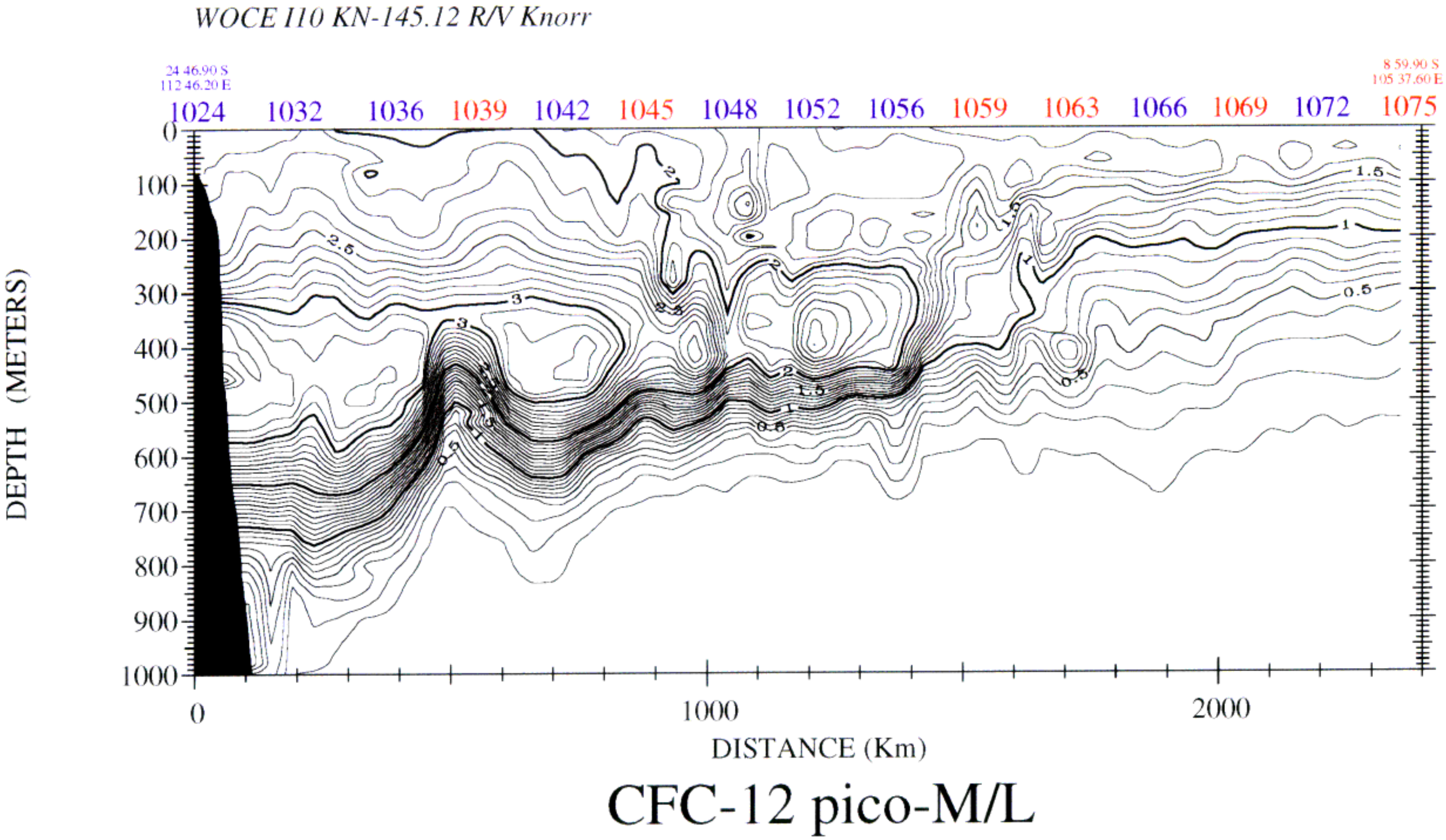


Figure A4-6. CFC-12 in the top 1000m.

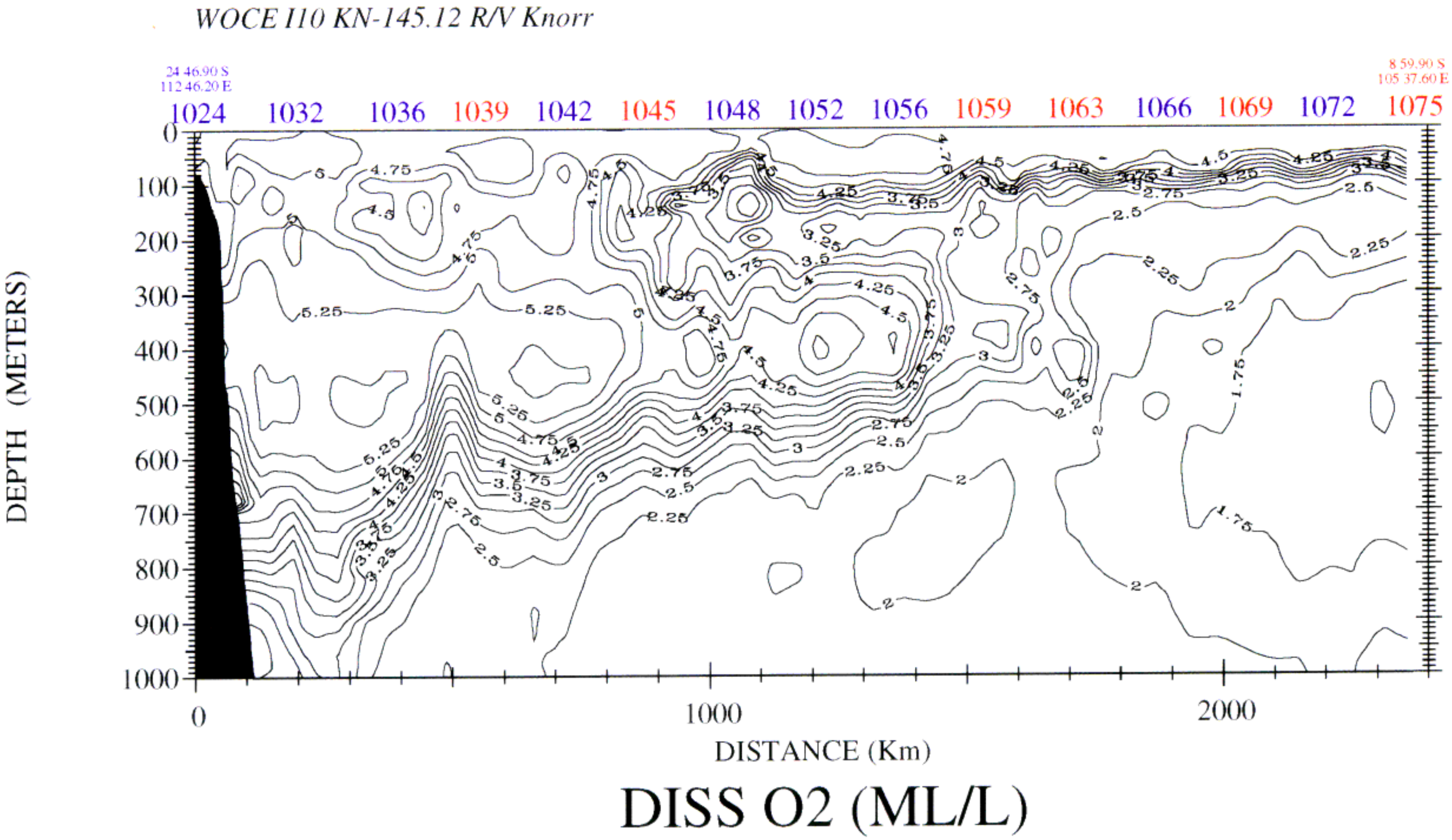


Figure A4-7. Dissolved oxygen in the top 1000m.

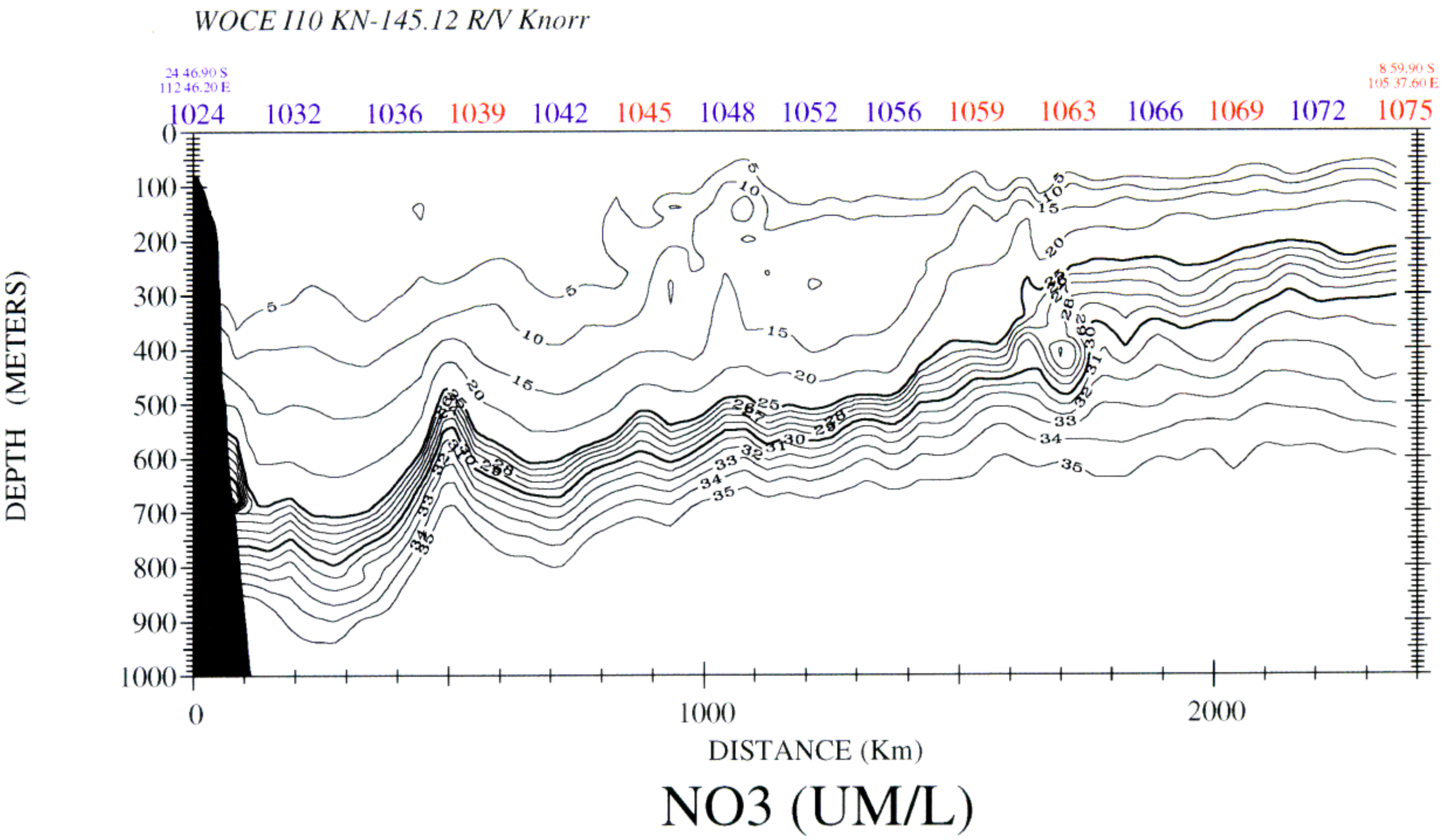


Figure A4-8. Nitrate in the top 1000m.

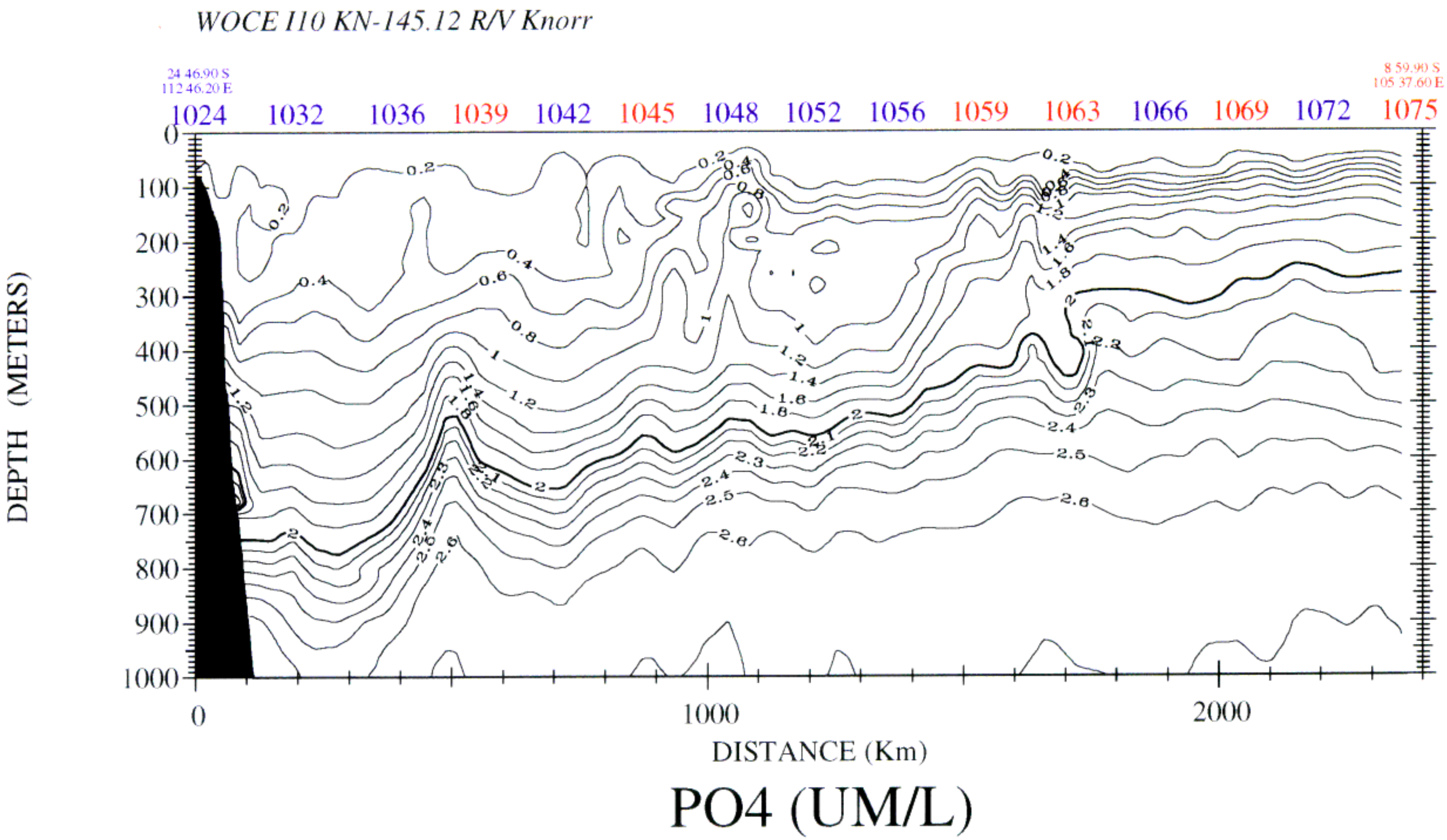


Figure A4-9. Phosphate in the top 1000m.

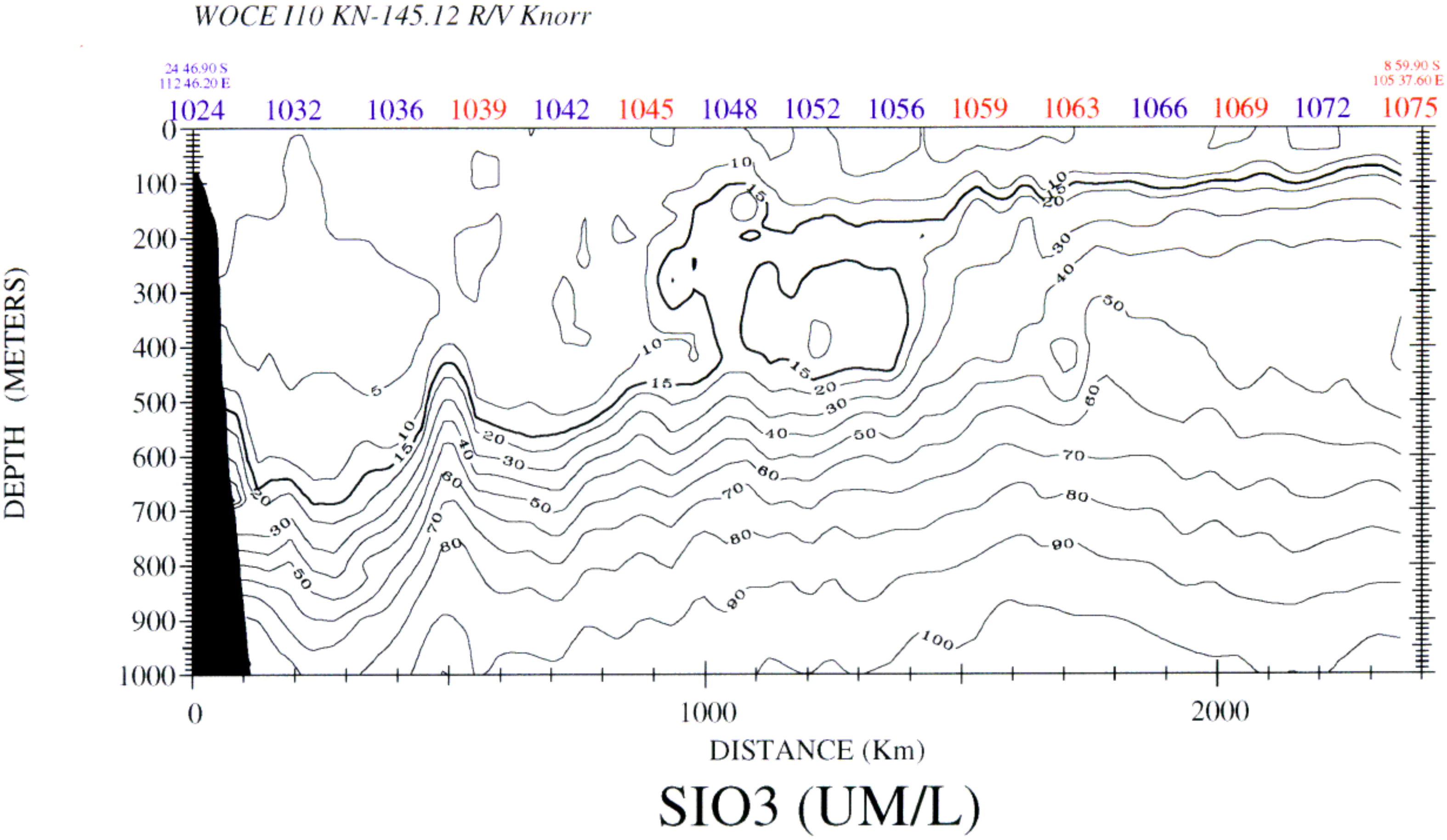
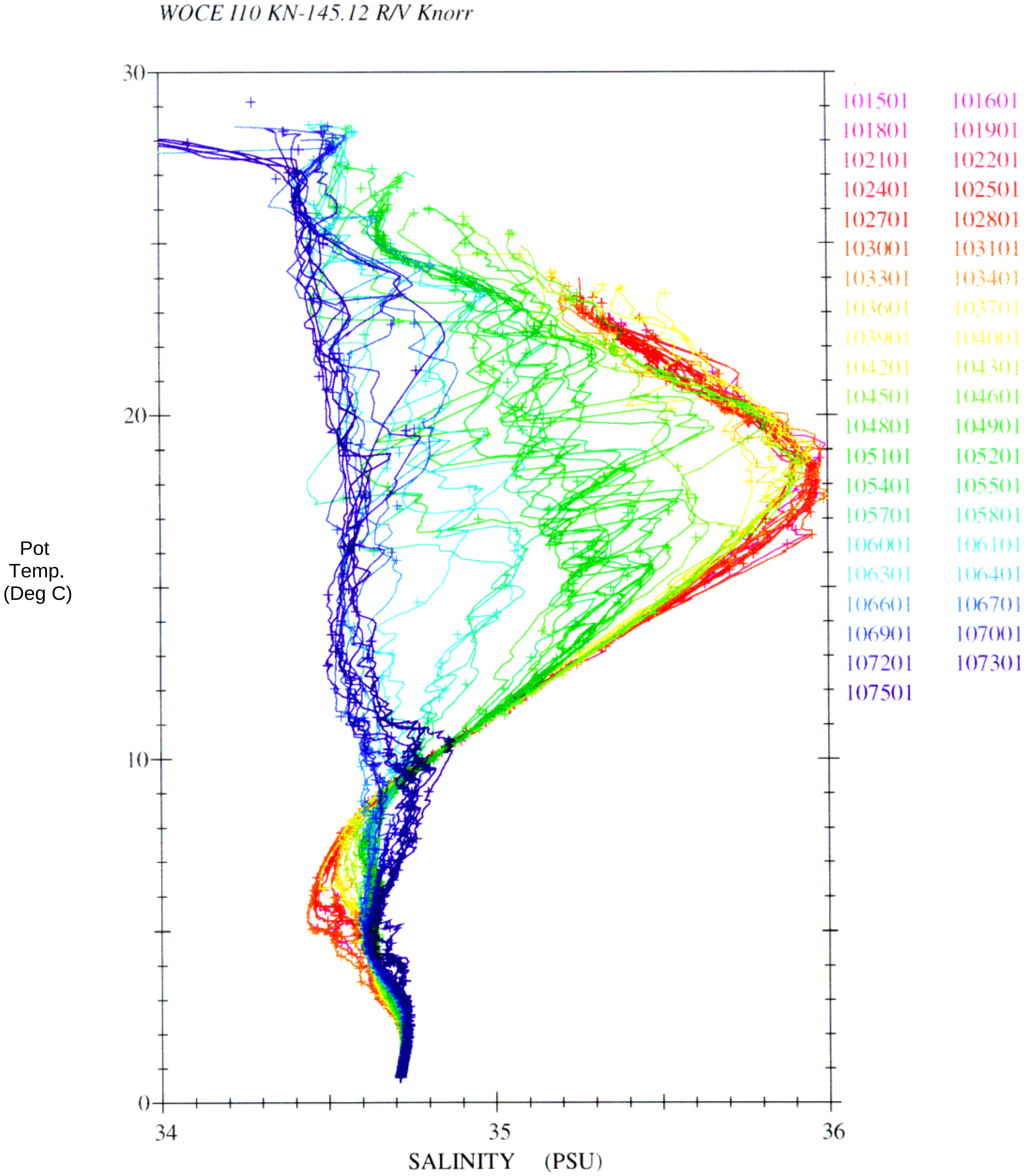


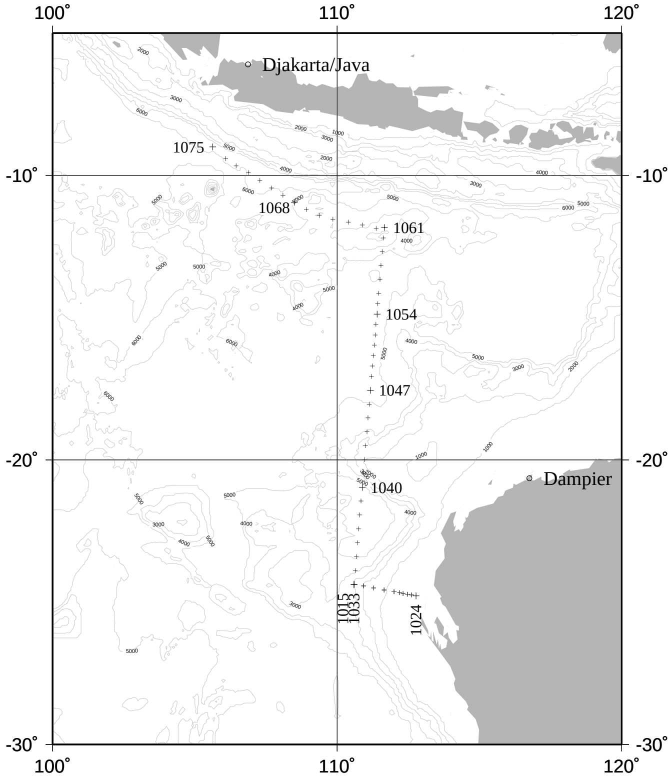
Figure A4-10. Silicate in the top 1000m.

Figure A4-11. Potential temperature - salinity curves for I10 section.



World Ocean Circulation Experiment
Indian Ocean I10
R/V Knorr Voyage 145 Leg 13
11-28 November 1995
Dampier, W. Australia - Singapore
Expocode: 316N145/13

Chief Scientist:
Janet Sprintall, Scripps Institution of Oceanography
(initially Dr. Nan Bray, now at CSIRO/Australia)



I10 Cruise Track

Oceanographic Data Facility (ODF)
Final Cruise Report
12 April 2001

Data Submitted by:

Oceanographic Data Facility
Scripps Institution of Oceanography
La Jolla, CA 92093-0214

DESCRIPTION OF MEASUREMENT TECHNIQUES AND CALIBRATIONS

1. Basic Hydrography Program

The basic hydrography program consisted of salinity, dissolved oxygen and nutrient (nitrite, nitrate, phosphate and silicate) measurements made from bottles taken on CTD/rosette casts, plus pressure, temperature, salinity and dissolved oxygen from CTD profiles. 62 CTD/rosette casts were made, usually to within 5-10 meters of the bottom. Station 1076 was a test cast to the bottom, ~6500 meters, with the LADCP removed and an FSI OPM pressure sensor attached to the CTD; it is not reported with these final WOCE data. 9 ALACE floats were also deployed during this cruise.

The ship departed from Dampier, W. Australia on November 11, 1995. The first line was occupied twice: stations 1015 to 1024 ran slightly south of east from a position in the Leeuwin Current towards the Australian coast off Shark Bay. Stations 1025-1033 were repeat casts at the same locations as stations 1023-1015. Then the track headed in a direction slightly east of north to station 1061, at the edge of the Indonesian EEZ. The Indonesians did not give permission to enter their EEZ, so the last section ran in a northwesterly direction, following the EEZ boundary toward the planned cruisetrack. The last WOCE station 1075 was on the intended track, about halfway between the west end of Java and Christmas Island on the EEZ boundary. The ship returned to Singapore on November 28, 1995.

