WHP Cruise Summary Information
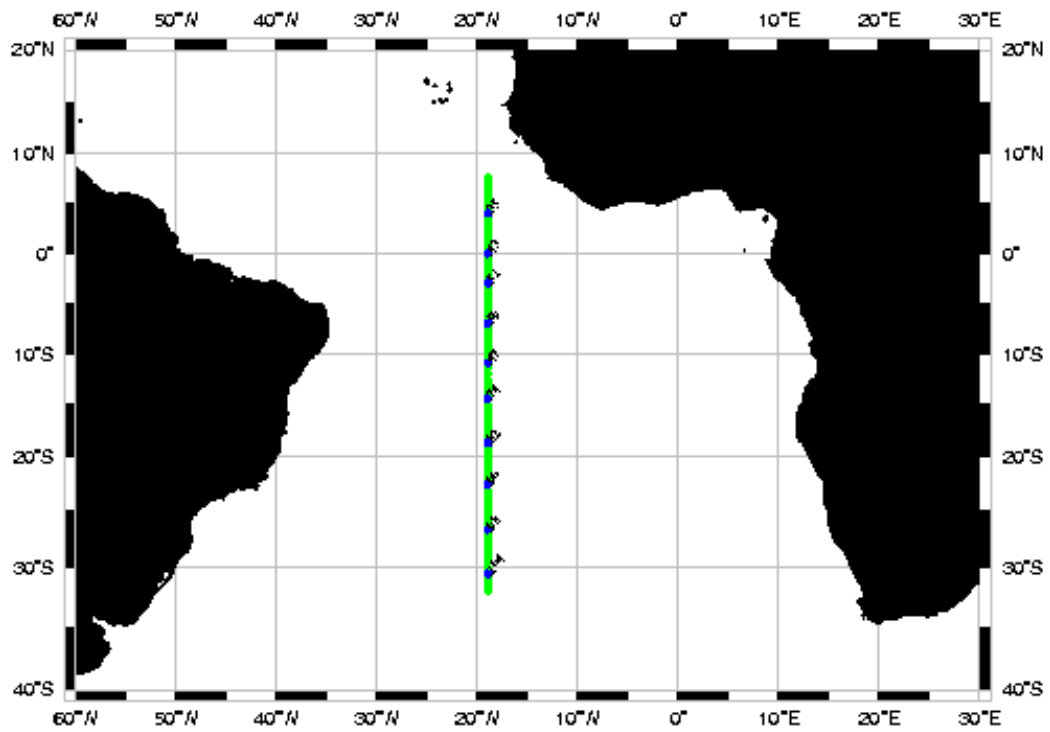
WOCE section designation	A15
Expedition designation (EXPOCODE)	316N142_3
Chief Scientist(s) and their affiliation	William M. Smethie, LDEO
Dates	1994.04.03 – 1994.05.21
Ship	KNORR
Ports of call	Recife, Brazil to Salvador, Brazil
Number of stations	149

Geographic boundaries of the stations

	7˚30.03''N	
19°00.62''W		18°58.80''W
	32˚0.03''S	

Floats and drifters deployed	28 floats
Moorings deployed or recovered	none
Contributing Authors	none

WHP Cruise and Data Information

Instructions: Click on items below 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	
	Salinity
Floats and drifters deployed	Oxygen
	Nutrients
Principal Investigators for all measurements	
Cruise Participants	
Problems and goals not achieved	
Other incidents of note	
Underway Data Information	
Navigation	**References**
Bathymetry	
	DQE Reports
	S/O2/nutrients
	ODF Report
	Data Status Notes

Station locations for a15

(Produced from .SUM files by WHPO)

WOCE INITIAL CRUISE REPORT

A. Cruise narrative

A.1. Highlights

a. **WOCE designation:** A15 and AR15 (Deep Basin Experiment)

b. **Expedition designation:** 316N142/3
Knorr 142/3

c. **Chief scientist:** William M. Smethie, Jr.
Lamont-Doherty Earth Observatory
Palisades, New York 10964
bsmeth@ldeo.columbia.edu

c. **Co-Chief scientist:** George Weatherly
Florida State University
Tallahassee, FL 32306

d. **Ship:** R/V Knorr

e. **Ports of call:** Recife, Brazil and Salvador, Brazil

f. **Cruise dates:** April 3 - May 21, 1994

A.2. Cruise Summary Information

a. Geographic boundaries:

The area of investigation extends to 7˚30'N at the north end of A15 and to 32˚S at the south end along 19˚W. The A15 line is the eastern boundary of AR15 and two sections were done in the AR15 area on the way to and from the A15 line. The southern section in AR15 was done along roughly 17˚ to 19˚S from 18˚W westward to the South American shelf ending at 38˚W. The northern section began on the South American shelf at roughly 4˚S 38˚W and ended at the northern end of A15 at 7˚30'N 19˚W.

b.   Stations occupied:

Table 1. Summary of the number of samples collected.

Parameter sampled/measured	No. stations	No. samples
Salinity	149	5345
oxygen	149	5345
nutrients	149	5345
halocarbons	96	1641
CO_2 and alkalinity	90	
tritium	17	136
sulfur hexafluoride	16	63
biooptical parameters (listed below)	34	

   surface irradiance
   downwelling irradiance
   upwelling irradiance
   photosynthetically available radiation
   light attenuation
   chlorophyll florescence
   chlorophyll
   particulate absorbance spectra

c.   Floats and drifters deployed:

Table 2. Summary of RAFOS float deployments

Float ID No.	Latitude	Longitude	Date	Time
203	0˚59.16'S	35˚56.49'W	94 04 07	06 28
210	0˚00.089'S	35˚56.904'W	94 04 08	06 16
211	0˚59.94'N	35˚56.90'W	94 04 09	08 01
187	3˚24.11'S	18˚59.94'W	94 04 20	17 50
186	3˚24.16'S	18˚59.96'W	94 04 20	17 56
212	5˚30.00'S	19˚00.00'W	94 04 21	19 05
215	5˚30.00'S	19˚00.00'W	94 04 21	19 15
214	8˚00.27'S	19˚00.26'W	94 04 23	02 45
213	8˚00.30'S	19˚00.29'W	94 04 23	02 50
202	9˚59.98'S	19˚00.01'W	94 04 24	04 xx
209	9˚59.98'S	19˚00.01'W	94 04 24	04 xx
222	11˚59.16S	18˚59.95'W	94 04 25	03 22
221	11˚59.18'S	18˚59.91'W	94 04 25	03 28
216	13˚59.02'S	19˚00.05'W	94 04 26	09 40
206	16˚09.16'S	19˚00.17'W	94 04 27	14 20
205	16˚01.16'S	19˚00.17'W	94 04 27	14 25
189	18˚34.536'S	19˚00.098'W	94 04 28	19 23

Float ID No.	Latitude	Longitude	Date	Time
188	18˚34.527'S	19˚00.209'S	94 04 28	19 29
218	20˚08.04'S	19˚00.04'W	94 04 29	14 30
219	20˚08.04'S	19˚00.08'W	94 04 29	14 36
207	22˚04.98'S	19˚00.01'W	94 04 30	15 20
208	22˚04.98'S	19˚00.01'W	94 04 30	15 25
220	24˚12.11'S	19˚00.07'W	94 05 01	17 22
158	24˚12.11'S	19˚00.11'W	94 05 01	17 29
224	18˚23.90'S	22˚10.50'W	94 05 11	02 47
185	18˚23.90'S	22˚10.50'W	94 05 11	02 53
157	17˚56.60'S	24˚49.40'W	94 05 12	11 28
201	17˚56.60'S	24˚49.30'W	94 05 12	11 34

A.3. List of Principal Investigators

Name and address	Measurement Responsibility
Catherine Goyet, WHOI	Total CO_2, Total Alkalinity, pCO_2
Nelson Hogg, WHOI	RAFOS floats
William Jenkins, WHOI	Tritium
Jim Ledwell, WHOI	Sulfur hexafluoride
John Marra, LDEO	Bio-optics
Ocean Data Facility (J. Swift), SIO	CTD, rosette, oxygen, salinity, nutrients
Breck Owens, WHOI	RAFOS floats
William Smethie, LDEO	Halocarbons
Georges Weatherly, FSU	Western boundary current meter array at 19˚S

A.4. Scientific Programme and Methods

This cruise consisted of three legs (Figure 1) and was a combination of legs carried out as part of the Deep Basin Experiment and the WHP one time survey. All hydrographic/tracer stations were taken using a SIO/ODF 36-place rosette equipped a General Oceanics 36 position pylon and SIO/ODF 10-l bottles and interfaced to a SIO/ODF modified NBIS Mark 3 CTD. Stations extended from surface to bottom and all rosette samples were analyzed on board for salinity, oxygen, phosphate, silicate, nitrate and nitrite. Samples were also collected and analyzed on board for the halocarbons, CFC-11, CFC-12, CFC-113, and CCl_4 and for total CO_2 and alkalinity. Halocarbons were generally sampled on every other station at 20 to 24 depths. Alkalinity and CO_2 were generally sampled on 3 out of 4 stations. Tritium samples were collected on both equatorial crossings and sulfur hexafluoride samples were collected at a few select stations in the Brazil Basin. The total numbers of the various types of samples collected are presented in Table 1. Casts were also taken once per day to 200m for biooptics measurements. These casts were normally done between 1000 and 1400 local time on a hydrographic station during the CTD/rosette cast, but some separate stations were taken on transit lines. RAFOS floats were

deployed at various locations along the cruise track (Table 2). Generally two floats were deployed at each location, one set for 2500m and one set for 4000m.

The first leg crossed the western boundary current regime just south of the equator and crossed the equator in a north/south line at about 35˚57'. This line of stations was along the US current meter-mooring array deployed in the deep channel that connects the Brazil Basin to the western North Atlantic Basin. Station spacing was nominally 15nm along the mooring line and between 15 and 30nm for the western boundary crossing. A total of 22 stations were taken along this line.

The second leg extended from 7.5˚N to 32˚S along 19˚W. This leg is the WHP A15 line. Station spacing was nominally 30nm with closer spacing near the equator. A total of 82 stations were taken along this line.

The third leg extended across the Brazil Basin from the 19˚W line to the Brazil continental shelf along a line along about 18.5˚S. The western part of this line was along the US western boundary current meter mooring array. Station spacing was nominally 30nm with closer spacing at the western boundary. A total of 44 stations were taken along this line.

Description of Preliminary Hydrographic Measurements

This cruise is one of a number of cruises being carried out as part of the Deep Basin Experiment. The overall objective of the Deep Basin Experiment is to gain a better understanding of deep circulation in an ocean basin and the Brazil Basin was chosen as the site to conduct this experiment. The investigation consists of a combination of hydrographic and tracer measurements, current meter measurements, subsurface floats, modeling and theory. The overall hydrographic/tracer program consists of several zonal and meridional lines which will yield a detailed picture of the 3-dimensional distribution of temperature, salinity, oxygen, nutrients, and CFCs. Ultimately these data will be used to develop and test models of deep ocean circulation.

This cruise consisted of three legs as described above. Two of the legs provided hydrographic/tracer measurements along the United States current meter arrays across 1) the equatorial channel connecting the Brazil Basin to the western North Atlantic and 2) across the deep western boundary current regime at about 19˚S. The other leg extended along the western flank of the mid-Atlantic Ridge. Vertical sections of preliminary data for potential temperature, salinity, density, oxygen, and nutrients along these lines are presented in Figures 2, 3 and 4 and described below. Note that Figures 3 and 4 are plotted using the same scale. Figure 2 is plotted on an expanded horizontal scale.

Beneath the main thermocline in the South Atlantic, the water masses are comprised of North Atlantic Deep Water flowing southward and Antarctic Intermediate Water (AAIW), Circumpolar Deep Water, and Antarctic Bottom Water (AABW) flowing northward. In section I (stations 1-22, Figure 2) AAIW is clearly observed as a salinity minimum centered at 700-800m depth and extending across the entire section. The salinity is lowest in the western part of the section. This salinity minimum is associated with a

maximum in phosphate and nitrate. At about 1800m there is a salinity maximum associated with a silica minimum. This is the core of upper NADW, which is thought to have its origins in the vicinity of the Labrador Sea. Beneath the upper NADW is a thick region of relatively high oxygen, low nutrient water that is comprised of denser versions of NADW. There is an oxygen maximum at the base of the NADW complex that apparently originates from the Iceland-Scotland and Denmark Strait overflow waters that form the densest components of NADW. Cold, fresh, low oxygen, high nutrient water is observed in the equatorial channel (stations 10-21) beneath the NADW with a slight intensification on the northern side of the channel. This is AABW flowing from the Brazil Basin to the western North Atlantic basin.

The same basic structure is observed in section 3 (stations 110-153, Figure 4) except the concentrations of the NADW and AABW cores are western intensified indicating flow of these water masses in deep western boundary currents. Also core concentrations are different reflecting mixing along the flow path with adjacent water masses. The AABW layer is colder, fresher, and higher in silica and nutrients at section 3 than section 1 since section 3 is closer to the source of AABW. The NADW layer is saltier, lower in silica and nutrients and higher in oxygen for section 1 than section 3 since section 1 is closer to the NADW source regions.

The same water mass layers are observed in section 2 (Figure 3) which extends from 7.5˚N to 32˚S. The AAIW salinity minimum extends along the entire section and shoals from about 900m at 32˚S to about 700m at the northern end of the section. At the southern end, it is associated with an oxygen maximum. NADW is observed as a broad tongue of salty, high oxygen, low nutrient water extending southward, becoming thinner at higher southern latitudes. Cores of upper and lower NADW are observed at the equator as maxima in oxygen and minima in silica and nutrients. This indicates that this water mass either flows or mixes laterally from the western boundary eastward along the equator. The AABW layer extends along the bottom to the equator where it abruptly ends because the section crosses the Mid-Atlantic Ridge into the eastern basin at this point.

One striking feature in section 2 is the anomalous water between stations 80 and 82. From about 1400m to 2500m this water is warmer, saltier, higher in oxygen and lower in silica and nutrients than the water to the north or south indicating water with stronger NADW characteristics. In the bottom water just the opposite is observed, indicating water with stronger AABW characteristics. The core of the anomalous AABW is centered above a fracture zone, the St. Helena Fracture Zone, and is offset slightly to the south of the overlying core of anomalous NADW (Figure 3). On section 3 a couple of stations were added east of section 2 to better map these features. In addition to finding the anomalous NADW core at the same location 10 days later, a second core was seen eastward of it (Figure 4). The core of anomalous AABW has shifted slightly (50km) towards the east. The location of these features at about 19˚S may be the result of the NADW and AABW Deep Western Boundary Currents having to flow around the Vitoria-Trindade Seamount Chain that extends eastward from the Brazilian coast to 28˚W longitude at 21˚S.

Comparison of Measurements to Previous Measurements

The cruise track for this cruise crossed the cruise tracks for the South Atlantic Ventilation Experiment (SAVE) and the Hydros Leg 4 cruises, which were carried out in the late 1980s, at several locations. Comparisons between the two data sets were made by comparing plots of salinity, oxygen, phosphate, nitrate and silica verses potential temperature for the deep waters (colder than 6°C). Differences between cruises indicate either a measurement problem or a change in deep water characteristics during the 6-7 year period between the two cruises.

The Hydros Leg 4 cruise crossed the deep equatorial channel at nearly the same longitude as section 1 of this cruise (36°30' for Hydros Leg 4, 36°57' for this cruise). Salinity, oxygen, nitrate, and silica verses potential temperature are in excellent agreement for the two cruises. However for phosphate, this cruise has much more station to station variability than the Hydros Leg 4 cruise although the trends in phosphate verses potential temperature are the same for both cruises. The maximum difference between any two stations in the channel for the Hydros Leg 4 cruise was 0.05mM/Kg compared to 0.17mM/Kg for this cruise.

Comparisons have also been made at the three locations where section 2 crossed the SAVE cruise track. Again there was good agreement for salinity, oxygen, nitrate, and silicate, but not as good agreement for phosphate.   Differences in phosphate concentration of up to 0.1mM/Kg were observed between cruises.

Comparison with Meteor Cruise 28/1

This cruise was carried out at the same time as another Deep Basin Experiment cruise, Meteor cruise 28/1, which occupied a zonal section across the South Atlantic Ocean at 11°20'S latitude. The cruise track of these two cruises crossed at 11°20'S, 19°W within about 1 week of each other. The Meteor chief scientist, Thomas Mueller, and I arranged to have an inter-calibration station at the crossing point. The station numbers were 68 for the Knorr cruise and 206 for the Meteor cruise.

Comparisons of the preliminary data were made at sea. q/S plots of the deep CTD data were slightly offset with the Knorr data being either 0.01° higher or 0.001 fresher in salinity than the Meteor data. This is very good agreement, but final comparison must await post cruise calibration of the CTDs. Vertical profiles of temperature, salinity, oxygen, nitrate and silicate showed identical features and were at the same level of precision, but there was a systematic difference in the oxygen, nitrate and silicate data. The Meteor data was 4% lower than the Knorr data for oxygen and 6% lower for nitrate and silicate. Phosphate was not measured for the Meteor station. We do not yet know the reason for these differences.

B.   Underway Measurements

Underway measurements were made for bathymetry, ADCP, temperature and salinity using the thermosalinograph, pCO_2, and meteorology. The Ocean Data Facility is responsible for the bathymetric data and Catherine Goyet of Woods Hole Oceanographic Institution is responsible for the pCO_2 data. Funding has not been provided for the collection of the temperature, salinity, ADCP, and meteorology data. The raw data has been submitted to the WOCE Hydrographic Office in Woods Hole for archival and distribution to interested investigators.

A.5.   Major Problems and Goals Not Achieved

There were not any major problems on this cruise, but there were some minor problems. One was the phosphate measurements which have been discussed above. At any given station the vertical profiles were very smooth indicating a precision within the WOCE guidelines of 0.4%. However, occasionally there appeared to be a shift in calibration between stations that ranged from 1 to 6%; some of these shifts were larger than the WOCE guideline for accuracy of 2%.

There were two minor problems for the chlorofluorocarbon measurements. There was a small peak in the blank that eluted a few seconds before F-11 which may cause problems for samples with low concentrations. All chromatograms were stored and will be reintegrated to separate the area of this interference peak from the area of the F-11 peak. There was a large peak with the identical retention time as F-113 in water samples taken from the oxygen maximum just beneath the base of the mixed layer. This is apparently caused by a naturally produced halogenated compound and will render the F-113 measurements useless for this depth region. However, F-113 is not a routine WOCE parameter.

A.6.   Other Incidents of Note

None noted.

A.7.   List of Cruise Participants

Name/Affiliation/Address	Responsibility
William M. Smethie, Jr.	Chief Scientist
Lamont-Doherty Earth Observatory	
Palisades, NY 10964	
bsmeth@ldeo.columbia.edu	
George Weatherly	Co-Chief Scientist
Florida State University	
Tallahassee, FL 32306	

Name/Affiliation/Address	Responsibility
Craig Hallman	Salt analyst, rosette handler, sampler
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Mary Johnson	CTD data processing
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Leonard Lopez	O_2 analyst, rosette handler, sampler
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Carl Mattson	Electronics Tech, rosette handler
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Rebecca Streib Montee	Nutrient analyst
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Stacy Morgan	Nutrient analyst
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Ron Patrick	Data processing, O_2 analyst, rosette handler
Ocean Data Facility	
Scripps Institution of Oceanography	
La Jolla, CA 92093	
Eugene Gorman	CFC analyst
Lamont-Doherty Earth Observatory	
Palisades, NY 10964	
Carol Knudson	Biooptics analyst, salt analyst, rosette handler, sampler
Lamont-Doherty Earth Observatory	
Palisades, NY 10964	

Name/Affiliation/Address	Responsibility
Xian-Feng (Frank) Zheng	CFC analyst
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Bob Adams	CO_2 analyst
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Woods Hole, MA 02543	
Joanne Donoghue	CO_2 analyst
Woods Hole Oceanographic Institution	
Woods Hole, MA 02543	
Will Handley	Knorr Resident Tech.
Woods Hole Oceanographic Institution	
Woods Hole, MA 02543	
Nancy Hayward	CO_2 analyst
Woods Hole Oceanographic Institution	
Woods Hole, MA 02543	
Mariann McAllister	CO_2 analyst
Tufts University	
Damon Chaky	Salt analyst, rosette handler, sampler
Mississippi State University	
Mississippi State, MS 39762	
Antonio Da Silva Fraga Filho	Brazilian Observer
Brazilian Navy	
Brazil	

3 April – 21 May 1994
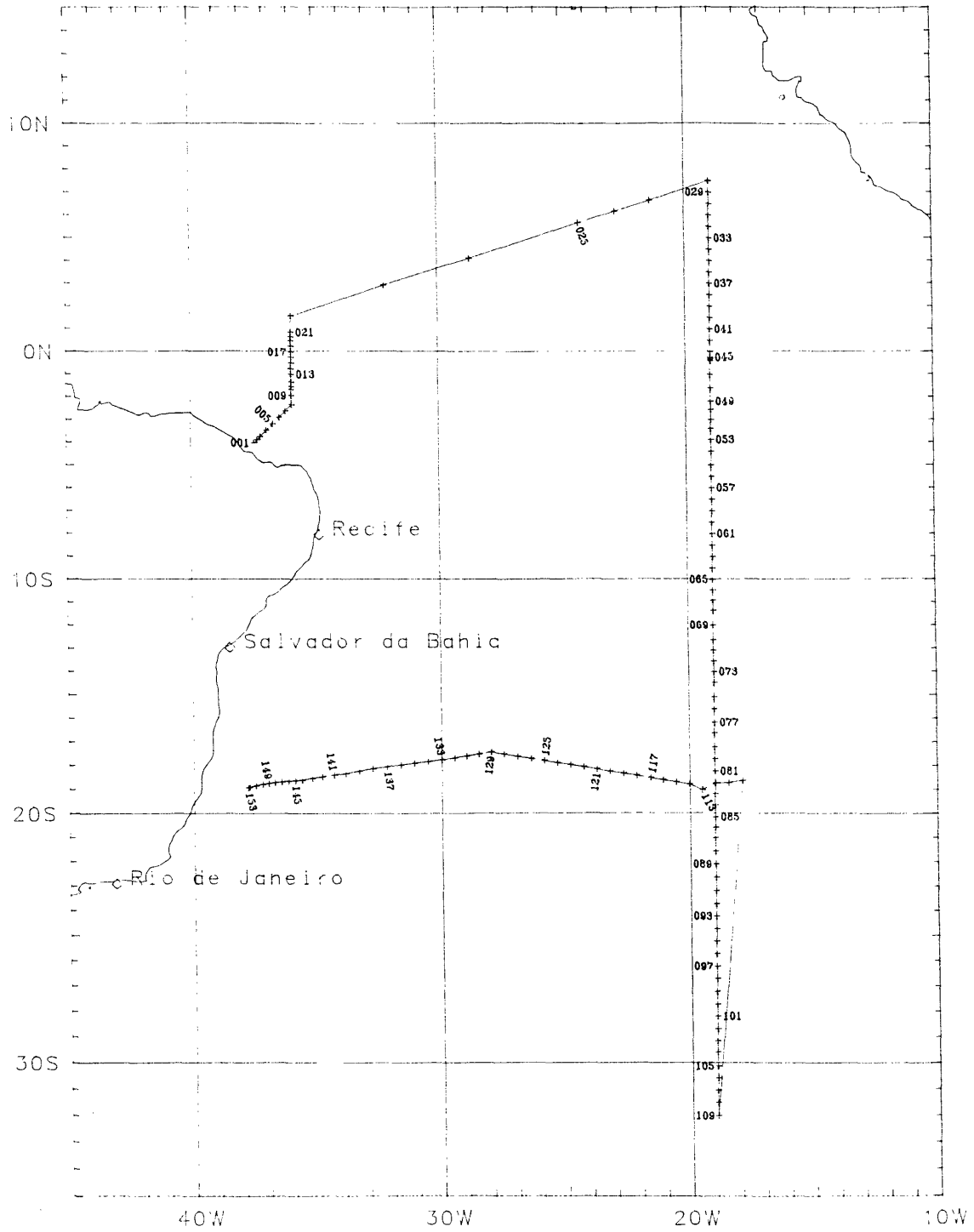
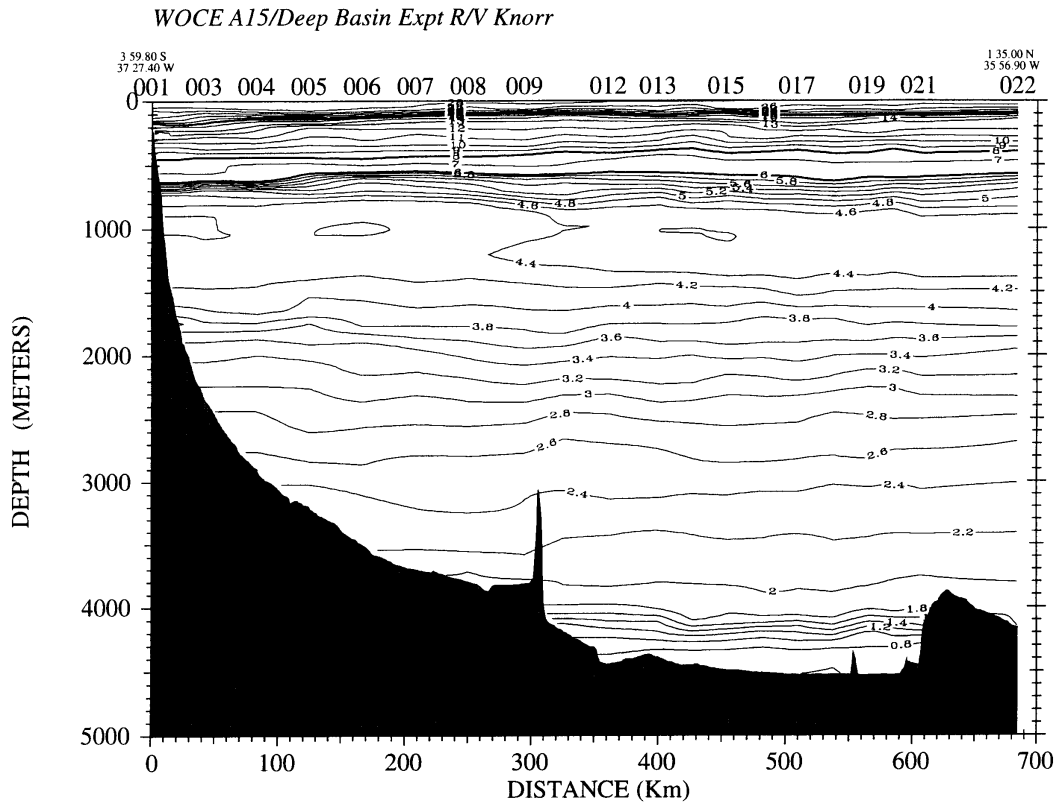Fig. 1: WOCE A15/Deep Basin Experiment
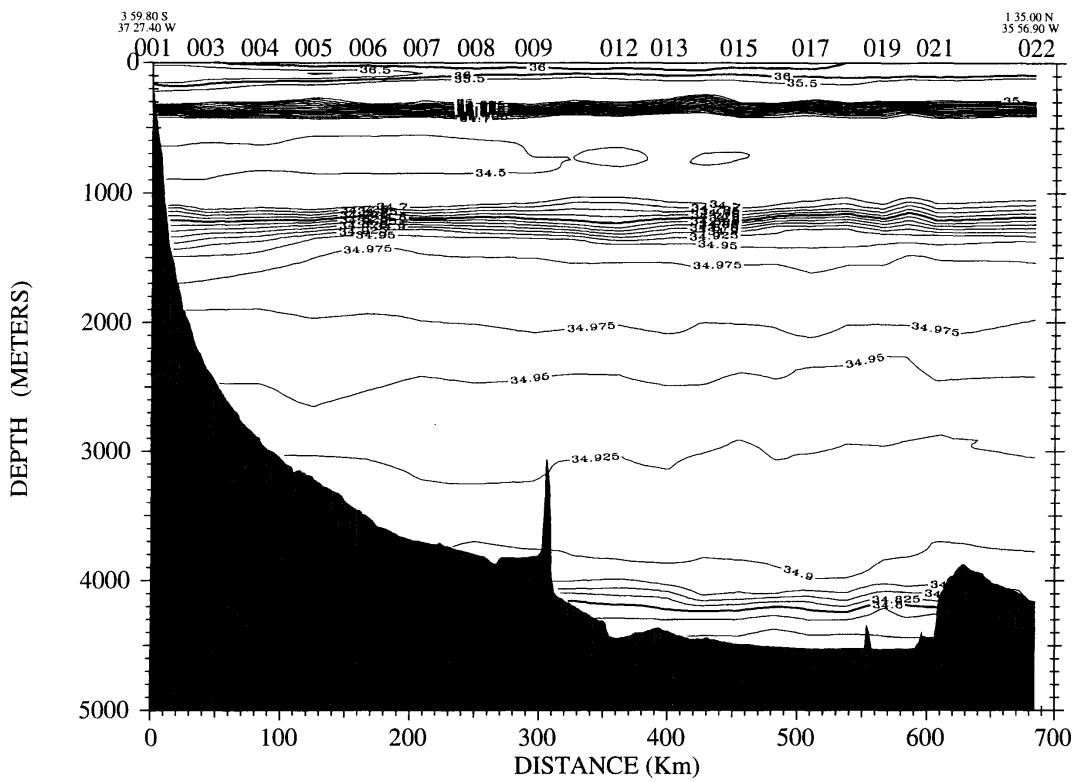R/V Knorr, Mercator Projection

Fig. 2a: POTENTIAL TEMPERATURE (°C)

Fig. 2b: SALINITY (PSU)
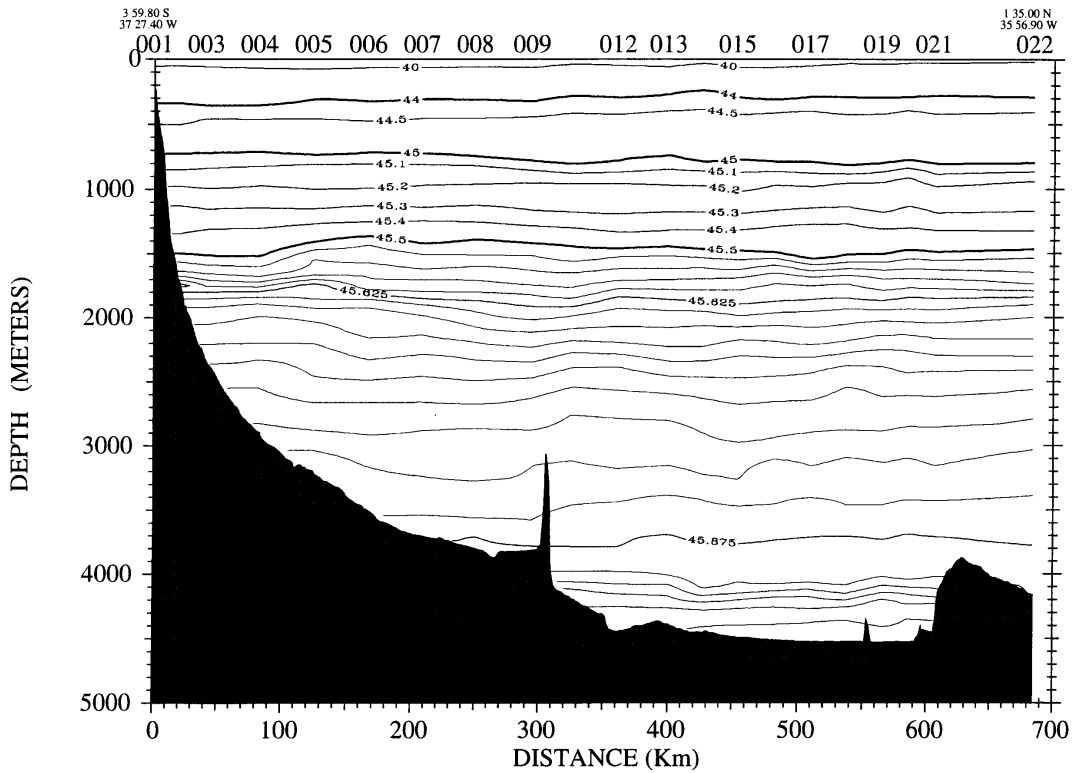
Fig. 2c: SIGMA THETA

Fig. 2d: SIGMA 4
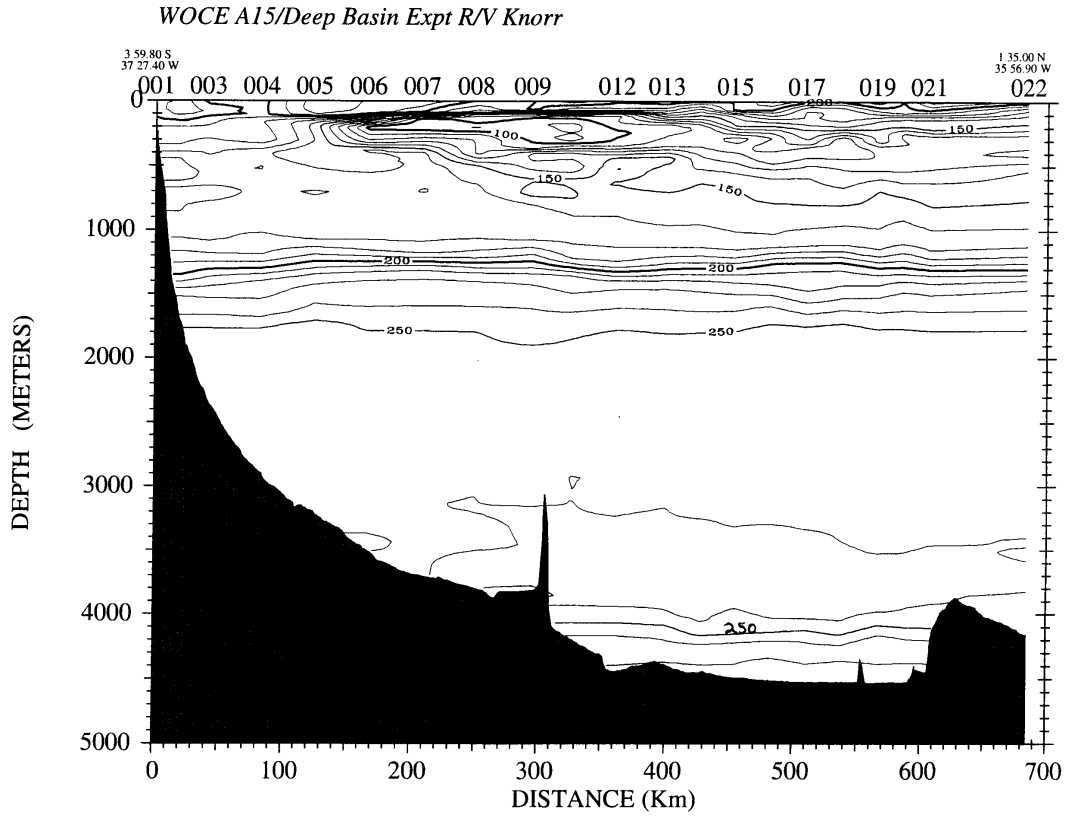
Fig. 2e: BOTTLE O_2 (UM/KG)
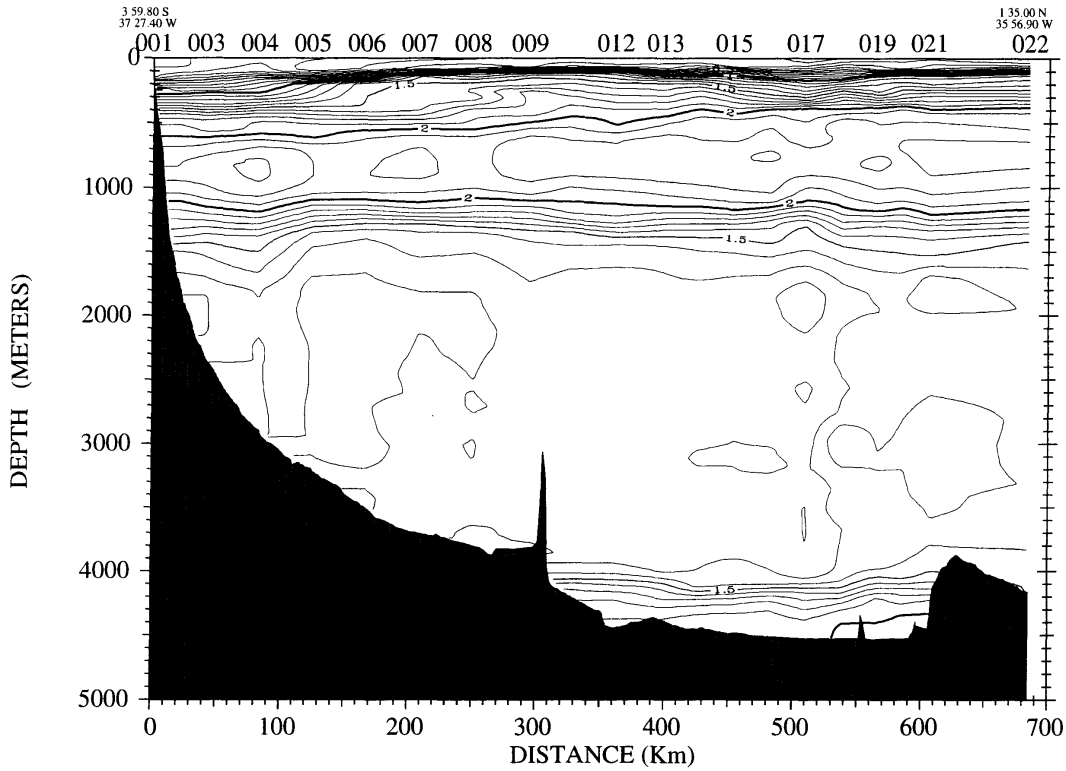
Fig. 2f: PO_4 (UM/KG)
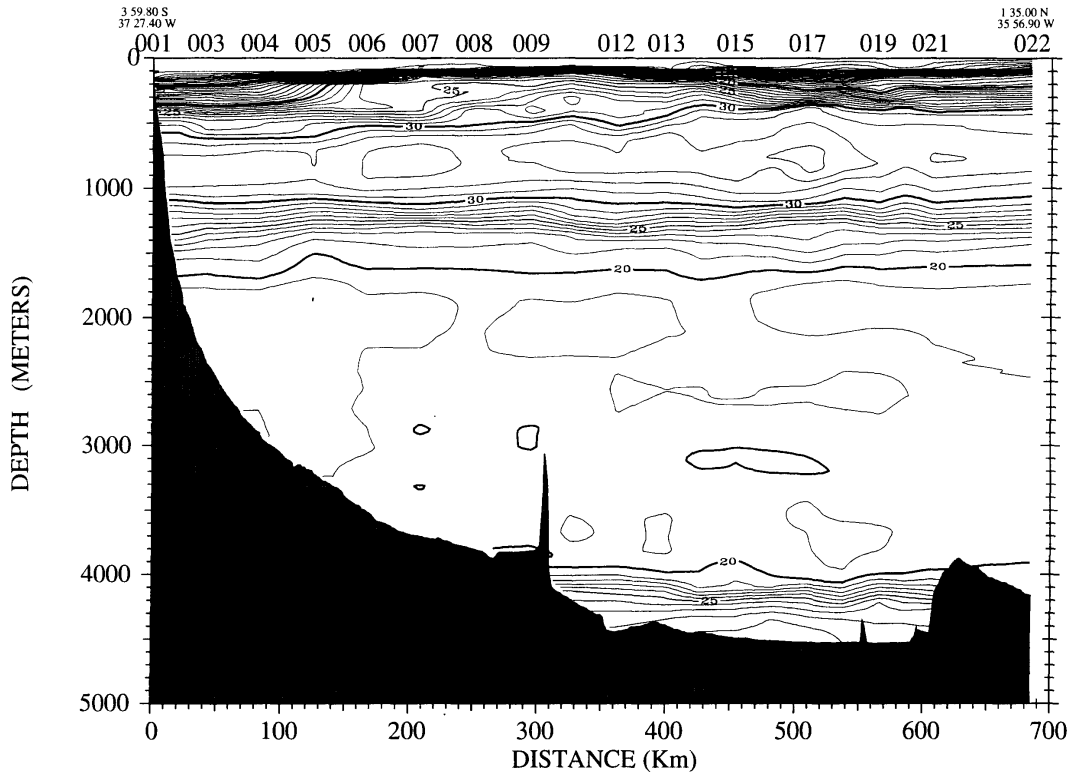
Fig. 2g: NO₃ (UM/KG)
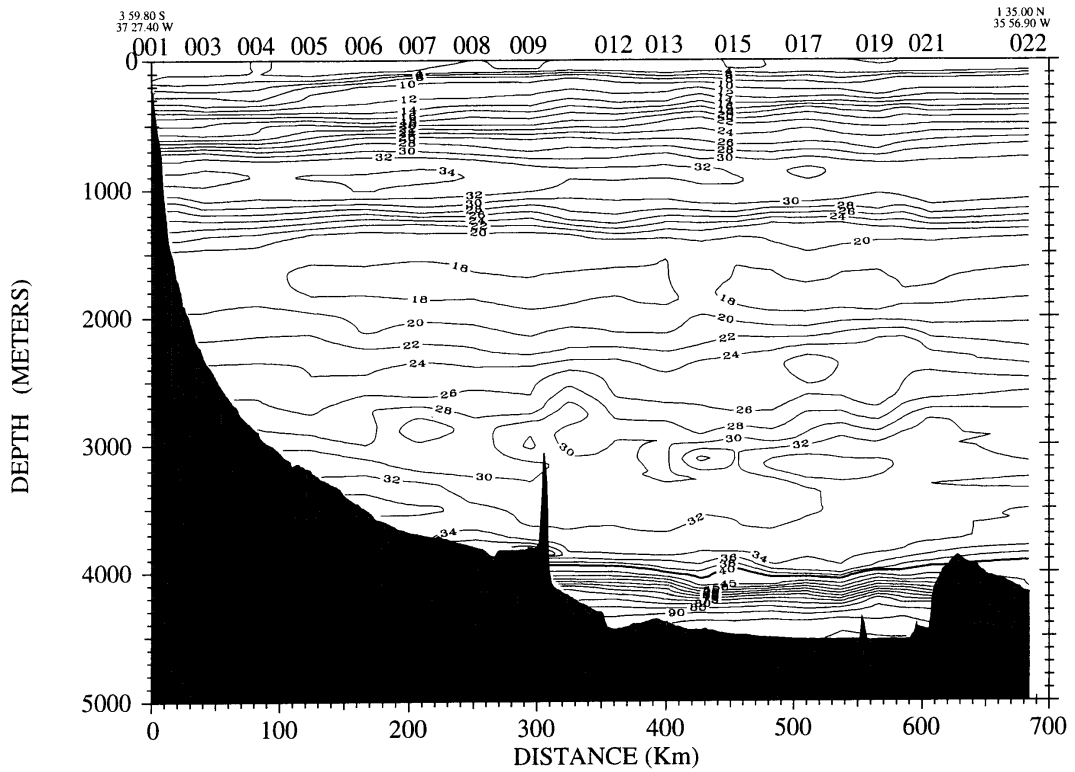
Fig. 2h: SIO₃ (UM/KG)
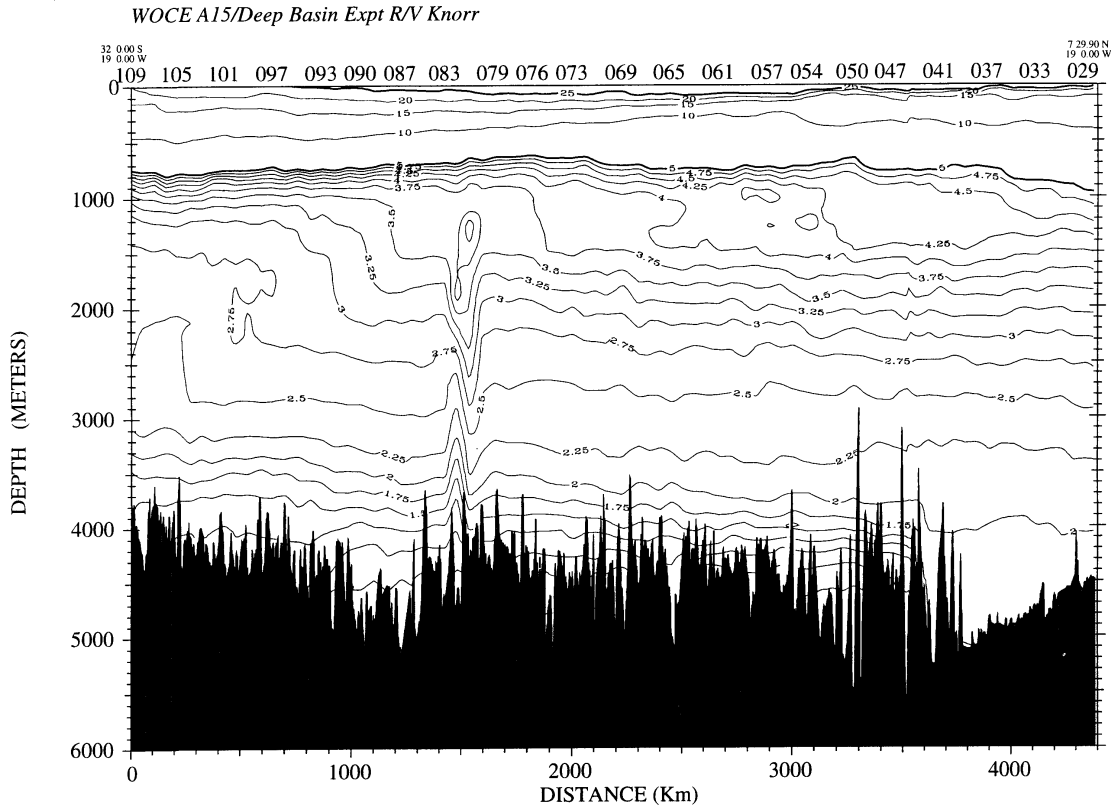
Fig. 3a: POTENTIAL TEMPERATURE (°C)
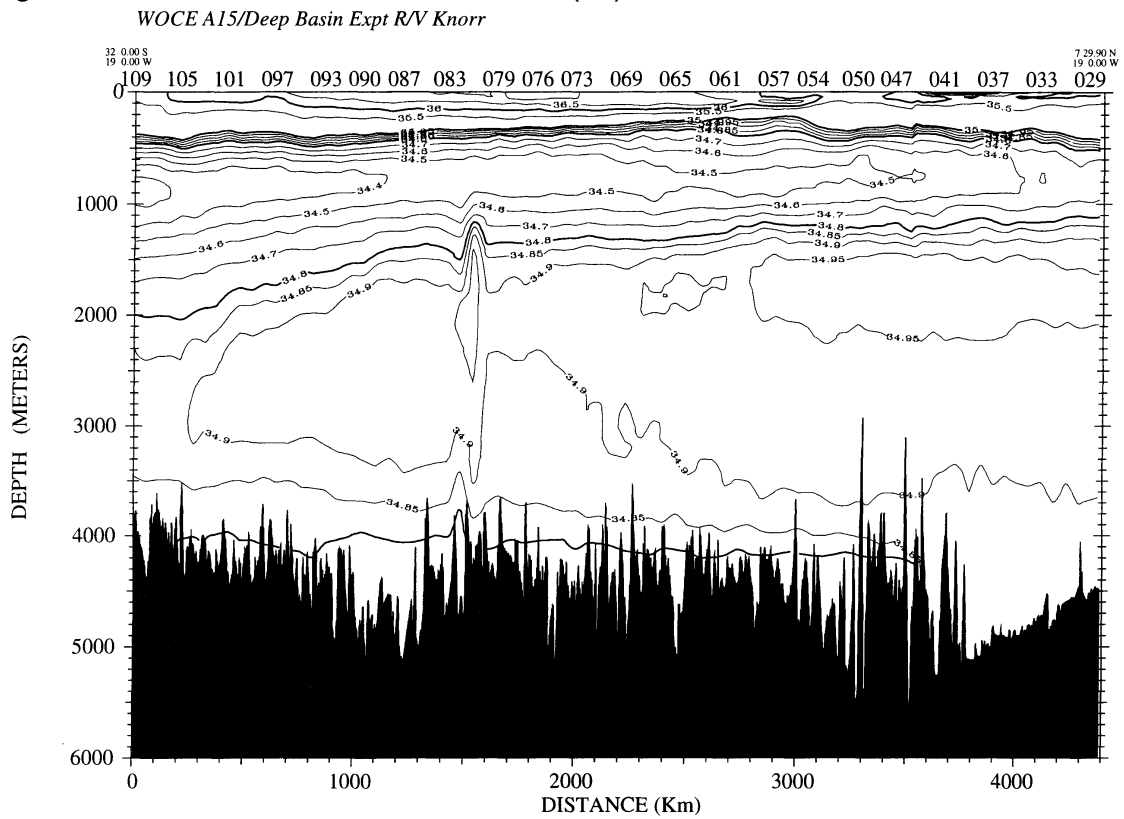
Fig. 3b: SALINITY (PSU)
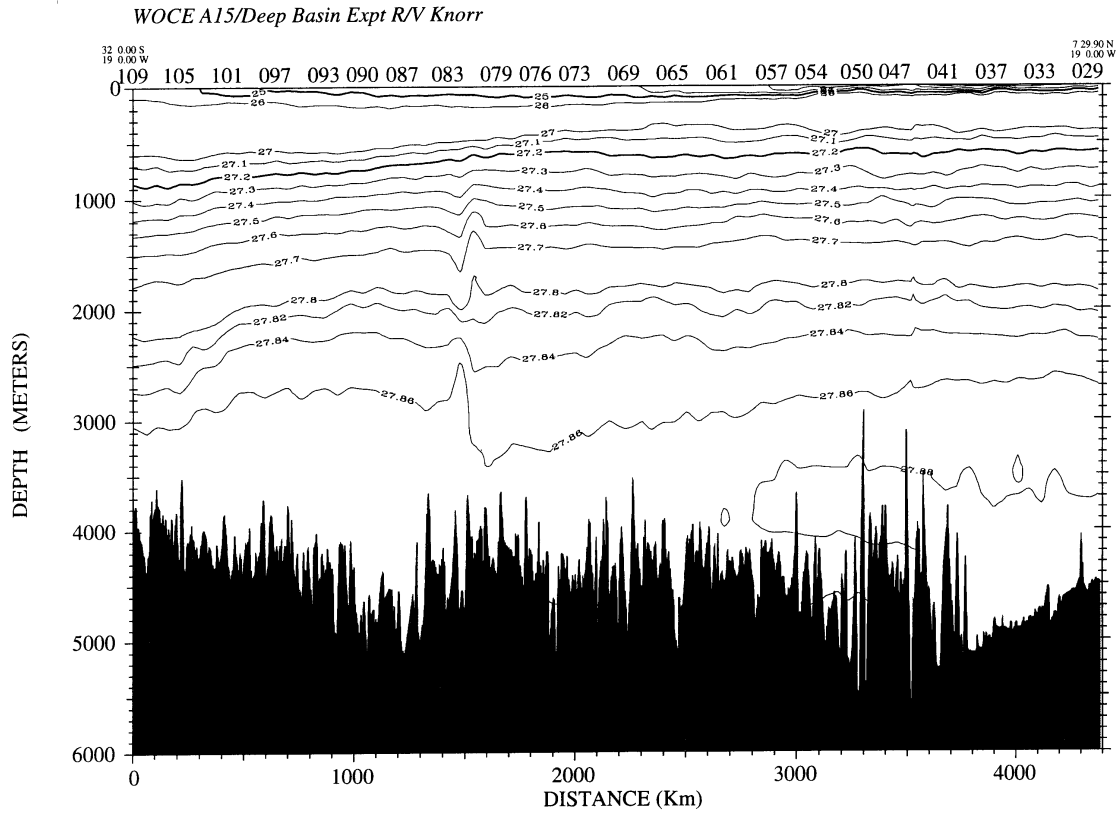
Fig. 3c: SIGMA THETA