1737 bottles were tripped resulting in 1734 usable bottles. No insurmountable problems were encountered during any phase of the operation. The resulting data set met and in many cases exceeded WHP specifications. The distribution of samples is illustrated in Figure 1.0.

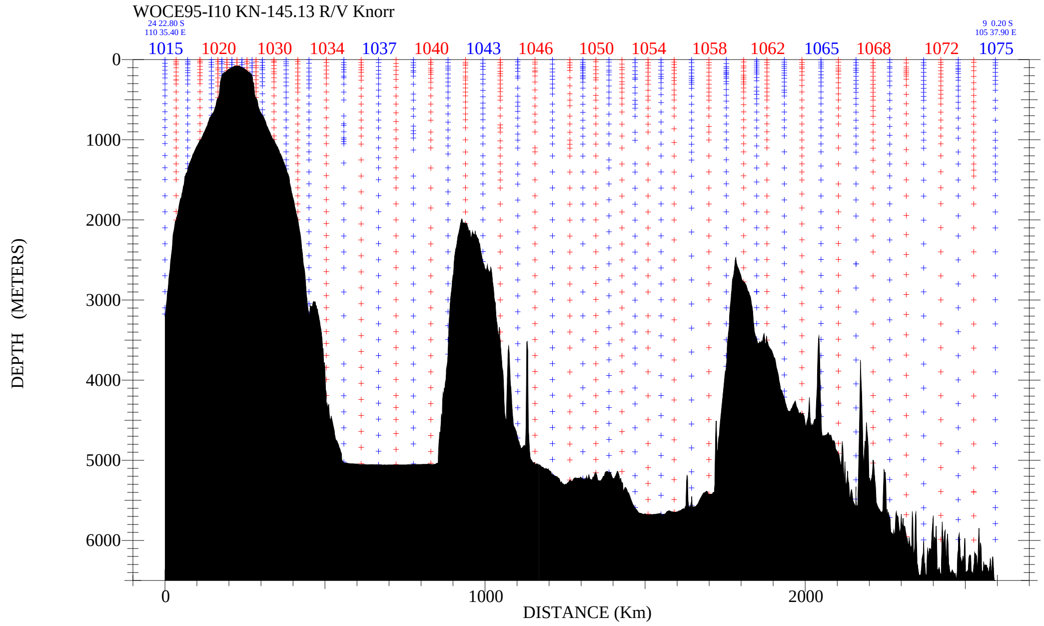


Figure 1.0 I10 sample distribution, stas 1015-1075

2. Water Sampling Package

Hydrographic (rosette) casts were performed with a rosette system consisting of a 36-bottle rosette frame (ODF), a 36-place pylon (General Oceanics 1016) and 36 10-liter PVC bottles (ODF). Underwater electronic components consisted of an ODF-modified NBIS Mark III CTD (ODF #1) and associated sensors, SeaTech transmissometer (TAMU), RDI LADCP (UofH), Benthos altimeter and Benthos pinger. The CTD was mounted horizontally along the bottom of the rosette frame, with the transmissometer, a SensorMedics dissolved oxygen sensor and an FSI secondary PRT sensor deployed next to the CTD. The LADCP was vertically mounted to the frame inside the bottle rings. The altimeter provided distance-above-bottom in the CTD data stream. The pinger was monitored during a cast with a precision depth recorder (PDR) in the ship's laboratory. The rosette system was suspended from a three-conductor 0.322" electro-mechanical cable. Power to the CTD and pylon was provided through the cable from the ship. Separate conductors were used for the CTD and pylon signals. The transmissometer, dissolved oxygen, secondary temperature and altimeter were interfaced with the CTD, and their data were incorporated into the CTD data stream. Deep Sea Reversing Thermometers (DSRTs) were used occasionally on this leg to monitor for CTD pressure or temperature drift.

The deck watch prepared the rosette approximately 45 minutes prior to each cast. All valves, vents and lanyards were checked for proper orientation. The bottles were cocked and all hardware and connections rechecked. Time, position and bottom depth were logged by the console operator at arrival on station. The rosette was deployed from the starboard side of the main deck. Each rosette cast was lowered to within 5-10 meters of the bottom, unless the bottom returns from both the pinger and altimeter were extremely poor or the bottom depth exceeded the range of the instrumentation. Stations 1071 through 1075, casts 1, were lowered to 6000 meters (~ 6100 db pressure), the maximum depth rating for the CTD and LADCP. These five casts were terminated between 66 and 500+ meters off the bottom, according to readings from the PDR and/or altimeter.

Bottles on the rosette were each identified with a unique serial number. Usually these numbers corresponded to the pylon tripping sequence, 1-36, where the first (deepest) bottle tripped was bottle #1. Bottle #37 replaced bottle #3 only during station 1038, while repairs were made to bottle #3. There were three stations where the bottles were tripped in a special sequence for freon blank checks. The trip sequences, deepest to shallowest, for these stations were bottles 16-36, then 1-15, at station 1038; bottles 12-36, then 1-11, at station 1066; and bottles 13-36, then 1-12, at station 1075.

Averages of CTD data corresponding to the time of bottle closure were associated with the bottle data during a cast. Pressure, depth, temperature, salinity and density were immediately available to facilitate examination and quality control of the bottle data as the sampling and laboratory analyses progressed.

Recovering the package at the end of deployment was essentially the reverse of the launching with the additional use of air-tuggers for added stabilization. The rosette was moved into the starboard-side (forward) hangar for sampling. The bottles and rosette were examined before samples were taken, and any unusual situations or circumstances were noted on the sample log for the cast.

Routine CTD maintenance included soaking the conductivity and CTD O_2 sensors in distilled water between casts to maintain sensor stability. The rosette was stored in the rosette room between casts to insure the CTD was not exposed to direct sunlight or wind, in order to maintain the internal CTD temperature near ambient air temperature.

Rosette maintenance was performed on a regular basis. O-rings were changed as necessary and bottle maintenance was performed each day to insure proper closure and sealing. Valves were inspected for leaks and repaired or replaced as needed.

The transmissometer windows were cleaned prior to deployment approximately every 20 casts. The air readings were noted in the TAMU transmissometer log book after each cleaning. Transmissometer data were monitored for potential problems during every cast.

The R/V Knorr's port-side Markey CTD winch was used for all I10 casts.

3. Underwater Electronics Packages

CTD data were collected with a modified NBIS Mark III CTD (ODF #1). This instrument provided pressure, temperature, conductivity and dissolved O_2 channels, and additionally measured a second temperature (FSI temperature module/OTM) as a calibration check. An FSI pressure module/OPM was substituted in place of the secondary temperature/OTM for four casts. Other data channels included elapsed-time, altimeter, several power supply voltages and transmissometer. The instrument supplied a 15-byte NBIS-format data stream at a data rate of 25 Hz. Modifications to the instrument included revised pressure and dissolved O_2 sensor mountings; ODF-designed sensor interfaces for O_2, FSI PRT and transmissometer; implementation of 8-bit and 16-bit multiplexer channels; an elapsed-time channel; instrument ID in the polarity byte and power supply voltages channels.

Table 3.0 summarizes the winches and serial numbers of instruments and sensors used during I10.

Station(s)	ODF CTD† ID#	SensorMedics Oxygen Sensor	SeaTech Transmissometer (TAMU)	Winch
1015-1036	1a	5-01-10	152D	Port
1037-1038			151D*	
1039-1067		5-01-03		
1068		5-01-10		
1069-1072		5-01-07		
1073-1076	1b			

*NOTE: No transmissometer was installed during station 1041
† See table below for ODF CTD serial numbers

ODF CTD #1 sensor serial numbers:

NBIS MKIIIB CTD (ODF-ID#)	Pressure Paine Model 211-35-440-05 strain gage/0-8850psi	Temperature		Conductivity NBIS Model 09035-00151
		PRT1 Rosemount Model 171BJ	PRT2/(PRS2) FSI OTM/(OPM)	
1a	131910	14304	OTM/1319T	5902-F117
1b			(OPM/1326P)	

Table 3.0 I10 Instrument/Sensor Serial Numbers

The CTD pressure sensor mounting had been modified to reduce the dynamic thermal effects on pressure. The sensor was attached to a section of coiled stainless-steel tubing that was connected to the end-cap pressure port. The transducer was also insulated. The NBIS temperature compensation circuit on the pressure interface was disabled; all thermal response characteristics were modeled and corrected in software.

The O_2 sensor was deployed in a pressure-compensated holder assembly mounted separately on the rosette frame and connected to the CTD by an underwater cable. The O_2 sensor interface was designed and built by ODF using an off-the-shelf 12-bit A/D converter. The transmissometer interface was a similar design.

Although the secondary temperature sensor was located within 6 inches of the CTD conductivity sensor, it was not sufficiently close to calculate coherent salinities. It was used as a secondary temperature calibration reference rather than as a redundant sensor, with the intent of eliminating the need for mercury or electronic DSRTs as calibration checks.

The General Oceanics (GO) 1016 36-place pylon was used in conjunction with an ODF-built deck unit and external power supply instead of a GO pylon deck unit. This combination provided generally reliable operation and positive confirmation. The pylon emitted a confirmation message containing its current notion of bottle trip position, which could be useful in sorting out mis-trips. The acquisition software averaged CTD data corresponding to the rosette trip as soon as the trip was initiated until the trip confirmed, typically 3±0.5 seconds on I10.

There were 3 random bad trip confirmations during I10; all of these were noticed in a timely manner by the console operator. Two trip levels were re-done using the next bottle in line, resulting in the original bottle being open at the surface. The pylon was re-positioned for the third level, and the bottle was re-tripped successfully at its intended nominal depth. Bad confirmations and any effects on bottle trips are documented in Appendix D.

4. Navigation and Bathymetry Data Acquisition

Navigation data were acquired from the ship's Trimble GPS receiver via RS-232, which reported full P-code position information from November 11-18. P-code was lost on November 19 when new codes, not available for

I10, went into effect. Standard GPS was recorded for the remainder of the cruise. Data were logged automatically at one-minute intervals by one of the Sun SPARCstations. Underway bathymetry was logged manually from the 12 kHz Raytheon PDR at five-minute intervals, then corrected according to Carter [Cart80] and merged with the navigation data to provide a time-series of underway position, course, speed and bathymetry data. These data were used for all station positions, PDR depths and bathymetry on vertical sections.

5. CTD Data Acquisition, Processing and Control System

The CTD data acquisition, processing and control system consisted of a Sun SPARCstation LX computer workstation, ODF-built CTD and pylon deck units, CTD and pylon power supplies, and a VCR recorder for real-time analog backup recording of the sea-cable signal. The Sun system consisted of a color display with trackball and keyboard (the CTD console), 18 RS-232 ports, 2.5 GB disk and 8mm cartridge tape. Two other Sun SPARCstation LX systems were networked to the data acquisition system, as well as to the rest of the networked computers aboard the Knorr. These systems were available for real-time CTD data display and provided for hydrographic data management and backup. Two HP 1200C color inkjet printers provided hardcopy capability from any of the workstations.

The CTD FSK signal was demodulated and converted to a 9600 baud RS-232C binary data stream by the CTD deck unit. This data stream was fed to the Sun SPARCstation. The pylon deck unit was connected to the Sun LX through a bi-directional 300 baud serial line, allowing bottle trips to be initiated and confirmed by the data acquisition software. A bitmapped color display provided interactive graphical display and control of the CTD rosette sampling system, including real-time raw and processed CTD data, navigation, winch and rosette trip displays.

The CTD data acquisition, processing and control system was prepared by the console watch a few minutes before each deployment. A console operations log was maintained for each deployment, containing a record of every attempt to trip a bottle as well as any pertinent comments. Most CTD console control functions, including starting the data acquisition, were initiated by pointing and clicking a trackball cursor on the display at icons representing functions to perform. The system then presented the operator with short dialog prompts with automatically-generated choices that could either be accepted as defaults or overridden. The operator was instructed to turn on the CTD and pylon power supplies, then to examine a real-time CTD data display on the screen for stable voltages from the underwater unit. Once this was accomplished, the data acquisition and processing were begun and a time and position were automatically logged for the beginning of the cast. A backup analog recording of the CTD signal on a VCR tape was started at the same time as the data acquisition. A rosette trip display and pylon control window popped up, giving visual confirmation that the pylon was initializing properly. Various plots and displays were initiated. When all was ready, the console operator informed the deck watch by radio.

Once the deck watch had deployed the rosette and informed the console operator that the rosette was at the surface (also confirmed by the computer displays), the console operator or watch leader provided the winch operator with a target depth (wire-out) and maximum lowering rate, normally 60 meters/minute for this package. The package then began its descent, building up to the maximum rate during the first few hundred meters, then optimally continuing at a steady rate without any stops during the down-cast.

The console operator examined the processed CTD data during descent via interactive plot windows on the display, which could also be run at other workstations on the network. Additionally, the operator decided where to trip bottles on the up-cast, noting this on the console log. The PDR was monitored to insure the bottom depth was known at all times.

The deck watch leader assisted the console operator by monitoring the rosette’s distance to the bottom using the difference between the rosette’s pinger signal and its bottom reflection displayed on the PDR. Around 100-200 meters above the bottom, depending on bottom conditions, the altimeter typically began signaling a bottom return on the console. The winch speed was usually slowed to ~30 meters/minute during the final approach. The winch and altimeter displays allowed the watch leader to refine the target depth relayed to the winch operator and safely approach to within 5-10 meters of the bottom.

Bottles were closed on the up-cast by pointing the console trackball cursor at a graphic firing control and clicking a button. The data acquisition system responded with the CTD rosette trip data and a pylon confirmation message in a window. A bad or suspicious confirmation signal typically resulted in the console operator repositioning the pylon trip arm via software, then re-tripping the bottle, until a good confirmation was received. All tripping attempts were noted on the console log. The console operator then instructed the winch operator to bring the rosette up to the next bottle depth. The console operator was also responsible for generating the sample log for the cast.

After the last bottle was tripped, the console operator directed the deck watch to bring the rosette on deck. Once the rosette was on deck, the console operator terminated the data acquisition and turned off the CTD, pylon and VCR recording. The VCR tape was filed. Usually the console operator also brought the sample log to the rosette room and served as the *sample cop*.

6. CTD Data Processing

ODF CTD processing software consists of over 30 programs running under the Unix operating system. The initial CTD processing program (ctdba) is used either in real-time or with existing raw data sets to:

- Convert raw CTD scans into scaled engineering units, and assign the data to logical channels
- Filter various channels according to specified filtering criteria
- Apply sensor- or instrument-specific response-correction models
- Provide periodic averages of the channels corresponding to the output time-series interval
- Store the output time-series in a CTD-independent format

Once the CTD data are reduced to a standard-format time-series, they can be manipulated in various ways. Channels can be additionally filtered. The time-series can be split up into shorter time-series or pasted together to form longer time-series. A time-series can be transformed into a pressure-series, or into a larger-interval time-series. The pressure calibration corrections are applied during reduction of the data to time-series. Temperature, conductivity and oxygen corrections to the series are maintained in separate files and are applied whenever the data are accessed.

ODF data acquisition software acquired and processed the CTD data in real-time, providing calibrated, processed data for interactive plotting and reporting during a cast. The 25 Hz data from the CTD were filtered, response-corrected and averaged to a 2 Hz (0.5-second) time-series. Sensor correction and calibration models were applied to pressure, temperature, conductivity and O_2. Rosette trip data were extracted from this time-series in response to trip initiation and confirmation signals. The calibrated 2 Hz time-series data, as well as the 25 Hz raw data, were stored on disk and were available in real-time for reporting and graphical display. At the end of the cast, various consistency and calibration checks were performed, and a 2.0-db pressure-series of the down-cast was generated and subsequently used for reports and plots.

CTD plots generated automatically at the completion of deployment were checked daily for potential problems. The two PRT temperature sensors were inter-calibrated and checked for sensor drift. The CTD conductivity sensor was monitored by comparing CTD values to check-sample conductivities, and by deep theta-salinity comparisons between down- and up-casts as well as adjacent stations. The CTD O_2 sensor was calibrated to check-sample data.

A few casts exhibited conductivity offsets due to biological or particulate artifacts. Some casts were subject to noise in the data stream caused by sea cable or slip-ring problems, or by moisture in the interconnect cables between the CTD and external sensors (i.e. O_2). Intermittent noisy data were filtered out of the 2 Hz data using a spike-removal filter. A least-squares polynomial of specified order was fit to fixed-length segments of data. Points exceeding a specified multiple of the residual standard deviation were replaced by the polynomial value.

Density inversions can be induced in high-gradient regions by ship-generated vertical motion of the rosette. Detailed examination of the raw data shows significant mixing occurring in these areas because of "ship roll". In order to minimize density inversions, a ship-roll filter was applied to all casts during pressure-sequencing to disallow pressure reversals.

The first few seconds of in-water data were excluded from the pressure-series data, since the sensors were still adjusting to the going-in-water transition. However, some casts exhibited up to a 0.036 sigma theta drop during the top 12 db, or a sharply increasing density gradient in the top few meters of the water column. A time-series data check verified these density features were probably real: the data were consistent over many frames of data at the same pressures. Appendix C details the magnitude of the larger density drops or gradients for the casts affected.

Pressure intervals with no time-series data can optionally be filled by double-quadratic interpolation/extrapolation. The only pressure intervals missing/filled during this leg were at 0 db, caused by chopping off going-in-water transition data during pressure-sequencing.

When the down-cast CTD data have excessive noise, gaps or offsets, the up-cast data are used instead. CTD data from down- and up-casts are not mixed together in the pressure-series data because they do not represent identical water columns (due to ship movement, wire angles, etc.). It was not necessary to use any up-casts for I10 CTD data.

There is an inherent problem in the internal digitizing circuitry of the NBIS Mark III CTD when the sign bit for temperature flips. Raw temperature can shift 1-2 millidegrees as values cross between positive and negative, a problem avoided by offsetting the raw PRT readings by ~1.5°C. The conductivity channel also can shift by 0.001-0.002 mS/cm as raw data values change between 32768/32767, where all the bits flip at once. This is typically not a problem in shallow to intermediate depths because such a small shift becomes negligible in higher gradient areas.

Raw CTD conductivity traversed 32768/32767 at ~1350±150 db (~3.75±0.15°C theta) during I10 casts. There is no apparent salinity shift seen during this leg because the +0.001 PSU effect was corrected during block-averaging. Also, the higher gradients at these depths vs deeper water tend to make the effect unnoticeable.

Appendix C contains a table of CTD casts requiring special attention. I10 CTD-related comments, problems and solutions are documented in detail.

7. CTD Laboratory Calibration Procedures

Pre-cruise laboratory calibrations of CTD pressure and temperature sensors were used to generate tables of corrections applied by the CTD data acquisition and processing software at sea. These laboratory calibrations were also performed post-cruise.

Pressure and temperature calibrations were performed on CTD #1 at the ODF Calibration Facility in La Jolla. The pre-cruise calibrations were done in September 1995, following five consecutive ODF WOCE legs in the Indian Ocean, and the post-cruise calibrations were done in December 1995.

The CTD pressure transducer was calibrated in a temperature-controlled water bath to a Ruska Model 2400 Piston Gage pressure reference. Calibration data were measured pre-/post-cruise at 0/-1.14°C to a maximum loading pressure of 6080 db, and 31.24/30.71°C to 1190 db. Additional pressure calibrations were done post-cruise at 5.04°C, to both 1190 and 6080 db. Figures 7.0 and 7.1 summarize the CTD #1 laboratory pressure calibrations performed in September and December 1995.

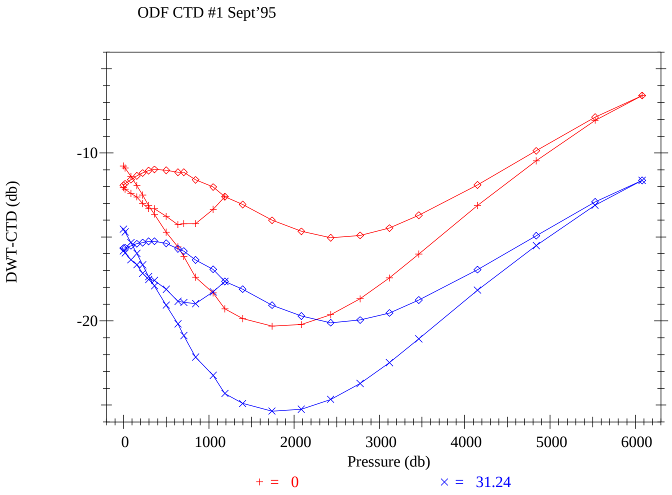


Figure 7.0 Pressure calibration for ODF CTD #1, September 1995.

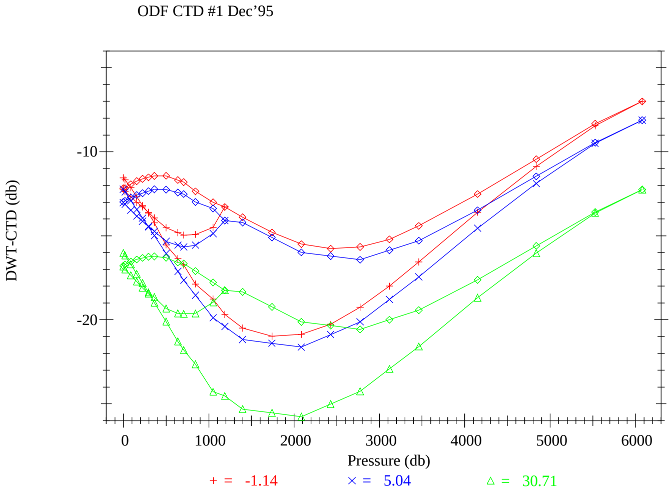


Figure 7.1 Pressure calibration for ODF CTD #1, December 1995.

Additionally, dynamic thermal-response step tests were conducted on the pressure transducer to calibrate dynamic thermal effects. These results were combined with the static temperature calibrations to optimally correct the CTD pressure.

CTD PRT temperatures were calibrated to an NBIS ATB-1250 resistance bridge and Rosemount standard PRT in a temperature-controlled bath. The primary and secondary CTD temperatures were offset by ~1.5 and ~2°C to avoid the 0-point discontinuity inherent in the internal digitizing circuitry. Standard and PRT temperatures were measured at 9 or more different bath temperatures between -1.2 and 31.3°C, both pre- and post-cruise. Figures 7.2 and 7.3 summarize the laboratory calibrations performed on the CTD #1 primary PRT during September and December 1995.

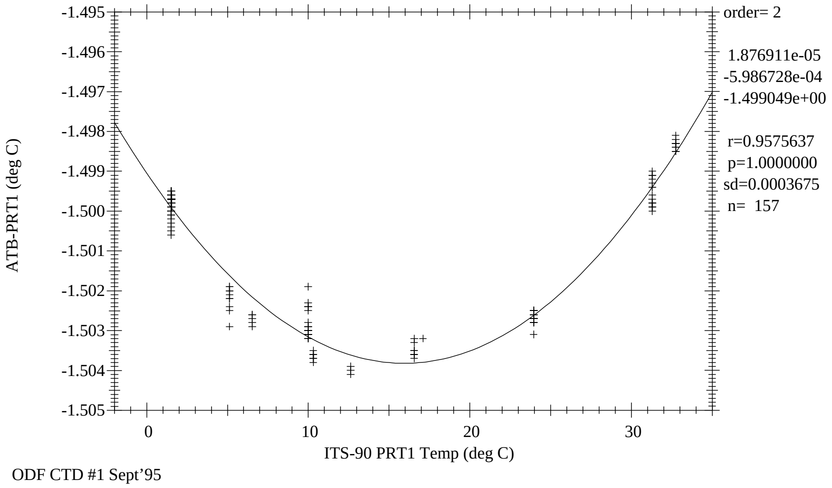


Figure 7.2 Primary PRT Temperature Calibration for ODF CTD #1, September 1995.

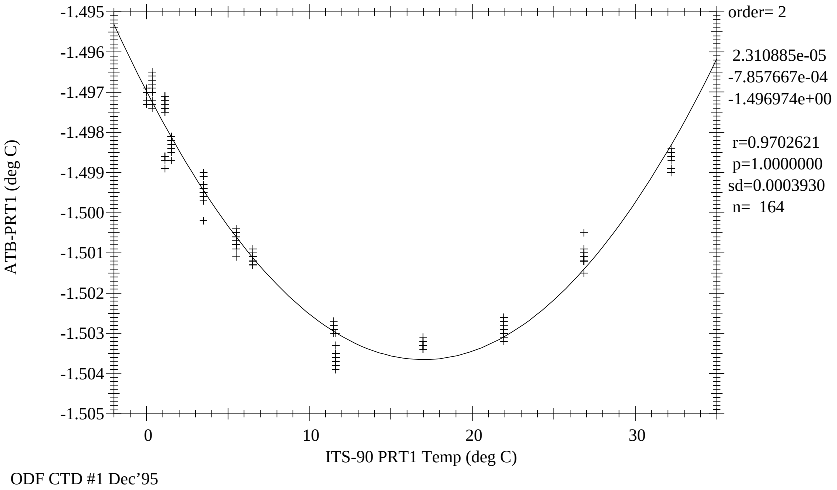


Figure 7.3 Primary PRT Temperature Calibration for ODF CTD #1, December 1995.

These laboratory temperature calibrations were referenced to an ITS-90 standard. Temperatures were converted to the IPTS-68 standard during processing in order to calculate other parameters, including salinity and density, which are currently defined in terms of that standard only. Final calibrated CTD temperatures are reported using the ITS-90 standard.

8. CTD Calibration Procedures

A redundant PRT sensor was used as a temperature calibration check while at sea. CTD conductivity and dissolved O_2 were calibrated to *in situ* check samples collected during each rosette cast.

Final pressure, temperature, conductivity and oxygen corrections were determined during post-cruise processing.