Fig. 3d: SIGMA 4

32 0.00 S
19 0.00 W

7 29.90 N
19 0.00 W

109 105 101 097 093 090 087 083 079 076 073 069 065 061 057 054 050 047 041 037 033 029
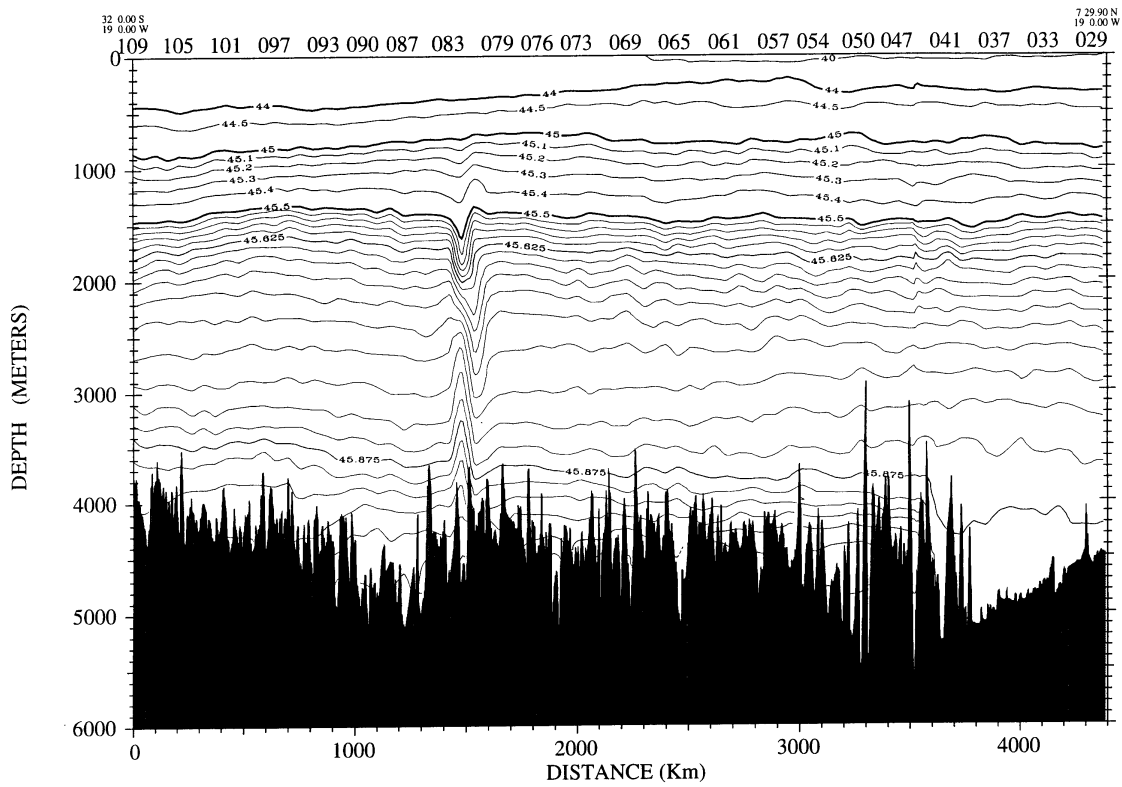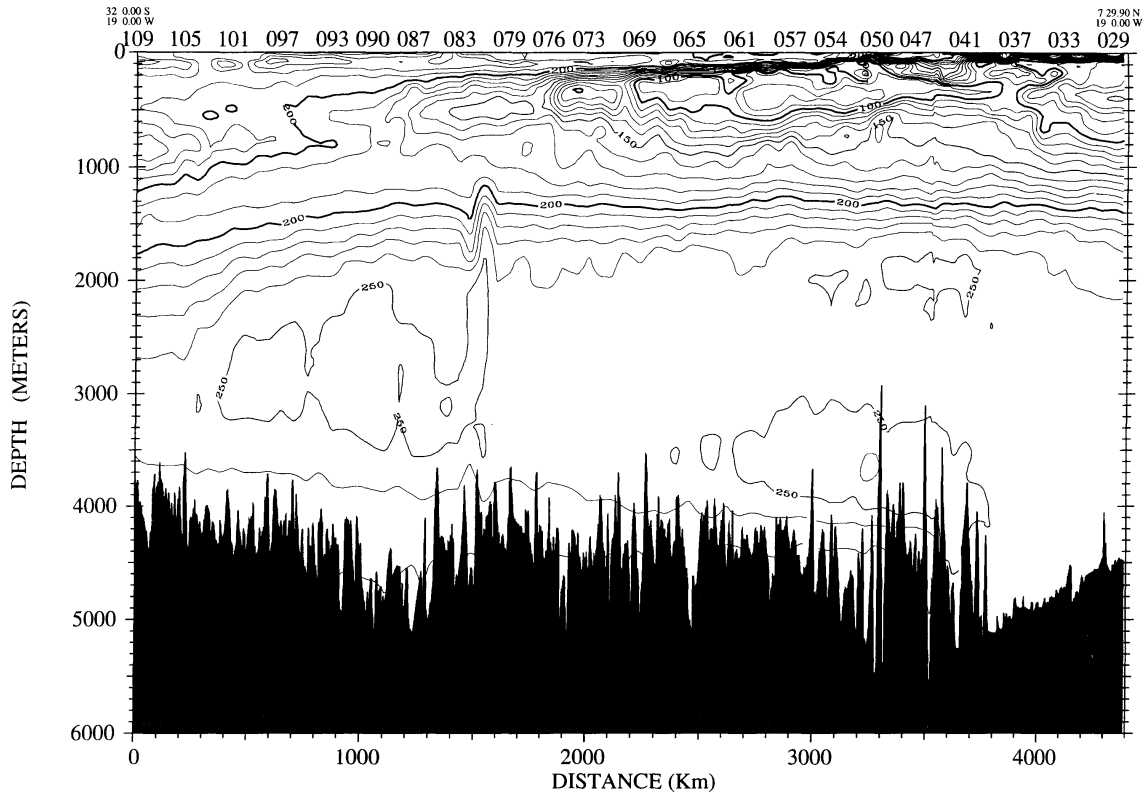
Fig. 3e: BOTTLE O$_2$ (UM/KG)
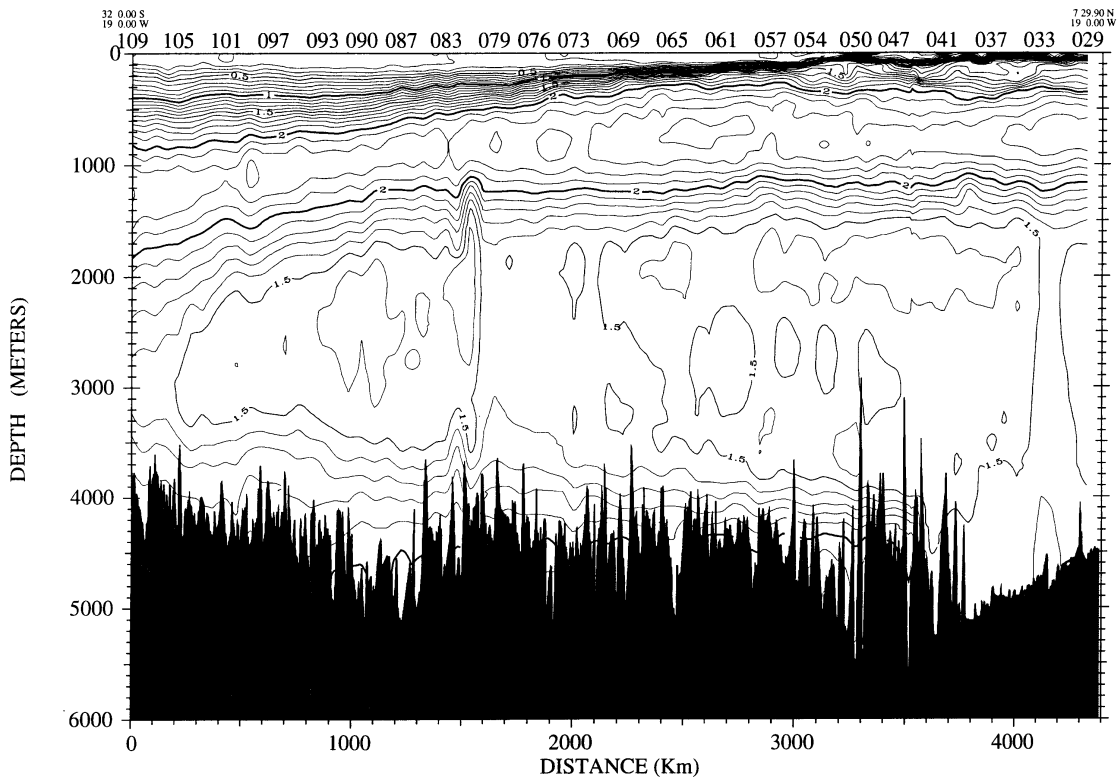
32 0.00 S
19 0.00 W

7 29.90 N
19 0.00 W

109 105 101 097 093 090 087 083 079 076 073 069 065 061 057 054 050 047 041 037 033 029
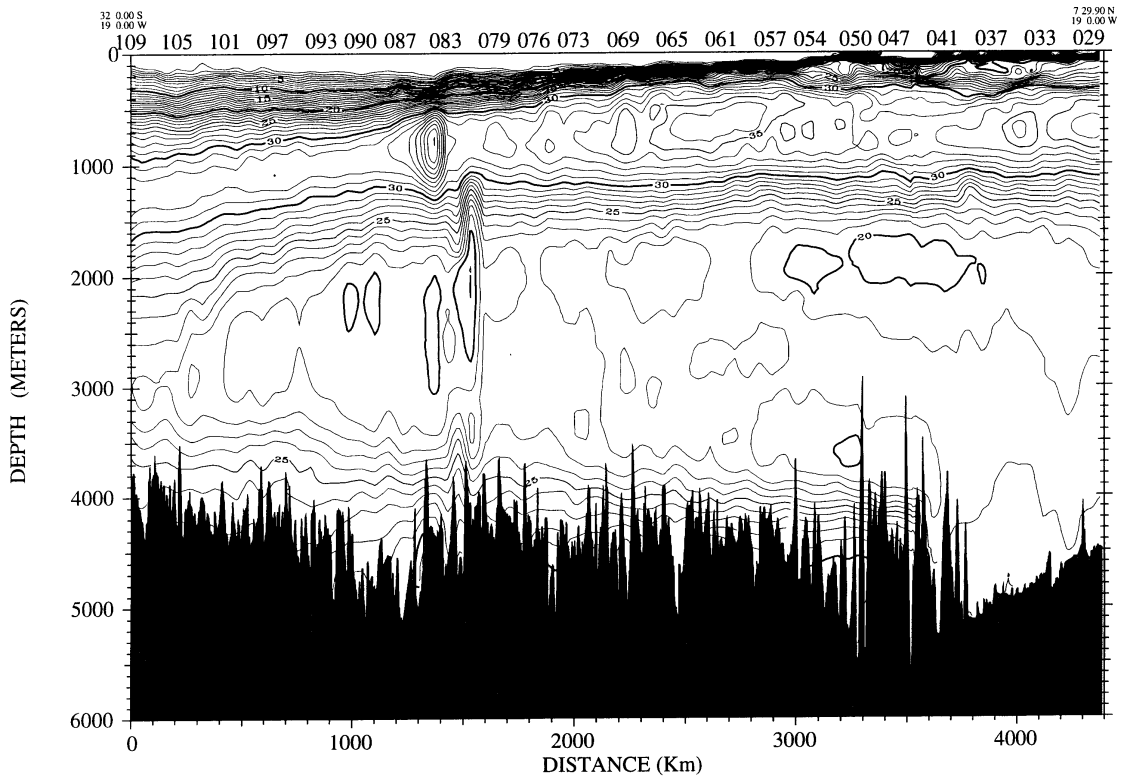
Fig. 3f: PO$_4$ (UM/KG)

Fig. 3g: NO$_3$ (UM/KG)

Fig. 3h: SIO$_3$ (UM/KG)

Fig. 4a: POTENTIAL TEMPERATURE (°C)

Fig. 4b: SALINITY (PSU)
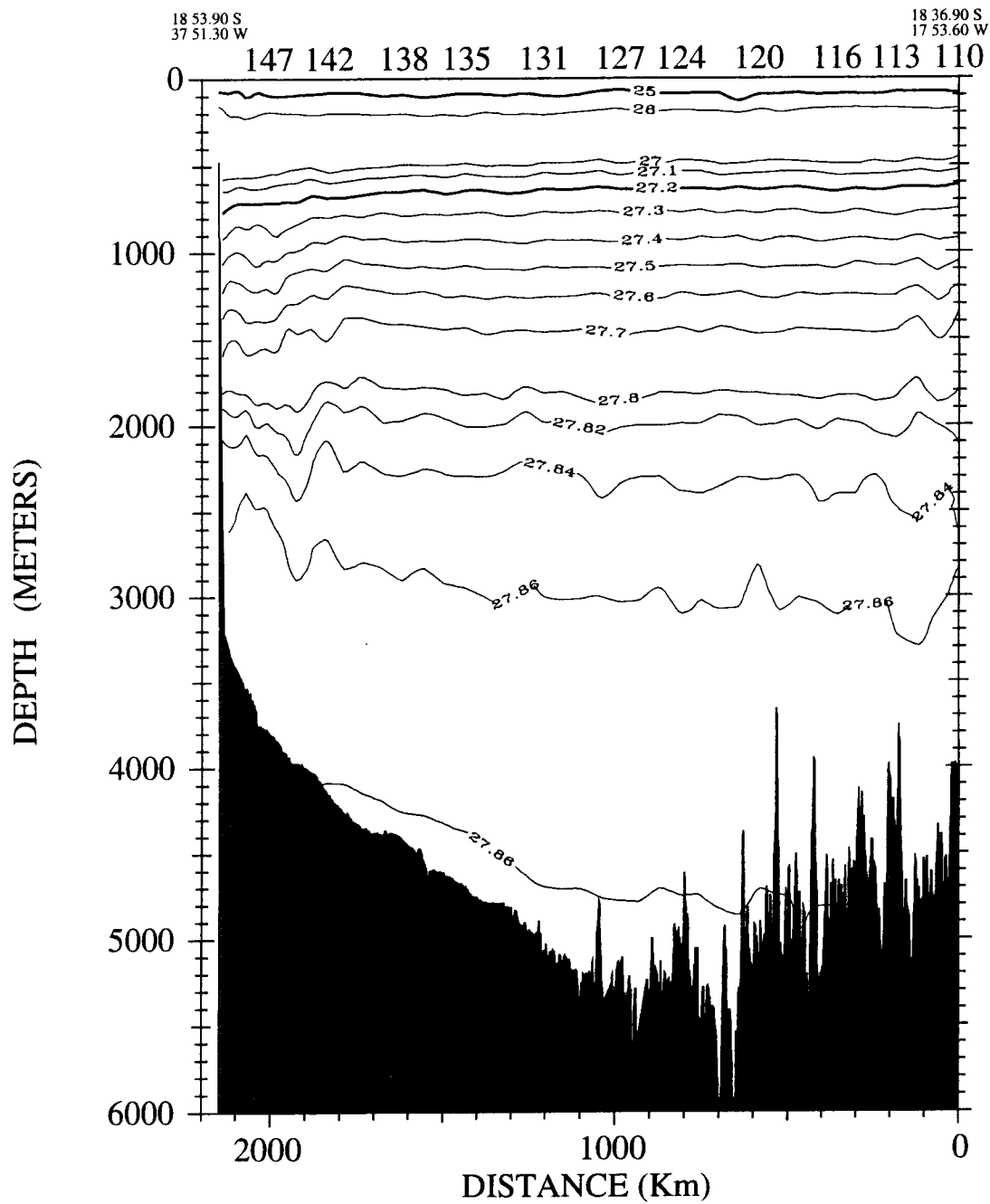
Fig. 4c: SIGMA THETA
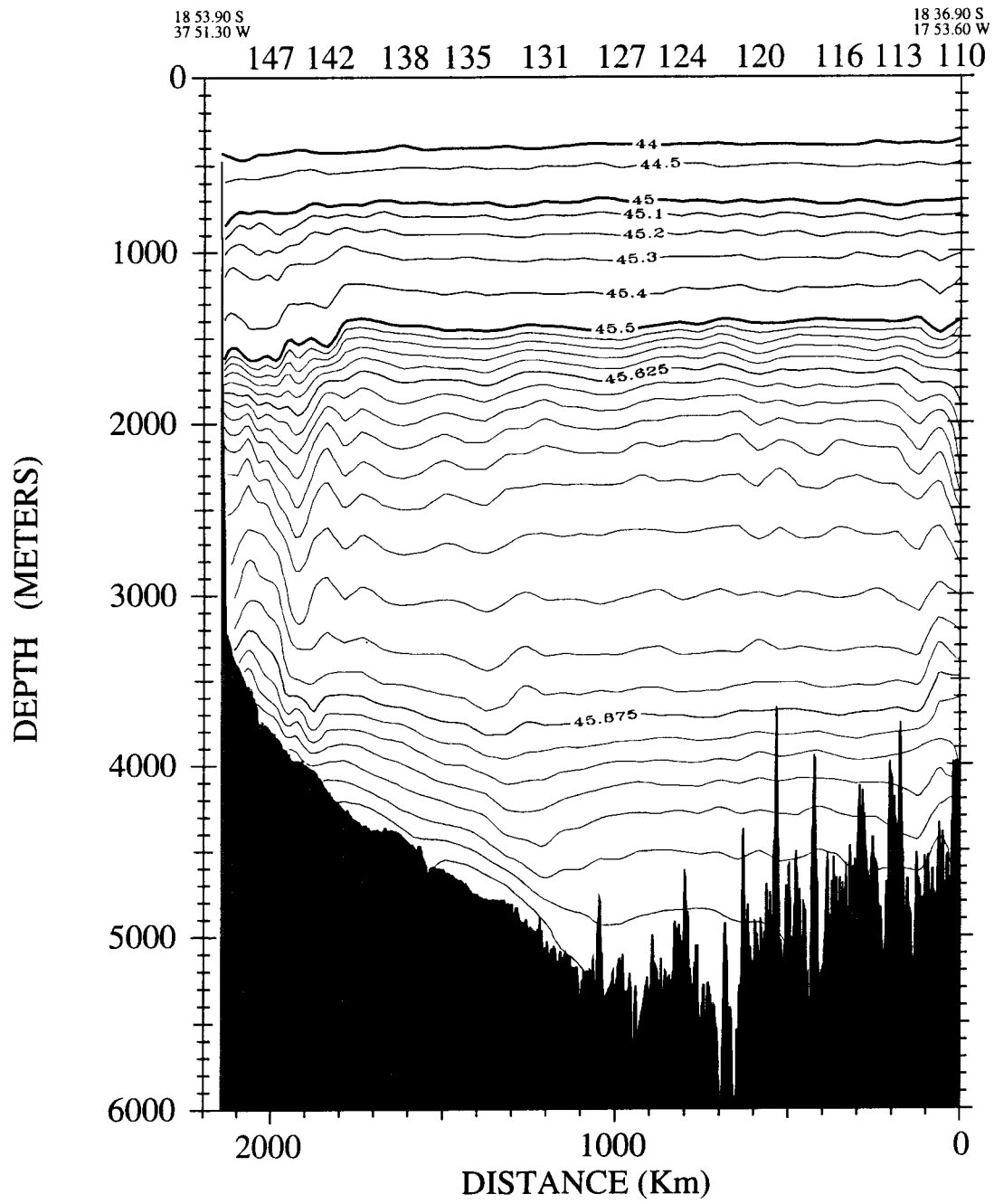
Fig. 4d: SIGMA 4
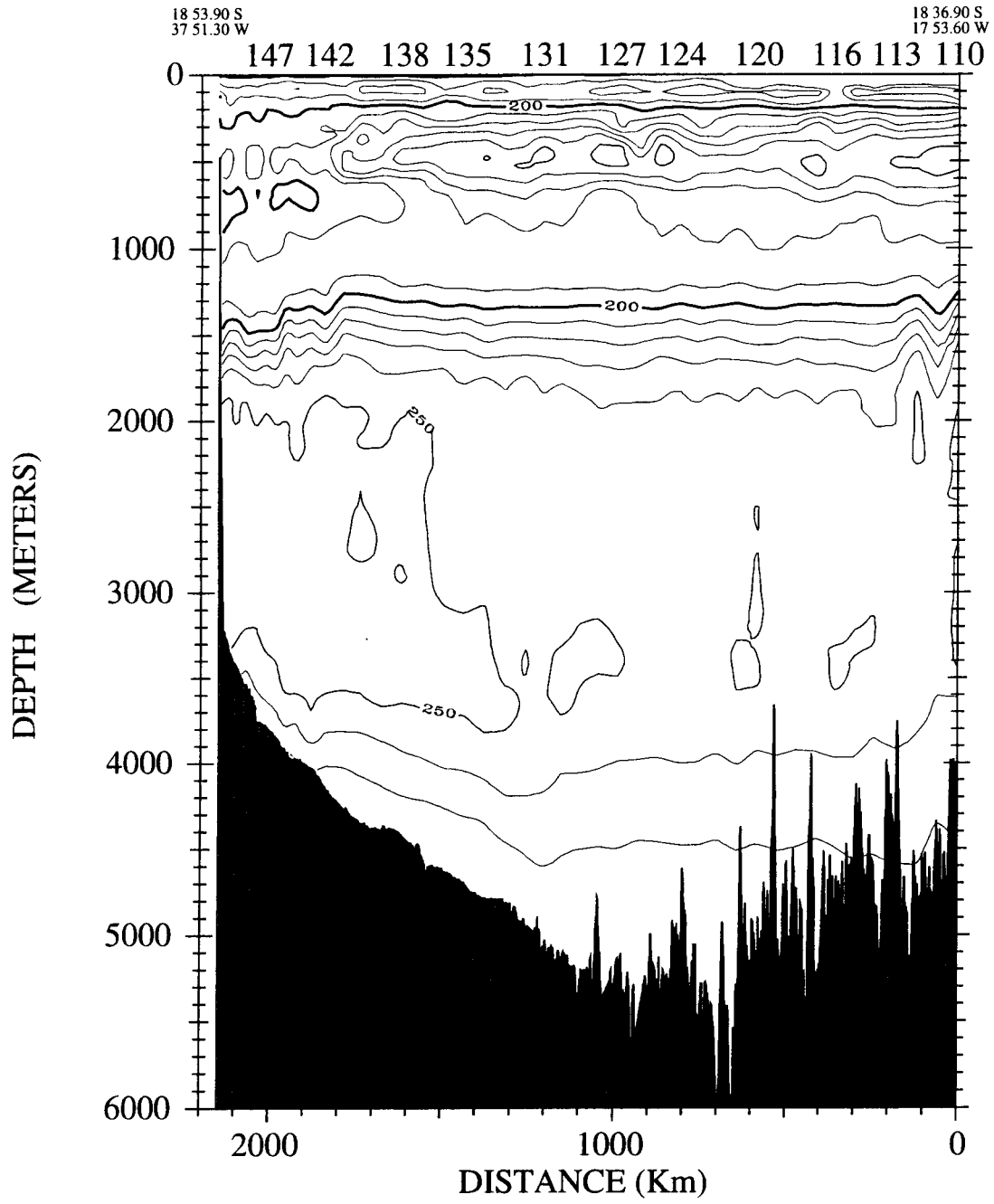
Fig. 4e: BOTTLE O$_2$ (UM/KG)
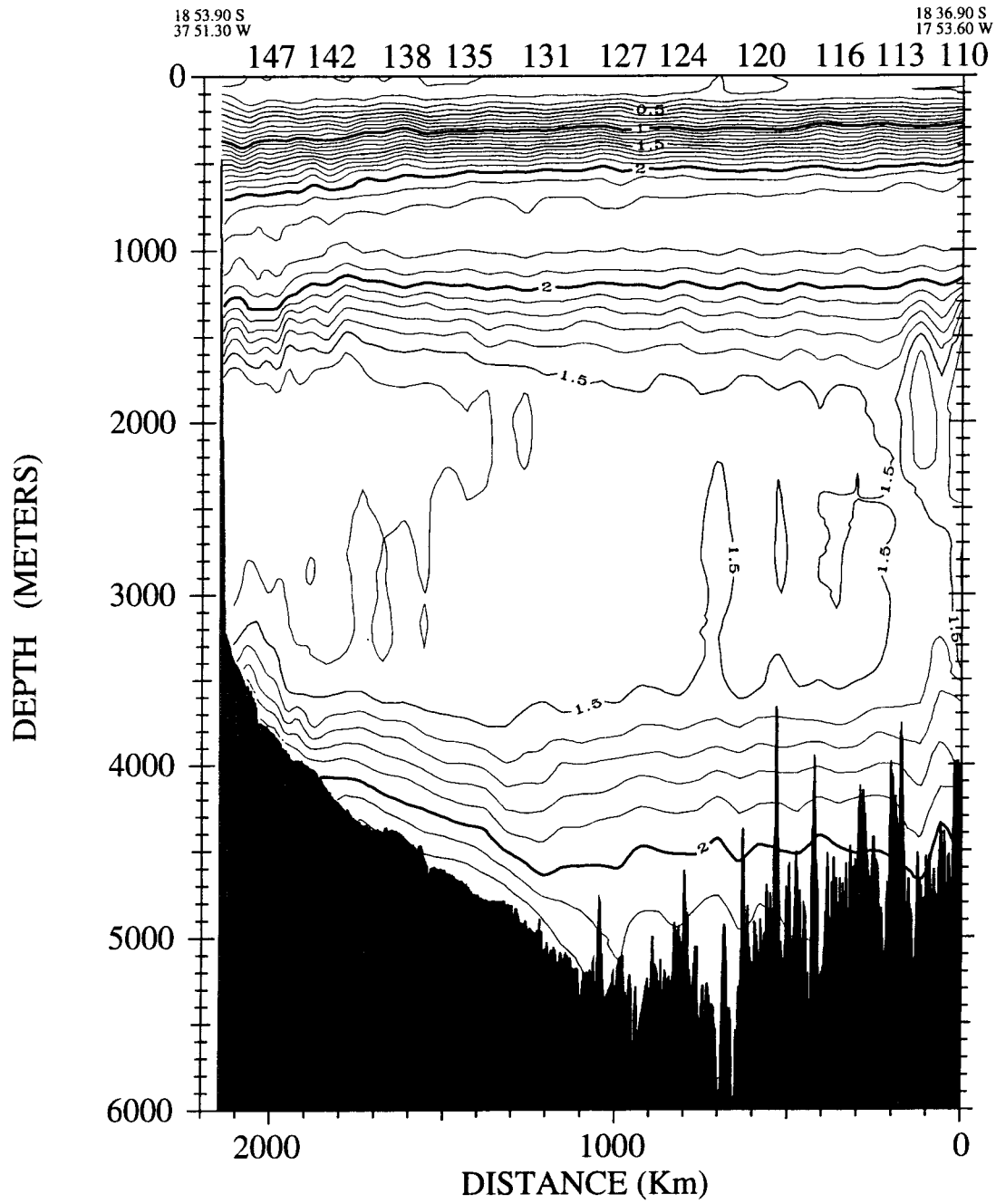
Fig. 4f: PO$_4$ (UM/KG)
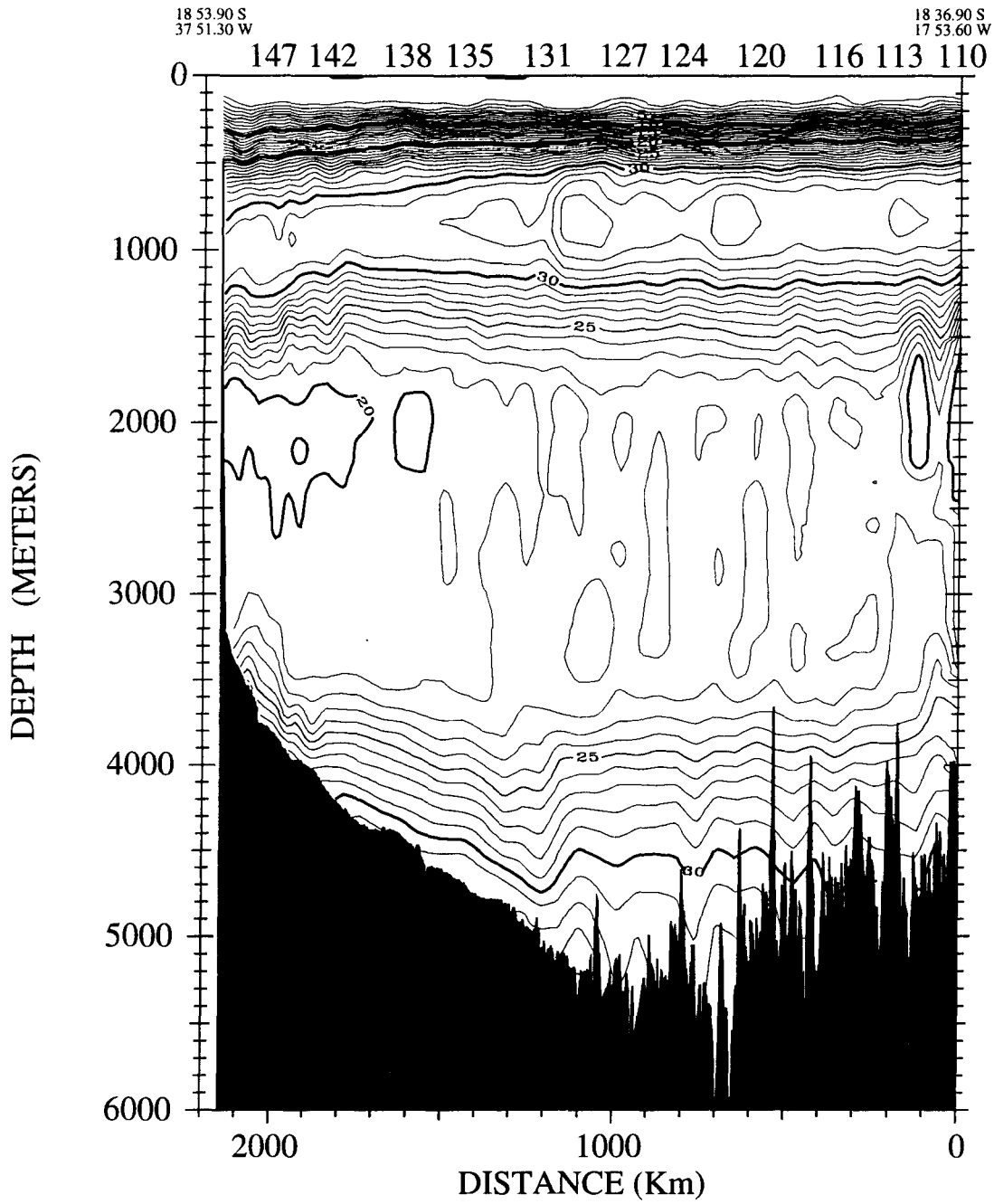
Fig. 4g: NO$_3$ (UM/KG)
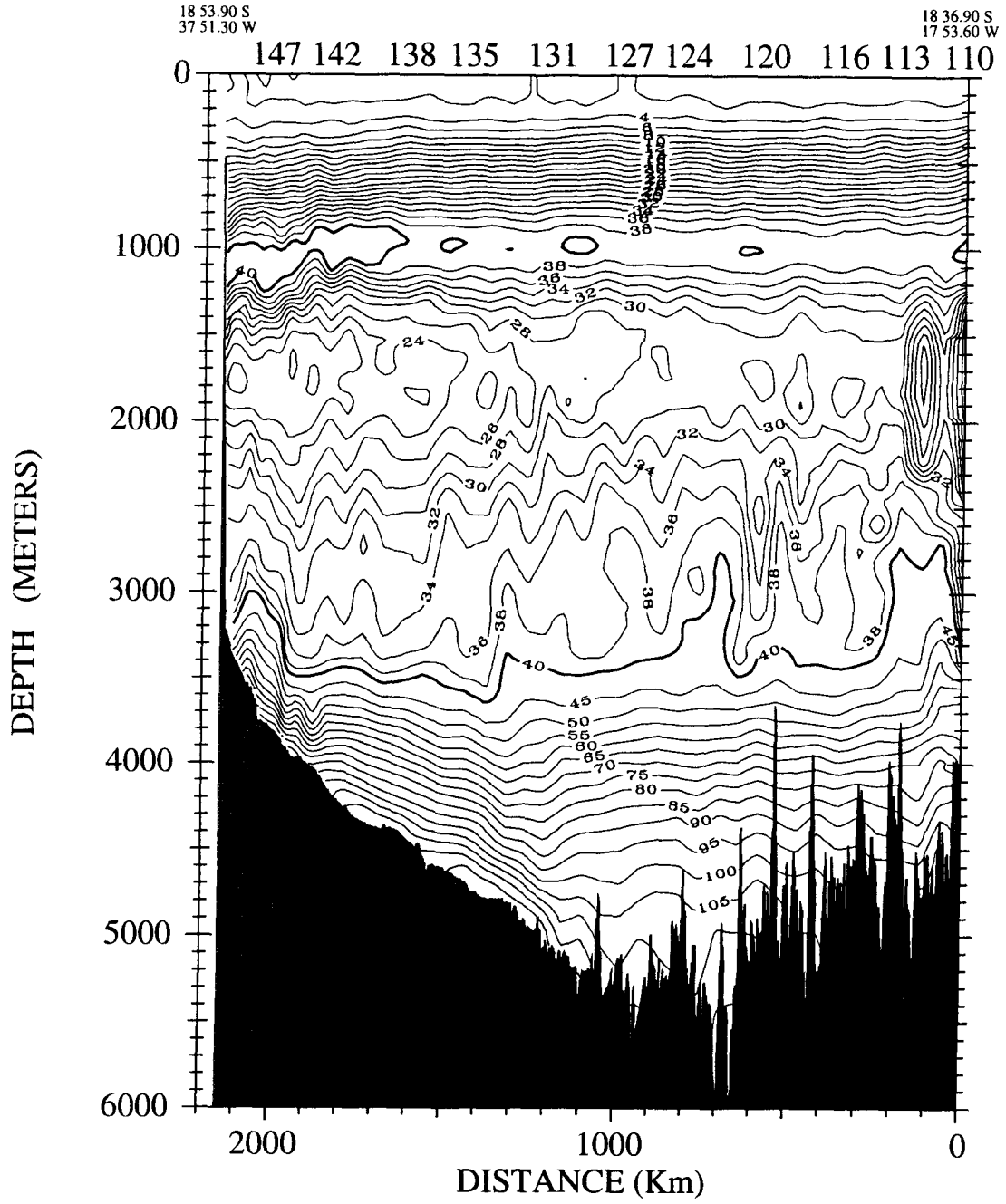
Fig. 4h: SIO$_3$ (UM/KG)

A15 DQE notes: Nutrients and dissolved oxygen
     Joe C. Jennings, Jr. and Louis I. Gordon

Overall impressions:

The WOCE A15 section is a South Atlantic transect along the nominal longitude of 19° West. We were assigned stations numbered 28 – 109 running from 7.5° North to 32° South as listed in the ".SUM" file. Additional station data in the ".HYD" file was not part of the main A15 section, but we have assigned quality flags to all data in the ".HYD" file. The data was collected in April/May 1994 on R/V KNORR. Dissolved oxygen, silicate, nitrate, nitrite, and phosphate were all reported.

Overall, the data quality appears to be very high and the initial QC checking by the data originators caught the vast majority of the questionable data. A considerable number of the dissolved oxygen values were flagged by the data originators, apparently on the basis of poor agreement with the CTD oxygen rather than problems obvious on vertical profiles or oxygen/theta plots. We agreed with flagging some of these as questionable, but think the data originators may have been over zealous in some of their flagging. Most of the oxygen samples flagged as questionable were from the upper water column where there are strong gradients and the poor fit with the CTD oxygen sensor may be due to the lag time of the sensor response more than to the bottle oxygen sampler. The depth range or effective sampling position of the rosette bottles relative to the CTD oxygen sensor might also be a factor.