8.1. CTD #1 Pressure

A substitute FSI OPM/Pressure module (1326P) was used from station 1073 through 1075 as a secondary pressure sensor. No calibrations were available for this sensor. The port was left plugged on the OPM during station 1073. The primary pressure data from stations 1074 and 1075 were used to calculate an approximate correction for the

FSI. 1326P was used as the primary pressure sensor on station 1076, whose maximum cast depth exceeded the capacity of the primary pressure sensor. Station 1076 was considered a test cast, not a WOCE station, and is not included with the I10 data release.

There was a pre- to post-cruise shift of -0.5 to -0.75 db at shallow and deep pressures in the cold-bath laboratory calibrations for pressure. The warm-bath pressure correction shifted by -1.0 to -0.5 db. The change averages about -0.75 db when temperature differences between the pre-/post-cruise calibrations are taken into account. There were no significant slope differences between pre- and post-cruise pressure calibrations.

In order to determine when the pressure shift occurred, start-of-cast out-of-water pressure and temperature data from the cruise were compared with similar data from the pre- and post-cruise laboratory calibrations for temperature. The pressure data from the I10 leg shifted ~0.3 db compared to pre-cruise laboratory data at all temperatures. A -0.3 db offset was applied to the entire pre-cruise pressure calibration. These revised calibration data, plus the dynamic thermal-response correction, were applied to I10 CTD #1 pressures.

Down-cast surface pressures were automatically adjusted to 0 db as the CTD entered the water; any difference between this value and the calibration value was automatically adjusted during the top 50 decibars. Residual pressure offsets at the end of each up-cast (the difference between the last corrected pressure in-water and 0 db) averaged 0.7 db, thus indicating no problems with the final pressure corrections. Figure 8.1.0 shows the offset pre-cruise laboratory calibration used to correct I10 CTD #1 pressure data.

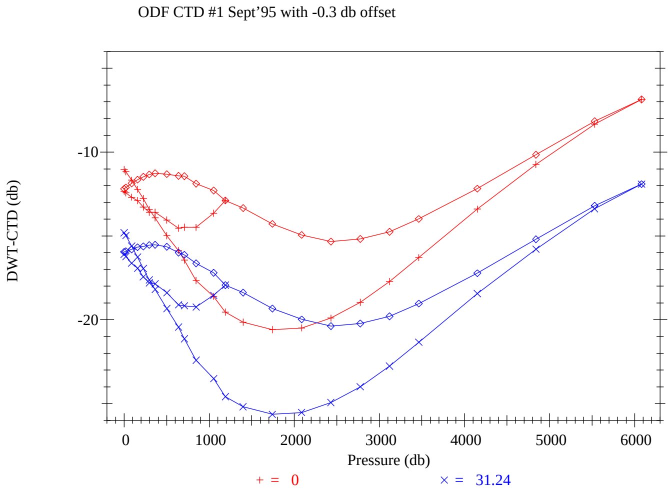


Figure 8.1.0 I10 Pressure correction for ODF CTD #1: September 1995 calibration offset by -0.3 db.

The entire pre- to post-cruise laboratory calibration shift for the pressure sensor on CTD #1 was less than one-third the magnitude of the WOCE accuracy specification of 3 db. Final adjusted I10 CTD pressures should be well within the desired standards.

8.2. CTD #1 Temperature

An FSI PRT sensor (PRT2 = S/N 1319T) was deployed as a second temperature channel and compared with the primary PRT channel (PRT1) on all casts through station 1072 to monitor for drift. The response times of the primary and secondary PRT sensors were matched, then preliminary corrected temperatures were compared for a series of standard depths from each CTD down-cast.

Since it was not calibrated pre-cruise, a correction for PRT2 was back-calculated to match corrected PRT1 data. The differences between the CTD #1 primary PRT and FSI-1319T data remained a fairly stable +0.0005°C for pressures deeper than 2000 db. A stable conductivity correction also indicated no shift in the primary PRT. The PRT2 data were not otherwise evaluated or used.

Figure 8.2.0 summarizes the comparison between the primary and secondary PRT temperatures.

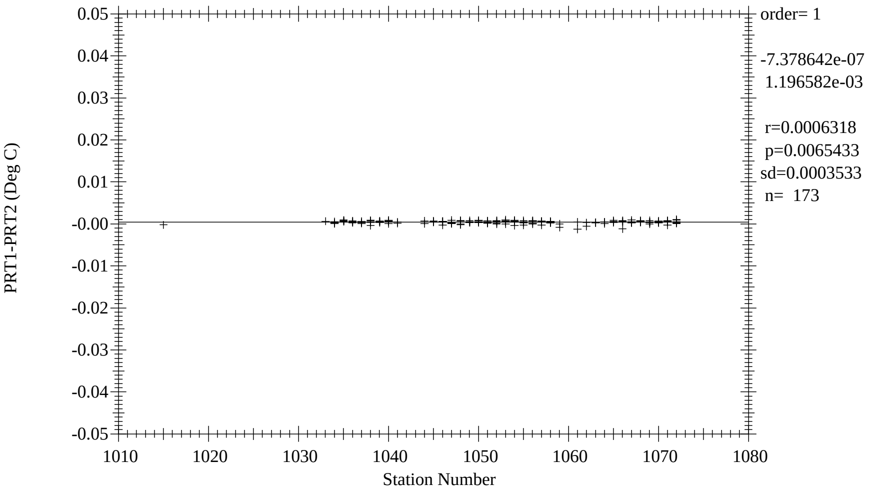
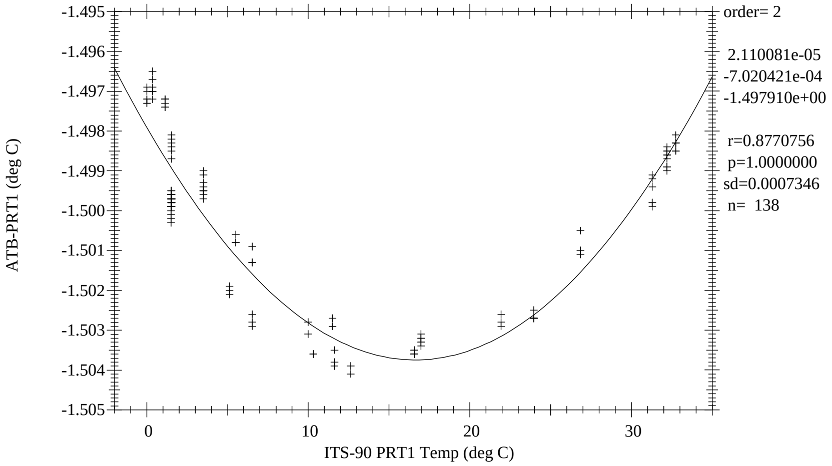


Figure 8.2.0 I10 comparison of CTD #1 primary/secondary PRT temperatures, pressure > 2000 db.

The primary temperature sensor laboratory calibrations indicated a +0.002°C shift at 0°C, a +0.0006°C shift at mid-range temperatures, and a +0.0006°C shift at 32°C from pre- to post-cruise. The pre- and post-cruise temperature calibrations were equally weighted and combined to generate an average temperature correction, which was applied to all CTD casts done during I10. Figure 8.2.1 summarizes the average of the pre-/post-cruise laboratory temperature calibrations for CTD #1.



ODF CTD #1 Equally Weighted Average of Sept'95 + Dec'95

Figure 8.2.1 WOCE95 Primary temperature correction for ODF CTD #1, Sept./Dec.95 equally weighted average.

One or two racks of mercury DSRTs were deployed beginning at station 1072 as a further check for pressure and temperature drift. Only 3 racks of therms on 2 stations were soaked and read. They were not useful for monitoring CTD pressure or temperature drift.

The pre- to post-cruise laboratory calibration shift for the primary temperature sensor on CTD #1 was, at worst, the same as the magnitude of the WOCE accuracy standard of 0.002°C. Since an average of the two calibrations was applied to the data, I10 CTD temperatures should be within the WOCE accuracy specifications.

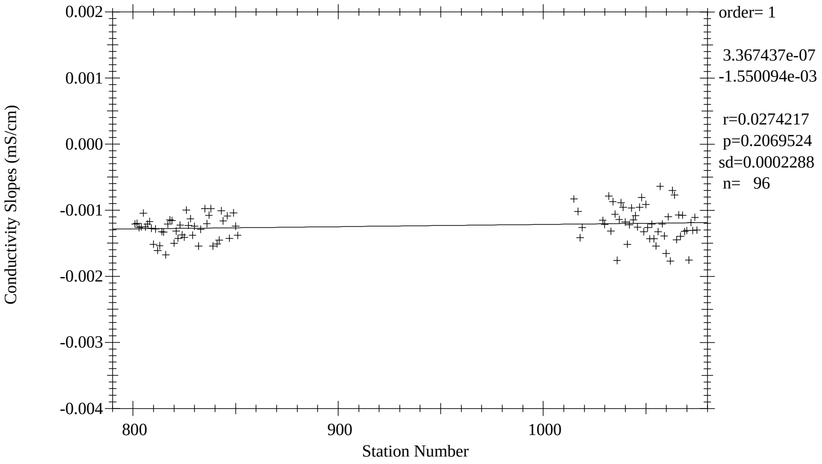
8.3. CTD #1 Conductivity

The corrected CTD rosette trip pressure and temperature were used with the bottle salinity to calculate a bottle conductivity. Differences between the bottle and CTD conductivities were then used to derive a conductivity correction. This correction is normally linear for the 3-cm conductivity cell used in the Mark III CTD.

Due to small shifts in CTD conductivity, probably caused by organic matter, the conductivity sensor was swabbed with distilled water several times during the 5 consecutive ODF WOCE95 legs earlier in the year. Conductivity offsets began a slow downward drift during I7N, suspected to be caused by organic growth on the sensor. After I7N station 800, the conductivity sensor was soaked in RBS solution for several hours, then swabbed with distilled water. This had the effect of changing the conductivity sensor's slope and offset, while stabilizing the drifting problem. The new conductivity slope appeared to remain stable through the rest of I7N and all of I10, two months later.

There were intermittent ±0.001 mS/cm mid-cast offsets in the conductivity signal beginning with station 1044 during I10. The sensor was swabbed with distilled water between stations 1051 and 1052, again because of suspected organic contamination of the sensor, without any apparent effect on the conductivity slope.

Conductivity differences above and below the thermocline were fit to CTD conductivity for stations 801-856 (I7N) and 1015-1076 (I10) together to determine conductivity slopes. Figure 8.3.0 shows the individual preliminary conductivity slopes.

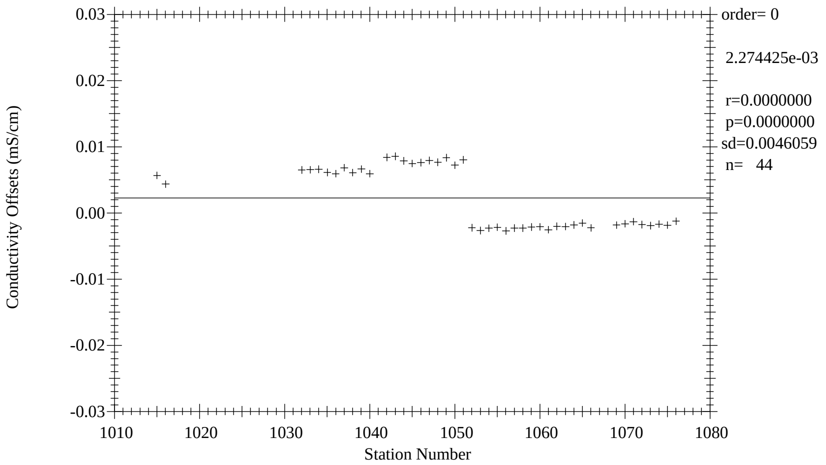


CTD #1, IO95 stas 801-856 + 1015-1076 individual-cast conductivity slopes, pressure < 25 db or > 250 db only

Figure 8.3.0 CTD #1 prelim. conductivity slopes for WOCE95 stations 801-856(I7N) + 1015-1076(I10).

These preliminary conductivity slopes for stations 801-856 and 1015-1076 were then fit to station number, with outlying values (4,2 standard deviations) rejected. Conductivity slopes were calculated from the first-order fit and applied to each I10 cast.

Once the conductivity slopes were applied, residual CTD conductivity offset values were calculated for each cast using bottle conductivities deeper than 1400 db. Figure 8.3.1 illustrates the I10 preliminary conductivity offset residual values.

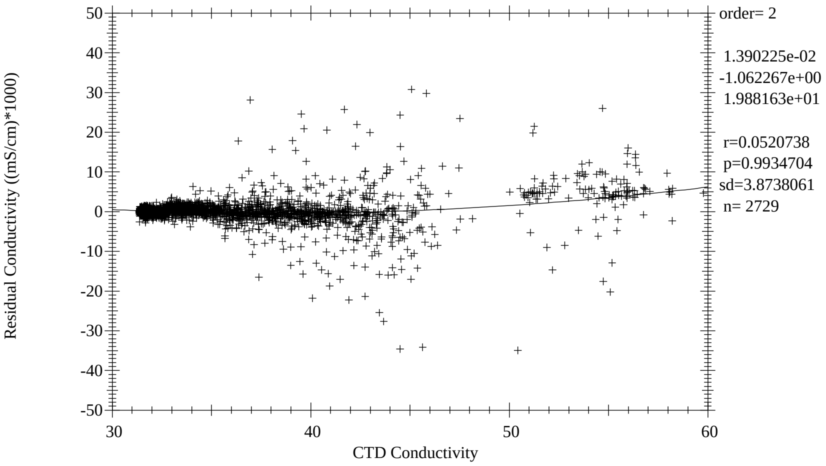


CTD #1, I10 individual-cast conductivity offsets, pressure > 1400 db only

Figure 8.3.1 I10 CTD #1 preliminary conductivity offsets by station number.

There was a +0.004 mS/cm shift in conductivity offsets between I7N and I10, so I10 offsets were determined independently from I7N. Casts were grouped together based on drift and/or known CTD conductivity shifts, such as the offset caused by cleaning the sensor after station 1051, to determine average offsets. This also smoothed the effect of any cast-to-cast bottle salinity variation, typically on the order of ±0.001 PSU. 15 casts were omitted from the groups because they were shallower than 1400 db. 3 other casts were omitted because of CTD shifts relative to nearby casts. Smoothed offsets were applied to each cast, then some offsets were manually adjusted to account for discontinuous shifts in the conductivity transducer response or bottle salinities, or to maintain deep theta-salinity consistency from cast to cast.

After applying the conductivity slopes and offsets to each cast, it was determined that surface salinity differences were ~0.008 PSU high compared to intermediate and deep differences. After offset adjustments were made, a mean second-order conductivity correction was calculated for stations 801-856 and 1015-1076. Figure 8.3.2 shows the residual conductivity differences used for determining this correction.



CTD #1, IO95 stas 801-856 + 1015-1076 residual conductivity slope, after linear corrxn

Figure 8.3.2 CTD #1 residual non-linear conductivity slope (WOCE95 stations 801-856 + 1015-1076).

A 4,2-standard deviation rejection of the second-order fit was performed on these differences, then the remaining values were fit to conductivity. This non-linear correction, added to the linear corrections for each cast, effectively pulled in surface differences while having minimal effect on differences below the thermocline/halocline.

The final I10 conductivity slopes, a combination of the linear coefficients from the preliminary and second-order fits, are summarized in Figure 8.3.3. Figure 8.3.4 summarizes the final combined conductivity offsets by station number.

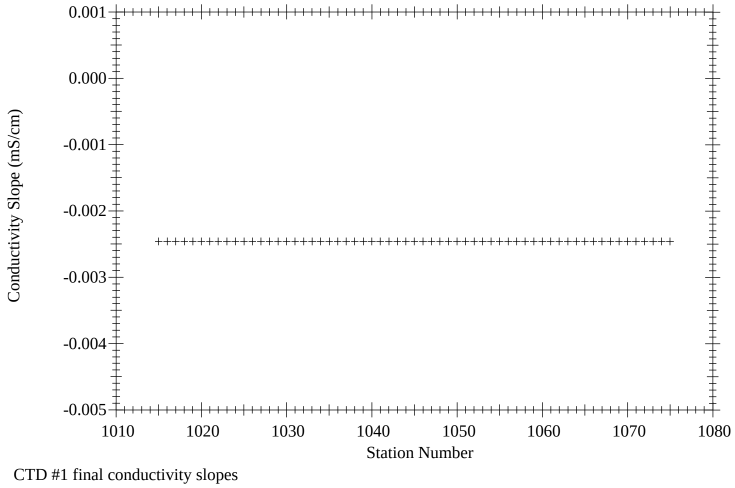


Figure 8.3.3 I10 CTD #1 conductivity slope corrections by station number.

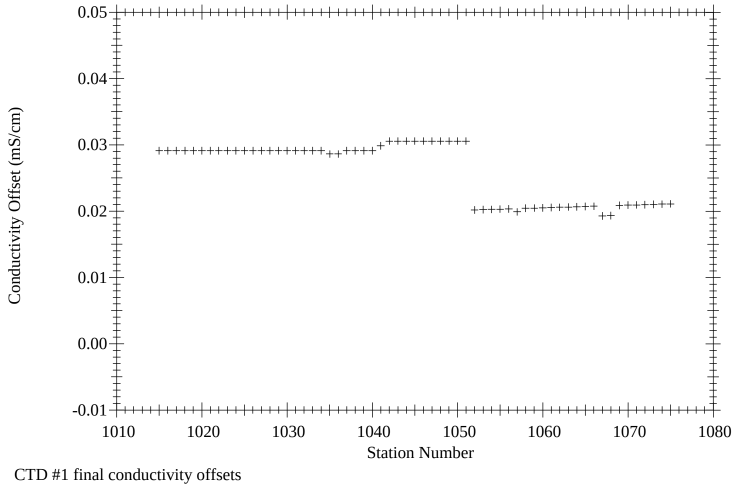


Figure 8.3.4 I10 CTD #1 conductivity offsets by station number.

I10 temperature and conductivity correction coefficients are also tabulated in Appendix A.

Summary of Residual Salinity Differences

Figures 8.3.5, 8.3.6 and 8.3.7 summarize the I10 residual differences between bottle and CTD salinities after applying the conductivity corrections. Only CTD and bottle salinities with final quality code 2 (acceptable) were used to generate these figures and statistics. Residual differences exceeding ±0.025 PSU are included in the calculations for averages and standard deviations, even though they are not plotted.

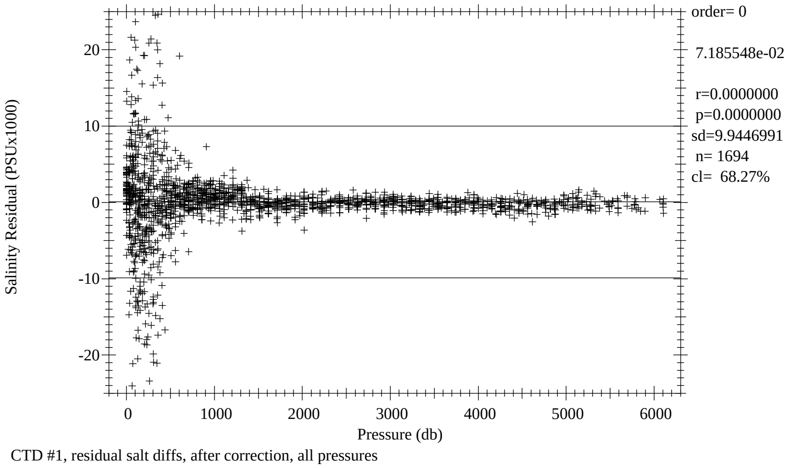


Figure 8.3.5 I10 Salinity residual differences vs pressure (after correction).

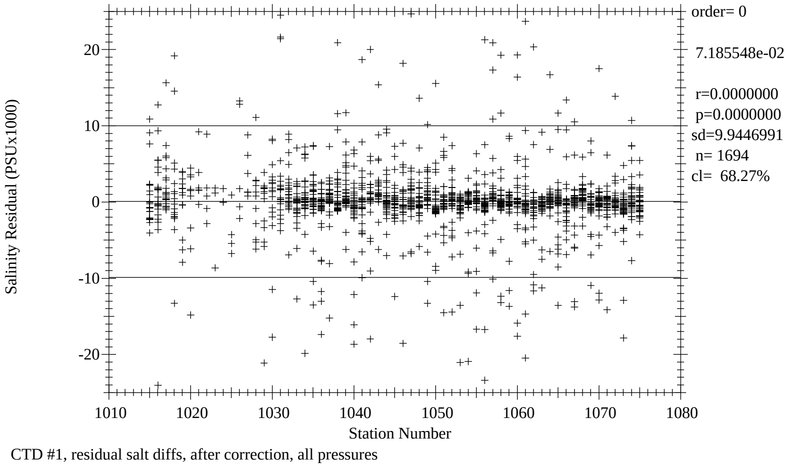


Figure 8.3.6 I10 Salinity residual differences vs station # (after correction).

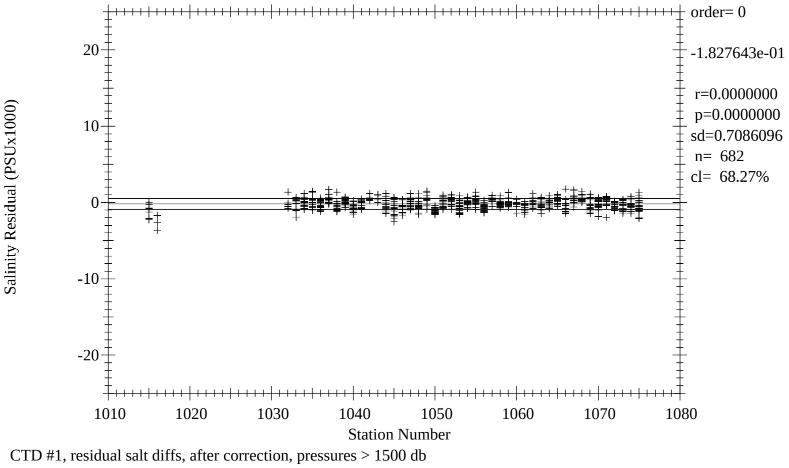


Figure 8.3.7 I10 Deep salinity residual differences vs station # (after correction).

The CTD conductivity calibration represents a best estimate of the conductivity field throughout the water column. 3σ from the mean residual in Figures 8.3.6 and 8.3.7, or ±0.0149 PSU for all salinities and ±0.0011 PSU for deep salinities, represents the limit of repeatability of the bottle salinities (Autosal, rosette, operators and samplers). This limit agrees with station overlays of deep theta-salinity. Within most casts (a single salinometer run), the precision of bottle salinities appears to be better than 0.001 PSU. The precision of the CTD salinities appears to be better than 0.0005 PSU.

Final calibrated CTD data from WOCE95-I10 and WOCE95-I3 were compared at their two closest stations: 1039 and 543, about 8.5 nautical miles (nm) and 6.5 months apart. Station 1039 was about -0.0005 PSU compared to station 543 in the bottom 1°C theta of both casts.

WOCE95-I2E stations 1077 and 1078 were taken at the I10 station 1075 position ~2 weeks later. The I2E CTD data (Dec. 1995) from the WHPO website were compared with I10 data. Theta-salinity comparisons of the bottom 1°C of the casts showed that station 1077 and 1078, which used two different CTDs, were approx. +0.0005 PSU and -0.001 PSU, respectively, compared to station 1075. Station 1077 CTD data were quality-coded "questionable" below 5750 db, but this only affected the bottom 0.004°C theta and did not skew the comparisons. The 1077-1075 difference becomes +0.001 to +0.0015 PSU, and the 1078-1075 difference becomes negligible, if corrections were applied for Standard Seawater batch differences for I10 (P-126) and I2E (P-128) [Culk98].

Three WOCE-IR6 data sets on the WHPO website overlapped I10 positions. IR06 (Aug. 1989) had two stations near I10 station 1075, but the casts were not lowered deep enough to compare with I10. IR6_3 (Apr. 1995) stations 2-20 overlapped I10 stations 1015-1033; however, all CTD salinities on stations 1-25 were quality-coded "bad" because of a cracked conductivity cell [Wijf99]. IR6_3 stations 55-64 returned to the positions of I10 stations 1015-1033; I10 stations 1015 and 1033 were compared to IR6_3 station 55, since they were the deepest casts of the groups and taken at the same position. Station 55 agreed within ±0.0005 PSU of stations 1015/1033 for the deepest 0.5°C theta, then dropped to -0.0015 PSU or more at shallower depths. IR6_3 station 54 was taken at the same position as I10 station 1075. Both were within ±0.001 PSU for the deepest 1°C theta, then 54 abruptly dropped by -0.002 PSU above ~1.8°C theta.

IR6_4 (Sept.-Oct. 1995) stations 3-21 also overlapped I10 stations 1015-1033. Stations 3/21 are ~+0.001 PSU compared to stations 1015/1033 for the deepest 0.5°C theta, then overlap with and gradually become lower than the I10 stations at shallower thetas. IR6_4 stations 84-70 were taken along the same line and within 0.3 to 7.2 nm (mostly within 1.0 nm) of I10 stations 1061-1075. Stations 71-70 showed good agreement (±0.001 PSU at deepest thetas) with stations 1074-1075. As the IR6_4 casts proceeded along the line, their salinities became increasingly lower than I10 data, typically offset by -0.002 to -0.003 PSU at the deepest 1°C theta, and more at shallower theta, compared to the I10 casts. Since all 15 I10 casts along this line are within ±0.0012 PSU of each other (and other nearby WOCE data) at their deepest 0.5°C theta, these I10 salinity data appear to be fine.

There were no GEOSECS stations near enough to the I10 cruisetrack to compare. ODF WOCE95 Indian Ocean data from previous lines compare well, with less than a ±0.0005 PSU difference after Standard Seawater batch differences are corrected.