Comparisons with other WOCE cruises:
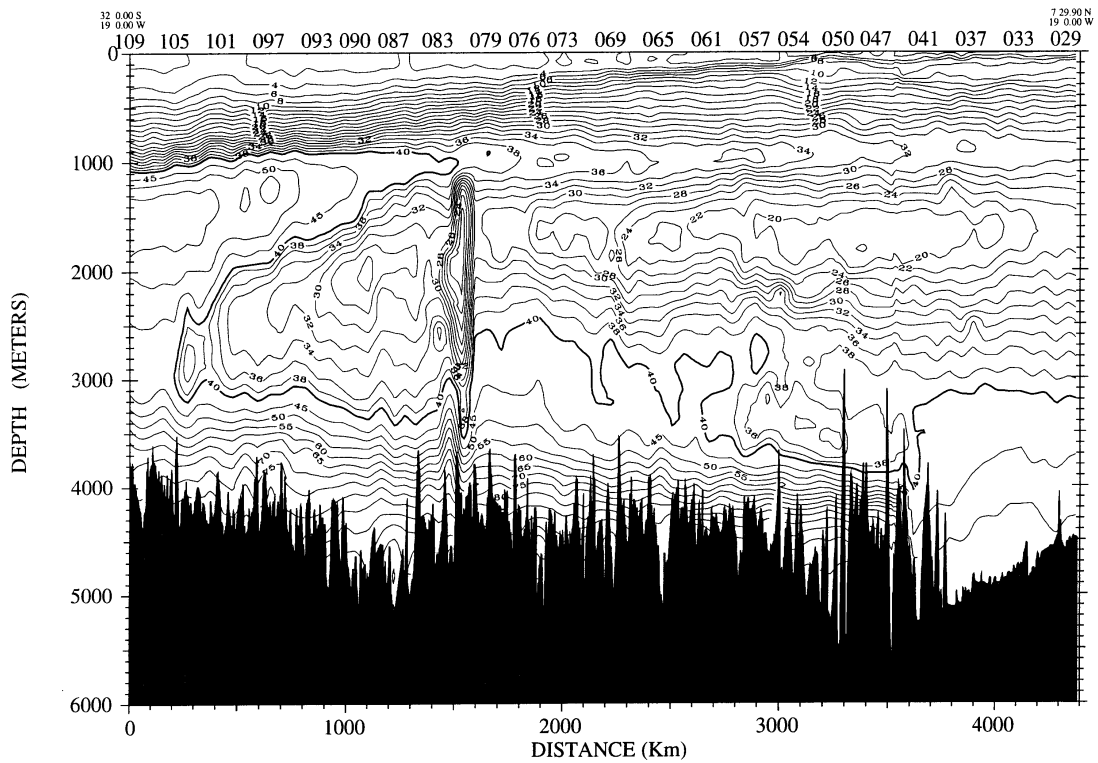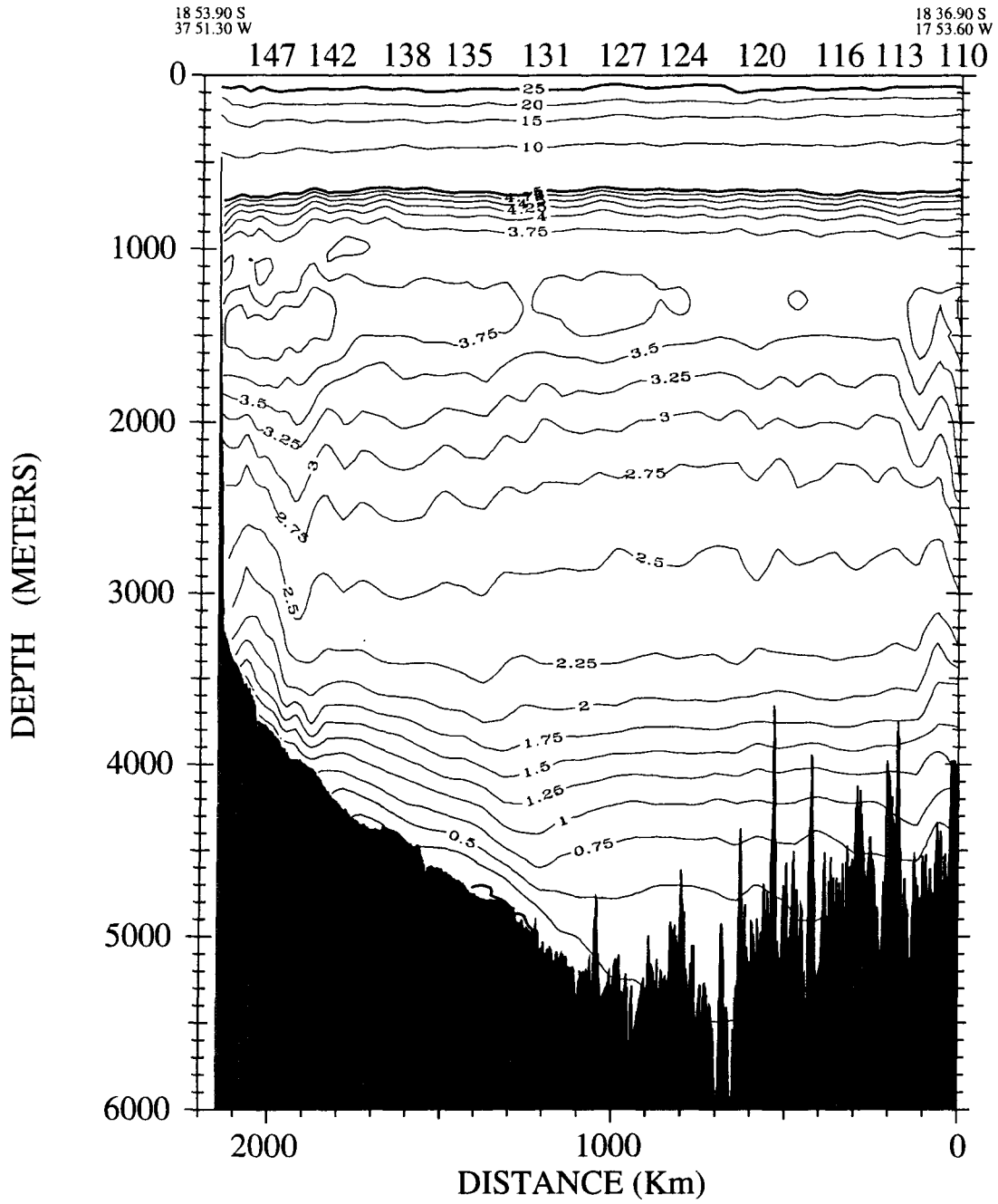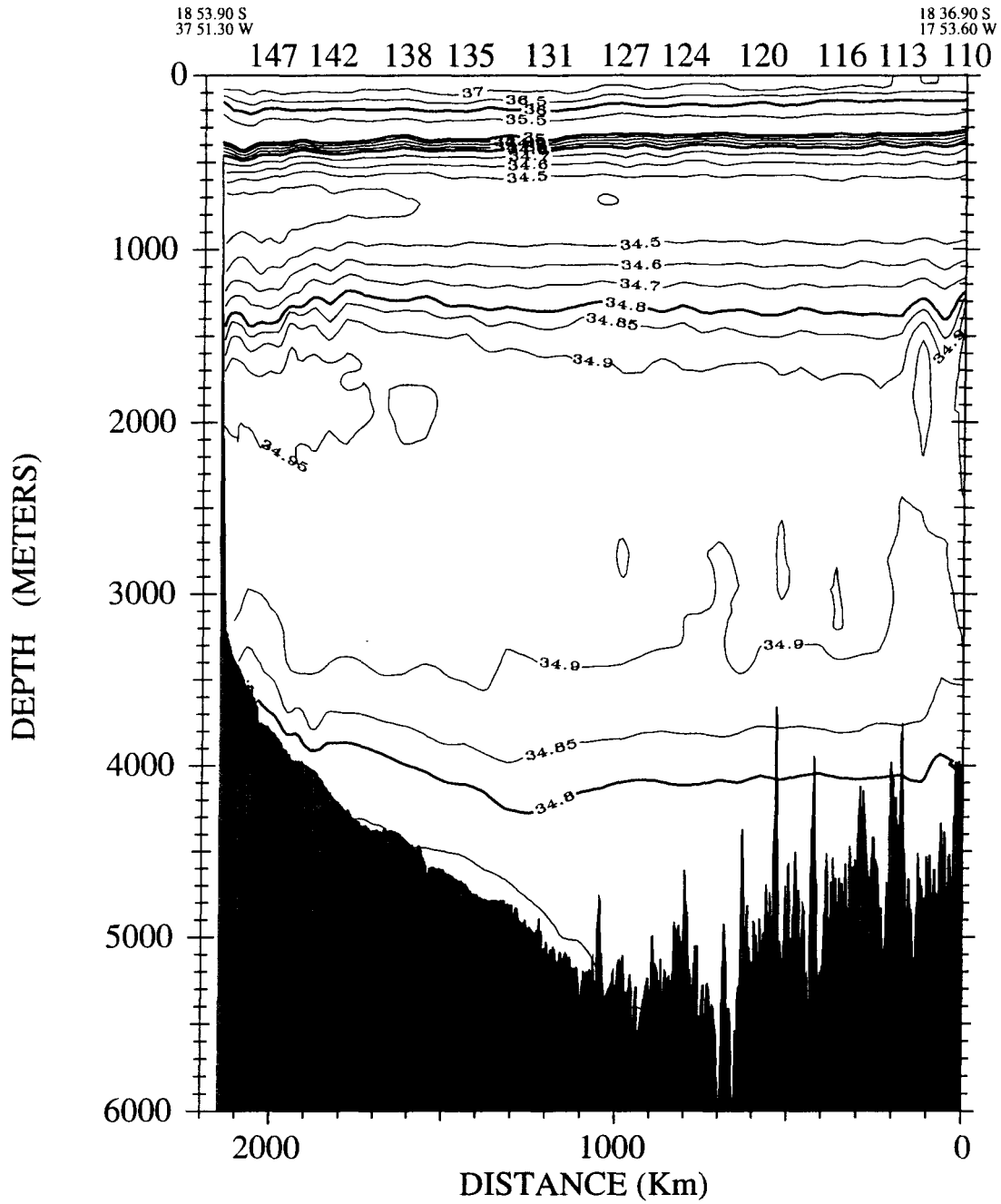
There are several zonal WOCE lines that are crossed by the A15 section. We made very preliminary comparisons of the data at the intersections of A15 with A10 and A08. (We have been funded separately to do a detailed examination of WOCE line crossings that is presently underway.)

The A15 and A10 data sets appear to agree well. Below about 3500 m, the A15 phosphate and nitrate fall within the "envelope" of the A10 data. Dissolved oxygen and silicate mostly overlap although the oxygen at A10 station 46 is higher by ca. 2 – 4μM/kg below 3500m than at the other stations and the silicate is lower by 5 – 8μM/kg. A15 station 104 has higher oxygen and lower nutrients at the oxygen maximum/nutrient minimum (2000m – 3000m) than do the other stations at the crossing, but the salinity at this station is also higher in this depth range so these differences are probably real.

The A15 cruise track crosses the A08 track at ca 11.5° South. In the upper 1000m, there is some overlap of the oxygen data, but the oxygen concentrations diverge below this depth. Here, there is a notable difference in the deep-water oxygen concentrations, with A08 being some 20μM/Kg lower than the A15 oxygen below 2000m. The A08 nitrates are ca 1 - 2μM/Kg lower than the A15 data, and the

silicates are ca. 2 – 3μM/Kg lower. There is no readily apparent difference in the t/s structures of the stations at the crossover. No phosphate was reported for the A08 cruise.

Comments on specific stations:

Five stations had one of the nutrients flagged in entirety by the data originator.

Stations 32: and 33: All of the phosphate was flagged as "bad". The deep values all appear to be too high by 0.03 – 0.05 μM/Kg. The shallower values at these two stations appear to be consistent with those at adjacent stations, but we have flagged them as questionable because the data originator flagged all of these values as bad. Since only the deep values are obviously offset, the problem may have been an uncorrectable baseline shift or drift in the phosphate channel of the nutrient analyzer.

Station 84 and 85: All of the nitrate values were flagged as questionable by both the data originator and ourselves. The nitrate at these stations appears to be too high at the nutrient maximum, too low at the minimum, and high again in the deepest waters.

Station 97: We flagged all phosphate as questionable. It had been flagged as bad by the data originator. The values as reported are low from about 1000db to 3500db, then shift up abruptly and appear too high below 3500db.

At station 39, the nutrient values for bottle 23 look too high while those for bottle 24 seem too low. It seems possible that a sampling error was made and that the samples from these two bottles were reversed, either when the samples were drawn, or when they were analyzed.

We note that samples from sampler # 42 were questionable four times during the middle to latter part of the leg, indicating possible tripping problems with this sampler.

A complete listing of flagged data is attached.

A15 DQE Notes: Nutrients and Oxygen

Station	Sample	Pressure	O$_2$	Sil	NO$_3$	PO$_4$	Comments
2	17	727.4		Low	Low	Low	
2	20	505.4		Low	Low	Low	
3	6	1868				High	
3	7	1766.2				High	
4	18	1046.1	High				
5	13	1860.4		Low	Low		
7	2	3654	Low				
7	8	2905.2	High				
7	9	2779.9	Low	Low	High	High	
8	8	2883.6		High			
8	14	1969.9		Low	High	High	
8	17	1767.5			High	High	
9	39	4.8		High	High		
14	12	3136.4			High		
21	2	4403.9		Low	Low		
26	10	3795.4		Low		High	
26	12	3795				High	
32	All					High	All flagged as "bad" by data originator
33	28	454		Low	Low		
33	All					High	All flagged as "bad" by data originator
37	14	2710.2		High			
37	15	2504.7		High			
39	13	3036.2	High				
39	23	1415.3		High	High	High	
40	13	2933.7	High				
41	42	50.6		High	High	High	
42	15	2531.5	High				
43	5	3903.8	High				
45	1	5300.2	Low				
45	15	2531.5	High				
45	16	2731.8	High				
48	33	174	High	High	High	High	Could these have been reversed?
48	38	103.9	Low	Low	Low	Low	#38 looks low and #33 a bit high.
49	42	554.6	Low		Low	Low	
50	25	1195.7		High	High	High	
50	28		High				

A15 DQE Notes Page 2

Station	Sample	Pressure	O$_2$	Sil	NO$_3$	PO$_4$	Comments
55	14	2220.9	Low	High	High	High	
55	40	1817.5	High				
56	10	3190.1		Low			
62	7	3566.8		High			
64	11	2681.3	Low	Low	Low	Low	
71	11	3549.5	Low	Low	Low	Low	
76	16	2018.7		High			
84	All				Bad		All nitrate flagged
85	All				Bad		All nitrate flagged
88	22	1564.8	High				
91	9	3190.1	High				
92	25	1130.8	High				
93	5	3854.5	High				
97	1	4428.3	High				
97	All					Bad	All phosphate flagged; shift problem.
109	11	2653	Low	Low	Low		
109	16	1992.8	Low				
112	28	207.9	High	High	Low	Low	
132	29	769.3		Low	Low	Low	
146	40	1750.4	Low				
151	41			Low?	Low	Low	Sil may be ok, but PO$_4$ and NO$_3$ are low
151	42	164.9		High	High	High	
152	41	253.5		Low?	Low	Low	Sil may be ok, but PO$_4$ and NO$_3$ are low
152	42	169.2		High	High	High	

World Ocean Circulation Experiment
A15 and AR15
Deep Basin Experiment
R/V Knorr Voyage 142 Leg 3
3 April 1994 - 21 May 1994
Recife, Brazil - Salvador, Brazil
Expocode: 316N142/3

Chief Scientist: Dr. William Smethie, Jr.
Lamont-Doherty Earth Observatory
Columbia University
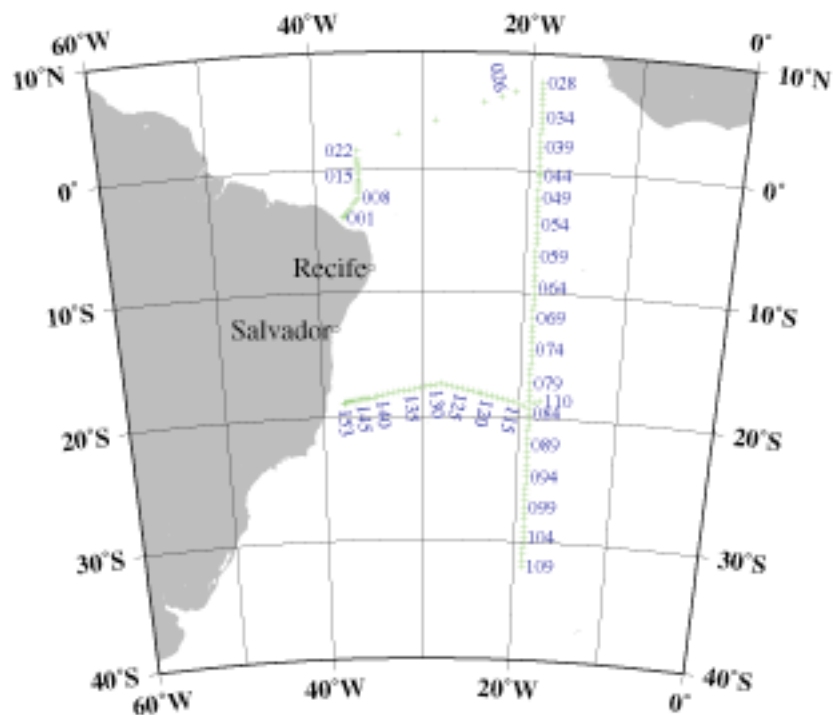
A15 and AR15 Cruise Track

Oceanographic Data Facility (ODF)
Final Cruise Report
October 18, 1996

Data Submitted by:

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

1. DESCRIPTION OF MEASUREMENT TECHNIQUES AND CALIBRATIONS

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. 158 CTD/rosette casts were made, usually to within 5 meters of the bottom. 149 casts at Stations 1-22, 26 and 28-153 were reported. Three test casts, one prior to the first station and two CTD #10 tests, were not reported. Six casts were aborted and not reported, four for winch problems and two for technical difficulties at launch time. Another cast was aborted because the ship was not at the desired position; this cast (station 10 cast 1) was reported with the final CTD data. Stations 23-25 and 27 had MER bio-optics casts only; CTD/bottle data were neither collected nor reported for these stations. 5319 bottles were tripped resulting in 5188 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 Figures 1.0.0, 1.0.1, and 1.0.2.
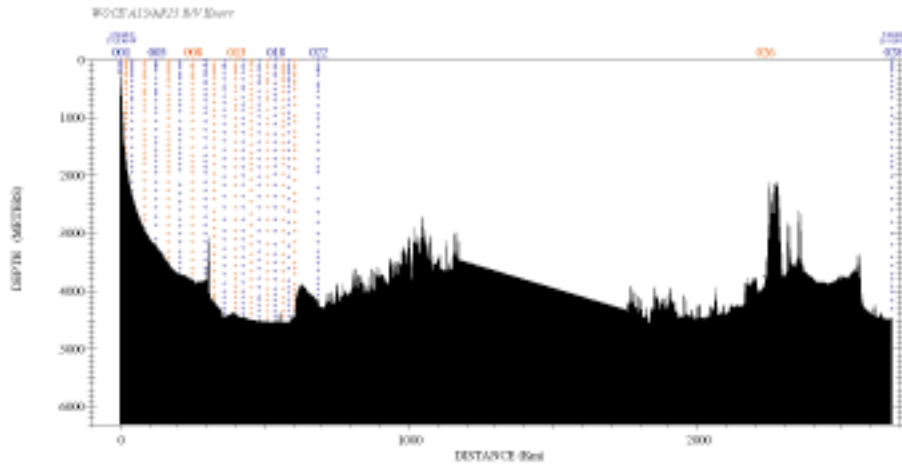
Figure 1.0.0 AR15 sample distribution, stas 1-22, 26, 28
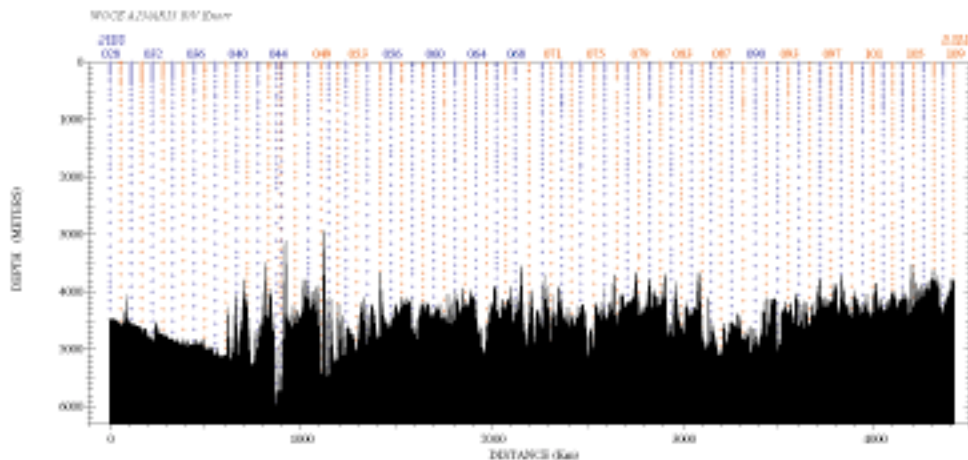
Figure 1.0.1 A15 sample distribution, stas 28-109
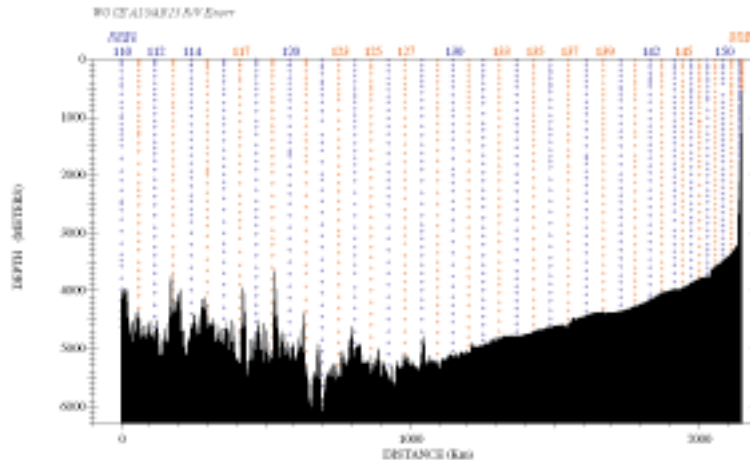
Figure 1.0.2 AR15 sample distribution, stas 110-153

1.1. 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 #10 or ODF #4) and associated sensors, Benthos altimeter and Benthos pinger. The CTD was mounted horizontally along the bottom of the rosette frame, with the dissolved oxygen sensor deployed alongside. 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 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. Deep Sea Reversing Thermometers (DSRTs) were used on this leg to monitor for CTD pressure or temperature drift.

CTD #10 was used for stations 1-60 of the WOCE-A15/AR15 expedition. CTD #4 was used for the remainder of the cruise, stations 61-153.

Each rosette cast was performed to within 5 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. 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. During the first 10 days, there were many samples lost because the o-rings were falling out of place before the bottle closed. Bottle replacements, numbered 37 through 42, were necessary. Table 1.1.0 shows the rosette position and the corresponding replacement bottle number.

STATIONS AFFECTED	ROSETTE POSITION	REPLACEMENT BOTTLE #
22	2	39
26-153	18	40
8-153	30	37
26-153	32	41
150-152	33	42
8-153	34	38
34-51	35	42
9-21	36	39
22	36	2
23-153	36	39

Table 1.1.0 WOCE A15/AR15 Bottle Replacements

The replacement bottles had the o-rings in the body of the bottle as opposed to the original set of 36 which had the o-rings in the endcaps. During the rest of the cruise, the rosette worked well with only an occasional lanyard hangup or dislodged o-ring. On Station 22, bottle 39 was placed in rosette position 2, and bottle 2 in rosette position 36, to get a freon blank for bottle 39. There were two other stations where the bottles were tripped in a special sequence for freon checks. The trip sequences, deepest to shallowest, were 7-36, then 1-6, at station 49; and bottles 19-36, then 1-18, at station 78.

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.

The deck watch prepared the rosette approximately 45 minutes prior to a cast. All valves, vents and lanyards were checked for proper orientation. The bottles were cocked and all hardware and connections rechecked. Upon arrival at station, time, position and bottom depth were logged and the deployment begun. The rosette was moved into position under a projecting boom from the rosette room using an air-powered cart on tracks. Two stabilizing tag lines were threaded through rings on the frame. CTD sensor covers were removed and the pinger was turned on. Once the CTD acquisition and control system in the ship's laboratory had been initiated by the console operator and the CTD and pylon had passed their diagnostics, the winch operator raised the package and extended the boom over the side of the ship. The package was then quickly lowered into the water, the tag lines removed and the console operator notified by radio that the rosette was at the surface.

Recovering the package at the end of deployment was essentially the reverse of the launching. Two tag lines connected to air tuggers and terminating in large snap hooks

were manipulated on long poles by the deck watch to snag recovery rings on the rosette frame. The package was then lifted out of the water under tension from the tag lines, the boom retracted, and the rosette lowered onto the cart. Sensor covers were replaced, the pinger turned off and the cart with the rosette moved into the rosette room for sampling. A detailed examination of the bottles and rosette occurred before samples were taken, and any extraordinary situations or circumstances were noted on the sample log for the cast.

Routine CTD maintenance included soaking the conductivity and CTD O2 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 performed each day to insure proper closure and sealing. Valves were inspected for leaks and repaired or replaced as needed.

1.2. Underwater Electronics Packages

CTD data were collected with a modified NBIS Mark III CTD (ODF CTD #10 or #4). Either instrument provided pressure, temperature, conductivity and dissolved O2 channels, and additionally measured a second temperature as a calibration check. Other data channels included elapsed-time, an altimeter and several power supply voltages. The instruments supplied a standard 15-byte NBIS-format data stream at a data rate of 25 Hz. Modifications to the instruments included a revised dissolved O2 sensor mounting, 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 1.2.0 summarizes the winches and serial numbers of instruments and sensors used during A15/AR15.