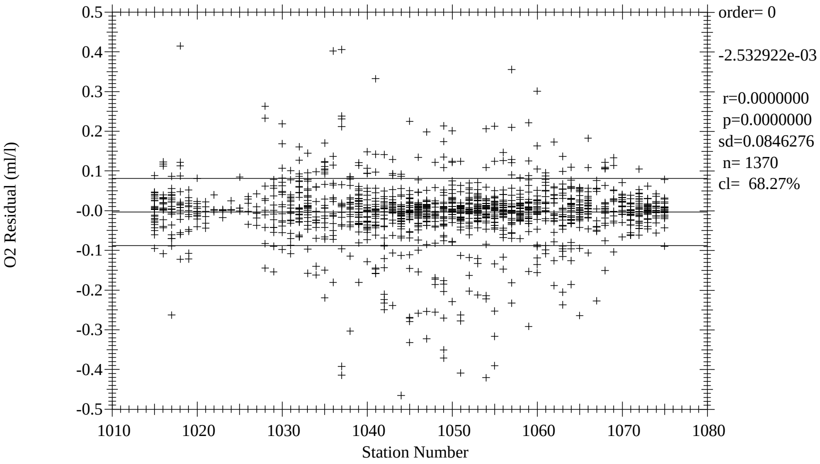
8.4. CTD Dissolved Oxygen

Three O_2 sensors were used during I10: the first one was new at the beginning of I7N, and the other two were brand new. Each sensor eventually developed pressure-related response problems, apparently due to repeated rosette lowerings below 5000 meters. The third sensor was not replaced after failing during station 1072. This response problem did not occur during any of the previous 5 ODF WOCE95 legs, and may indicate a manufacturing problem with more recent sensor batches.

There are a number of problems with the response characteristics of the SensorMedics O_2 sensor used in the NBIS Mark III CTD, the major ones being a secondary thermal response and a sensitivity to profiling velocity. Stopping the rosette for as little as half a minute, or slowing down for a bottom approach, can cause shifts in the CTD O_2 profile as oxygen becomes depleted in water near the sensor. Such shifts could usually be corrected by offsetting the raw oxygen data from the stop or slow-down area until some time after the sensor has been moving again, occasionally until the bottom of the cast. All offset sections, winch stops or slow-downs that affected CTD oxygen data are documented in Appendix C.

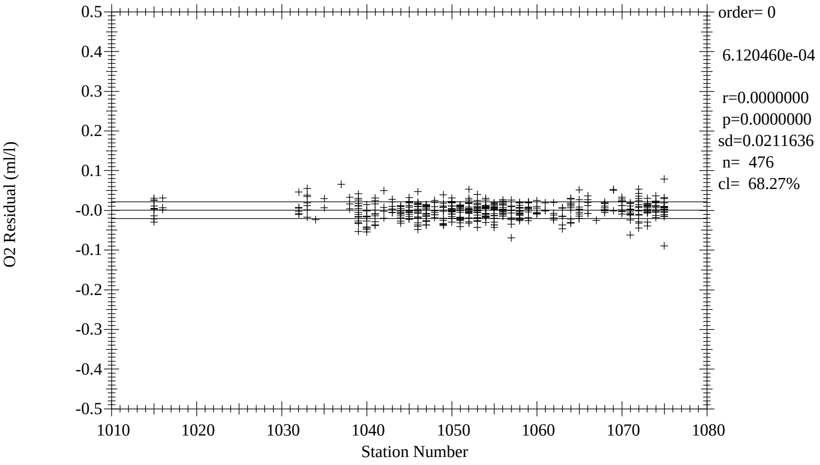
Because of these same stop/slow-down problems, up-cast CTD O_2 data cannot be optimally calibrated to O_2 check samples. Instead, down-cast CTD O_2 data are derived by matching the up-cast rosette trips along isopycnal surfaces. The differences between CTD O_2 data modeled from these derived values and check samples are then minimized using a non-linear least-squares fitting procedure.

Figures 8.4.0 and 8.4.1 show the residual differences between the corrected CTD O_2 and the bottle O_2 (ml/l) for each station. Only CTD and bottle oxygens with final quality code 2 (acceptable) were used to generate these figures and statistics. Residual differences exceeding ±0.5 ml/l are included in the calculations for averages and standard deviations, even though they are not plotted.



CTD #1, residual o2 diffs, after correction, all pressures

Figure 8.4.0 I10 O_2 residual differences vs station # (after correction).



CTD #1, residual o2 diffs, after correction, pressures > 1500 db

Figure 8.4.1 I10 Deep O_2 residual differences vs station # (after correction).

The standard deviations of 0.085 ml/l for all oxygens and 0.021 ml/l for deep oxygens are only intended as indicators of how well the up-cast bottle and down-cast CTD O_2 values match up. 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 follows Brown and Morrison [Brow78] and Millard [Mill82], [Owen85]. ODF does not use a digitized O_2 sensor temperature to model the secondary thermal response but instead models membrane and sensor temperatures by low-pass filtering the PRT temperature. *In*situ pressure and temperature are filtered to match the sensor response. Time-constants for the pressure response τ_p, and two temperature responses τ_{Ts} and τ_{Tf} are fitting parameters. 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 cathode. The time-constant for this filter, τ_{og}, is a fitting parameter. Oxygen partial-pressure is then calculated:

$$O_{pp} = [c_1 O_c + c_2] \cdot f_{sat}(S,T,P) \cdot e^{(c_3 P_l + c_4 T_f + c_5 T_s + c_6 \frac{dO_c}{dt})} \tag{8.4.0}$$

where:

O_{pp} = Dissolved O_2 partial-pressure in atmospheres (atm);
O_c = Sensor current (μamps);
$f_{sat}(S,T,P)$ = O_2 saturation partial-pressure at S,T,P (atm);
S = Salinity at O_2 response-time (PSUs);
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).

I10 CTD O_2 correction coefficients (c_1 through c_6) are tabulated in Appendix B.

9. Bottle Sampling

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

- CFCs;
- ^3He;
- O_2;
- Total CO_2;
- Alkalinity;
- AMS ^{14}C;
- Tritium;
- Nutrients;
- Salinity.

The correspondence between individual sample containers and the rosette bottle from which the sample was drawn was recorded on the sample log for the cast. This log also included any comments 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 to their respective laboratories for analysis. Oxygen, nutrients and salinity analyses were performed on computer-assisted (PC) analytical equipment networked to Sun SPARCstations for centralized data analysis. The analysts for each specific property were responsible for insuring that their results were updated into the cruise database.

10. Bottle Data Processing

Bottle data processing began with sample drawing, and continued until the data were considered to be final. One of the most important pieces of information, the sample log sheet, was filled out during the drawing of the many different samples. It was useful both as a sample inventory and as a guide for the technicians in carrying out their analyses. Any problems observed with the rosette before or during the sample drawing were noted on this form, including indications of bottle leaks, out-of-order drawing, etc. Oxygen draw temperatures recorded on this form were at times the first indicator of rosette bottle-tripping problems. Additional clues regarding bottle tripping or leak problems were found by individual analysts as the samples were analyzed and the resulting data were processed and checked by those personnel.

The next stage of processing was accomplished after the individual parameter files were merged into a common station file, along with CTD-derived parameters (pressure, temperature, conductivity, etc.). The rosette cast and bottle numbers were the primary identification for all ODF-analyzed samples taken from the bottle, and were used to merge the analytical results with the CTD data associated with the bottle. At this stage, bottle tripping problems were usually resolved, sometimes resulting in changes to the pressure, temperature and other CTD properties associated with the bottle. All CTD information from each bottle trip (confirmed or not) was retained in a file, so resolving bottle tripping problems consisted of correlating CTD trip data with the rosette bottles.

Diagnostic comments from the sample log, and notes from analysts and/or bottle data processors were entered into a computer file associated with each station (the "quality" file) as part of the quality control procedure. Sample data from bottles suspected of leaking were checked to see if the properties were consistent with the profile for the cast, with adjacent stations, and, where applicable, with the CTD data. Various property-property plots and vertical sections were examined for both consistency within a cast and consistency with adjacent stations by data processors, who advised analysts of possible errors or irregularities. The analysts reviewed and sometimes revised their data as additional calibration or diagnostic results became available.

Based on the outcome of investigations of the various comments in the quality files, WHP water sample codes were selected to indicate the reliability of the individual parameters affected by the comments. WHP bottle codes were assigned where evidence showed the entire bottle was affected, as in the case of a leak, or a bottle trip at other than the intended depth.

WHP water bottle quality codes were assigned as defined in the WOCE Operations Manual [Joyc94] with the following additional interpretations:

2	No problems noted.
3	Leaking. *An air leak large enough to produce an observable effect on a sample is identified by a code of 3 on the bottle and a code of 4 on the oxygen. (Small air leaks may have no observable effect, or may only affect gas samples.)*
4	Did not trip correctly. *Bottles tripped at other than the intended depth were assigned a code of 4. There may be no problems with the associated water sample data.*
5	Not reported. *No water sample data reported. This is a representative level derived from the CTD data for reporting purposes. The sample number should be in the range of 80-99.*
9	The samples were not drawn from this bottle.

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

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

WHP water sample quality flags were assigned to the CTDSAL (CTD salinity) parameter as follows:

2	Acceptable measurement.
3	Questionable measurement. *The data did not fit the bottle data, or there was a CTD conductivity calibration shift during the up-cast.*
4	Bad measurement. *The CTD up-cast data were determined to be unusable for calculating a salinity.*
7	Despiked. *The CTD data have been filtered to eliminate a spike or offset.*

WHP water sample quality flags were assigned to the CTDOXY (CTD O_2) parameter as follows:

1	Not calibrated. *Data are uncalibrated.*
2	Acceptable measurement.
3	Questionable measurement.
4	Bad measurement. *The CTD data were determined to be unusable for calculating a dissolved oxygen concentration.*
5	Not reported. *The CTD data could not be reported, typically when CTD salinity is coded 3 or 4.*
7	Despiked. *The CTD data have been filtered to eliminate a spike or offset.*
9	Not sampled. *No operational CTD O_2 sensor was present on this cast.*

Note that CTDOXY values were derived from the down-cast pressure-series CTD data. CTD data were matched to the up-cast bottle data along isopycnal surfaces. If the CTD salinity is footnoted as bad or questionable, the CTD O_2 is not reported.

Table 10.0 shows the number of samples drawn and the number of times each WHP sample quality flag was assigned for each basic hydrographic property:

Rosette Samples Stations 1015-1075								
	Reported Levels	WHP Quality Codes						
		1	2	3	4	5	7	9
Bottle	1737	0	1730	4	0	0	0	3
CTD Salt	1737	0	1721	5	11	0	0	0
CTD Oxy	1721	0	1413	148	160	16	0	0
Salinity	1732	0	1710	10	12	0	0	5
Oxygen	1730	0	1688	24	18	4	0	3
Silicate	1725	0	1718	0	7	5	0	7
Nitrate	1730	0	1724	1	5	0	0	7
Nitrite	1730	0	1725	0	5	0	0	7
Phosphate	1730	0	1725	0	5	0	0	7

Table 10.0 Frequency of WHP quality flag assignments for I10.

Additionally, all WHP water bottle/sample quality code comments are presented in Appendix D.

11. Pressure and Temperatures

All pressures and temperatures for the bottle data tabulations on the rosette casts were obtained by averaging CTD data for a brief interval at the time the bottle was closed on the rosette, then correcting the data based on CTD laboratory calibrations.

The temperatures are reported using the International Temperature Scale of 1990.

12. Salinity Analysis

Equipment and Techniques

Two Guildline Autosal Model 8400A salinometers were available for measuring salinities. The salinometers were modified by ODF and contained interfaces for computer-aided measurement. Autosal #55-654 was used to measure salinity on all stations. Both water bath temperatures were set and maintained at 27°C. Autosal #57-396 was a backup unit but was not used on this expedition.

The salinity analyses were performed when samples had equilibrated to laboratory temperature, within 8-25 hours after collection. The salinometer was standardized for each group of analyses (typically one cast, usually 36 samples) using at least one fresh vial of standard seawater per group. A computer (PC) prompted the analyst for control functions such as changing sample, flushing, or switching to "read" mode. At the correct time, the computer acquired conductivity ratio measurements, and logged results. The sample conductivity was redetermined until readings met software criteria for consistency. Measurements were then averaged for a final result.

Sampling and Data Processing

Salinity samples were drawn into 200 ml Kimax high-alumina borosilicate bottles, which were rinsed three times with sample prior to filling. The bottles were sealed with custom-made plastic insert thimbles and Nalgene screw caps. This assembly provides very low container dissolution and sample evaporation. Prior to collecting each sample, inserts were inspected for proper fit and loose inserts were replaced to insure an airtight seal. The draw time and equilibration time were logged for all casts. Laboratory temperatures were logged at the beginning and end of each run.

PSS-78 salinity [UNES81] was calculated for each sample from the measured conductivity ratios. The difference (if any) between the initial vial of standard water and one run at the end as an unknown was applied linearly to the data to account for any drift. The data were added to the cruise database. 1732 salinity measurements were made and 134 vials of standard water were used. The estimated accuracy of bottle salinities run at sea is usually better than 0.002 PSU relative to the particular standard seawater batch used.

Laboratory Temperature

The temperature stability in the salinometer laboratory was good, varying less than 0.5°C during a run of samples. The laboratory temperature was 0.5-3°C lower than the Autosal bath temperature.

Standards

IAPSO Standard Seawater (SSW) Batch P-126 was used to standardize the salinometers.

13. Oxygen Analysis

Equipment and Techniques

Dissolved oxygen analyses were performed with an ODF-designed automated oxygen titrator using photometric end-point detection based on the absorption of 365nm wavelength ultra-violet light. The titration of the samples and the data logging were controlled by PC software. Thiosulfate was dispensed by a Dosimat 665 buret driver fitted with a 1.0 ml buret. ODF used a whole-bottle modified-Winkler titration following the technique of Carpenter [Carp65] with modifications by Culberson *et al.* [Culb91], but with higher concentrations of potassium iodate standard (approximately 0.012N) and thiosulfate solution (50 gm/l). Standard solutions prepared from pre-weighed potassium iodate crystals were run at the beginning of each session of analyses, which typically included from 1 to 3 stations. Several standards were made up during the cruise and compared to assure that the results were reproducible, and to preclude the possibility of a weighing or dilution error. Reagent/distilled water blanks were determined, to account for presence of oxidizing or reducing materials.

Sampling and Data Processing

Samples were collected for dissolved oxygen analyses soon after the rosette sampler was brought on board, and after samples for CFC and helium were drawn. Using a Tygon drawing tube, nominal 125ml volume-calibrated iodine flasks were rinsed twice with minimal agitation, then filled and allowed to overflow for at least 3 flask volumes. The sample draw temperature was measured with a small platinum resistance thermometer embedded in the drawing tube. Reagents were added to fix the oxygen before stoppering. The flasks were shaken twice to assure thorough dispersion of the precipitate, once immediately after drawing, and then again after about 20 minutes. The samples were analyzed within 1-6 hours of collection, and then the data were merged into the cruise database.

Thiosulfate normalities were calculated from each standardization and corrected to 20°C. The 20°C normalities and the blanks were plotted versus time and were reviewed for possible problems. New thiosulfate normalities were recalculated after the blanks had been smoothed as a function of time, if warranted. These normalities were then smoothed, and the oxygen data were recalculated.

Oxygens were converted from milliliters per liter to micromoles per kilogram using the *in situ* temperature. Sample temperatures were measured at the time the samples were drawn from the rosette bottle, and these temperatures were useful in indicating whether or not a bottle tripped properly.

1730 oxygen measurements were made, with no major problems with the analyses. During shorebased finalization of the data, it was discovered that there may have been a leak in the buret. A few stations, 1057, 1061 and 1062, have problems in the data indicating a leak. After 1062, the problem was not seen, but there were no notes indicating that a leak had been discovered and fixed.

Volumetric Calibration

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

Standards

Potassium iodate standards, nominally 0.44 gram, were pre-weighed in ODF’s chemistry laboratory to ±0.0001 grams. The exact normality was calculated at sea after the volumetric flask volume and dilution temperature were known. Potassium iodate was obtained from Johnson Matthey Chemical Co. and was reported by the supplier to be >99.4% pure. All other reagents were "reagent grade" and were tested for levels of oxidizing and reducing impurities prior to use.

14. Nutrient Analysis

Equipment and Techniques

Nutrient analyses (phosphate, silicate, nitrate and nitrite) were performed on an ODF-modified 4-channel Technicon AutoAnalyzer II, generally within a few hours after sample collection. Occasionally samples were refrigerated up to maximum of 8 hours at 2-6°C. All samples were brought to room temperature prior to analysis.

The methods used are described by Gordon *et al.* [Gord92]. The analog outputs from each of the four channels were digitized and logged automatically by computer (PC) at 2-second intervals.

Silicate was analyzed using the technique of Armstrong *et al.* [Arms67]. An acidic solution of ammonium molybdate was added to a seawater sample to produce silicomolybdic acid which was then reduced to silicomolybdous acid (a blue compound) following the addition of stannous chloride. Tartaric acid was also added to impede PO_4 color development. The sample was passed through a 15mm flowcell and the absorbance measured at 660nm.

A modification of the Armstrong *et al.* [Arms67] procedure was used for the analysis of nitrate and nitrite. For the nitrate analysis, the seawater sample was passed through a cadmium reduction column where nitrate was quantitatively reduced to nitrite. Sulfanilamide was introduced to the sample stream followed by N-(1-naphthyl)ethylenediamine dihydrochloride which coupled to form a red azo dye. The stream was then passed through a 15mm flowcell and the absorbance measured at 540nm. The same technique was employed for nitrite analysis, except the cadmium column was bypassed, and a 50mm flowcell was used for measurement.

Phosphate was analyzed using a modification of the Bernhardt and Wilhelms [Bern67] technique. An acidic solution of ammonium molybdate was added to the sample to produce phosphomolybdic acid, then reduced to phosphomolybdous acid (a blue compound) following the addition of dihydrazine sulfate. The reaction product was heated to ~55°C to enhance color development, then passed through a 50mm flowcell and the absorbance measured at 820m.

Sampling and Data Processing

Nutrient samples were drawn into 45 ml polypropylene, screw-capped "oak-ridge type" centrifuge tubes. The tubes were cleaned with 10% HCl and rinsed with sample twice before filling. Standardizations were performed at the beginning and end of each group of analyses (typically one cast, usually 36 samples) with an intermediate concentration mixed nutrient standard prepared prior to each run from a secondary standard in a low-nutrient seawater matrix. The secondary standards were prepared aboard ship by dilution from primary standard solutions. Dry standards were pre-weighed at the laboratory at ODF, and transported to the vessel for dilution to the primary standard. Sets of 6-7 different standard concentrations were analyzed periodically to determine any deviation from linearity as a function of concentration for each nutrient analysis. A correction for non-linearity was applied to the final nutrient concentrations when necessary.

After each group of samples was analyzed, the raw data file was processed to produce another file of response factors, baseline values, and absorbances. Computer-produced absorbance readings were checked for accuracy against values taken from a strip chart recording. The data were then added to the cruise database.

1730 nutrient samples were analyzed. No major problems were encountered with the measurements. The pump tubing was changed once, and deep seawater was run as a substandard check. The temperature stability of the laboratory used for the analyses was poor, varying from 22 to 28°C over short time scales. Portable fans were used to assist in maintaining some temperature stability.

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

Standards

Na_2SiF_6, the silicate primary standard, was obtained from Johnson Matthey Company and Fisher Scientific and was reported by the suppliers to be >98% pure. Primary standards for nitrate (KNO_3), nitrite ($NaNO_2$), and phosphate (KH_2PO_4) were obtained from Johnson Matthey Chemical Co. and the supplier reported purities of 99.999%, 97%, and 99.999%, respectively.

3. CFCs

Two chlorofluorocarbons (CFC-11 and CFC-12) were measured on WOCE leg I10 by Kevin Sullivan and Jorina Waworuntu of the University of Miami. The shipboard measurement of the two CFCs was done using the University of Miami analytical system, by an established procedure (Bullister and Weiss, 1988). Analytical blanks for CFC-11 and CFC-12 were close to zero. At two stations bottles were tripped in a different order to test for bottle blanks. Bottle blanks ranged 0.002-0.004 pM/kg, and were not applied to the preliminary data. Stations 1019-1024 at the beginning of the cruise were not sampled because of a problem with the analytical system. Nine hundred and nineteen samples were collected and analyzed at 53 of the 60 stations. Approximately 20 samples were analyzed at each station normally above 2000 m. Blank levels of CFCs were usually reached by 1500 m. Eleven replicate water samples were drawn. The average standard deviations of these replicates were 0.0018 pM CFC-12/kg and 0.0013 pM CFC-11/kg. The I10 CFC-11 and CFC-12 data well exceed WOCE analytical standards. In addition to water analyses, marine airs were analyzed. The average concentrations were 510 pptr CFC-12 and 267 pptr CFC-11.

4. CO2 and Alkalinity

As part of a global survey of carbon dioxide in the oceans sponsored by the Department of Energy, the Princeton University Ocean Tracers Lab (OTL) was responsible for making inorganic carbon measurements on WOCE line I10. In addition to the contribution to the current global carbon inventory estimate, we expect to use the data from this line together with our data from the far western Pacific and WOCE line I-9N to evaluate the carbon transport associated with the Indonesian through-flow and the influence this area has on the alkalinity budgets of the Pacific and Indian Oceans. Four members of the OTL- CO2 group participated in the cruise: Christopher Sabine, Susan Boehme, Gerard McDonald, and Marian Markham. Discrete samples were collected and analyzed for total carbon dioxide (TCO2) and total alkalinity (TA). Carbon dioxide partial pressure (pCO2) was measured quasi-continuously in the air and surface water throughout the cruise.

Samples for TCO2 were collected in 300 ml borosilicate bottles and analyzed using two SOMMA-coulometer systems following the methods of Johnson et al. (1985; 1987). TA samples were collected in 500 ml borosilicate bottles and analyzed with two closed cell titration systems using methods similar to those described by Bradshaw et al. (1981). Evaluation of the titration results were made using the non-linear least-squares approach described by Dickson (1981) and by Johansson & Wedborg (1982).

No major problems were encountered on the cruise. By sending four analysts and running multiple systems, we were able to analyze 936 (>50% of total) samples for both TCO2 and TA. This is more than a 50% increase over the typical coverage for the Pacific WOCE legs. Full profiles were collected at 33 stations. Samples were collected from the surface niskin of 20 additional stations to get maximum coverage in the surface waters. Duplicate samples were drawn and analyzed from approximately 8% of the niskins to evaluate sampling and analytical precision. Duplicate 500 ml samples were also drawn from one surface and one deep niskin at 5 stations distributed along the cruise track. These samples will be shipped to Scripps for TCO2 analysis by C. D. Keeling as part of the standard CO2 QA/QC program for WOCE legs.

5. C14

The Princeton University Ocean Tracers Lab (OTL) was responsible for collecting samples for carbon 14 analysis on WOCE line I10. The data from this line together with data from the far western Pacific and other WOCE Indian Ocean lines will be used to characterize the water masses in the Indonesian throughflow. One member of the OTL group participated in the cruise: Tonalee Key. One hundred twenty eight samples were collected at 6 stations on this line. Full water profiles were collected at two stations, shallow profiles, 1700m or less, were collected at 4 stations. The samples will be analyzed at a later date in the land based Atomic Mass Spectrometry lab at Woods Hole Oceanographic Institution.

6. 3He/3H

A total of 216 tritium and 384 helium samples were collected during I-10. Helium samples, taken at depth between 1 and 6400 m, were extracted for helium isotopes using WHOI's shipboard sample processing system within 12 hours of acquisition. The isotope ratio measurements will be made by mass spectrometer at the WHOI facility. The tritium samples, taken at depths between 1 and 1500 m, were degassed using the WHOI shipboard sea water degassing system and stored in 1000 ml aluminum silicate glass vessels for subsequent tritium determination by mass spectrometric measurement of the decay product 3He at the WHOI facility.