Station(s)	CTD@ ID#	Oxygen Sensor	Winch
998,1-15			Port
16-19cast1	10a		Stbd.
19cast2-60			Port
61-109	4a		Port
777/test	10b		Stbd.
110-115	4b		Stbd.
116-123	4b		Stbd.
778/test	10b	3-11-31	Port
124-127			Port
128			Stbd.
129-136			Port
137-138casts1,2	4b		Stbd.
138casts4,5-150			Port
151-153			Stbd.

@ ODF CTDs #4 and #10 sensor serial numbers:

ODF CTD ID#	Paine Model 211-35-440-05 Pressure	Rosemount Model171BJ Temperature		NBIS Model 09035-00151 Conductivity
		PRT1	PRT2	
4a	none	15765	10500	H136
4b			16186	
10a	150089	16185	16187	H137
10b				N5

Table 1.2.0 A15/AR15 Instrument/Sensor Serial Numbers

The O2 sensor was deployed in an ODF-designed pressure-compensated holder assembly mounted separately on the rosette frame and connected to the CTD by an underwater cable.

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 the GO pylon deck unit. There were occasional tripping problems caused by the GO pylon/deck unit combination. Usually these could be resolved by the console operator via the pylon diagnostics routine. The pylon emitted a confirmation message containing its current notion of bottle trip position, which was an aid in sorting out mis-trips. The GO pylon took a variable amount of time to trip a bottle after the trip had been initiated. The trip time varied from 4.5 to 18 seconds, with one exception of nearly 30 seconds. The acquisition software began averaging data corresponding to the rosette trip as soon as the trip was initiated, ending when the trip confirmed. Consequently, CTD rosette trip data used for the differences contained variable-length averages. This could have caused the standard deviation of bottle-CTD salinity differences to be less than optimal, especially in higher-gradient areas with longer averages.

1.3. Navigation and Bathymetry Data Acquisition

Navigation data were acquired from the ship's Magnavox MX GPS system via RS-232. Data were logged automatically at one-minute intervals by one of the Sun SPARC stations. Underway bathymetry was logged manually from the 12 kHz Raytheon PDR at five-minute intervals, then 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 for bathymetry on vertical sections [Cart80].

1.4. CTD Data Acquisition, Processing and Control System

The CTD data acquisition, processing and control system consisted of a Sun SPARCstation 2 computer workstation, ODF-built CTD deck unit, General Oceanics 1016 pylon deck unit, 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. One other Sun SPARCstation 2 system was 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. Each Sun SPARCstation was equipped with a printer and an 8-color drum plotter.

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 data acquisition system through a serial port, allowing the data acquisition system to initiate and confirm bottle trips. A bitmapped color display provided interactive graphical display and control of the CTD rosette sampling system, including real-time raw and processed 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 was begun and a time and position automatically associated with the beginning of the cast. A backup analog recording of the CTD signal was made on a VCR tape, which was started at the same time as the data acquisition. A rosette trip display and pylon control window then 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, typically at a steady rate without any stops during the down-cast.

There were numerous problems with both the port and starboard winches during A15/AR15. When problems occurred, the winch operator stopped the descent or recovery

in order to check the winch. These stops often caused a problem in fitting CTD oxygen data because the raw oxygen signal shifted as oxygen became depleted in water near the stationary sensor. Winch operators attempted to defer check-stops to up-casts whenever possible on later casts.

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 watch leader assisted the console operator when the package was ~400 meters above the bottom by monitoring the range to the bottom using the distance between the rosette's pinger signal and its bottom reflection displayed on the PDR. Between 100 and 60 meters above the bottom, depending on bottom conditions, the altimeter typically began signaling a bottom return on the console. 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 meters of the bottom.

Bottles were tripped 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 directed the winch operator to the next bottle stop. 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*.

1.5. 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; and
- 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 O2. Rosette trip data were extracted from this time- series in response to trip initiation and confirmation signals. The calibrated 2 Hz time-series data were stored on disk (as were the 25 Hz raw data) 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 sensors were monitored by comparing CTD values to check-sample conductivities and by deep T-S comparisons with adjacent stations. The CTD O2 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 1 or more channels caused by sea cable or slip-ring problems. 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 appear in high-gradient regions. 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.

Multiple casts exhibited up to a .02 density drop during the top 10 db, or much lower densities in the top few meters of the water column. A time- series data check verified these density differences were probably real: the data were consistent over many frames of data at the same pressures. Appendix C details the magnitude of the density drops or gradients for the casts affected.

Pressure intervals with no time-series data can optionally be filled by double-parabolic interpolation.

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.). The 15 up-casts used for final A15/AR15 data are indicated in Appendix C.

There is an inherent problem in the internal digitizing circuitry of the NBIS Mark III CTD when all the bits flip at once. Raw temperature can shift 1-2 millidegrees as values cross between positive and negative values, a problem avoided by offsetting the raw PRT readings by ~1.5ºC. The conductivity channel also can shift by .001-.002 mmho/cm as raw data values change between 32767/32768. This is typically not a problem in shallow to intermediate depths because such a small shift becomes negligible in higher gradient areas. However, in the middle to south Atlantic Ocean, this shift can occur in deep water and will be quite visible on deep theta-salinity plots. This digitizing problem occurred on a few casts during A15/AR15. The affected conductivity data between stations 29-40 were identified and offset to negate the shift caused by the digitizing problem. Station 42 was also minimally impacted; attempts to offset data in the vicinity of 4700 db made the offsetting worse, so this cast was not changed.

Appendix C contains a table of CTD casts requiring special attention; A15/AR15 CTD-related comments, problems and solutions are documented in detail.

1.6. 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 #10 and CTD #4 at the ODF Calibration Facility in La Jolla. The pre-cruise calibrations were done in January 1994 before the start of the A15/AR15 expedition, and the post-cruise calibrations were done in July 1994.

The CTD pressure transducers were calibrated in a temperature-controlled water bath to a Ruska Model 2400 Piston Gage pressure reference. Calibration data were measured at -1.05/-0.99, 13.72/18.56 and 30.92/30.84ºC to 2 maximum loading pressures (1400 and 6080 db) pre-/post-cruise. Figures 1.6.0 and 1.6.1 summarize the CTD #10 laboratory pressure calibrations performed in January and July 1994. Figures 1.6.2 and 1.6.3 show the same for CTD #4.
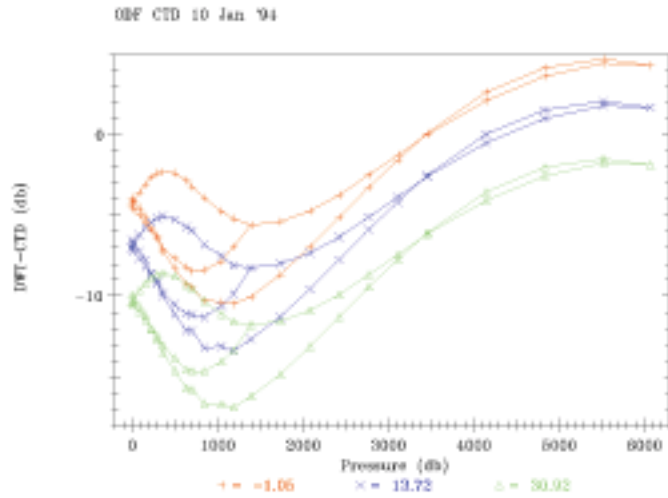
ODF CTD 10 Jan '94

Figure 1.6.0 Pressure calibration for ODF CTD #10, January 1994.
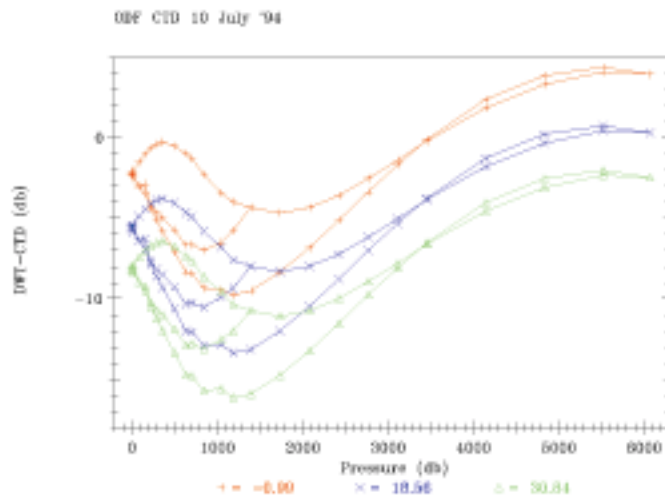
ODF CTD 10 July '94

Figure 1.6.1 Pressure calibration for ODF CTD #10, July 1994.
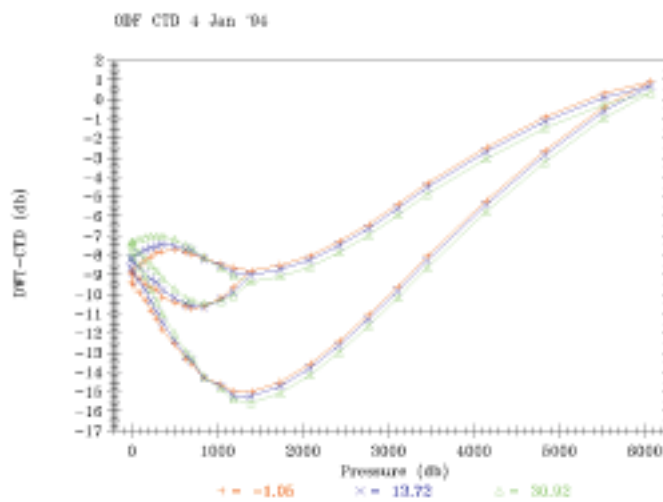
ODF CTD 4 Jan '94

Figure 1.6.2 Pressure calibration for ODF CTD #4, January 1994.
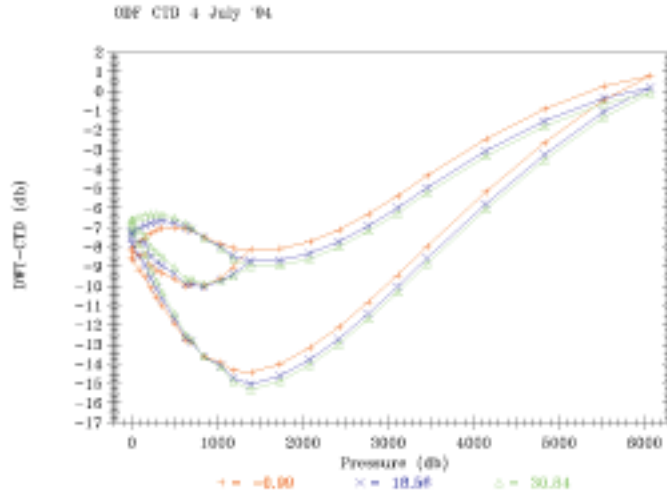
ODF CTD 4 July '94

Figure 1.6.3 Pressure calibration for ODF CTD #4, July 1994.

Additionally, dynamic thermal-response step tests were conducted on the pressure transducer to calibrate dynamic thermal effects.

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 ~1.5ºC 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 and 31ºC, both pre- and post-cruise. Figure 1.6.4 summarizes the laboratory calibration performed on the CTD #10 primary PRT during January 1994. Figures 1.6.5 and 1.6.6 summarize the laboratory calibrations performed on the CTD #10 secondary PRT during January and July 1994. Figures 1.6.7 and 1.6.8 summarize the laboratory calibrations performed on the CTD #4 primary PRT during January and July 1994.
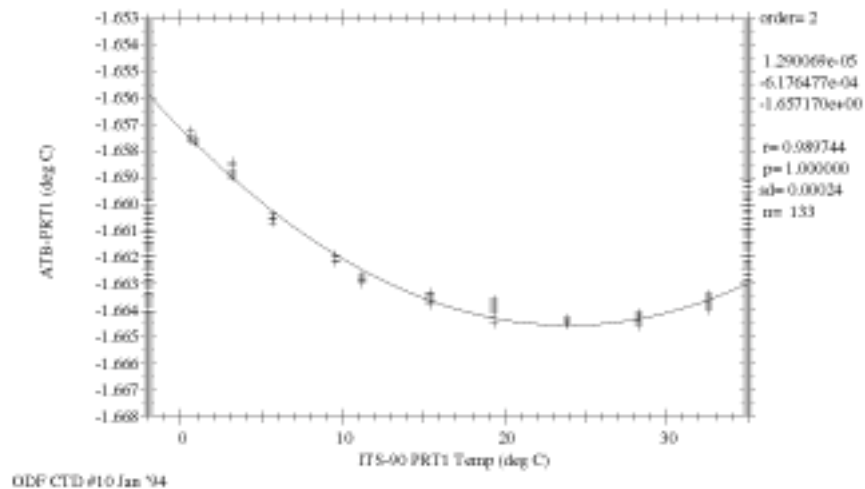
ODF CTD #10 Jan '94

Figure 1.6.4 Primary PRT Temperature Calibration for ODF CTD #10, January 1994.
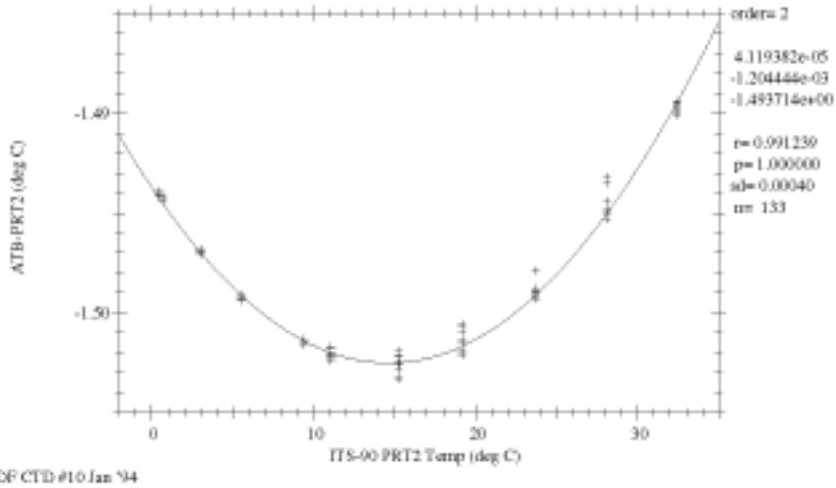
Figure 1.6.5 Secondary PRT Temperature Calibration for ODF CTD #10, January 1994.
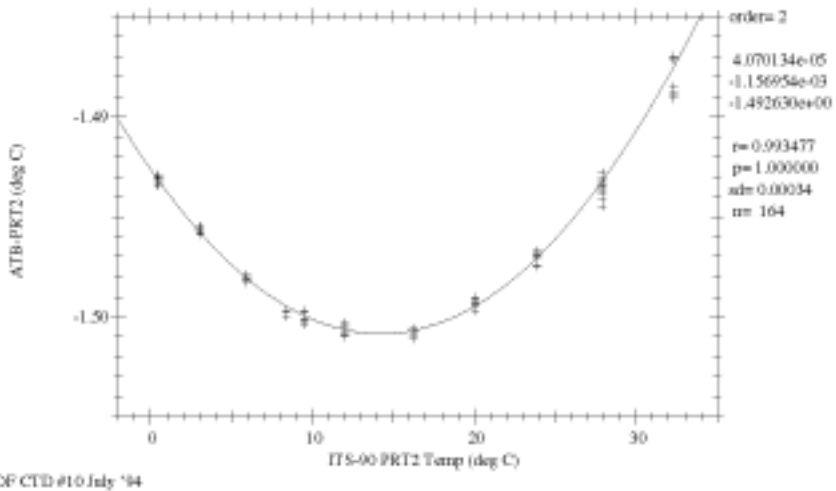
Figure 1.6.6 Secondary PRT Temperature Calibration for ODF CTD #10, July 1994.
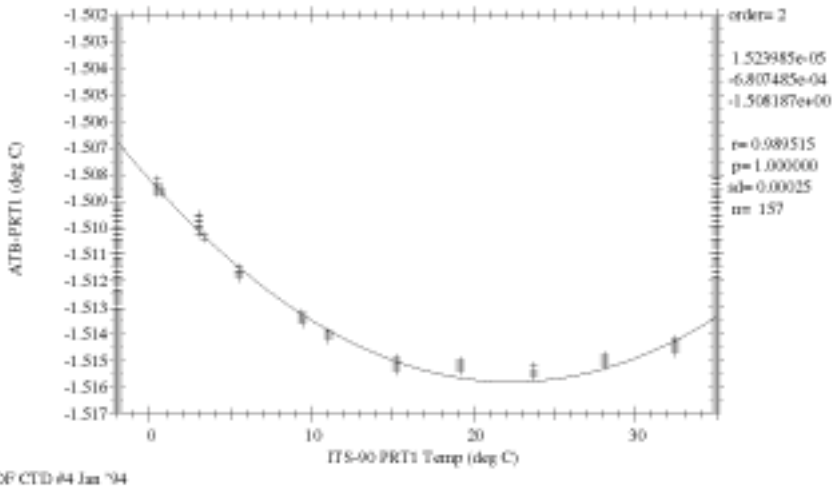
Figure 1.6.7 Primary PRT Temperature Calibration for ODF CTD #4, January 1994.
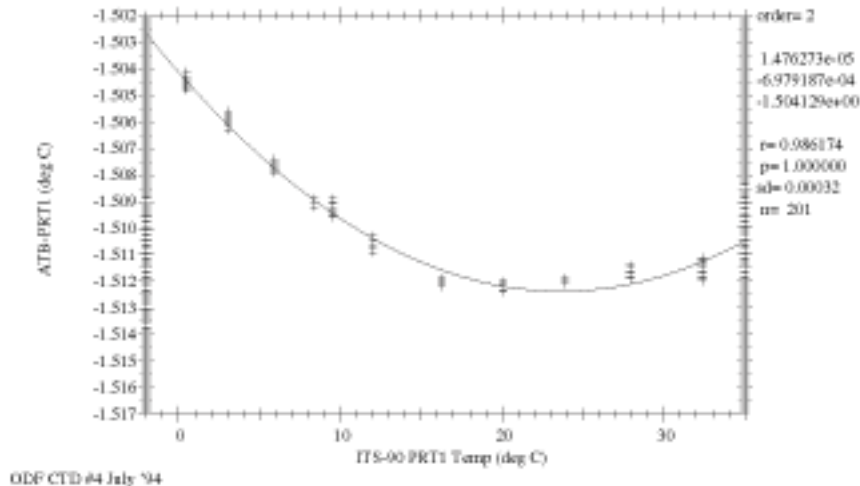
Figure 1.6.8 Primary PRT Temperature Calibration for ODF CTD #4, July 1994.

The CTD #10 primary PRT post-cruise calibration is not shown because that sensor was effectively destroyed after its last use on the cruise. Calibrations for the CTD #10 secondary PRT are shown because PRT2 changes were used to determine the PRT1 calibration. The CTD #4 secondary PRT was changed mid-cruise, so its pre- and post-cruise calibrations are not useful to compare and are not shown.

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 were reported using the ITS-90 standard.

1.7. Final CTD Calibration Procedures

A redundant sensor was used on each CTD as a temperature calibration check while at sea. CTD conductivity and dissolved O2 were calibrated to *in-situ* check samples collected during each rosette cast.

ODF CTD #10 was used during stations 1-60. It developed a non-linear drift in the conductivity channel starting at station 51. The problem was noted when bottle salinity results for station 53 became available, after station 56 had been completed. The CTD #10 conductivity sensor was cleaned prior to station 57, but the drifting problem continued. When bottle salinities for station 57 became available after station 60, it was apparent that the drift remained. CTD #10 was removed, and ODF CTD #4 was used from station 61 to the end of the cruise. Its second temperature drifted more than -.03ºC from stations 80-100. The CTD #4 secondary temperature sensor was replaced after station 109, and no further drift was noted.

1.7.1. Pressure and Temperature

The final pressure and temperature calibrations were determined for both CTD #10 and CTD #4 during post-cruise processing.

A second Rosemount PRT sensor was deployed as the secondary temperature channel and compared with the primary PRT channel on all casts during this expedition to monitor for drift. The response times of the sensors were first matched, then preliminary corrected temperatures were compared for a series of standard depths from each CTD down-cast.

One or two racks of DSRTs were deployed approximately once daily beginning at station 26 as a further check for pressure and temperature drift.

DSRT-CTD pressure differences varied up to 2 db for any particular rack. DSRTs used for pressure had last been calibrated 3-8 years prior to this cruise and were merely used to verify that the pressure calibrations were reasonably stable during the cruise.

CTD #10
There was a slope change of ~2.5-db from 0-6200 db between the pre- and post-cruise cold "deep" pressure laboratory calibrations. The shallow sections of each calibration shifted by ~+2.0 to +2.5 db pre- to post- cruise, while the deep section of the cold calibration shifted by ~-0.5 db. In order to determine when the 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 cruise were within 0.5 db of the post-cruise laboratory data at all temperatures, so the post-cruise pressure calibration was applied for CTD #10.

The CTD #10 primary temperature sensor (PRT1) used during A15/AR15 was ruined during a test cast following its last use on the cruise. The CTD #10 conductivity sensor was changed after station 60; when the CTD was tested later in the cruise, the new conductivity sensor was defective and flooded the turret containing it and the primary PRT. This effectively ruined the primary PRT and made post-cruise calibration results useless for calibration checks.

The CTD #10 secondary temperature sensor (PRT2) was not affected by the flooded turret because it was mounted in a different turret. Using the PRT2 sensor for reporting CTD data was not a reasonable solution because its distance from the single conductivity sensor would cause an unacceptable level of noise in CTD salinity. Since PRT1 was not destroyed until after its use during the cruise, a comparison of shipboard PRT1 and PRT2 data, combined with changes in the PRT2 laboratory calibrations, was used to decide if any further correction was required for PRT1.

There was a constant offset maintained between the two PRTs on CTD #10. Figure 1.7.1.0 summarizes the shipboard comparison between the primary and secondary PRT channels for CTD #10.
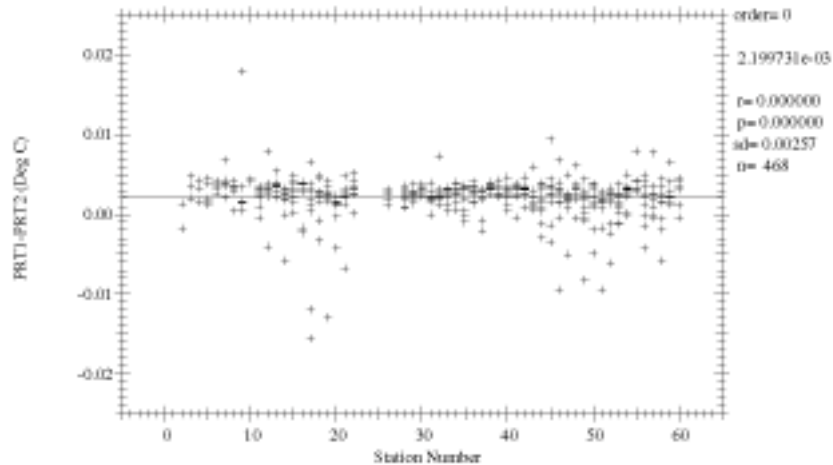
Figure 1.7.1.0 Shipboard comparison of CTD #10 primary/secondary PRT channels, pressure>1000db.