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Appendix A

WOCE95-I10: CTD Temperature and Conductivity Corrections Summary

Sta/ Cast	PRT Response Time(secs)	ITS-90 Temperature Coefficients corT = $t2*T^2 + t1*T + t0$			Conductivity Coefficients corC = $c2*C^2 + c1*C + c0$		
		t2	t1	t0	c2	c1	c0
1015/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1016/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1017/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1018/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1019/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1020/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1021/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1022/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1023/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1024/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1025/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1026/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1027/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1028/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1029/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1030/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1031/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1032/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1033/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1034/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1035/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02864
1036/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02864
1037/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1038/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1039/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1040/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02914
1041/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02987
1042/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1043/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1044/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1045/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1046/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1047/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1048/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1049/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060

Sta/ Cast	PRT Response Time(secs)	ITS-90 Temperature Coefficients corT = $t2*T^2 + t1*T + t0$			Conductivity Coefficients corC = $c2*C^2 + c1*C + c0$		
		t2	t1	t0	c2	c1	c0
1050/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1051/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.03060
1052/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02020
1053/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02024
1054/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02028
1055/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02032
1056/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02036
1057/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.01990
1058/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02044
1059/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02048
1060/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02053
1061/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02056
1062/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02060
1063/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02065
1064/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02069
1065/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02073
1066/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02077
1067/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.01931
1068/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.01935
1069/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02089
1070/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02093
1071/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02097
1072/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02101
1073/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02105
1074/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02109
1075/01	.34	2.1101e-05	-7.0204e-04	-1.4979	1.63778e-05	-2.45768e-03	0.02113

Appendix B

Summary of WOCE95-I10 CTD Oxygen Time Constants

(time constants in seconds)

	Temperature		Pressure	O_2 Gradient
Stations *	Fast(τ_{Tf})	Slow(τ_{Ts})	(τ_p)	(τ_{og})
1015-1038, 1068, 1071	1.0	400.0	24.0	16.0
1039-1067	1.0	500.0	24.0	16.0
1069	10.0	1200.0	30.0	24.0
1070, 1075	1.0	1000.0	24.0	16.0
1072-1074	1.0	800.0	24.0	16.0

* NOTE: since sensor S/N 5-01-07 was malfunctioning during its entire use, time constants were determined individually for stas 1069-1075 in order to minimize noise and optimize the fits to bottle oxygen data

WOCE95-I10: Conversion Equation Coefficients for CTD Oxygen

(refer to Equation 8.4.0)

Sta/ Cast	O_cSlope (c_1)	Offset (c_2)	$P_l$coeff (c_3)	$T_f$coeff (c_4)	$T_s$coeff (c_5)	$\frac{dO_c}{dt}$coeff (c_6)
1015/01	9.86809e-04	1.84223e-02	1.52147e-04	-3.80119e-03	-2.57167e-02	-8.09500e-06
1016/01	1.13653e-03	-1.12053e-02	1.35332e-04	-2.01089e-05	-3.34519e-02	6.63940e-06
1017/01	1.14796e-03	-4.84633e-03	1.15268e-04	-3.17684e-03	-3.15460e-02	5.81256e-06
1018/01	1.55126e-03	1.24986e-01	-3.44249e-04	-1.45812e-02	-3.32783e-02	-2.64678e-06
1019/01	7.37452e-04	8.62241e-02	1.34000e-04	-9.95584e-04	-1.50431e-02	1.34014e-05
1020/01	6.71780e-04	3.32969e-01	-1.55790e-04	-8.26726e-03	-1.15202e-02	4.97413e-06
1021/01	6.82763e-04	3.97250e-01	1.46652e-04	3.08970e-02	-5.32562e-02	3.27779e-06
1022/01	-8.94997e-03	6.86683e+01	-4.65295e-04	1.34615e-01	-3.07520e-01	-1.62080e-05
1023/01	1.36946e-02	4.00917e+02	5.73614e-05	2.03794e-01	-4.75865e-01	-3.35194e-06
1024/01	-1.78003e-02	1.48443e+02	-2.28556e-04	3.05385e-01	-5.17264e-01	5.67774e-07
1025/01	3.14618e-03	1.95171e+01	-8.16015e-04	1.82198e-02	-1.62683e-01	3.66631e-07
1026/01	5.95184e-01	2.60967e+03	-9.11288e-04	5.57811e-02	-4.15280e-01	-1.82768e-06
1027/01	4.49619e-04	1.07033e-01	-1.09565e-04	-2.66398e-02	2.62487e-02	8.09685e-07
1028/01	5.79190e-04	1.05002e-01	4.56554e-04	-2.08929e-03	-9.63918e-03	1.99581e-06
1029/01	7.36106e-04	1.28002e-01	9.45232e-06	-1.33810e-02	-6.11070e-03	1.55741e-06
1030/01	9.80946e-04	1.60718e-02	2.04900e-04	3.95578e-03	-3.13766e-02	-9.07866e-07
1031/01	8.36818e-04	3.74556e-02	2.11583e-04	-3.40620e-03	-1.81640e-02	-3.38039e-06
1032/01	1.11029e-03	-4.52510e-03	1.87963e-04	9.13562e-03	-3.93941e-02	-1.41431e-06
1033/01	1.03835e-03	2.80267e-03	2.16209e-04	7.68198e-03	-3.58592e-02	-3.03476e-06
1034/01	1.02961e-03	1.89349e-02	2.11369e-04	9.35103e-03	-3.67232e-02	1.98690e-06
1035/01	9.39792e-04	-1.36126e-02	3.27868e-04	5.02293e-03	-2.99895e-02	-9.29889e-06
1036/01	6.94331e-04	2.24287e-02	3.85692e-04	-1.91914e-03	-1.33700e-02	3.95794e-06
1037/01	8.84317e-04	-4.37009e-02	4.81715e-04	-3.02626e-03	-2.34662e-02	-5.41169e-06
1038/01	9.27210e-04	-3.75952e-02	4.62492e-04	1.00952e-02	-3.34891e-02	4.93601e-06
1039/01	1.27375e-03	-1.46966e-01	1.37397e-04	-2.21469e-03	-3.50763e-02	-2.11407e-06

Sta/ Cast	O_c Slope (c_1)	Offset (c_2)	P_l coeff (c_3)	T_f coeff (c_4)	T_s coeff (c_5)	$\frac{dO_c}{dt}$ coeff (c_6)
1040/01	1.56715e-03	-2.99026e-01	9.21963e-05	1.93025e-03	-4.35504e-02	4.89690e-06
1041/01	1.59610e-03	-2.70015e-01	7.16298e-05	4.72652e-03	-4.77929e-02	8.60353e-06
1042/01	1.48886e-03	-2.13828e-01	2.80307e-05	4.34009e-03	-4.22204e-02	4.34476e-06
1043/01	1.46639e-03	-2.04283e-01	2.12246e-05	-7.01641e-03	-3.56162e-02	-3.90092e-06
1044/01	1.18587e-03	-1.35279e-01	6.41799e-05	-9.42263e-04	-2.98239e-02	2.45431e-06
1045/01	1.23460e-03	-1.26471e-01	8.81921e-05	4.75866e-03	-3.64390e-02	-1.34281e-05
1046/01	1.73070e-03	-2.79497e-01	8.34665e-05	3.78129e-03	-4.69416e-02	1.09072e-05
1047/01	1.68293e-03	-2.60679e-01	6.54745e-05	6.97082e-03	-4.94028e-02	9.50415e-07
1048/01	1.53316e-03	-2.02457e-01	1.13677e-04	3.20867e-03	-4.36837e-02	7.85119e-06
1049/01	1.43900e-03	-1.73624e-01	1.21043e-04	7.25511e-03	-4.30142e-02	-5.42295e-07
1050/01	1.35419e-03	-1.58684e-01	1.51452e-04	6.05596e-03	-4.13210e-02	-4.58447e-06
1051/01	1.33798e-03	-1.49121e-01	1.55121e-04	9.47812e-03	-4.17518e-02	6.87696e-06
1052/01	1.36794e-03	-1.48067e-01	1.53867e-04	9.55621e-05	-3.73655e-02	9.39465e-07
1053/01	1.34940e-03	-1.36343e-01	1.51053e-04	3.24903e-03	-3.72471e-02	9.06915e-07
1054/01	1.38634e-03	-1.52189e-01	1.56356e-04	6.20642e-03	-3.97013e-02	-1.89973e-07
1055/01	1.31295e-03	-1.16001e-01	1.47682e-04	8.08256e-03	-4.11661e-02	1.16613e-05
1056/01	1.33764e-03	-1.30029e-01	1.52978e-04	3.94902e-03	-3.78353e-02	1.53510e-06
1057/01	1.35727e-03	-1.16697e-01	1.41955e-04	5.48135e-03	-4.10543e-02	-2.26810e-06
1058/01	1.31997e-03	-1.09114e-01	1.46515e-04	7.32611e-03	-3.92996e-02	-2.16305e-06
1059/01	1.24008e-03	-1.11423e-01	1.45215e-04	8.39445e-03	-3.98761e-02	6.12966e-06
1060/01	1.40769e-03	-1.67053e-01	1.00455e-04	3.96324e-03	-4.04321e-02	5.75544e-06
1061/01	1.51036e-03	-2.32627e-01	8.46124e-05	2.46021e-03	-4.22010e-02	-1.49222e-06
1062/01	1.10747e-03	-8.36076e-02	8.31279e-05	6.99772e-03	-3.60509e-02	6.15932e-06
1063/01	1.38169e-03	-1.81346e-01	8.05020e-05	4.60615e-04	-3.85448e-02	4.69599e-06
1064/01	1.40619e-03	-2.07818e-01	5.14446e-05	1.71403e-03	-4.08210e-02	-1.03785e-06
1065/01	1.28309e-03	-1.50398e-01	5.58537e-05	2.28864e-03	-3.81988e-02	-8.44328e-07
1066/01	1.54820e-03	-1.91568e-01	2.66422e-05	4.55428e-03	-4.73591e-02	2.72089e-06
1067/01	7.92386e-04	5.20071e-02	2.05650e-04	1.53826e-02	-3.51039e-02	3.25169e-07
1068/01	7.55739e-04	8.14328e-02	1.37698e-04	9.95786e-03	-2.92308e-02	-6.45611e-06
1069/01	8.83860e-04	-1.77907e-01	2.29616e-04	2.30957e-02	-5.54140e-02	-8.62286e-06
1070/01	4.54611e-04	2.77997e-01	5.91896e-05	2.56722e-02	-5.57487e-02	2.30853e-03
1071/01	4.68246e-04	3.63535e-01	8.04083e-05	-3.72584e-01	1.09499e-01	-8.50768e-03
1072/01	6.20606e-04	2.83480e-01	5.89452e-05	-2.21505e-02	-5.38748e-02	1.21104e-02
1073/01	5.72570e-04	3.23820e-01	6.60114e-05	-1.40896e-01	-7.29719e-03	-1.90950e-02
1074/01	1.04031e-03	1.01418e-01	1.03765e-04	-1.10404e-01	-2.13148e-02	-9.78561e-03
1075/01	2.36591e-04	4.78388e-01	6.20135e-05	-2.42376e-01	1.42249e-02	1.95343e-02

Appendix C

WOCE95-I10: CTD Shipboard and Processing Comments

Key to Problem/Comment Abbreviations	
BQ	bottle oxygen value(s) questionable/missing, need to estimate for ctdoxy fit
CO	conductivity offset
DG/DI	density gradient/inversion in top 12db, data consistent/smooth in time-series ctd; possibly real
OB	bottom ctdoxy signal shift coincides with slowdown for bottom approach
OF	ctdoxy fit off more than 0.02 ml/l (deeper) or 0.10 ml/l (shallower) compared to bottle data and/or nearby ctd casts
OH	ctdoxy fit high near surface: high raw ctdoxy signal
ON	ctdoxy signal unusually noisy
OO	ctdoxy sensor off/dying?: will not fit to bottles at pressures indicated
OS	ctdoxy signal shifts
SS	probable sea slime on conductivity sensor
WS	winch slowdown/stop, potential shift in ctdoxy signal (also, see "OB")

Key to Solution/Action Abbreviations	
DO	despiked raw ctdoxy, despiked data ok unless otherwise indicated
DU	down/up ctdoxy differ or similar features at different pressures in this area; but downcast ctd Salinity and Oxygen structures often correspond well with each other
EB	used nearby bottles and/or casts to estimate bottle oxygen value(s) for ctdoxy fit
GD/GS	downcast high-gradient areas Deeper/Shallower than upcast, ok if (upcast) bottles do not match (downcast) ctdoxy in these areas
NA	no action taken, used default quality code 2
O3/O4	quality code 3/4 oxygen in .ctd file for pressures specified
OC	offset conductivity channel to account for shift/offset (units: mS/cm)
RO	offset raw ctdoxy data to account for signal shift caused by slowdown/stop/yoyo; usually "DO" in transition area near offset
S3	quality code 3 salinity in .ctd file for pressures specified

Sta/Cast	Problem/Comment	Solution/Action
1015/01	ON/OF/max. ±0.15 ml/l compared to btls ON	DO/0-650db, GS 15m DO/RO -1/3212-3218db
1016/01	ON OF/+0.30 ml/l bulge not seen on upcast, nearby casts	DO/0-650db DO/O3/0-18db
1017/01	ON/OF/max. ±0.30 ml/l compared to btls	DO/0-850db, GD 0-20m
1018/01	ON/OF/max. ±0.12 ml/l compared to btls	DO/0-900db, GD 10-20m; fit reasonable for high noise level of cast
1019/01	ON	DO/0-698db/btm
1020/01	ON	DO/0-478db/btm
1021/01	ON	DO/0-202db/btm
1022/01	OF/max. +0.15 ml/l compared to btl/nearby casts OF/max. -0.04 ml/l compared to btl	O3/0-14db, although upcast ctdoxy also higher here NA/138-142db/btm, fit reasonable for this shallow

Sta/Cast	Problem/Comment	Solution/Action
1026/01	ON	DO/66-140db/btm
1027/01	DG/+0.12, high srfc ctdT/C; upcast density also low at srfc	NA/top 10db
	ON	DO/0-198db/btm
1028/01	DG/+0.14, high srfc ctdT/C; only downcast density low at srfc	NA/top 6db
	ON/OF/max. ±0.10 ml/l compared to btls	DO/0-476db/btm, GS 10-15m; fit reasonable for high noise level of cast
	OS	DO/RO +25 to +35/2-8db, ok after dspk
	OH/raw ctdoxy signal up to 12% high	DO/RO -150 to -40/O3/10-32db, max. +0.05 ml/l compared to btl after dspk, but coded questionable because large dspk near srfc
	ON/OF/max. -0.30 ml/l compared to nearest btls/upcast/sta 1020	O3/220-248db
	OB	RO +25/472-476db/btm,
1029/01	ON/OF/max. ±0.10 ml/l compared to btls	DO/0-650db, DU
1030/01	DG/+0.13, high srfc ctdT/C; upcast density also low at srfc	NA/top 10db
	ON/OF/max. ±0.15 ml/l compared to btls top 140db	DO/0-750db, DU/GD 10-15m/up also drops near-srfc, but not as much
	WS/2.0 mins. at 908db	NA/906-910db, less than 0.02 ml/l momentary drop in ctdoxy
1031/01	ON/max.(+-0.10 ml/l noise level	DO/0-650db, DU/GD 10m; fit reasonable for high noise level of cast
	ON/OF/max. -0.20 ml/l compared to btls 530-580db	O3/530-560db, DU/GD 10m, up also drops near 550db, but only slightly
1032/01	ON	DO/0-850db
	OB	RO +4/2014-2020db/btm
1033 - 1038	ctdoxy sensor malfunctioning, will not fit to deep btls	see codes below; sensor changed out before sta 1039
1033/01	ON	DO/0-650db
	OF/max. -0.20 ml/l compared to btls, ok compared to nearby casts	DO/240-360db, GS 5-10m; similar drops on upcast
	ON/raw ctdoxy signal drops 4%, possibly sensor contamination	DO/2296-2316db, ok after dspk, seemed to affect only this short section
	OO/OF/max. +0.04 ml/l compared to nearby btls/sta 1015; ctdoxy will not fit to deep btls	O3/2478-2644db; O4/2646-3220db/btm

Sta/Cast	Problem/Comment	Solution/Action
1034/01	ON/OF/max. ±0.10 ml/l compared to btls	DO/0-650db, fit reasonable for high noise level of cast
	OF/max. +0.20 ml/l compared to btls	O3/700-1100db, fit too far off to be accounted for by DU/GD 20-30m
	OO/OF/max. ±0.03 ml/l compared to btls; ctdoxy will not fit to deep btls	O3/1748-2676db; O4/2678-4446db/btm
1035/01	DG/+0.13, high srfc ctdT/C/S; upcast density also low at srfc	NA/top 12db
	ON/OF/max. ±0.20 ml/l compared to btls	DO/0-650db, GD 5-10m top 200db, GS 10-20m 250-500db; fit reasonable for high noise level of cast
	OF/max. ±0.15 ml/l compared to btls	NA/650-1100db, GS 15-20m 650-900db, GD 15-20m 900-1100db
	OO/OF/max. -0.15 ml/l compared to btls 1870-1946db, max. ±0.03 ml/l till 2224db; ctdoxy will not fit to deep btls	O3/1870-2224db, drop not seen on upcast; O4/2226-5110db/btm
1036/01	ON	DO/0-600db
	OS	RO +60/0-4db
	OF/max. -0.50 ml/l compared to btls	NA/50-380db, DU/GD 5-15m top 450db, fit reasonable for high noise level of cast and larger features down vs up this area
	OF/max. -0.07 ml/l compared to btl	NA/1194-1286db, correlates with ctdS feature
	OO/OF/max. -0.03 ml/l compared to btls; ctdoxy will not fit to deep btls	O3/1552-2134db; O4/2136-5134db/btm
1037/01	transmissometer dysfunctional/low last 3 casts	replaced transmissometer #152D with #151D prior to cast
	ON	DO/0-650db
	OH/raw ctdoxy signal 2-10% high near surface, dips lower this area on upcast	DO/RO -130 to -40/O3/0-32db, looks ok after dspk, but coded questionable because large offset/wide section
	OF/max. ±0.40 ml/l compared to btls	NA/50-800db, DU/GD 5-10m top 140db, DU/GS 5-15m 140-300db, GD 10-45m 300-800db
	OO/OF/max. +0.05 ml/l compared to btls; ctdoxy will not fit to deep btls	O3/1628-2104db; O4/2106-5142db/btm
1038/01	ON/OF/max. ±0.30 ml/l compared to btls	DO/0-550db, GD 5-30m 30-450db
	OF/max. -0.30 ml/l compared to nearby ctd	O3/42-48db, only small drop seen upcast
	OO/OF/max. +0.05 ml/l compared to btls; ctdoxy will not fit to deep btls	O3/2034-2176db; O4/2178-5142db/btm

Sta/Cast	Problem/Comment	Solution/Action
1039/01	replaced ctdoxy sensor 05-01-10 with new sensor 5-01-03 prior to cast	
	DI/-0.036, lowest density at 6db	NA/top 6db
	ON	DO/0-620db
	ON/raw ctdoxy spiking 20% high, ctdoxy bulges +0.10 ml/l 212-278db	DO/212-216db, ok after dspk: bulge correlates with ctdS feature
	OF/max. ±0.15 ml/l compared to btls	NA/400-1300db, GD 10-15m 400-730db, GS 10-25m 730-1300db
	ON/±0.02 ml/l deep noise level	DO/1700-5134db/btm
	ON/raw ctdoxy spiking up to ±24% in 2 sections	DO/2600-2750db, ok after dspk
	ON/raw ctdoxy spiking up to ±17%	DO/O3/2868-3180db, looks ok after dspk, but coded questionable because continuous large section
	OF/ctdoxy drifting higher, max. +0.05 ml/l at btm	O3/5062-5134db/btm, RO -1/5126-5134db
1040/01	DI/-0.023, lowest density at 8db	NA/top 6db
	ON	DO/0-550db
	OF/max. ±0.15 ml/l compared to btls	NA/400-1500db, GD 20-40m
	ctdoxy drops up to -0.10 ml/l between btls, upcast also	NA/1390-1450db, correlates with ctdS feature
	OF/max. -0.05 ml/l compared to btls	O3/2970-4600db, ctdoxy fit would improve greatly if btloxys shifted one level deeper (if samples mis-drawn), but theta-oxy overlays and upcast test-fit indicate the btloxys are fine
1041/01	transmissometer removed this cast only	
	DG/+0.19, high srfc ctdT/C, low ctdS; top 60db down/upcasts differ, down density drops to meet up only at very srfc	NA/top 8db
	ON	DO/0-600db
	OF/max. ±0.35 ml/l compared to btls	NA/0-800db, DU/GD 10-15m
	OF/max. -0.04 ml/l compared to btls	O3/2860-3288db
	ON	DO/3714-3728db
1042/01	ON/OF/max. ±0.15 ml/l compared to btls	DO/0-550db, GD 5-15m
	SS/-1.25 to -2.73 PSU ctdS dropout until stop/yoyos back up at 1066db	S3/870-1066db, looks ok after dspk, but coded questionable because long section
	WS/2.5 mins. to yoyo from 1066 back to 1008db to clear SS problem	NA/1066-1068db, no apparent effect on ctdoxy
1043/01	ON	DO/0-550db
	OF/max. ±0.15 ml/l compared to btls	NA/400-900db, GD 10-15m

Sta/Cast	Problem/Comment	Solution/Action
1044 - 1051	multiple/intermittent ~0.001 ctdC/S drop-outs	see comments below; cleaned Cond sensor after station 1051 - fixed problem
1044/01	ON/OF/max. ±0.15 ml/l compared to btls	DO/0-550db, GS 5-10m
	SS/CO	OC +0.0005 to +0.0008/1386-1438db, 2558-2570db, 2768-2798db, 2932-2990db, 3080-3212db, 3224-3298db, 3360-3428db
1045/01	OF/max. ±0.20 ml/l compared to btl, nearby ctd casts	DO/O3/0-18db, much smaller drop on upcast
	ON/OF/max. ±0.60 ml/l compared to btls	DO/0-500db, DU/GD 10-40m
	OF/max. ±0.30 ml/l compared to btls	NA/500-2000db, DU/GD 20-40m
	SS/CO	OC +0.0005 to +0.0007/2722-2766db, 3258-3356db, 3738-3866db, 4048-4708db, 4726-4800db/btm
	ON	DO/4400-4800db
	OF/max. +0.05 ml/l compared to nearby btl/ctdoxys	O3/4714-4744db, not seen on upcast either
1046/01	DG/+0.13, high srfc ctdT/C, low ctdS; upcast density also low at srfc, downcast lower	NA/top 12db
	ON	DO/0-500db
	OF/max. ±0.20 ml/l compared to btls	NA/20-120db, DU
	OF/max. ±0.20 ml/l compared to btls	NA/260-700db, GD 20m/260-500db, GS ~10m/500-700db
	SS/CO	OC +0.0005 to +0.0008/2486-2500db, 2580-2646db, 2840-2876db, 2890-2988db
	SS/CO	OC +0.0005 to +0.0015/3232-5144db/btm in 6 contiguous segments
	OF/+0.02-3 compared to bottom 2 btls	NA/4946-5144db/btm, ok compared to sta 1047 btl/ctdoxys
	ON	DO/5136-5144db/btm
1047/01	ON/OF/max. ±0.30 ml/l compared to btls	DO/0-700db, DU/GD 5-20m
	SS/CO	OC +0.0007 to +0.001/3420-3608db, 3876-4010db
	OF/max. -0.03 ml/l compared to btls	O3/3600-4400db, similar problem sta 1048/1049

Sta/Cast	Problem/Comment	Solution/Action
1048/01	DI/-0.024, lowest density at 8-10db	NA/top 10db
	ON/OF/max. -0.30 ml/l compared to btls	DO/O3/0-32db, slow transit through surface area, no drop/stable mixed layer top 15db of upcast before ctdoxy peaks
	OF/max. ±0.30 ml/l compared to btls	NA/0-650db, GD 5-10m 20-70db, GS 5-10m 70-200db, GD 5-25m 200-650db
	OF/max. +0.03 ml/l compared to btls	O3/1528-2136db
	OF/max. -0.04 ml/l compared to btls	O3/3328-4600db, similar problem stas 1047/1049
	SS/CO	OC +0.0007 to +0.001/2082-2176db, 2238-2596db, 2658-2674db, 3470-3602db, 3838-4020db
	OB/OF/+0.02-07 ml/l compared to btls/nearby casts	O3/5074-5338db/btm, RO -3 to -2/5324-5338/btm: signal drops ~5290db at btm slowdown, then drifts upward until btm; not on upcast
1049/01	ON/OF/max. -0.30 ml/l compared to btls	DO/O3/0-28db, slow transit through surface area, small rise top 25db of upcast before ctdoxy peaks
	OF/max. ±0.40 ml/l compared to btls	NA/0-800db, GD 10-25m
	SS/CO	OC +0.001/3290-3440db, 4338-4474db
	OF/max. -0.03 ml/l compared to btls	O3/3700-4030db, similar problem stas 1047/1048
	ON/raw ctdoxy intermittently spiking up to ±3%	DO/4700-5318db, ok after dspk
1050/01	DI/-0.016, lowest density at 10-16db	NA/top 10db
	OF/max. -0.30 ml/l compared to btl	O3/24-36db, slow transit through surface area; sm. ctdoxy drop on upcast near here probably due to btl stop
	ON	DO/0-450db
	OF/max. ±0.65 ml/l compared to btls	NA/20-900db, DU/GD 10-15m 20-480db, GS 10-20m 480-900db
	SS/CO	OC +0.0008/2090-2122db, 2142-2160db, 2172-2218db, 2662-2774db, 3190-3458db, 3944-5198db
	ON/OB/raw ctdoxy intermittently spiking up to ±3%	DO/4700-5244db/btm, ok after dspk
1051/01	ON	DO/0-500db
	OF/max. -0.15 ml/l compared to btl	O3/6-30db, slow transit through surface area; no ctdoxy drop on upcast
	OF/max. ±0.40 ml/l compared to btls	NA/40-200db, GD 5-20m
	SS/CO	OC +0.0005/2080-2090db, 2120-5238db
	OF/max. ±0.03 ml/l compared to btls/nearby casts	O3/4502-4560db, 5014-5240db/btm

Sta/Cast	Problem/Comment	Solution/Action
1052/01	cleaned conductivity cell prior to cast because of ±0.001 offsetting problems during recent casts	adjusted conductivity offset coefficient for signal shift caused by cleaning; no more mid-cast offsetting problems, sensor appears stable
	OS/OF/max. -0.10 ml/l compared to btls	DO/RO +40(2-10db)/O3/0-14db, no ctdoxy drop on upcast
	OF/max. -0.15 ml/l compared to nearby btls	NA/24-38db, ctdoxy drop also on upcast
1053/01	ON	DO/0-800db
	OF/max. +0.20 ml/l compared to btls	NA/120-220db, GD 5-15m
1054/01	ON	DO/0-500db
	OF/max. -0.30 ml/l compared to btls	NA/120-180db, DU/ctdoxy drop also on upcast
	OF/max. -0.50 ml/l compared to btls	NA/400-550db, GD 10-20m
1055/01	OF/max. -0.25 ml/l compared to btls	O3/8-42db, no ctdoxy drops on upcast here
	ON/especially top 120db	DO/0-450db
	OF/max. -0.60 ml/l compared to btls	NA/50-700db, GD 15-30m
	OF/max. +0.04 ml/l compared to btls/nearby casts	O3/2860-2938db
1056/01	OS/raw ctdoxy signal 2.5-39% high top 4db, then drops low	DO/RO +50/O3/0-34db, looks ok after dspk, similar to up, but coded questionable because large dspk near srfc
	ON/espec. top 120db	DO/0-450db
1057/01	ON/espec. top 100db	DO/0-420db
	OF/max. -0.25 ml/l compared to btls/nearby casts	O3/52-62db, may correlate with ctdS feature, but no ctdoxy drop on upcast here
	OF/max. ±0.30 ml/l compared to btls	NA/80-520db, GD 5-20m
	BQ/btm 2 btls	EB/5500-5666db
	OF/max. -0.05 ml/l compared to nearby casts	DO/O3/5558-5666db/btm, no ctdoxy drop on upcast or nearby casts
1058/01	ON	DO/0-110db
	OF/max. ±1.0 ml/l compared to btls	NA/50-230db, DU/GD 15-20m
	raw ctdoxy intermittently spiking +1% to +32%	DO/1150-4800db, ok after dspk
	OF/max. -0.04 ml/l compared to btls/previous cast	O3/4030-4502db
1059/01	ON	DO/0-80db
	OF/max. -0.40 ml/l compared to nearby btls/casts	NA/10-26db, ctdoxy drop also on upcast
	OF/max. -0.20 ml/l compared to nearby btls/casts	NA/42-48db, correlates with ctdS feature, maybe smaller ctdoxy drop on upcast
	OF/max. ±0.25 ml/l compared to btls	NA/20-350db, GD 5-10m
	OF/max. -0.04 ml/l compared to btls/previous cast	O3/3784-3882db, no ctdoxy drop on upcast