The pre- and post-cruise laboratory calibrations showed an average shift of +.0013ºC in the PRT2 correction. Deep shipboard-corrected PRT1-PRT2 differences for CTD #10 averaged +.0025ºC; half of this difference could be accounted for by the pre-/post-cruise shift in the PRT2 calibration. The remaining .0012ºC difference was subtracted from the PRT1 pre-cruise calibration and applied to A15/AR15 CTD #10 data. Whether there was a .0025 shift in PRT1 prior to the cruise, or the PRT2 shift occurred before the cruise, this extra correction would bring the CTD #10 PRT1 temperature within the .002ºC WOCE accuracy specifications for CTD temperature.

Shipboard DSRT-PRT1 differences varied from -.0051 to +.0035ºC, averaging ~-.001ºC, for the most frequently used rack. This supported the decision to apply the offset to the CTD #10 PRT1 pre-cruise calibration for final temperature data.

CTD #4
There was an ~1.5-db slope change from 0-6200 db between the pre- and post- cruise cold "deep" pressure laboratory calibrations. The shallow sections of each calibration shifted by ~+1.0 db pre- to post-cruise, while the deep section of the cold calibration shifted by ~-0.5 db. In order to determine when the 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 cruise were within 0.5 db of the post-cruise laboratory data at all temperatures, so the post-cruise pressure calibration was applied for CTD #4.

The laboratory calibrations for the CTD #4 primary temperature sensor (PRT1), show a +.004ºC shift near 0ºC and a +.003ºC shift near 30ºC. Daily shipboard DSRT-PRT1 differences varied from -.0040 to +.0093ºC, averaging ~+.004ºC, for the most frequently used rack.

Comparison of the two CTD #4 PRTs showed a steady drift from stations 84-100. The stability of the CTD #4 conductivity calibrations during these stations excluded PRT1 as the problem. The CTD #4 PRT2a was replaced between stations 109 and 110, during a 3-day run between two lines of the cruise track. A rough correction for this new PRT2b was determined shipboard using shipboard-corrected PRT1 values as the standard. PRT1-PRT2b differences were monitored to check for PRT1 drift; the differences were stable and indicated no significant drift in either PRT1 or PRT2b during the remainder of the cruise. Figure 1.7.1.1 summarizes the shipboard comparison between the primary and secondary PRT channels for CTD #4.
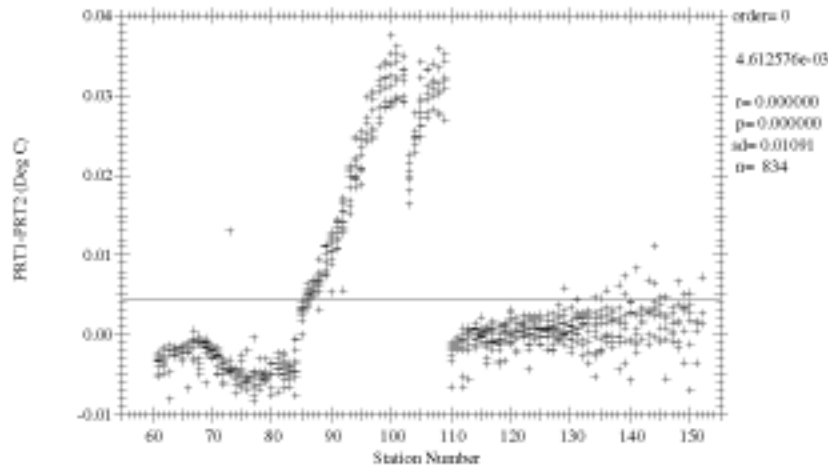
Figure 1.7.1.1 Shipboard comparison of CTD #4 primary/secondary PRT channels, pressure>1000db.

In order to determine when the PRT1 shift occurred, differences between PRT1 and PRT2 or DSRT temperatures were examined. Deep PRT1-PRT2 differences for stations 60-80, the first 20 casts where CTD #4 was used, show a slight downward drift from ~-.002ºC to -.005ºC. This could indicate a need for a more positive correction to PRT1, or it could be the start of PRT2a's problems. No significant drift was noted from stations 110 to the end, nor was any drift noted in DSRT-PRT1 differences during all of CTD #4's use.

An equally weighted average of the PRT1 pre- and post-cruise calibrations was applied to CTD #4 temperature data. This pulled the PRT1-PRT2 and DSRT-PRT1 differences closer to 0, and brought the PRT1 values up to the .002ºC WOCE standard for CTD temperature. Figure 1.7.1.2 summarizes the average of the pre-/post-cruise laboratory temperature calibrations for CTD #4.
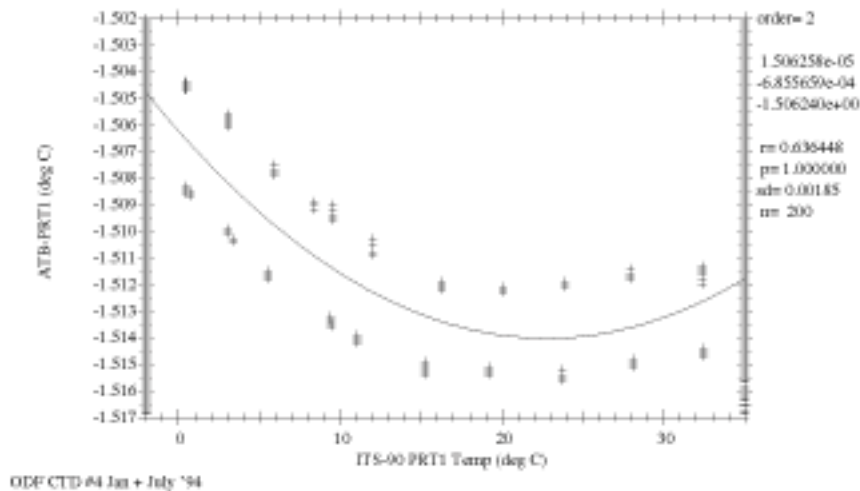
ODF CTD #4 Jan + July '94

Figure 1.7.1.2 Primary temperature calibration for ODF CTD #4, January/July 1994 average.

Summary of Residual Temperature Differences
The residual DSRT-PRT1 differences for the same DSRTs were nearly the same for CTDs #10 and #4 after final CTD temperature corrections were applied (.0015-.002°C). Figure 1.7.1.3 summarizes the final DSRT-CTD differences for all casts where thermometer racks were used.

DSRT vs CTD Temperature Differences
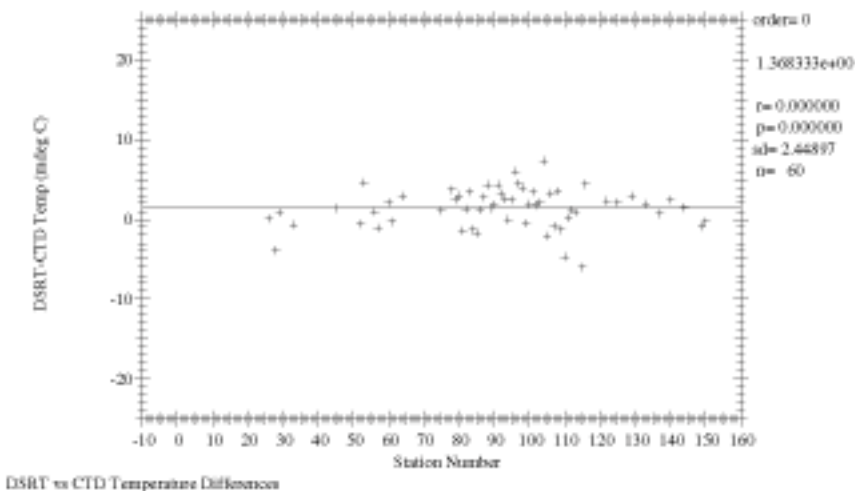
Figure 1.7.1.3 Temperature residual differences vs station # (after correction).

1.7.2. Conductivity

The 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 as a linear function of conductivity.

CTD #10
Cast-by-cast comparisons of bottle-CTD conductivities showed a fairly constant downward drift in the conductivity differences after the first few casts. There was a small shift during the 4-day run between stations 22 and 28, then a slower downward drift continued from stations 31-50. There was a dramatic change beginning at station 51: the spread in preliminary bottle-CTD differences was about .02 mmho/cm for bottles greater than 1500 db, four times the .005 mmho/cm spread seen on previous casts. Autosal problems were ruled out by re-running a few casts on a second Autosal; then the CTD conductivity sensor was aggressively cleaned after station 56. The bottle-CTD offset shifted at this point because of the cleaning, but the wide spread in deep differences persisted. CTD #10 was replaced by CTD #4 after station 60.

Conductivity differences were fit to CTD conductivity for stations 1-50 to determine the mean conductivity slope. The individual station slopes were fit as a function of station number, and the smoothed slopes were applied to each CTD #10 cast, including stations 51-60. The conductivity slopes for stations 51-60 were later re-checked/adjusted after correcting conductivity for pressure dependence. The conductivity slope corrections are summarized in figure 1.7.2.0.
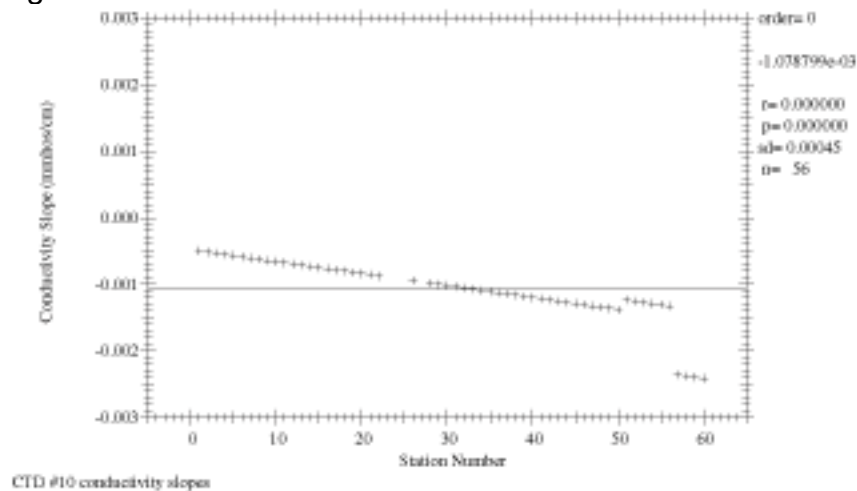
Figure 1.7.2.0 CTD #10 conductivity slope corrections by station number.

After applying the conductivity slopes, residual CTD #10 conductivity offset values were calculated. Smoothed offsets were calculated in station groups and applied for each cast using bottle conductivities deeper than 1500 db. Some offsets were manually re-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. Figure 1.7.2.1 summarizes the final applied conductivity offsets by station number.
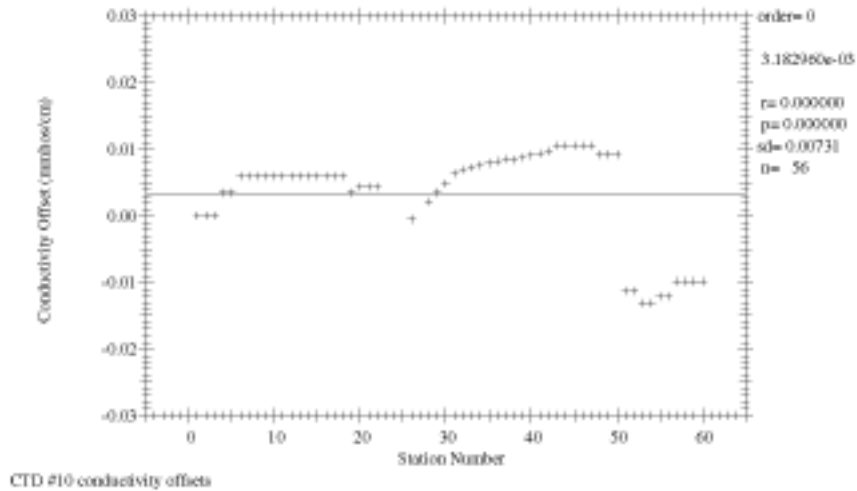
Figure 1.7.2.1 CTD #10 conductivity offsets by station number.

During the year following the cruise, it was determined that CTD #10 had a bad digitizer card for its conductivity sensor, which would probably have had a very nonlinear effect on conductivity. Because of the unusually large spread in residual conductivity differences for stations 51-60, it is likely that these casts occurred as the card began to malfunction.

The residual conductivity differences for stations 51-60 were fit to CTD pressure in three groups: stations 51-56, 57-60 and 51-60. Although a second-order fit was statistically significant, a fourth-order fit to pressure best pulled in the intermediate and deep differences without compromising shallow differences. Stations 51-56 were used to generate a preliminary fourth-order fit; those coefficients were used to correct all 10 casts. Stations 51-52 and 57-60 required additional adjustments to pull the surface differences closer. After applying the C(C,P) corrections to stations 51-60, the residual conductivity differences were as tight as those for the previous 50 stations. A summary of the final pressure- dependent coefficients used to correct conductivity appears at the end of Appendix A.

CTD #4
Cast-by-cast comparisons showed only minor shifts in the conductivity sensor offset and no slope changes, aside from a shift caused by removing a black coating from the conductivity sensor housing during the 3-day run between stations 109 and 110. Conductivity differences were fit to CTD conductivity for all CTD #4 casts in two station groups, 61-109 and 110 to the end of the cruise, to determine the mean conductivity slope. The mean conductivity slope corrections are summarized in figure 1.7.2.2.
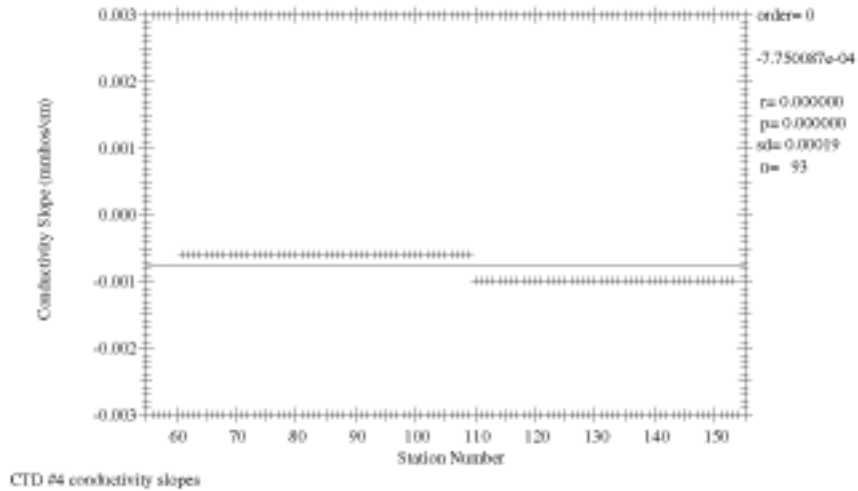
CTD #4 conductivity slopes

Figure 1.7.2.2 CTD #4 conductivity slope corrections by station number.

After applying the conductivity slopes, residual CTD #4 conductivity offset values were calculated. Smoothed offsets were calculated in station groups and applied for each cast using bottle conductivities deeper than 1500 db. No adjustments to the smoothed offsets were required to maintain deep theta-salinity consistency from cast to cast. Figure 1.7.2.3 summarizes the final applied conductivity offsets by station number.

CTD #4 conductivity offsets
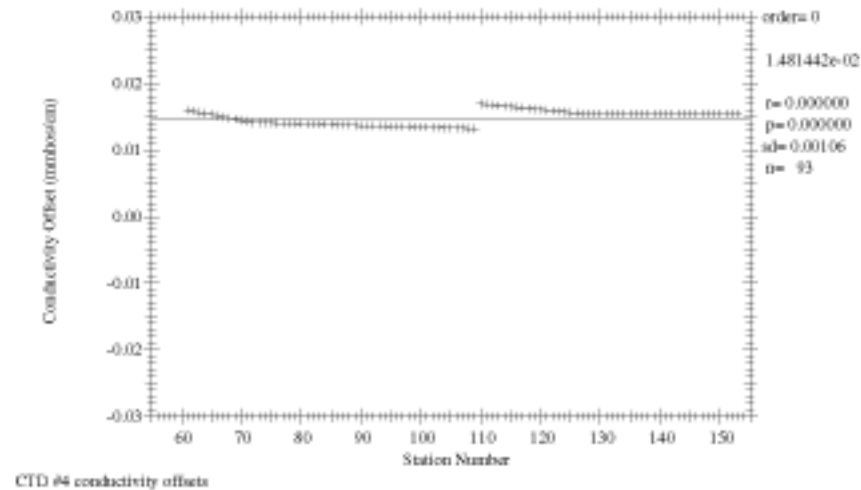
Figure 1.7.2.3 CTD #4 conductivity offsets by station number.

Summary of Residual Salinity Differences
A15/AR15 temperature and conductivity correction coefficients are tabulated in Appendix A.

Figures 1.7.2.4, 1.7.2.5 and 1.7.2.6 summarize the residual differences between bottle and CTD #10 and #4 salinities after applying the conductivity corrections.

order= 0

-2.457938e-01

r= 0.000000
p= 0.000000
sd= 4.39688
n= 4968
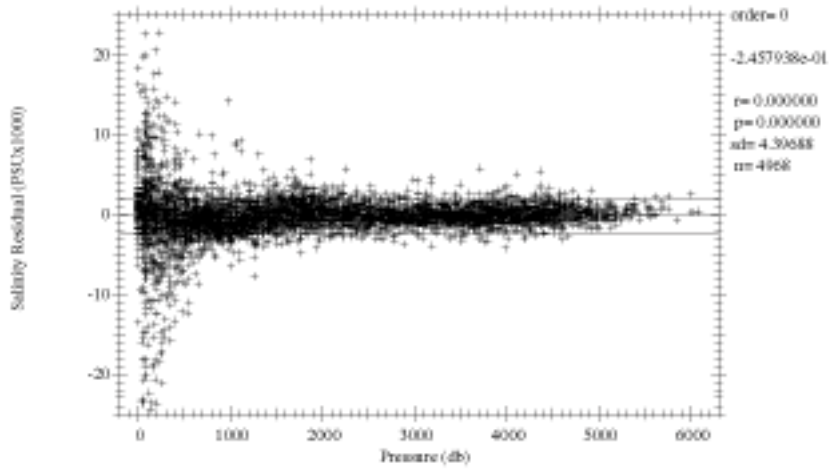
CTDs #10 and #4, residual salt diffs, after correction

Figure 1.7.2.4 Salinity residual differences vs pressure (after correction).

order= 0

-2.457938e-01

r= 0.000000
p= 0.000000
sd= 4.39688
n= 4968
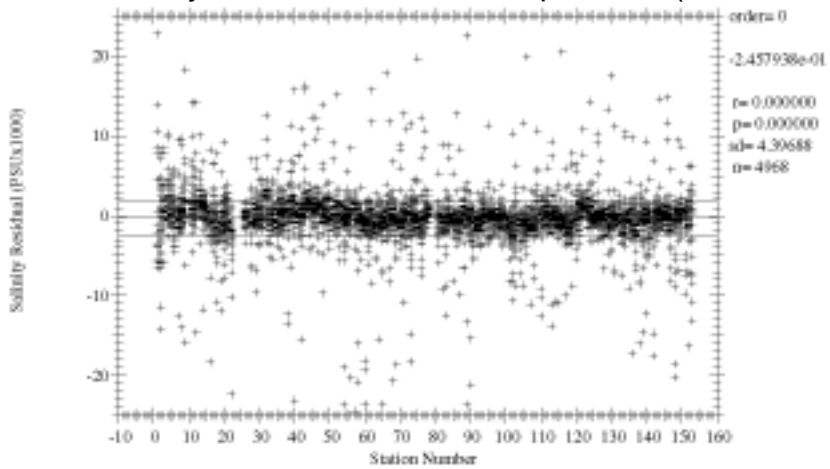
CTDs #10 and #4, residual salt diffs, after correction

Figure 1.7.2.5 Salinity residual differences vs station # (after correction).

order= 0

4.855008e-02

r= 0.000000
p= 0.000000
sd= 1.22498
n= 2818
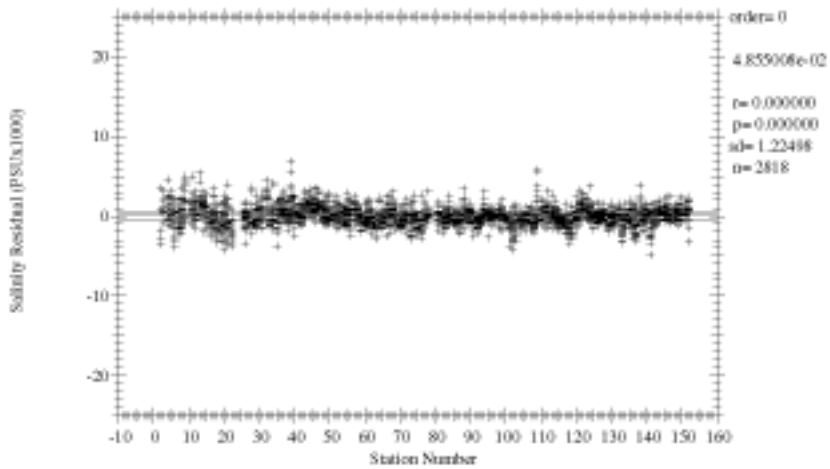
CTDs #10 and #4, residual salt diffs > 1500db, after correction

Figure 1.7.2.6 Deep salinity residual differences vs station # (after correction).

The CTD conductivity calibrations represent a best estimate of the conductivity field throughout the water column. 3-sigma from the mean residual in Figures 1.7.2.5 and 1.7.2.6, or +/-0.0044 PSU for all salinities and +/-0.0012 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 T-S. Within a cast (a single salinometer run), the precision of bottle salinities appears to exceed 0.001 PSU. The precision of the CTD salinities appears to exceed 0.0005 PSU.

1.7.3. CTD Dissolved Oxygen

There are a number of problems with the response characteristics of the Sensormedics O2 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 O2 profile. Winch stops longer than 1 minute which may have affected CTD oxygen data are documented in Appendix C.

Because of these problems, up-cast CTD rosette trip data cannot be optimally calibrated to O2 check samples. Instead, down-cast CTD O2 data are derived by matching the up-cast rosette trips along isopycnal surfaces. When down-casts were deemed to be unusable (see Appendix C), up-cast CTD O2 data were processed despite the signal drop-offs typically seen at bottle stops. The differences between CTD O2 data modeled from these derived values and check samples are then minimized using a non-linear least-squares fitting procedure.

A single oxygen sensor was used for the entire cruise, with both CTDs. Figures 1.7.3.0 and 1.7.3.1 show the residual differences between the corrected CTD O2 and the bottle O2 (ml/l) for each station.