Sta/Cast	Problem/Comment	Solution/Action
1060/01	ON OF/max. ±0.20 ml/l compared to btls	DO/0-100db NA/20-400db, DU/GD 10-20m
1061/01	ON OF/max. ±0.55 ml/l compared to btls BQ/10 btloxys max. +0.22 ml/l compared to ctdoxy ON/OF/max. ±0.03 ml/l compared to btl/next few casts	DO/0-50db NA/30-300db, GD 15-20m EB/750-3000db, did not use anomalous btloxys for ctdoxy fit; used deep theta-oxy overlays to check fit O3/3486-3534db/btm, noisy signal near/at btm
1062/01	ON OF/max. ±0.55 ml/l compared to btls BQ/9 btloxys +0.05 to +0.14 ml/l compared to ctdoxy CO/SS?/small-scale offset seen in overlays with upcast/nearby casts	DO/0-50db NA/20-500db, GD 20-40m EB/700-3548db/btm, did not use anomalous btloxys for ctdoxy fit - used stas 1061/1063 btloxys to fill in gaps below 700db; used deep theta-oxy overlays to check fit OC +0.002/S3/1000-1054db, looks ok after offset, but difficult to determine exact end of problem
1063 - 1067	ctdoxy sensor malfunctioning, will not fit to deep btls	see codes below; sensor changed out before sta 1068
1063/01	ON OF/max. -0.15 ml/l compared to nearby btls/casts OF/max. ±0.20 ml/l compared to btls OF/max. -0.05 ml/l compared to btls; OO/OF/ctdoxy will not fit to deep btls	DO/0-80db O3/10-24db, no ctdoxy drop on upcast NA/50-500db, DU/GD 0-10m O3/2492-3110db; O4/3502-4276db/btm
1064/01	ON OF/max. -0.20 ml/l compared to nearby btls/casts OF/max. ±0.15 ml/l compared to btls OO/OF/max. +0.03 ml/l compared to btl; ctdoxy will not fit to deep btls	DO/0-80db O3/24-34db, no ctdoxy drop on upcast, deeper drops correlate with ctdS structure NA/70-220db, GS 5-10m O3/3222-3286db; O4/3288-4486db/btm
1065/01	DG/+0.40, low srfc ctdT/C/S/density, downcast only ON OF/max. -0.20 ml/l compared to nearby btls/casts OF/max. ±0.15 ml/l compared to btls OO/OF/max. ±0.03 ml/l compared to btl; ctdoxy will not fit to deep btls	NA/top 8db DO/0-50db NA/14-58db, ctdoxy drops also on upcast NA/40-420db, GD 5-10m O3/3424-3594db; O4/3596-4526db/btm

Sta/Cast	Problem/Comment	Solution/Action
1066/01	ON	DO/0-70db
	OF/max. ±0.20 ml/l compared to btls	NA/30-600db, GD 5-10m
	BQ/5 btloxys automatically omitted because of cts 3 code	1700-2750db, included the btloxys for ctdoxy fit
	OO/OF/max. +0.04 ml/l compared to btl; ctdoxy noisy and will not fit to deep btls	O3/3702-3820db; O4/3822-4996db/btm
1067/01	DG/+0.34, high srfc ctdT, low ctdC/S; upcast density also low at srfc, downcast lower	NA/top 10db
	OF/max. -0.15 ml/l compared to nearby btls	NA/12-38db, ctdoxy drops also on upcast
	OF/max. ±0.20 ml/l compared to btls	NA/40-300db, GD 10-15m
	OF/max. +0.05 ml/l compared to btls	DO/O3/410-436db, area preceding major ctdoxy spiking/drifting problems
	OO/ON/OF/raw ctdoxy spiking from one-fourth to 3x normal values, then slowly drifts upward	DO/O4/438-628db
	OO/OF/max. -0.07 ml/l, no despiking required	O3/630-1112db
	ON/signal crazy through this section, raw ctdoxy half to more than 20x typical values; settles down/steady drift upward from about 2400db	DO/O4/1114-2498db, dspkd only to get final values in-range for reports
	ON/raw ctdoxy spiking up to ±18%	DO/2522-2600db, 4346-4400db
	OO/OF/max. ±0.06 ml/l compared to btls; ctdoxy noisy and will not fit to deep btls	O3/2500-4066db; O4/4068-5582db/btm
1068/01	changed ctdoxy sensor back to 05-01-10 prior to cast	
	ON	DO/0-90db
	OF/max. ±0.15 ml/l compared to btls	NA/70-300db, DU/GD 5-10m
	OF/max. ±0.10 ml/l compared to btls	NA/300-450db, GS 10-15m
	ON/raw ctdoxy spiking from 50% low up to 75% above normal	DO/O3/484-540db, looks ok after dspk, but coded questionable because large dspk/long section
	OO/ON/signal crazy through this section: raw ctdoxy half to more than 2.5x typical values, then drifts slowly back	DO/O4/640-1900db
	OO/OF/max. +0.06 ml/l compared to btls	O3/1902-2220db
	OO/OF/max. +0.04 ml/l compared to btls; ctdoxy noisy and will not fit to deep btls	O3/4354-4636db; O4/4638-5120db/btm

Sta/Cast	Problem/Comment	Solution/Action
1069 - 1076	replaced ctdoxy sensor with new sensor 5-01-07 for these casts	surface raw ctdoxy values are 1.3-2x typical values of previous 2 sensors
1069/01	OS	RO -30/2-6db
	ON/OF/max. ±0.40 ml/l compared to btls	DO/0-90db, ok compared to nearby ctd casts, smaller ctdoxy drops also on upcast; btl at 32db looks high, but correlates with low btlS/upcast -0.15 PSU ctdS feature from 24-38db
	OF/max. -0.25 ml/l compared to btls/nearby casts	O3/132-396db
	ON/OF/raw ctdoxy ±70% compared to typical values, max. +0.10 ml/l compared to btls after dspk	DO/O3/538-758db
	ON/OF/noise level up to ±0.07 ml/l, max. ±0.05 ml/l compared to btls	O3/2146-5820db/btm
1070/01	OO/ON/OF/-0.15 to -0.25 ml/l compared to btls/nearby casts; raw ctdoxy high/stuck at value 4512 for top 14db	DO/O4/0-48db
	OF/max. ±0.20 ml/l compared to btls	O3/50-258db, GD 5-10m 30-180db, sensor possibly still recovering from surface problems
	OF/max. ±0.05 ml/l compared to btls	NA/260-350db, GS 10-15m
	OF/max. ±0.07 ml/l compared to btls, espec. below 3938db	O3/3102-5056db
1071 - 1075	btm much deeper than primary pressure sensor capacity	limited casts to 6000m max. depth
1071/01	OO/OF/ctdoxy will not fit to shallow btls; raw ctdoxy high/stuck at value 4512 for top 64db	O4/0-242db
	OO/OF/max. ±0.10 ml/l compared to btls/nearby casts	O3/244-448db, sensor still recovering from surface problems
	OF/max. -0.07 ml/l compared to btls	O3/2662-3600db
1072/01	DG/+0.17, high srfc ctdT, low ctdC/S, downcast only	NA/top 8db
	OO/OF/ctdoxy will not fit to shallow btls; raw ctdoxy rises +34% in 1 sec. at 129-130db	O4/0-136db
	OO/OF/max. ±0.35 ml/l compared to btls	O3/138-236db, sensor still recovering from drifting problem
	OO/OF/max. +0.15 ml/l compared to btls	O3/4464-4930db, not on upcast, suspect sensor still having problems

Sta/Cast	Problem/Comment	Solution/Action
1073/01	PRT-2 replaced with FSI-OPM; OPM port plugged this cast only	
	ctdoxy sensor may have been removed and/or replaced prior to this cast	ctdoxy sensor seems to behave the same for stas 1073-1076 as previous casts (sticking at 4512 and/or sharp jumps mid-cast); probably no change, perhaps just checked out by electronics tech
	OO/OF/ctdoxy will not fit to shallow btls; raw ctdoxy rises +20% in 2 secs. at 136-138db and +8% in 1 sec. at 208-209db	O4/0-258db
	OO/OF/+0.25 ml/l compared to one btl/ok compared to other btls	O3/260-438db, btls ok vs upcast, ctdoxy rises not seen in upcast; suspect sensor still recovering from drifting problem
	OF/max. ±0.02 ml/l compared to btl/nearby casts	O3/6010-6104db, ctdoxy appears to drift high, although did not use btm btl for fit (+0.04 ml/l compared to nearby casts)
1074/01	short in one conductor	re-terminated wire prior to cast
	OO/OF/ctdoxy will not fit to shallow btls; raw ctdoxy high/stuck at value 4512 for top 72db	O4/0-366db
	OO/OF/max. ±0.10 ml/l compared to btls (except 810db btl - suspect high/questionable)/nearby casts	O3/368-988db, suspect sensor still recovering from drifting problem
	OF/max. +0.05 ml/l compared to btls	NA/990-1350db, DU/GD 15-30m
	BQ/3 of 4 btloxys omitted - high/coded 4	EB/3050-4550db, deep fit within ±0.02 ml/l of adjacent casts
1075/01	DG/+0.37, high srfc ctdT, low ctdC/S; upcast density also low at srfc	NA/top 12db
	OO/OF/ctdoxy will not fit to shallow btls; raw ctdoxy rises +12% in 5 secs. at 214-219db	O4/0-900db
	OO/OF/max. -0.15 ml/l compared to btls/nearby casts	O3/902-1012db, suspect sensor still recovering from drifting problem

Appendix D

WOCE95-I10: Bottle Quality Comments

Remarks for deleted samples, missing samples, PI data comments, and WOCE codes other than 2 from WOCE95-I10 KN-145.13. Investigation of data may include comparison of bottle salinity and oxygen data with CTD data, review of data plots of the station profile and adjoining stations, and rereading of charts (i.e., nutrients). Comments from the Sample Logs and the results of ODF's investigations are included in this report. Units stated in these comments are degrees Celsius for temperature, Practical Salinity Units for salinity, and unless otherwise noted, milliliters per liter for oxygen and micromoles per liter for Silicate, Nitrate, Nitrite, and Phosphate. The first number before the comment is the cast number (CASTNO) times 100 plus the bottle number (BTLNBR).

Station 1015

122-118	Bubble in silicate line, cleared the bubble and tried to rerun the samples, but the system got another bubble, and SiO3 samples were lost.
105	Sample log: "Large leak (bottom), did not reseat." Salinity is acceptable. Oxygen and nutrients are acceptable.
103	Sample log: "Leaker (bottom), reseated okay." Bottle salinity is low compared with CTD. No indication of a problem during salinity run. Salinity could have been switched with 2. Footnote salinity bad. Oxygen appears acceptable. Nutrients are also acceptable, suspect that observation regarding the bottle did not affect the samples.
101	Bottle salinity is low compared with CTD. Salinity is outside specifications of instrument. There were 5 tries before obtaining readings which agreed, this is a clear indication that there was a problem. This sample also does not agree with Station 1033 which was a reoccupation of this station. Footnote salinity bad.

Station 1016

125	CTDO Processor: "+0.30 ml/l ctdoxy bulge not seen on upcast, nearby casts." Footnote CTD oxygen questionable.
124	Oxygen: "Operator error, lost sample." Entered thio late, footnote oxygen sample lost. Bottle salinity is low compared with CTD. Gradient area, salinity is acceptable. Reexamination of salinity: "does not agree with reoccupation station; there are no analytical notes." Footnote salinity questionable and oxygen lost.
123	Oxygen: "Operator error, lost sample." Entered thio late, footnote oxygen sample lost.
117	Sample log: "Bottle did not trip." Bottle 18 tripped at this depth.
102	Oxygen appears high. No problems noted. Footnote oxygen bad, other samples are acceptable. PI: "Oxygen and salinity are marginally high suggesting possibility of leaky bottle. However, no comments on Sample Log, also nutrients okay. Bottle salinity is low compared with CTD. Salinity Analyses: "3 attempts for a good reading." Nutrients agree with re-occupation Station 1032." Footnote salinity and oxygen bad.
101	Bottle salinity is low compared with CTD. Salinometer took 5 tries before getting two to agree. Footnote salinity bad. PI: "Agrees with re-occupation Station 1032. Code salinity acceptable."

Station 1017

Cast 1	Sample log: "No comments."
116	Oxygen appears low, but CTD also indicates this to be a true feature. PI: "O2 analysis looks okay, agrees with re-occupation Station 1031."

Station 1018

117	Sample log: "Bottle 17 tripped, but was not scheduled to trip. Samples were drawn and agree with other surface trip data. Bottle salinity is high compared with CTD. PI agrees.
105	Oxygen: "Overtitrated, not sure why." Oxygen is acceptable. Salinity: "Had trouble with getting a reading, there was a bubble in cell that would not clear. Ran low on water, but rerun tried after the run." Bottle salinity is high compared with CTD. Footnote salinity bad, does not agree with CTD or adjoining stations. PI: "O2 agrees with CTD shape, and agrees with re-occupation station 1030. Salinity agrees with re-occupation station, salinity is acceptable."

Station 1019

Cast 1	Sample log: "No comments."

Station 1020

104	Sample log: "Slight bottom leak." Oxygen as well as other samples are acceptable. PI: "O2 fits re-occupation Station 1028 beautifully."
103	Sample log: "Bottom leak after venting." Oxygen as well as other samples are acceptable. PI: "O2 fits re-occupation Station 1028 beautifully."
101	Bottle salinity is high compared with CTD. Salinity Analyses: "3 attempts for a good reading." Also high compared with re-occupation Station 1028. Footnote salinity bad.

Station 1021

104	Sample log: "Bottom leak again." Oxygen as well as other data are acceptable. PI agrees. PI: "Salinity acceptable."

Station 1022

Cast 1	Sample log: "Salinity case was nearly dry before new fill."
105	CTDO Processor: "ctdoxy max. +0.15 ml/l compared to bottle/nearby casts, although upcast ctdoxy also higher here." Footnote CTD oxygen questionable.
104	Sample log: "Slight leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
103	Sample log: "Slight leak, reseated." Oxygen as well as other data are acceptable. PI agrees.

Station 1023

104	Sample log: "Broken end cap leak, reseated, but out of water." Oxygen was the only parameter sampled, and appears to be okay. PI agrees.
103	Sample log: "Leak after venting, reseated okay." Oxygen as well as other data are acceptable. PI agrees.

Station 1024

Cast 1	Sample log: "No comments."

Station 1025

Cast 1	Sample log: "No comments."

Station 1026

101	Sample log: "Slight leak." Salinity is a little low, but acceptable as well as other samples. PI agrees.

Station 1027

Cast 1	Sample log: "No comments."
104	Oxygen appears low, but probably okay, nutrients high. PI: "Salinity acceptable, O2 low compared to re-occupation, but high compared to Station 1028. Okay."

103 Oxygen appears low, but probably okay, nutrients high. PI: "Salinity high ˜0.1 psu compared with re-occupation. O2 low compared to re-occupation, but high compared to Station 1028. Okay."

Station 1028

110 CTDO Processor: "raw ctdoxy signal up to 12% high, max. +0.05 ml/l compared to bottle after despike; coded questionable because large despike near surface." Footnote CTD oxygen questionable.

103 Sample log: "Leaked at the bottom." Data appears acceptable, salinity agrees with CTD and feature, high no3 and po4 and low salt, on station profile appears real. PI agrees.

Station 1029

103 Sample log: "Leak on top." Data appears to be acceptable. PI agrees.

Station 1030

107 Sample log: "Leaked at stop cock." Data appears acceptable. PI agrees.

103 Sample log: "Leak at bottom." Data appears acceptable. PI: "Salt looks high compared with re-occupation, but okay."

Station 1031

117 Oxygen appears low on station profile, however it agrees with CTDO. NO3 appears low, nutrients appear high. Appears to be a real feature. Let PI decide. PI: "All nutrients a little high compared with re-occupation, oxygen and salinity acceptable, oxygen, nutrients high compared with Station 1030, salinity low, oxygen okay, nutrients high compared with Station 1031. Okay based on re-occupation.

110 CTDO Processor: "ctdoxy noisy and max. -0.20 ml/l compared to bottles 530-580db; up also drops near 550db, but only slightly." Footnote CTD oxygen questionable.

103 Sample log: "Top valve opened a few minutes before sampling CFC's, then reclosed." Oxygen as well as other samples are acceptable. PI agrees.

Station 1032

126 Sample log: Bottom leak." Salinity appears low compared with adjoining stations, however, it agrees with the CTD. Oxygen as well as other data are acceptable. PI agrees.

103 Sample log: "Slight Bottom leak." Oxygen as well as other data are acceptable. PI agrees.

Station 1033

129 Sample log: "Slight leaked, fixed." Oxygen as well as other data are acceptable. PI agrees.

126 Sample log: "Leaked after venting from bottom, reseated okay." Oxygen as well as other data are acceptable. PI agrees.

125 Sample log: "Slight leak bottom, reseated okay." Oxygen as well as other data are acceptable. PI agrees.

124 Gradient area, salinity is acceptable. PI agrees.

123 Sample log: "Leak from bottom after venting, reseated okay." Oxygen as well as other data are acceptable. PI agrees.

105 Salinity (0.003), NO3 and SiO3 low, PO4 and O2 high. No notes indicating a problem. Bottle salinity is low compared with CTD. PI: "Salinity a little low, O2 high compared with re-occupation, but re-occupation questionable also at this point. 1800 to 2700 db PO4 higher than Station 1034, 1015. PI: "1800-2700db PO4 higher than Station 1034, 1015 bottle 3: NO3 less than re-occupation, Station 1034 less than salinity. Salinity a little low or high compared with Station 1015, but re-occupation questionable also at this point." CTDO Processor: "ctdoxy sensor malfunctioning, max. +0.04 ml/l compared to nearby bottles/sta 1015." Footnote bottle leaking CTD oxygen questionable and samples bad.

104-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
103	Sample log: "Leaked from bottom after venting, reseated okay." Oxygen as well as other data are acceptable. PI: "Okay with re-occupation." See 104-101 CTD oxygen comments. Footnote CTD oxygen bad.

Station 1034

129	Sample log: "Bottom leak, reseated okay." Oxygen as well as other data are acceptable.
126-123	CTDO Processor: "ctdoxy max. +0.20 ml/l compared to bottles, fit too far off to be accounted for by down/up differences." Footnote CTD oxygen questionable.
118-112	CTDO Processor: "ctdoxy sensor malfunctioning, max. ±0.03 ml/l compared to bottles." Footnote CTD oxygen questionable.
112	SiO3 0.7 low. Nutrient Analyst: "Odd shaped peak. Unable to devise correct peak height. Footnote silicate bad." PI: "NO3 and PO4 a little low also." Footnote all nutrients bad, must have been some kind of contamination. See 118-112 CTD oxygen comment. Footnote CTD oxygen questionable and nutrients bad.
111-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
103	Sample log: "Bottom leak." Bottle salinity is low compared with CTD. Oxygen and nutrients are are acceptable. PI: "Oxygen and salinity could be higher compared with Stations 1035-1037, nutrients okay. Footnote oxygen bad." See 111-101 CTD oxygen comments. Footnote CTD oxygen, bottle salinity and oxygen bad.

Station 1035

Cast 1	Sample log: "No comments." PO4 low compared with Stations 1036 through 1044 Nutrient analyst adjusted PO4 and agrees with 1034, and 1036 through 1044 just slightly lower.
129	Bottle salinity is high compared with CTD. Spike in CTD up trace, footnote CTD salinity bad. Salinity and other data are acceptable. No CTDOXY is calculated because the CTD salinity is coded bad.
124	O2 low vs. SiO3 and Potemp, O2 draw temperature reasonable. PI: "Agrees with CTDOXY from real-time plot." Data are acceptable.
123	Salinity and nutrients appear low on station profile, however oxygen is high and salinity and oxygen agree with CTD. PI: "Local O2 max." PI agrees data acceptable.
121	PI: "Local O2 min."
120	PI: "Local O2 max."
119	PI: "Local O2 min."
118	PI: "Local O2 max."
114-113	CTDO Processor: "ctdoxy sensor malfunctioning, max. -0.15 ml/l compared to bottles 1870-1946db, max. ±0.03 ml/l deeper; drop not seen on upcast." Footnote CTD oxygen questionable.
112-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.

Station 1036

133	Bottle salinity is low compared with CTD. Gradient area, salinity and other data agree with adjoining stations. PI agrees.
129	Sample log: "Bottom valve leaker (significantly)." Oxygen and other data are acceptable. PI agrees.

127	Sample log: "Stop cock leaker before top valve opened." Oxygen and other data are acceptable. PI agrees.
126	Sample log: "Slight leak, reseated." Bottle salinity is low compared with CTD. Oxygen and other data are acceptable. PI agrees.
118-116	CTDO Processor: "ctdoxy sensor malfunctioning, max. -0.03 ml/l compared to bottles." Footnote CTD oxygen questionable.
115-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
103	Sample log: "Slow leak, bottom." Oxygen as well as other samples are acceptable. PI agrees. See 115-101 CTD oxygen comment. Footnote CTD oxygen bad, other samples acceptable.

Station 1037

136	CTDO Processor: "raw ctdoxy signal 2-10% high near surface, dips lower this area on upcast; looks okay after despike, but coded questionable because large offset/wide section." Footnote CTD oxygen questionable.
135	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD Processor: "CTD salinity is acceptable."
129	Sample log: "Leak after venting, no reseat all samples drawn asap. Oxygen as well as other samples are acceptable. Gradient area, salinity okay. PI: "Salinity agrees with 1029, oxygen okay." Bottle salinity is low compared with CTD. Salinity Analyses: "3 attempts for a good reading."
125	Sample log: "Air leak top cap, reseated okay." Bottle salinity is high compared with CTD. But, within the accuracy of the measurement. Oxygen and other data appear acceptable. Bottle appears to be okay. Let PI decide. PI: "Okay, salinity, oxygen at Station 1032 consistent low if anything."
118-117	CTDO Processor: "ctdoxy sensor malfunctioning, max. +0.05 ml/l compared to bottles." Footnote CTD oxygen questionable.
116-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
112	Bottle salinity is high compared with CTD. No analytical problems noted, other data are acceptable. Salinity is usable but not as precise as other salinity data. PI: "Salinity agrees with Station 1033." See 101-116 CTD oxygen comments. Footnote CTD oxygen bad and bottle salinity questionable.
108	Sample log: "Leak after venting, reseated okay." Oxygen as well as other data are acceptable. PI: "Good agreement with Stations 1036 and 1038."

Station 1038

Cast 1	Sample log: "Bottles fired starting at 16 (deepest)-36, 1-2, 37, 4-15 (shallowest) for freon blank test."
115	Sample log: Leaks from valve, did it trip partially in air?, seemed low on water." Oxygen as well as other data are acceptable. PI agrees.
114	CTDO Processor: "ctdoxy max. -0.30 ml/l compared to nearby ctd; only small drop seen upcast." Footnote CTD oxygen questionable.
113	O2 vs. SiO3 is acceptable. PI agrees.
109	Sample log: "Slight end cap leak - reseated." Oxygen as well as other data are acceptable. Bottle salinity is high compared with CTD. Bottle salinity agrees with adjoining stations. PI agrees. CTD salinity is acceptable.

108-105	Oxygen low, nutrients high. Let PI decide. Salinity max higher in the water column than adjoining stations. PI: "Okay, there’s an eddy here."
131-116	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
122	Sample log: "End cap leaker - reseated." Oxygen as well as other data are acceptable. PI agrees. See 131-116 CTD oxygen comments. Footnote CTD oxygen bad.

Station 1039

Cast 1	Sample log: "No comments."
126	Oxygen may be high. No analytical notes, draw temperature is reasonable. Let PI decide. PI: "CTD indicates a small low salt feature. Nutrients are acceptable. Footnote oxygen questionable."
121	Oxygen may be high. No analytical notes, draw temperature is reasonable. Let PI decide. PI: "CTD indicates a slightly low salinity feature. Nutrients are acceptable. Footnote oxygen questionable."
111	CTDO Processor: "raw ctdoxy noisy/spiking up to ±17%; looks okay after despike, but coded questionable because continuous large section." Footnote CTD oxygen questionable.
101	CTDO Processor: "ctdoxy drifting higher, max. +0.05 ml/l at bottom." Footnote CTD oxygen questionable.

Station 1040

129	Bottle salinity is low compared with CTD. Gradient area, salinity and oxygen agree with adjoining stations. PI: "Okay, oxygen low."
128	Bottle salinity is low compared with CTD. Gradient area, salinity and oxygen agree with adjoining stations. PI: "Okay, oxygen low."
125	Sample log: "Stop cock flows with vent closed." Bottle salinity is high compared with CTD. Salinity agrees with adjoining stations. Oxygen also appears acceptable. PI agrees.
111	Oxygen ˜0.05 high, no analytical notes. Salinity is acceptable. Footnote oxygen bad. PI: "Nutrients okay, maybe little low compared to Station 1039 and 1041, but okay for 1040." CTDO Processor: "Bottle O2 coded 4, but looked okay in test-fit of upcast CTD vs bottles." Leave O2 coded as is per PI’s evaluation. See 104-111 CTD oxygen comments. Footnote CTD oxygen questionable and bottle oxygen bad.
111-104	CTDO Processor: "ctdoxy max. -0.05 ml/l compared to bottles; ctdoxy fit would improve greatly if bottle O2 shifted one level deeper (if samples mis-drawn), but theta-oxy overlays and upcast test-fit indicate the bottle O2 are fine." Footnote CTD oxygen questionable.
105	Bottle salinity is low compared with CTD. This may be within the tolerance of the autosal, but will code as questionable. Does not agree with Station 1039 either. See 104-111 CTD oxygen comments. Footnote CTD oxygen questionable and bottle salinity questionable.
104	Bottle salinity is slightly low compared with CTD. This is within the tolerance of the autosal. Leave salinity as acceptable. See 104-111 CTD oxygen comments. Footnote CTD oxygen questionable and bottle salinity acceptable.
102	Bottle salinity is low compared with CTD. This may be within the tolerance of the autosal, but will code as questionable. Does not agree with Station 1039 either.

Station 1041

132	Bottle salinity is low compared with CTD. Bottle salinity agrees with adjoining stations. Oxygen as well as other data are also acceptable. PI agrees. CTD salinity is acceptable.

126	Sample log: "Bottom leak after venting, reseated." Oxygen as well as other samples are acceptable. PI agrees.
109	Sample log: "Bottom leak after venting, reseated." Oxygen as well as other samples are acceptable. PI agrees.
106-104	CTDO Processor: "ctdoxy max. -0.04 ml/l compared to bottles." Footnote CTD oxygen questionable.
104	Bottle salinity is high compared with CTD. No analytical problems noted. Footnote salinity questionable. Salinity is usable, just not as precise as the other salinity data. PI: "Salinity is the same as Station 1041, but doesn't fit profile, oxygen less than Station 1041." See 106-104 CTD oxygen comment. Footnote CTD oxygen and bottle salinity questionable.
101	Bottle salinity is high compared with CTD. Footnote salinity questionable. Salinity is usable, just not as precise as the other salinity data. PI agrees.

Station 1042

125	Sample log: "Bottom leak - reseated." Oxygen as well as other samples are acceptable. Bottle salinity is low compared with CTD. Salinity agrees with adjoining stations. Spike in CTD uptrace, footnote CTD salinity bad. PI: "Salinity slightly low, fits profile okay."
111	Salinity low compared with adjoining stations, no analytical notes. Oxygen as well as other data are acceptable. Footnote salinity questionable, just not as precise as other salinity data. PI: "Agrees with Station 1040 and CTD. Oxygen is a little lower than adjoining stations, fits Station 1042. Looks a little low on station profile. Salinity is acceptable."

Station 1043

122	Oxygen: "Overtitrated, recovery was not possible." Footnote oxygen bad. PI: "Salinity agrees with CTD."
120	Sample log: "Valve flows when not vented." Oxygen is acceptable. Bottle salinity is high compared with CTD. However, salinity agrees with adjoining stations. Gradient area. CTD Processor: "CTD salinity is acceptable."
120-119	Sample log: "Check O2 on 19-20, 19 was inadvertently resampled, but noticed on next bottle." Oxygen is acceptable. PI: "Salinity okay too."
110	Console Ops Log: "Tripped on the fly."
108-107	SiO3 is ˜2-4 high. There is also a feature, but not this strong in the other nutrients. Let PI decide. PI: "Feature in PO4, not NO3, salinity is acceptable, oxygen less than or equal to adjoining station, NO3 is acceptable. Footnote SiO3 bad." Nutrient Analyst: "Peaks look okay, oxygen is a little odd too."
104	Delta-S at 2020db is 0.0025, salinity is 34.722. Bottle salinity is high compared with CTD. Just outside of specs of the measurement. No analytical problems noted. Footnote salinity questionable. PI: "Salinity higher than adjoining station, oxygen is acceptable."
102	PO4 ˜0.4 low. Analyst rechecked value and adjusted accordingly. PO4 is acceptable. PI agrees PO4 is acceptable.

Station 1044

134	Bottle salinity is high compared with CTD. Bottle data agrees with adjoining stations. PI agrees. CTD salinity is acceptable.
133	Sample log: "Flask switched with 34, this note is only for data checking procedure, correct numbers were recorded on Sample log and correct bottle assignment will be done." Oxygen is acceptable. PI agrees.
127	Sample log: "Bottom cap open, lanyard caught in hose clamp of 26." No water samples.

Station 1045

136	CTDO Processor: "ctdoxy max. ±0.20 ml/l compared to bottle, nearby CTD casts; much smaller drop on upcast." Footnote CTD oxygen questionable.
130	Bottle salinity is low compared with CTD. Gradient area, salinity and other data are acceptable. PI agrees.
125	Nutrients: "No sample drawn." Samples were scheduled to be collected.
112	Sample log: "Bottom is leaking." Oxygen and other data are acceptable. PI agrees.
111	Oxygen slightly high. First bottle that freon was drawn on. Let PI decide on code. PI: "Potemp vs. O2 is okay, oxygen is acceptable."
110	Oxygen slightly high. First bottle that freon was drawn on. Let PI decide on code. PI: "Potemp vs. O2 is okay, oxygen is acceptable."
109	Sample log: "Lanyard caught in cap." Bottle salinity is high compared with CTD. Nutrients are low, oxygen is slightly low, but bottle definitely leaked. Footnote bottle leaking and samples bad. PI agrees.
106	Oxygen 0.01 low, within specs of measurement. Other data are acceptable. No analytical problems noted. PI agrees.

Station 1046

135	Bottle salinity is low compared with CTD. Salinity and other data are acceptable. PI agrees. CTD salinity is acceptable.
132	Bottle salinity is low compared with CTD. Oxygen appears to be low, but agrees with CTD. PI agrees. CTD salinity is acceptable.
131	Bottle salinity is low compared with CTD. Gradient area, bottle salinity as well as other data are acceptable. PI: "Spike in CTD uptrace." Footnote CTD salinity bad, bottle salinity follows feature shown in CTD trace. No CTDOXY is calculated because the CTD salinity is coded bad.
126	Sample log: "Leaks bottom-reseated." Oxygen and other data are acceptable. PI agrees.
108	PO4 ˜0.02 high, within the specs of the measurement. Rechecked raw data and peak is slightly higher. Data are acceptable. PI agrees.
101	CTDO Processor: "Bottle O2 -0.03 ml/l compared to CTD/nearby (later) casts."

Station 1047

133	Sample log: "Bottom leaking." Oxygen as well as other data are acceptable. PI agrees.
132	Sample log: "Bottom leaking." Bottle salinity is high compared with CTD. Oxygen as well as other data are acceptable. PI agrees.
130	Oxygen: "Overtitrated." Oxygen appears to be okay. PI agrees.
129	Bottle salinity is high compared with CTD. Salinity as well as other data are acceptable. Salinity Analyses: "3 attempts for a good reading." PI agrees.
127	Sample log: "Vent left open." Oxygen as well as other samples are acceptable. PI agrees.
126	Sample log: "Slight leak, reseated." Oxygen as well as other samples are acceptable. PI agrees.
109	Sample log: "Slight leak, no reseat." Oxygen as well as other samples are acceptable. PI agrees. See 109-106 CTD oxygen comments. Footnote CTD oxygen questionable, other samples acceptable.
109-106	CTDO Processor: "ctdoxy max. -0.03 ml/l compared to bottles; similar problem sta 1048/1049." Footnote CTD oxygen questionable.
106-101	NO3 appears slightly low comparing adjoining stations vs. pressure, however agrees with adjoining stations when plotted vs. potemp. PI agrees.

104	Sample log: "Slight leak, reseated." Oxygen as well as other samples are acceptable. PI agrees.
103	Bottle salinity is high compared with CTD. Salinometer took 5 tries to get a reading, and water eventually used up. Footnote salinity bad. Suspect salt crystal contaminated analysis. PI agrees. Oxygen: "Overtitrated." Looks OK.

Station 1048

136	Sample log: "Leak at bottom." Oxygen as well as other data are acceptable. PI agrees. CTDO Processor: "ctdoxy noisy and max. -0.30 ml/l compared to bottles; slow transit through surface area, no drop/stable mixed layer top 15db of upcast before ctdoxy peaks." Footnote CTD oxygen questionable.
136-101	CTD Processor: "0.001 PSU shift between downcast and upcast.
135	Bottle salinity is low compared with CTD. Salinity and other data are acceptable. PI agrees. CTD salinity is acceptable.
131	Bottle salinity is high compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Salinity and other data are acceptable. PI agrees. No CTDOXY is calculated because the CTD salinity is coded bad.
127	Sample log: "Vent at top not closed." Oxygen and other data are acceptable. PI agrees.
126	Sample log: "Leak at bottom." Oxygen and other data are acceptable. PI agrees.
118-116	CTDO Processor: "ctdoxy max. +0.03 ml/l compared to bottles." Footnote CTD oxygen questionable.
109-105	CTDO Processor: "ctdoxy max. -0.04 ml/l compared to bottles; similar problem stas 1047/1049." Footnote CTD oxygen questionable.
102-101	CTDO Processor: "ctdoxy +0.02-07 ml/l compared to bottles/nearby casts; signal drops ~5290db at bottom slowdown, then drifts upward until bottom; not on upcast." Footnote CTD oxygen questionable.

Station 1049

Cast 1	Sample Log: "No comments."
136	CTDO Processor: "ctdoxy noisy and max. -0.30 ml/l compared to bottles; slow transit through surface area, small rise top 25db of upcast before ctdoxy peaks." Footnote CTD oxygen questionable.
135	Bottle salinity is low compared with CTD. Salinity agrees with adjoining stations and features seen in other properties. PI: "Large change in up and down, agree with coding." CTD salinity is acceptable.
134	Bottle salinity is high compared with CTD. Gradient area, salinity agrees with adjoining stations. PI agrees.
131	Bottle salinity is low compared with CTD. Gradient area, salinity lower than adjoining stations, but agrees with station profile features seen in other properties. PI agrees.
129	Bottle salinity is high compared with CTD. Gradient area, low compared to adjoining stations, but agrees with station profile features seen in other properties. PI agrees.
106	CTDO Processor: "ctdoxy max. -0.03 ml/l compared to bottles; similar problem stas 1047/1048." Footnote CTD oxygen questionable.
104-101	Salinity ˜0.001 higher than 1048 and 1050, but within specs of the measurement. Salinity agrees with Station 1051. Let PI decide if a real feature.
104-104	PI: "Yes, this is okay."

Station 1050

Cast 1	Sample log: "No comments."
135	CTDO Processor: "ctdoxy max. -0.30 ml/l compared to bottle; slow transit through surface area; small ctdoxy drop on upcast near here probably due to bottle stop." Footnote CTD oxygen questionable.
131	Bottle salinity is low compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Oxygen as well as other data are acceptable. PI agrees. No CTDOXY is calculated because the CTD salinity is coded bad.
130	Nutrients low, oxygen and salinity high compared with adjoining stations and station profile. However salinity and oxygen agree with CTD profile. Data are acceptable. PI agrees.
109	NO3 ˜0.1 low, within specs of measurement. Other data are also acceptable. PI: "Footnote nitrate questionable."
104	Bottle salinity is high compared with CTD. Salinometer took 3 tries to get a good reading. This is still within specs of measurement, just not as precise as other salinity data. Footnote salinity questionable, but still usable. Oxygen and other data are acceptable. PI agrees.

Station 1051

135	Bottle salinity is low compared with CTD. Gradient area, salinity and other data are acceptable. CTDO Processor: "ctdoxy max. -0.15 ml/l compared to bottle; slow transit through surface area; no ctdoxy drop on upcast." Footnote CTD oxygen questionable.
131	Delta-S at 192db is 0.0967, salinity is 35.330. Salinity and other data are acceptable. CTD salinity is acceptable. Bottle salinity is high compared with CTD.
130	Nutrients a little high compared to adjoining stations. Salinity compares with adjoining stations and oxygen a little lower. Let PI decide. PI: "Bottle within interleaving feature, data are acceptable."
121	Console Ops Log: "Tripped on the fly."
119	Bottle salinity is high compared with CTD. No analytical problems noted. Suspect drawing problem. Footnote salinity bad.
109	Sample log: "Slight leak, reseated mostly." Salinity is high, other data are acceptable. PI: "Oxygen slightly low compared with Station 1050, data are acceptable."
104	Sample log: "Slight leak, reseated." PO4 ˜0.02 high, SiO3 ˜1.0 high, these are within the specs of the measurement. Oxygen as well as other data are acceptable and do not indicate the leak effected the samples. PI: "If anything, oxygen may be slightly high compared with Station 1052. Data are acceptable."
102-101	CTDO Processor: "ctdoxy max. +0.03 ml/l compared to bottles/nearby casts." Footnote CTD oxygen questionable.

Station 1052

136	CTDO Processor: "ctdoxy max. -0.10 ml/l compared to bottles; no ctdoxy drop on upcast." Footnote CTD oxygen questionable.
133	Sample Log: "Leaking at bottom, reseated by O2 sampler." Oxygen as well as other data are acceptable. PI agrees. Gradient area, salinity as well as other data are acceptable. PI agrees.
132	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD salinity is acceptable.
122	Sample Log: "Leak at bottom vent." Oxygen as well as other data are acceptable. PI agrees.
112	Sample Log: "Leaking at vent, it filled okay." Oxygen as well as other data are acceptable. PI agrees.

Station 1053

Cast 1	Sample Log: No comments.
135	Bottle salinity is high compared with CTD. Salinity as well as other data are acceptable. PI: "Difference between up and down CTD trace less than 300db, agree with coding." CTD Processor: "CTD salinity is acceptable."
132	Bottle salinity is low compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Salinity as well as other data are acceptable. PI: "Difference between up and down CTD trace less than 300db, agree with coding." No CTDOXY is calculated because the CTD salinity is coded bad.
131	Bottle salinity is high compared with CTD. Gradient area, salinity as well as other data are acceptable. PI: "Difference between up and down CTD trace less than 300db, agree with coding."
130	Bottle salinity is high compared with CTD. Gradient area, salinity as well as other data are acceptable. PI: "Difference between up and down CTD trace less than 300db, agree with coding."
129	Bottle salinity is low compared with CTD. Gradient area, salinity as well as other data are acceptable. PI agrees.
101	Salinity ˜0.002 high compared with Station 1054, within specs of measurement. Let PI decide on code. PI: "Salinity is acceptable." Salinity Analyses: 3 attempts for a good reading.

Station 1054

136	Sample log: "Fired in air." Not sure what was meant by note from Sample Log, however, samples appear to be okay.
132	Bottle salinity is high compared with CTD. Sharp changes in CTD uptrace in gradient area. Salinity and other data agree with adjoining stations. PI: "Agrees with uptrace, okay."
130	Bottle salinity is high compared with CTD. Gradient area, salinity and other data agree with adjoining stations. PI agrees.
129	Bottle salinity is low compared with CTD. Gradient area, salinity and other data agree with adjoining stations. PI agrees.
127	Console Ops Log: "No-confirm from pylon at first trip attempt, re-initialized, second trip confirm okay."

Station 1055

135	CTDO Processor: "ctdoxy max. -0.25 ml/l compared to bottles; no ctdoxy drops on upcast here." Footnote CTD oxygen questionable.
130	Bottle salinity is high compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD salinity is acceptable.
126	Oxygen low, SiO3 high, NO3 high. Oxygen also low compared with CTDO. Salinity agrees with adjoining stations and CTD. Let PI decide. PI: "Salinity a little high compared with Station 1053, but CTD Station 1053 quite different than Station 1055. Real feature as properties are salinity consistent. Data are acceptable.
120	Bottle salinity is low compared with CTD. Salinometer took 3 tries to get a good reading. Footnote salinity bad. Oxygen as well as other data are acceptable. PI agrees.
105	Sample log: "Slight bottom drip." Oxygen as well as other data are acceptable. PI agrees.
102	Salinity is 0.001 high compared with adjoining stations, within accuracy of measurement. PI agrees.

Station 1056

136	Sample log: "Slow leak bottom, reseated." Oxygen as well as other data are acceptable. See 136-135 CTD oxygen comments. Footnote CTD oxygen questionable.
136-135	CTDO Processor: "raw ctdoxy signal 2.5-39% high top 4db, then drops low; looks okay after despike - similar to up, but coded questionable because large despike near surface." Footnote CTD oxygen questionable.
132	Oxygen appears low on Potemp/O2 plot, however, agrees with CTDO. PI: "No bottles nearby at Station 1057, 1055, but okay." Bottle salinity is low compared with CTD.
131	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD salinity is acceptable.
130	Bottle salinity is low compared with CTD. Gradient area. Salinity as well as other data are acceptable. PI agrees.
129	Bottle salinity is low compared with CTD. Gradient area. Salinity as well as other data are acceptable. PI agrees.
126	Sample log: "Bottom cap leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
112	SiO3 ˜1.0 low on station profile, within specs of measurement, Station 1055 also lower. PI agrees.

Station 1057

135	Bottle salinity is high compared with CTD. A lot of structure in CTD uptrace, bottle salinity and other data agree with adjoining stations. PI agrees.
134	Bottle salinity is high compared with CTD. Gradient area, salinity as well as other data are acceptable. PI agrees.
126	Sample Log: "Leak at bottom, okay when reseated." Oxygen as well as other samples are acceptable. PI agrees.
125	Sample Log: "Leak at bottom, okay when reseated." Oxygen as well as other samples are acceptable. PI agrees.
121	Oxygen ˜0.2 high, SiO3 ˜2.0 high. Other data are acceptable. Footnote oxygen bad. PI agrees.
119	Oxygen ˜0.2 high, other data are acceptable. Footnote oxygen bad. PI agrees.
113	Oxygen: "Bad end point." Oxygen slightly high, but is acceptable. PI agrees. CTDO Processor: "Bottle O2 +0.06 ml/l compared to CTD/nearby casts. Both 101, 113 were checked/flagged okay; don't appear okay to CTD processor - CTD is within 0.02 ml/l of nearby casts at these pressures; 5 other bottle O2s already deleted this cast." Since there are additional evidence, CTD comparison, that there was a problem, footnote oxygen bad.
112	Oxygen high, no analytical or sampling problems noted. PI agrees. Bottle salinity is high compared with CTD. No analytical notes. Salinity is usable, just not as precise as other salinity data. Footnote salinity questionable and oxygen bad.
110	Bottle salinity is high compared with CTD. No analytical notes. PI agrees. Salinity is also high compared with Station 1056 and 1058. Footnote salinity questionable.
108	Oxygen ˜0.03 high. No analytical or sampling problems noted. Other data are acceptable. Footnote oxygen bad. PI agrees.
102	Salinity 0.002 higher than Station 1056, but agrees with CTD and Station 1055 or a little high but acceptable. Oxygen ˜0.2 high, NO3 ˜0.3 low. SiO3 is also high. No analytical or sampling problems noted. Let PI decide. PI: "Oxygen looks okay on potemp vs. oxygen, compared to Stations 1056 and 1058. Footnote oxygen questionable."

101	Oxygen ˜0.2 high, NO3 ˜0.3 low. Other data are also acceptable. SiO3 is also high. Shipboard comparison: "Oxygen agrees with CTDO." PI agrees. CTDO Processor: "Bottle O2 +0.10 ml/l compared to CTD/nearby casts." Footnote oxygen questionable even though PI said it was acceptable. CTDO Processor: "ctdoxy max. -0.05 ml/l compared to nearby casts; no ctdoxy drop on upcast or nearby casts." Footnote CTD oxygen and bottle oxygen questionable.

Station 1058

133	Sample log: "Slight leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
131	Bottle salinity is high compared with CTD. Changing area, salinity as well as other data are acceptable. PI agrees.
125	Sample log: "Leak at bottom, okay when reseated." Oxygen as well as other data are acceptable. PI agrees.
122	Nutrients: "No sample." Sample log says sample was taken, must not have been. Footnote nutrients not drawn.
116	NO3 appears ˜0.1 low, within specs of measurement. PI agrees.
106	CTDO Processor: "ctdoxy max. -0.04 ml/l compared to bottles/previous cast." Footnote CTD oxygen questionable.

Station 1059

134	Bottle salinity is high compared with CTD. Changing area, salinity as well as other data are acceptable. PI agrees.
132	Bottle salinity is low compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Salinity as well as other data are acceptable for shallow data. PI agrees. No CTDOXY is calculated because the CTD salinity is coded bad.
131	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable for shallow data. PI agrees.
130	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable for shallow data. PI: "Spike in CTD data, footnote CTD salinity bad." No CTDOXY is calculated because the CTD salinity is coded bad.
129	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable for shallow data. PI agrees.
127	Sample log: "Vent not closed." Oxygen as well as other data are acceptable. PI agrees.
119	Sample log: "Slight leak, no reseat." Oxygen as well as other data are acceptable. PI agrees.
117	Sample log: "Bottom leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
108-101	SiO3 low ˜1.0, PO4 low ˜0.02, and NO3 is acceptable. Nutrient analyst rechecked and adjusted accordingly. SiO3 and PO4 are acceptable. PI: "Very similar to potemp vs. SiO3 and PO4 at Station 1058."
106	Sample log: "Slight bottom leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
101	CTDO Processor: "ctdoxy max. -0.04 ml/l compared to bottles/previous cast; no ctdoxy drop on upcast." Footnote CTD oxygen questionable.

Station 1060

129	Sample log: "Vent not closed." Oxygen as well as other samples are acceptable. PI agrees.
127	Bottle salinity is low compared with CTD. Changing area, salinity as well as other data are acceptable. PI agrees.
125	Bottle salinity is low compared with CTD. Salinity as well as other data agree with adjoining stations shallow waters. PI agrees. CTD salinity is acceptable.

124	Bottle salinity is high compared with CTD. Changing area, difficult to tell if salinity okay. No analytical problems noted. Oxygen and nutrients are acceptable for shallow water. PI agrees.

Station 1061

Cast 1	CTDO Processor: "numerous anomalous bottle O2s - explained as "boundary current" seen by LADCP. However, nothing anomalous appears in CTD (T/C/S/O2). 3 out of 7 anomalous bottle O2s on 1061 are shallower than 2500m. 5 out of 9 anomalous bottle O2s on 1062 are shallower than 2500m. There are no anomalous bottles on 1063, which also has strong vertical shear, albeit deeper. The deep, anomalous bottle O2s on all 3 are in a very stable area in all CTD parameters, with down/up agreeing well. These bottle O2s appear to be something more than the shear/boundary current seen in the LADCP data." CTD Processor rechecked after the expedition with LADCP PI. Comments from LADCP PI: "sta 1061 turns a corner into bad section for next few casts: "lies directly along a high pressure ridge/front and the South Equatorial Current" and "There is an eddy pair that the line cuts between... The eddies extend quite deep". "the LADCP shows strong vertical shear from 2500 m to the bottom on both [1061 and 1062]. Shear on station 1063 begins at about 3500 m." STS/ODF found other evidence that the bottle oxygens may be bad. Therefore, ODF will footnote the bottle oxygens, 03, 05, 07-11, 16-18 and 21 questionable even though the shipboard DQE disagreed. See 111-107 comments.
132	Sample log: "O2 redrawn, found bubbles after pickling." Oxygen agrees with CTD and adjoining stations. Other data are also acceptable. PI agrees.
129	Bottle salinity is low compared with CTD. Salinity as will as other data are acceptable. PI agrees. CTD Processor: "CTD salinity is acceptable."
121	CTDO Processor: "Bottle O2 +0.15 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
119	Oxygen: "Lost sample, analyst went to check bottom depth."
118	CTDO Processor: "Bottle O2 +0.15 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
117	CTDO Processor: "Bottle O2 +0.20 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
116	CTDO Processor: "Bottle O2 +0.07 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
111	CTDO Processor: "Bottle O2 +0.22 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
111-107	Oxygen high, not really sure what happened. Station 1062 also has a few problem points (high). Footnote oxygen bad. Could be that pickling caused a problem, not likely, because samplers are very careful. PI: "Real feature in oxygen, LADCP shows boundary current. PI: "SiO3 lower than Stations 1060, 1062-1066. Oxygen vs. potemp at bottle 8 less than Station 1062, bottle 7 less than Station 1057. Oxygen bottles 7-11 in boundary current per LADCP similar to Station 1062 (but deeper part of current not present at this Station). SiO3 bottles 8-11 less than Station 1060, 1062-1066, therefore, high oxygen and silicate and LADCP consistent, real feature. Data are acceptable." STS/ODF does not agree with PI assessment of the oxygen data. After further shorebased data review and CTD oxygen processing, have determined that there may have been a problem with the oxygen rig on this station and 1062. Footnote oxygen as questionable rather than bad because of comments made by Principal Investigators.
110	CTDO Processor: "Bottle O2 +0.10 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
109	CTDO Processor: "Bottle O2 +0.09 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.

108	CTDO Processor: "Bottle O2 +0.05 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
107	CTDO Processor: "Bottle O2 +0.15 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
106	CTDO Processor: "Bottle O2 appears to be okay compared to CTD/nearby casts."
105	Sample log: "Apparently tripped at same depth as bottle 4. Console operator error." Bottle salinity is slightly low compared with CTD. Sample agreement very good, except O2, this sample is acceptable bottle 4 is ˜0.06 high. PI agrees. See Cast 1 and 111-107 oxygen comments. CTDO Processor: "Bottle O2 +0.09 ml/l compared to CTD/nearby casts." Footnote bottle O2 questionable.
104	Oxygen high ˜0.06 with station profile and duplicate level bottle 5. Footnote oxygen bad. PI: "PO4, NO3 okay, salinity okay, agree with oxygen code."
103	CTDO Processor: "Bottle O2 +0.03 ml/l compared to CTD/nearby casts." See Cast 1 and 111-107 oxygen comments. Footnote bottle O2 questionable.
101	CTDO Processor: "ctdoxy noisy and max. ±0.03 ml/l compared to bottle/next few casts; noisy signal near/at bottom." Footnote CTD oxygen questionable.

Station 1062

Cast 1	Sample log: "No comments." See Station 1061 for oxygen comments. STS/ODF found other evidence that the bottle oxygens may be bad. Therefore, ODF will footnote the bottle oxygens, 01-04, 07, 10, 14-15, and 17 questionable even though the shipboard DQE deemed oxygen acceptable.
117	CTDO Processor: "Bottle O2 +0.12 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
115	CTDO Processor: "Bottle O2 +0.09 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
114	CTDO Processor: "Bottle O2 +0.05 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
110	O2 higher than Station 1060 lower than 1061, but we are questioning the validity of 1061. Footnote oxygen bad. Other data are acceptable. PI: "Boundary current, oxygen is acceptable." CTDO Processor: "Bottle O2 +0.10 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
107	Oxygen high, during the next station, during sampling the O2 sampler found the flask and stoppers switched with bottle 8. But on this station the oxygen for bottle 8 is okay. No sampling or analytical notes. Footnote oxygen bad. Other data are acceptable. PI: "Similar to Station 1061, change code to acceptable." CTDO Processor: "Bottle O2 +0.14 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
104	CTDO Processor: "Bottle O2 +0.12 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
104-101	O2 ˜0.07 high. No analytical problems noted. Footnote oxygen bad. Other data are acceptable. PI: "LADCP shows boundary current, SiO3 is also low. Data are acceptable." Even though PI determined during shipboard DQE of data that oxygen was acceptable, STS/ODF will code the samples as questionable. See Cast 1 oxygen comments.
103	CTDO Processor: "Bottle O2 +0.10 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.

102	CTDO Processor: "Bottle O2 +0.08 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.
101	CTDO Processor: "Bottle O2 +0.06 ml/l compared to CTD/nearby casts." See 104-101, Cast 1 and Station 1061 oxygen comments. Footnote bottle O2 questionable.

Station 1063

136	CTDO Processor: "ctdoxy max. -0.15 ml/l compared to nearby bottles/casts; no ctdoxy drop on upcast." Footnote CTD oxygen questionable.
135	Bottle salinity is low compared with CTD. Spike in CTD trace, footnote CTD salinity bad. Salinity as well as other data are acceptable. PI agrees. No CTDOXY is calculated because the CTD salinity is coded bad.
132	Bottle salinity is high compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD salinity is acceptable.
131	Bottle salinity is high compared with CTD. Changing area lot of feature in CTD trace. Salinity as well as other data are acceptable. PI: "Large gradient, data are acceptable."
130	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD salinity is acceptable.
112	Sample log: "Leak at bottom, okay when reseated." Oxygen as well as other data are acceptable. PI agrees.
111-108	CTDO Processor: "ctdoxy max. -0.05 ml/l compared to bottles." Footnote CTD oxygen questionable.
105-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
104-101	PO4 ˜0.01 low, well within the specs of the measurement. Nutrient analyst rechecked the data and found no problems. PO4 as well as other data are acceptable. PI: "Okay, looks like agreement with Stations 1065 and 1066." See 105-101 CTD oxygen comment. Footnote CTD oxygen bad.

Station 1064

Cast 1	Sample log: "No comments."
135	Bottle salinity is low compared with CTD. Salinity and other data are acceptable. PI agrees. CTD salinity is acceptable.
133	Bottle salinity is high compared with CTD. Gradient area, salinity and other data are acceptable. PI agrees.
131	Bottle salinity is low compared with CTD. Salinity and other data are acceptable. PI agrees. CTD Processor: "CTD salinity is acceptable."
110-101	SiO3 appeared ˜1.5 high, nutrients analyst reviewed the data and all appears okay. Within specs of the measurement, data are acceptable. PI agrees.
106-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
101	PO4 0.01uM high, well within specs just does not fit as well as the rest of the data. PO4 as well as other data are acceptable. Analyst: "Value is real, no correction made." PI agrees. See 105-101 CTD oxygen comments. Footnote CTD oxygen bad.

Station 1065

108	Sample log: "O2 stopper switch with bottle 7, flask 1360 had stopper 1156." Oxygen slightly low compared with Station 1064, okay compared with Station 1066. Footnote oxygen questionable. PI: "Okay with adjoining stations. Oxygen is acceptable."
107	Sample log: "Slight leak, reseated." Sample log: "O2 stopper switched with bottle 8, flask 1156 had stopper 1360." Oxygen appears to be acceptable. Other data also okay. The combination of stopper and flask volume must be close to proper combination volume. PI agrees.
106	CTDO Processor: "ctdoxy sensor malfunctioning, max. ±0.03 ml/l compared to bottle." Footnote CTD oxygen questionable.
105-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.

Station 1066

Cast 1	Sample log: "Bottles fired starting at 12 (deepest)-36, 1-11 (shallowest) for freon blank test."
111	Sample log: "Lanyard caught in cap." Oxygen as well as other data are acceptable. Evidently, the seal was still good on the bottle. PI agrees.
132	Sample log: "Water flows at stop cock, while vent closed." Oxygen as well as other data are acceptable. PI agrees.
130-112	SiO3 ˜1.0 low, nutrient analyst reviewed data and changed accordingly. Data are acceptable. NO3 ˜0.02 high within specs, nutrient analyst reviewed data and changed accordingly. Data are acceptable. PI: "SiO3 vs. potemp range of Stations 1065, 1067 and 1069. Data are acceptable."
127-123	Upcast sloping CTD cond offset. CTD trips are uncalibrated. Footnote CTD salinity questionable. No CTDOXY is calculated because the CTD salinity is coded questionable.
126	Bottle salinity is high compared with CTD. See 123-127 CTD salinity comment, bottle salinity and other data are acceptable. PI agrees. Footnote CTD salinity questionable, CTD oxygen not reported.
125	Bottle salinity is high compared with CTD. See 123-127 CTD salinity comment, bottle salinity and other data are acceptable. PI agrees. Footnote CTD salinity questionable, CTD oxygen not reported.
124	Bottle salinity is high compared with CTD. See 123-127 CTD salinity comment, bottle salinity and other data are acceptable. PI agrees. Footnote CTD salinity questionable, CTD oxygen not reported.
123	Bottle salinity is high compared with CTD. See 123-127 CTD salinity comment, bottle salinity and other data are acceptable> PI agrees. Footnote CTD salinity questionable, CTD oxygen not reported.
119	PI: "Potemp vs. NO3 less than Station 1065, 1067 and 1068. Data are acceptable."
118	CTDO Processor: "ctdoxy sensor malfunctioning, max. +0.04 ml/l compared to bottle." Footnote CTD oxygen questionable.
117-112	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.

Station 1067

#CTDO	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; raw ctdoxy spiking from one-fourth to 3x normal values, still up to +0.15 ml/l compared to bottles after despiking.."
136	Bottle salinity is high compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD Processor: "CTD salinity is acceptable." CTD salinity is okay after data finalization.

133	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD Processor: "CTD salinity is acceptable." CTD salinity is okay after data finalization.
132	PI: "Delta-S is -0.0027, spike in CTD uptrace. Footnote CTD salinity bad." PI agrees. CTD Processor: "CTD salinity is acceptable." CTD salinity is okay after data finalization.
131	Bottle salinity is low compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Salinity as well as other data are acceptable. PI agrees. No CTDOXY is calculated because the CTD salinity is coded bad.
125-124	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; raw ctdoxy drops to one-fourth of normal values, then slowly drifts upward." Footnote CTD oxygen bad.
123	Salinity: "bottles 23 and 22 are out of order, but data DOES reflect proper bottle number." Salinity as well as other data are acceptable. PI agrees. See 123-119 CTD oxygen comments. Footnote CTD oxygen questionable.
123-119	CTDO Processor: "ctdoxy sensor malfunctioning, max. -0.07 ml/l, no despiking required." Footnote CTD oxygen questionable.
118-113	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; signal crazy through this section, raw ctdoxy half to more than 20x typical values; settles down/steady drift upward from about 2400db; despiked only to get final values in-range for reports." Footnote CTD oxygen bad.
111	Sample log: "Did not confirm, fired 12 at the same depth." No water samples. See 111-107 CTD oxygen comments. Footnote bottle samples not drawn, CTD oxygen questionable.
111-107	CTDO Processor: "ctdoxy sensor malfunctioning, max. ±0.06 ml/l compared to bottles." Footnote CTD oxygen questionable.
106-101	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.
103-101	Salinity 0.001 high compared with Stations 1066 and 1068, well within accuracy of the measurement. Data agrees with CTD. PI agrees. See 106-101 CTD oxygen comments. Footnote CTD oxygen bad.

Station 1068

127-125	PO4 and NO3 appear lower than adjoining stations. Suspect the feature is real. Salinity low and oxygen higher than adjoining stations. PI: "NO3 and PO4 at Station 1067 there is also a low feature, ˜8-10C potemp relative to Station 1069 and relative to the rest of the profile. Oxygen is a high feature while salinity low. Data are acceptable."
125	Sample log: "Still leaking." Oxygen as well as other samples are acceptable. PI agrees. CTDO Processor: "ctdoxy sensor malfunctioning, noisy; raw ctdoxy spiking from 50% low up to 75% above normal; looks okay after despike, but coded questionable because large despike/long section." Footnote CTD oxygen questionable.
123-120	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; signal crazy through this section, raw ctdoxy half to more than 2.5x typical values." Footnote CTD oxygen bad.
119-114	CTDO Processor: "ctdoxy sensor malfunctioning, -0.80 to +0.30 ml/l compared to bottles, signal drifting around through this section; normal base-noise level kicks in ~1700db, although signal still high." Footnote CTD oxygen bad.
113	CTDO Processor: "ctdoxy sensor malfunctioning, max. +0.06 ml/l compared to bottles." Footnote CTD oxygen questionable.
111-109	SiO3 low compared with adjoining stations, oxygen also lower on bottle 11 and 10. PI: "SiO3 and O2 okay when plotted vs. Potemp. Data are acceptable."

104	CTDO Processor: "ctdoxy sensor malfunctioning, max. +0.04 ml/l compared to bottles." Footnote CTD oxygen questionable.
103-101	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; ctdoxy will not fit to deep bottles." Footnote CTD oxygen bad.

Station 1069

136	Sample log: "Slight leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
134	Bottle salinity is low compared with CTD. Salinity as well as other data are acceptable. PI agrees. CTD salinity is acceptable.
132	Sample log: "Leaker, reseated." Oxygen as well as other data are acceptable. PI agrees. See 132-129 CTD oxygen comments. Footnote CTD oxygen questionable.
132-129	CTDO Processor: "ctdoxy max. -0.25 ml/l compared to bottles/nearby casts." Footnote CTD oxygen questionable.
128	Salinity low compared to adjoining stations, agrees with CTD though. Oxygen is low. Sil is low. Analyst: "Peak looks real, N:P odd also." Data are acceptable. PI agrees, feature is real.
126-125	CTDO Processor: "ctdoxy noisy and raw ctdoxy ±70% compared to typical values, max. +0.10 ml/l compared to bottles after despike." Footnote CTD oxygen questionable.
122-116	Sample log: "Did not get enough NaOH (bottle running out, tipped bottle for remaining samples." Oxygen are acceptable, except 20 lost. PI agrees.
120	Oxygen: "Sample lost, must have hit return before sample finished."
115-101	CTDO Processor: "ctdoxy noise level up to ±0.07 ml/l, max. ±0.05 ml/l compared to bottles." Footnote CTD oxygen questionable.
111	Suspect a salinity drawing error, 10 came from 09 and 11 from 10, and 11 was not drawn. Correct data using the above scenario and all is acceptable. PI agrees. See 115-101 CTD oxygen comments. Footnote CTD oxygen questionable, salinity not drawn.
110	Delta-S at 3542db is -0.0027, salinity is 34.715. After correcting the data for the drawing error, see 111 salinity comment, Delta-S is 0.001. Oxygen as well as other data are acceptable. PI agrees. See 115-101 CTD oxygen comments. Footnote CTD oxygen questionable.

Station 1070

136	Sample log: "Leak at bottom, okay when reseated." Oxygen as well as other data are acceptable. PI agrees. See 136-135 CTD oxygen comments. Footnote CTD oxygen bad.
136-135	CTDO Processor: "ctdoxy sensor malfunctioning, noisy; -0.15 to -0.25 ml/l compared to bottles/nearby casts; raw ctdoxy high/stuck at value 4512 for top 14db." Footnote CTD oxygen bad.
134	Sample log: "Leak at bottom, okay when reseated." Bottle salinity is high compared with CTD. Gradient area. PI agrees. CTD Processor: "CTD salinity is acceptable." See 134-128 CTD oxygen comments. Footnote CTD oxygen bad.
134-128	CTDO Processor: "ctdoxy max. ±0.20 ml/l compared to bottles; sensor possibly still recovering from surface problems." Footnote CTD oxygen questionable.
131	Sample log: "Leak at bottom, okay when reseated." Oxygen as well as other data are acceptable. PI agrees. See 134-128 CTD oxygen comments. Footnote CTD oxygen bad.
112-105	CTDO Processor: "ctdoxy max. ±0.07 ml/l compared to bottles, especially below 3938db." Footnote CTD oxygen questionable.

Station 1071

Cast 1	Deep salinities higher than Stations 1070, 1069 and 1072, PO4 and NO3 also a little higher. Oxygen and silicate agree with adjoining stations. Salinity agrees with CTD. All data acceptable. PI: "PO4 vs. Potemp only 13 is high compared to Stations 1070, 1072-1073, and 1067-1069. NO3 vs. Potemp only bottles 08-13 are high compared to Stations 1070, 1072-1073, and 1067-1069. Bottles 01-07 agree to 0.001 in salinity with Station 1073. Data are acceptable."
136-131	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to shallow bottles; raw ctdoxy high/stuck at value 4512 for top 64db." Footnote 131-132, 134-136 CTD oxygen bad. No CTDOXY for 133 is calculated because the CTD salinity is coded bad.
134	Bottle salinity is low compared with CTD. Gradient area, salinity as well as other data are acceptable. See 136-131 CTD oxygen comments. Footnote CTD oxygen bad.
133	Sample log: "Leak at bottom, reseated." Bottle salinity is low compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Oxygen agrees with CTDO, other data also acceptable. No CTDOXY is calculated because the CTD salinity is coded bad.
130-127	CTDO Processor: "ctdoxy sensor malfunctioning, max. ±0.10 ml/l compared to bottles/nearby casts; sensor still recovering from surface problems." Footnote CTD oxygen questionable.
112-110	CTDO Processor: "ctdoxy max. -0.07 ml/l compared to bottles." Footnote CTD oxygen questionable.

Station 1072

136-133	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to shallow bottles; raw ctdoxy rises +34% in 1 sec. at 129-130db." Footnote CTD oxygen bad.
135	Bottle salinity is high compared with CTD. Gradient area, salinity as well as other data are acceptable. PI agrees. See 136-133 CTD oxygen comments. Footnote CTD oxygen bad.
133	Sample log: "Spigot was pushed in prior to sampling, wasn't leaking though." Oxygen as well as other data are acceptable. PI agrees. See 136-133 CTD oxygen comments. Footnote CTD oxygen bad.
132-130	CTDO Processor: "ctdoxy sensor malfunctioning, max. ±0.35 ml/l compared to bottles; sensor still recovering from drifting problem." Footnote CTD oxygen questionable.
114-111	SiO3 higher than adjoining stations. Analyst: "Peaks look good. These point overlay well with subsequent stations." PI agrees.
106-105	CTDO Processor: "ctdoxy sensor malfunctioning, max. +0.15 ml/l compared to bottles; not on upcast, suspect sensor still having problems." Footnote CTD oxygen questionable.

Station 1073

Cast 1	Sample log: "No comments." PI: "Data are acceptable."
136-128	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to shallow bottles; raw ctdoxy rises +20% in 2 secs. at 136-138db and +8% in 1 sec. at 208-209db." Footnote CTD oxygen bad.
127-126	CTDO Processor: "ctdoxy sensor malfunctioning, +0.25 ml/l compared to one bottle/okay compared to other bottles; bottles okay vs upcast, ctdoxy rises not seen in upcast; suspect sensor still recovering from drifting problem." Footnote CTD oxygen questionable.
101	CTDO Processor: "Bottle O2 +0.04 ml/l compared to nearby casts/+0.02 ml/l compared to CTD; suspect ctdoxy drifting high last 100m of cast AND bottle O2 is off." Bottle oxygen is acceptable. CTDO Processor: "ctdoxy max. ±0.02 ml/l compared to bottle/nearby casts; ctdoxy appears to drift high, although did not use bottom bottle for fit (+0.04 ml/l compared to nearby casts)." Footnote CTD oxygen questionable.

Station 1074

Cast 1	Sample log: "No comments."
136-131	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to shallow bottles; raw ctdoxy high/stuck at value 4512 for top 72db." Footnote CTD oxygen bad.
130-124	CTDO Processor: "ctdoxy sensor malfunctioning, max. ±0.10 ml/l compared to bottles (except 810db bottle - suspect high/questionable)/nearby casts; suspect sensor still recovering from drifting problem." Footnote CTD oxygen questionable.
129	O2 appears low on station profile, however, Station 1075 also appears to have lower O2 at this potemp. Lower NO3 and PO4 also confirm this feature. PI agrees.
125	CTDO Processor: "Bottle O2 +0.15 ml/l compared to CTD/nearby casts (including theta-o2)." Oxygen is acceptable, see 125-120 comment.
125-120	O2 and SiO3 high, other nutrients verify this as a real feature. PI agrees.
118	PI: "Oxygen high compared to Stations 1071, 1073, 1075 vs. potemp. Footnote oxygen bad."
111	O2 appears high, but SiO3 and other nutrients are low salinity agrees with CTD. PI: "PO4, SiO3 agrees with Stations 1075 and 1073 vs. potemp. Footnote oxygen bad."
109	PI: "Oxygen higher than Stations 1072, 1073,1075 vs. potemp. Footnote oxygen bad."
108	O2 ˜0.1 high, no analytical or sampling notes indicating a problem. SiO3 and other nutrients do not show this feature. Footnote O2 bad. PI agrees.
105	CTDO Processor: "Bottle O2 +0.02-3 ml/l compared to CTD/nearby casts."
104	Console log: "Bottle was inadvertently tripped with bottle 3. Bottle salinity is low compared with CTD. No analytical notes indicating a problem. Oxygen is high, NO3 and SiO3 are slightly low. Suspect bottle contamination or leakage. PI agrees. Bottle must have been tripped as the rosette was moving. Footnote bottle leaking and samples bad.
103	Duplicate level with bottle 4, operator error, tripped 2 bottles.

Station 1075

Cast 1	Sample log: "Bottles fired starting at 13 (deepest)-36, 1-12 (shallowest) for freon blank test."
112-101	CTDO Processor: "ctdoxy sensor malfunctioning, ctdoxy will not fit to shallow bottles; raw ctdoxy rises +12% in 5 secs. at 214-219db." Footnote CTD oxygen bad for 101-108, 110-112. No CTDOXY for 109 is calculated because the CTD salinity is coded bad.
111	Sample log: "Bottom lanyard came free." Nutrients high, oxygen low, salinity Bottle salinity is high compared with CTD. PI agrees. See 112-101 CTD oxygen comments. Footnote bottle leaking, CTD oxygen bad, water samples bad.
109	Bottle salinity is low compared with CTD. Spike in CTD uptrace, footnote CTD salinity bad. Salinity and other data are acceptable. PI agrees. No CTDOXY is calculated because the CTD salinity is coded bad.
136-135	CTDO Processor: "ctdoxy sensor malfunctioning, max. -0.15 ml/l compared to bottles/nearby casts; suspect sensor still recovering from drifting problem." Footnote CTD oxygen questionable.
134	Sample log: "Slight leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
131	Sample log: "Slow leak, reseated." Oxygen as well as other data are acceptable. PI agrees.
125	Nutrients: "No sample in tube." Nutrients were not drawn, sampling error.

WHPO DATA PROCESSING HISTORY

Date	Contact	Data Type	Data Status Summary
	Notes:		
1/8/1990	Unk.	Cruise ID	Cruise Plan
	Agreement with Indonesia is required before the data are released.		
10/15/90	Unk.	DOC	Update
	PROJECT: JADE Cruise Location: Indian Ocean Dates: 30 July - 9 September, 1989 Chief Scientist: Michele Fieux Funding: in cooperation with Indonesia Sampling: Total 67 CTD stations between Colombo-Colombo,Sri Lanka 19 stations AUSTRALIA-BALI with Neil Brown CTD 5 of which with 36 sampling levels 10 of which with 24 sampling levels 20 stations between Bali and South Timor Strait 2 current meter moorings for one year 3 sections across the JAVA and Sumatra current 8 stations on the equator on way back to Colombo Parameters: freons, nutrients, tritium, helium, C14, CO2 Primary WOCE dataset for each cruise: (none listed)		
8/15/97	Uribe	DOC	Submitted
2/2/98	Sprintall	CTD/S/O/NUT	Not Public
7/29/98	Johnson	CTD	Next on ODF agneda
8/25/98	Willey	CFCs	Data Update
	Data are FINAL		
12/23/98	Muus	SUM	Update needed; see note:
	i10_su.txt - sumchk error "missing cast number" on all 9 "FLT" CAST TYPEs. Probably should be cast "2"s since all done after ROS cast #1. Left unchanged. COMMENTS include "# btls" & "dab= " leftover from ODF stacst. Already included in ABOVE BOTTOM & NO. OF BOTTLES. File would be easier to read with shortened COMMENTS section without losing information. Left unchanged. EXPOCODES not yet changed.		
4/16/99	Jenkins	He/Tr	Projected Submission Date:
	1999.12.15 (not yet processed)		

WHPO DATA PROCESSING HISTORY

<table>
<tr><th>Date</th><th>Contact</th><th>Data Type</th><th>Data Status Summary</th></tr>
<tr><td></td><td>Notes:</td><td></td><td></td></tr>
<tr><td>4/30/99</td><td>Bartolacci</td><td>BTL/SUM</td><td>Data Update; See note:</td></tr>
<tr><td></td><td colspan="3">I have replaced the .sum and the .hy file for I10 316N145_13 with the most current reformatted files (most current was done by Sarilee on 1998.02.06)
The following notes accompanied the reformatted files:
i10su.txt - changed first line from:
WOCE I10 KN-145.12 R/V Knorr 11 Nov 95 - 28 Nov 95 to:
R/V KNORR CR. 145, LEG 13 WHP-ID I10
- added time stamp
- changed EXPOCODE from 316N145/13 to 316N145_13
- records 59, 75, 91, 107, 123, 139, 152, 177, and 196 did not have a cast number. Since the EVENT CODE was FLT for float deployment, put a 1 in column forcast number.
- deleted last two records, they were blank
i10hy.txt - changed EXPOCODE from 316N145/13 to 316N145_13</td></tr>
<tr><td>9/29/99</td><td>Falkner</td><td>BA</td><td>Data Update; See note:</td></tr>
<tr><td></td><td colspan="3">The quality of the Ba data from most WOCE legs in the Indian Ocean turned out to be quite poor; far worse than attainable analytical precision (+/-20% as opposed to 2%). We recorded many vials which came back with loose caps and evaporation associated with that seems to be the primary problem. The only hope I have of producing a decent data set is to run both Ba and a conservative element simultaneously and then relating that to the original salinity of the sample. We will be taking delivery on a high resolution ICPMS here at OSU sometime this winter which would make the project analytically feasible and economical. I do not presently have the funds in hand to do this and so have archived the samples for the time being. I don't think the WHPO would derive any benefit from the present data set. -- KKF</td></tr>
<tr><td>10/28/99</td><td>Willey</td><td>CFCs</td><td>Data are Public; See note:</td></tr>
<tr><td></td><td colspan="3">This is a follow-up to last month's message requesting that all of our Pacific and Indian Ocean CFCs be made accessible to the public. Our cruises are; (Pacific) P17C, P1716S, P06E, P19C, P17N, P21E, and (Indian) I09N, I05W/I04, I07N, I10.</td></tr>
<tr><td>3/22/00</td><td>Sprintall</td><td>CTD/S/O/NUTs</td><td>Data are Public</td></tr>
<tr><td>3/28/00</td><td>Diggs</td><td>CFCs</td><td>Website Updated; data are public</td></tr>
<tr><td>5/16/00</td><td>Kozyr</td><td>ALKALI/TCARBN</td><td>Final Data Rcvd @ WHPO</td></tr>
<tr><td>10/17/00</td><td>Jenkins</td><td>TRITUM</td><td>Submitted/Preliminary</td></tr>
<tr><td></td><td colspan="3">*Files for Tritium Data:
WOCE Indian Ocean = WITrit.dat Contains all legs
WOCE Pacific P10 = WP10Trit.dat
WOCE Pacific P13 = WP13Trit.dat
WOCE Pacific P14c = WP14cTrit.dat
WOCE Pacific P18 = WP18Trit.dat
WOCE Pacific P19 = WP19Trit.dat
WOCE Pacific P21 = WP21Trit.dat
SAVE South Atlnt = SAVETrit.dat
*Column Layout as follows: Station, Cast, Bottle, Pressure, Tritium, ErrTritium
*Units as follows: Tritium and ErrTritium in T.U.
*All data are unfortunately still preliminary until we have completed the laboratory intercomparision and intercalibration that is still underway.</td></tr>
</table>

WHPO DATA PROCESSING HISTORY

Date	Contact Notes:	Data Type	Data Status Summary
10/17/00	Jenkins	HELIUM/DELHE3	Submitted/Preliminary
	HELIUM, DELHE3, NEON *Files for Helium and Neon Data: WOCE Indian Ocean = WIHe.dat Contains all legs WOCE Pacific P10 = WP10He.dat WOCE Pacific P18 = WP18He.dat WOCE Pacific P19 = WP19He.dat WOCE Pacific P21 = WP21He.dat *Column Layout as follows: Station, Cast, Bottle, Pressure, Delta3He, ErrDelta3He, ConcHelium, ErrConcHelium, ConcNeon, ErrConcNeon *Units as follows: Delta3He and ErrDelta3He in % ConcHelium, ErrConcHelium, ConcNeon, and ErrConcNeon in nmol/kg *Null values (for ConcNeon and ErrConcNeon only) = -9.000 *All data are unfortunately still preliminary until we have completed the laboratory intercomparision and intercalibration that is still underway.		
11/8/00	Anderson	HELIUM/NEON	Reformatted by WHPO; See Note:
	I have put the Jenkins helium and neon in WOCE format. There were no quality codes so I set the HELIUM, DELHE3, and NEON to 2.		
11/13/00	Anderson	TRITUM	Reformatted by WHPO; See Note:
	I have put the Jenkins tritium data into WOCE format. There were no quality codes so I set the TRITUM to 2.		
2/7/01	Mantyla	NUTs/S/O	DQE
	I would be glad to look over the Indian Ocean data for you. Sarilee has started plotting up I01 for me to start on. - Arnold		
2/26/01	Jenkins	He/Tr/Ne	Data are Public; See Note:
	It was brought to my attention that the WOCE Pacific/Indian He-Tr data was not as yet made public. After submitting it to you last year, I had intended on going through it one more time to ensure there were no problems with it. Unfortunately, I have not had the time to do this. Is it possible, therefore, to release it as public data, and if there are any subsequent minor revisions, to make changes? I suspect there might be a few samples in the set that might have got through our initial quality control.		
5/3/01	Sprintall	CTD/BTL	Final Data Rcvd @ WHPO
	As you may know we received the final data set April 19th from ODF. At that time I let Steve Diggs know that I was happy to make them publically available to the WHPO.		
6/19/01	Swift	CTDTMP	Update Needed; See Note:
	An oceanographically-insignificant error in CTDTMP data for this cruise has been found (ca. -0.00024*T - 0.00036 degC). A data update is forthcoming. In the interim the corrected data files can be obtained from: ftp://odf.ucsd.edu/pub/HydroData/woce/crs		
6/21/01	Uribe	CTD/BTL	Website Updated -- CSV File Added
	CTD and bottle exchange files were put online. These are NOT the corrected CTD data discussed by J Swift on 6/19/01.		