CTDs #10 and #4, residual o2 diffs, after correction
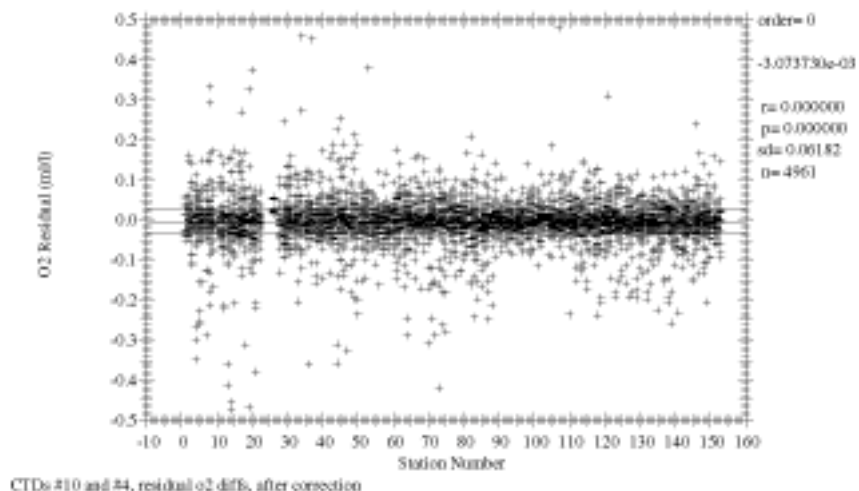
Figure 1.7.3.0 O2 residual differences vs station # (after correction).
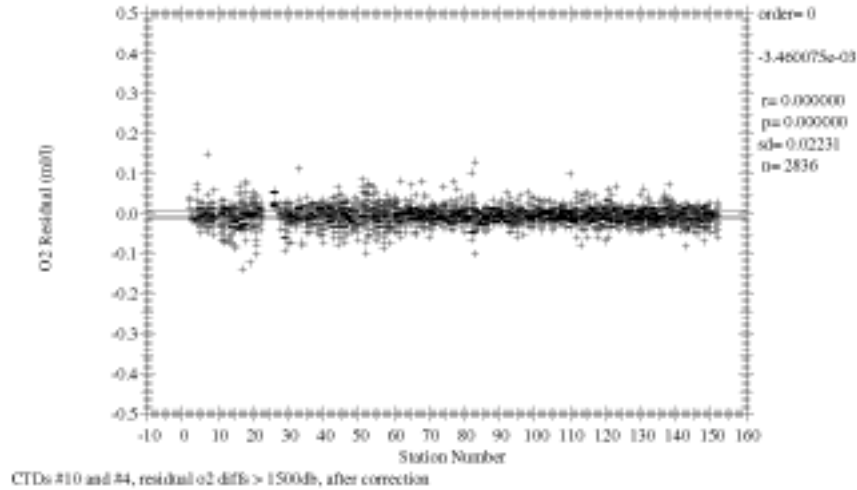
Figure 1.7.3.1 Deep O2 residual differences vs station # (after correction).

The standard deviations of 0.062 ml/l for all oxygens and 0.022 ml/l for deep oxygens are only intended as metrics of the goodness of the fits. ODF makes no claims regarding the precision or accuracy of CTD dissolved O2 data.

The general form of the ODF O2 conversion equation follows Brown and Morrison [Brow78] and Millard [Mill82], [Owen85]. ODF does not use a digitized O2 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 sensor current, or O_c, gradient is approximated by low-pass filtering 1st- order O_c differences. This term attempts to correct for reduction of species other than O2 at the cathode. The time-constant for this filter, τ_{og}, is a fitting parameter. Oxygen partial-pressure is then calculated:

$$(1.7.3.0)$$

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

where:
O_{pp} = Dissolved O2 partial-pressure in atmospheres (atm);
O_c = Sensor current (μamps);
$f_{sat}(S,T,P)$ = O2 saturation partial-pressure at S,T,P (atm);
S = Salinity at O2 response-time (PSUs);
T = Temperature at O2 response-time (ºC);
P = Pressure at O2 response-time (decibars);
P_l = Low-pass filtered pressure (decibars);
T_f = Fast low-pass filtered temperature (ºC);
T_s = Slow low-pass filtered temperature (ºC);
$\dfrac{dO_c}{dt}$ = Sensor current gradient (μamps/secs).

A15/AR15 CTD O2 correction coefficients (c_1 through c_6) are tabulated in Appendix B.

1.8. Bottle Sampling

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

- CFCs;
- Oxygen;
- Partial Pressure of CO2;
- Total CO2;
- pH;
- Alkalinity;
- 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 proper drawing order.

Normal sampling practice included opening the drain valve before opening 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 SPARC stations for centralized data analysis. The analysts for each specific property were responsible for insuring that their results were updated into the cruise database.

1.9. Bottle Data Processing

The first stage of bottle data processing consisted of verifying and validating individual samples, and checking the sample log (the sample inventory) for consistency. 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. Note that the rosette bottle number was the primary identification for all samples taken from the bottle, as well as for the CTD data associated with the bottle. All CTD trips were retained (whether confirmed or not), so resolving bottle tripping problems simply consisted of assigning the right rosette bottle number to the right CTD trip level.

Diagnostic comments from the sample log were entered into the computer as part of the quality control procedure. Every potential problem indicated in these computer files was investigated. The data were coded with the results of the investigation.

The second stage of processing began once all the samples for a cast had been accounted for. All samples for 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. All comments from the analysts were examined and turned into appropriate WHP water sample codes. Oxygen flask numbers were verified, as each flask is individually calibrated and significantly affects the calculated O2 concentration.

The third stage of processing continued throughout the cruise and until the data set was considered "final". Various property-property plots and vertical sections were examined for both consistency within a cast and consistency with adjacent stations. In conjunction with this process the analysts reviewed and sometimes revised their data as additional calibration or diagnostic results became available. Assignment of a WHP water sample code to an anomalous sample value was typically achieved through consensus between analysts and one of the chief scientists.

WHP water bottle quality flags were assigned with the following additional interpretations:

3	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	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.

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

1	The sample for this measurement was drawn from a 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. Does 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.
8	The CTD salinity was derived from the CTD down-cast, matched on an isopycnal surface.

WHP water sample quality flags were assigned to the CTDOXY (CTD O2) parameter as follows:

2	Acceptable 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.
9	Not sampled. No operational CTD O2 sensor was present on this cast.

Note that all CTDOXY values were derived from the pressure-series CTD data, typically down-casts. CTD data were matched to the up-cast bottle data along isopycnal surfaces. If the CTD salinity was footnoted as bad or questionable, the CTD O2 was not reported.

Table 1.9.0 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 1-153								
	Reported	WHP Quality Codes						
	Levels	1	2	3	4	5	8	9
Bottle	5319	0	5105	31	51	0	0	132
CTDSalt	5319	0	5304	9	6	0	0	0
CTDOxy	5304	0	5172	34	98	15	0	0
Salinity	5177	0	4982	77	118	4	0	138
Oxygen	5164	0	5103	9	52	2	0	153
Silicate	5176	0	5141	1	34	1	0	142
Nitrate	5176	0	5054	88	34	1	0	142
Nitrite	5174	0	5127	1	46	3	0	142
Phosphate	5170	0	5004	17	149	7	0	142

Table 1.9.0 Frequency of WHP quality flag assignments.

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

1.10. 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.

1.11. Salinity Analysis

Salinity samples were drawn into 200 ml Kimax high alumina borosilicate bottles after 3 rinses, and were sealed with custom-made plastic insert thimbles and Nalgene screw caps. This assembly provides very low container dissolution and sample evaporation. As loose inserts were found, they were replaced to insure a continued airtight seal. Salinity was determined after a box of samples had equilibrated to laboratory temperature, usually within 8-12 hours of collection. During the first week of the expedition, the salinity samples may not have been analyzed for 24-41 hours after collection. The draw time, equilibration time, and per-sample analysis time were logged.

Two Guildline Autosal Model 8400A salinometers (48-266 and 48-263) were used to measure salinities. These were located in a temperature-controlled laboratory. The salinometers were modified by ODF and contained interfaces for computer-aided measurement. A computer (PC) prompted the analyst for control functions (changing sample, flushing) while it made continuous measurements and logged results. The salinometer cell was flushed until successive readings met software criteria for consistency, then two successive measurements were made and averaged for a final result.

The salinometer was standardized for each cast with IAPSO Standard Seawater (SSW) Batch P-122, using at least one fresh vial per cast. The estimated accuracy of bottle salinities run at sea is usually better than 0.002 PSU relative to the particular Standard Seawater batch used. PSS-78 salinity [UNES81] was then calculated for each sample from the measured conductivity ratios, and the results were merged with the cruise database.

Two salinometers were set up at different bath temperatures. Autosal #48-266, set at 24ºC, was used on stations 1-26, 33-76, and 109. Autosal #48-263, set at 21ºC, was used for stations 28-32, after which a problem with the suppression switch was noted and repaired. It was used again from stations 76-153, except 109, where the lab temperature warranted using the warmer bath in 48-266.

On Station 26, all 36 bottles were tripped at ~3795db. Salinity samples were analyzed for each of the 36 bottles. Bottle 10 leaked and two other salinity values were not acceptable; they were not used in this comparison. Table 1.11.0 shows the standard deviation of the remaining samples.

Salinity (PSU) Mean	34.8938
Standard Deviation (PSU)	0.0009
Number of Samples Used	33

Table 1.11.0 Station 26 Salinity

5177 salinity measurements were made and 410 vials of standard water were used. The temperature stability of the laboratory where the salinometers were located was fair, with the lab temperature generally within one degree of the Autosal bath temperature.

1.12. Oxygen Analysis

Samples were collected for dissolved oxygen analyses soon after the rosette sampler was brought on board and after CFC was drawn. Nominal 125 ml volume-calibrated iodine flasks were rinsed twice with minimal agitation, then filled via a drawing tube, and allowed to overflow for at least 3 flask volumes. The sample 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 $MnO(OH)_2$ precipitate, once immediately after drawing, and then again after 20 minutes. The samples were analyzed within 4-36 hours of collection.

Dissolved oxygen analyses were performed with an ODF-designed automated oxygen titrator using photometric end-point detection based on the absorption of 365 nm wavelength ultra-violet light. Thiosulfate was dispensed by a Dosimat 665 buret driver fitted with a 1.0 ml buret. ODF uses 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 error. Reagent/distilled water blanks were determined to account for oxidizing or reducing materials in the reagents. The auto-titrator generally performed very well.

The samples were titrated and the data logged by the PC control software. The data were then used to update the cruise database on the Sun SPARC stations.

Thiosulfate normalities were calculated from each standardization and corrected to 20º. The 20ºC 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. 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. Ideally, for whole-bottle titrations, the conversion temperature should be the temperature of the water issuing from the bottle spigot. The sample temperatures were measured at the time the samples were drawn from the bottle, but were not used in the conversion from milliliters per liter to micromoles per kilogram because the software was not available. Aberrant drawing temperatures provided an additional flag indicating that a bottle may not have tripped properly.

Oxygen flasks were calibrated gravimetrically with degassed deionized water (DIW) 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. All volumetric glassware used in preparing standards is calibrated, as is the 10 ml Dosimat buret used to dispense standard iodate solution.

Iodate standards are pre-weighed in ODF's chemistry laboratory to a nominal weight of 0.44xx grams. The exact normality is calculated at sea when the volumetric flask volume and dilution temperature are known. Potassium iodate (KIO_3) is obtained from Johnson Matthey Chemical Co. and is reported by the supplier to be > 99.4% pure. All other reagents are "reagent grade".

On Station 26, all 36 bottles were tripped at ~3795db. Oxygen samples were analyzed for each of the 36 bottles. Bottle 10 leaked and its oxygen value was not used in this comparison. Table 1.12.0 shows the standard deviation of the remaining samples.

Oxygen (μM/kg) Mean	244.5
Standard Deviation (μM/kg)	0.13
Number of Samples Used	35

Table 1.12.0 Station 26 Oxygen

5436 oxygen measurements were made. No major problems were encountered with the analyses.

1.13. Nutrient Analysis

Nutrient samples were drawn into 45 ml high density polypropylene, narrow mouth, screw-capped centrifuge tubes which were rinsed three times before filling. Standardizations were performed at the beginning and end of each group of analyses (one cast, usually 36 samples) with a set of an intermediate concentration standard prepared for each run from secondary standards. These secondary standards were in turn prepared aboard ship by dilution from dry, pre-weighed primary standards. Sets of 5-6 different concentrations of shipboard standards were analyzed periodically to determine the deviation from linearity as a function of concentration for each nutrient.

Nutrient analyses (phosphate, silicate, nitrate and nitrite) were performed on an ODF-modified 4-channel Technicon AutoAnalyzer II, generally within one hour of the cast. Occasionally some samples were refrigerated at 2 to 6ºC for a maximum of 4 hours. The methods used are described by Gordon *et al.* [Gord92], [Hage72], [Atla71]. The colorimeter output from each of the four channels were digitized and logged automatically by computer (PC), then split into absorbance peaks. All the runs were manually verified.

Silicate is analyzed using the technique of Armstrong *et al.* [Arms67]. Ammonium molybdate is added to a seawater sample to produce silicomolybdic acid which is then reduced to silicomolybdous acid (a blue compound) following the addition of stannous chloride. Tartaric acid is also added to impede PO4 contamination. The sample is passed through a 15 mm flowcell and the absorbence measured at 820nm. ODF's methodology is known to be non-linear at high silicate concentrations (>120 μM); a correction for this non-linearity is applied in ODF's software.

Modifications of the Armstrong *et al.* [Arms67] techniques for nitrate and nitrite analysis are also used. The seawater sample for nitrate analysis is passed through a cadmium column where the nitrate is reduced to nitrite. Sulfanilamide is introduced, reacting with the nitrite, then N-(1-naphthyl)ethylenediamine dihydrochloride which couples to form a red azo dye. The reaction product is then passed through a 15 mm flowcell and the absorbence measured at 540 nm. The same technique is employed for nitrite analysis, except the cadmium column is not present, and a 50 mm flowcell is used.

Phosphate is analyzed using a modification of the Bernhardt and Wilhelms [Bern67] technique. Ammonium molybdate is 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 is heated to ~55ºC to enhance color development, then passed through a 50 mm flowcell and the absorbence measured at 820 nm.

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

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

5679 nutrient analyses were performed. Occasional electromagnetic interference was observed in the nitrite channel. This interference was intermittent and of varying intensity; it occurred at 30 minute cycles, sometimes lasting for days and sometimes for a few hours. The source of this interference was identified during a subsequent cruise as solenoids in the ship's water-cooled air-conditioning system. The nitrite data were

carefully reviewed, and corrected where appropriate. If a correction was required, but could not be applied, the data were coded as bad.

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Appendix A

WOCE94-A15/AR15: CTD Temperature and Conductivity Corrections Summary
@ Note: Stations 51-60 Pressure-Dependent Conductivity Coefficients at end of Appendix A

Sta/ Cast	PRT Response Time (secs)	ITS-90 Temperature Coefficients $corT = t2*T^2 + t1*T + t0$			Conductivity Coefficients $corC = c1*C + c0$	
		t2	t1	t0	c1	c0
001/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-4.97029e-04	0.00008
002/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-5.15023e-04	0.00008
003/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-5.33018e-04	0.00008
004/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-5.51012e-04	0.00349
005/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-5.69006e-04	0.00349
006/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-5.87000e-04	0.00599
007/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-6.04994e-04	0.00599
008/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-6.22989e-04	0.00599
009/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-6.40983e-04	0.00599
010/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-6.58977e-04	0.00599
011/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-6.76971e-04	0.00599
012/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-6.94966e-04	0.00599
013/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-7.12960e-04	0.00599
014/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-7.30954e-04	0.00599
015/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-7.48948e-04	0.00599
016/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-7.66943e-04	0.00599
017/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-7.84937e-04	0.00599
018/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-8.02931e-04	0.00599
019/02	.22	1.28280e-05	-6.11910e-04	-1.65840	-8.20925e-04	0.00349
020/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-8.38919e-04	0.00439
021/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-8.56914e-04	0.00439
022/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-8.74908e-04	0.00439
026/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-9.46885e-04	-0.00049
028/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-9.82873e-04	0.00219
029/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.00087e-03	0.00353
030/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.01886e-03	0.00487

Sta/ Cast	PRT Response Time (secs)	ITS-90 Temperature Coefficients $corT = t2*T^2 + t1*T + t0$			Conductivity Coefficients $corC = c1*C + c0$	
		t2	t1	t0	c1	c0
031/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.03686e-03	0.00642
032/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.05485e-03	0.00694
033/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.07284e-03	0.00727
034/02	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.09084e-03	0.00760
035/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.10883e-03	0.00793
036/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.12683e-03	0.00826
037/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.14482e-03	0.00858
038/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.16282e-03	0.00841
039/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.18081e-03	0.00874
040/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.19880e-03	0.00907
041/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.21680e-03	0.00940
042/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.23479e-03	0.00972
043/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.25279e-03	0.01056
044/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.27078e-03	0.01056
045/02	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.28878e-03	0.01056
046/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.30677e-03	0.01056
047/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.32476e-03	0.01056
048/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.34276e-03	0.00924
049/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.36075e-03	0.00924
050/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.37875e-03	0.00924
051/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.23517e-03	-0.01130@
052/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.25316e-03	-0.01130@
053/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.27116e-03	-0.01310@
054/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.28915e-03	-0.01310@
055/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.30715e-03	-0.01210@
056/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-1.32514e-03	-0.01210@
057/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-2.35676e-03	-0.00984@
058/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-2.37475e-03	-0.00984@
059/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-2.39274e-03	-0.00984@
060/01	.22	1.28280e-05	-6.11910e-04	-1.65840	-2.41074e-03	-0.00984@
061/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01599
062/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01582
063/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01565
064/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01548
065/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01531
066/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01513
067/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01496
068/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01479
069/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01462
070/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01445
071/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01427

Sta/ Cast	PRT Response Time (secs)	ITS-90 Temperature Coefficients $corT = t2*T^2 + t1*T + t0$			Conductivity Coefficients $corC = c1*C + c0$	
		t2	t1	t0	c1	c0
072/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01410
073/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01409
074/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01406
075/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01404
076/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01401
077/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01399
078/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01396
079/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01394
080/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01392
081/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01389
082/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01387
083/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01384
084/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01382
085/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01379
086/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01377
087/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01375
088/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01372
089/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01370
090/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01367
091/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01365
092/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01362
093/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01360
094/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01357
095/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01355
096/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01353
097/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01350
098/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01348
099/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01345
100/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01343
101/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01340
102/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01338
103/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01335
104/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01333
105/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01331
106/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01328
107/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01326
108/02	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01323
109/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-5.91961e-04	0.01321
110/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01692
111/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01683
112/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01675

Sta/ Cast	PRT Response Time (secs)	ITS-90 Temperature Coefficients $corT = t2*T^2 + t1*T + t0$			Conductivity Coefficients $corC = c1*C + c0$	
		t2	t1	t0	c1	c0
113/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01666
114/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01657
115/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01648
116/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01640
117/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01631
118/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01622
119/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01613
120/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01604
121/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01596
122/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01587
123/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01578
124/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01569
125/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01561
126/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01552
127/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01543
128/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
129/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
130/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
131/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
132/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
133/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
134/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
135/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
136/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
137/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
138/05	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
139/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
140/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
141/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
142/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
143/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
144/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
145/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
146/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
147/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
148/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
149/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
150/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
151/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
152/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542
153/01	.38	1.50630e-05	-6.85570e-04	-1.50620	-9.78857e-04	0.01542

Additional Conductivity Correction Coefficients as a Function of Pressure

$$corC(P) = p4*P^4 + p3*P^3 + p2*P^2 + p1*P + p0$$

Sta/Cast	p4	p3	p2	p1	p0
051/01	-3.10855e-17	7.38945e-13	-5.02714e-09	6.90986e-06	0.01187
052/01	-3.10855e-17	7.38945e-13	-5.02714e-09	6.90986e-06	0.01187
053/01	-3.10855e-17	7.38945e-13	-5.02714e-09	5.96600e-06	0.01526
054/01	-3.10855e-17	7.38945e-13	-5.02714e-09	5.96600e-06	0.01526
055/01	-3.10855e-17	7.38945e-13	-5.02714e-09	5.96600e-06	0.01526
056/01	-3.10855e-17	7.38945e-13	-5.02714e-09	5.96600e-06	0.01526
057/01	-3.10855e-17	9.30000e-13	-6.23047e-09	7.79402e-06	0.01505
058/01	-3.10855e-17	9.30000e-13	-6.23047e-09	7.79402e-06	0.01505
059/01	-3.10855e-17	9.30000e-13	-6.23047e-09	7.79402e-06	0.01505
060/01	-3.10855e-17	9.30000e-13	-6.23047e-09	7.79402e-06	0.01505

Appendix B

Summary of WOCE94-A15/AR15 CTD Oxygen Time Constants

Temperature		Press.	O2 Grad.
Fast(tauTF)	Slow(tauTS)	(tauP)	(tauOG)
10.0	400.0	16.0	16.0

WOCE94-A15/AR15 CTD Oxygen: O2 Conversion Equation Coefficients
(refer to Equation 1.7.3.0)

Sta/Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4)	Tscoeff (c5)	OGcoeff (c6)
001/01	4.59095e-05	3.60826e-01	6.25679e-04	2.17715e-02	7.40393e-03	-6.78650e-06
002/01	1.16614e-03	3.94626e-02	6.00741e-05	8.10269e-03	-3.58419e-02	2.21524e-05
003/01	9.67980e-04	8.36917e-02	1.18582e-04	7.71959e-03	-2.95694e-02	3.10737e-06
004/01	9.88347e-04	6.06430e-02	1.30142e-04	3.91128e-03	-2.62398e-02	9.14454e-06
005/01	9.98956e-04	5.29221e-02	1.29491e-04	9.16944e-03	-2.86203e-02	1.01042e-06
006/01	9.69184e-04	6.80387e-02	1.30437e-04	9.34888e-03	-2.84119e-02	-5.11152e-06
007/01	9.97362e-04	5.93905e-02	1.27691e-04	8.84886e-03	-2.86656e-02	-3.06151e-06
008/01	9.53902e-04	1.17116e-01	1.12311e-04	1.27233e-02	-3.48450e-02	2.30537e-06
009/01	9.50103e-04	1.00299e-01	1.21248e-04	1.09960e-02	-3.13262e-02	1.90955e-06
010/01	1.28764e-03	2.17274e-02	4.70399e-05	1.29565e-03	-3.53434e-02	1.16594e-05
011/01	1.05996e-03	2.26051e-02	1.38186e-04	2.34351e-03	-2.90865e-02	2.89622e-06
012/01	1.05035e-03	1.41607e-02	1.43351e-04	1.34581e-03	-2.41715e-02	2.59942e-07
013/01	1.09711e-03	1.17741e-02	1.37166e-04	-4.02690e-03	-2.31238e-02	3.66768e-06
014/01	1.05589e-03	3.76563e-02	1.31991e-04	4.03786e-03	-2.81971e-02	1.86032e-06
015/01	1.08843e-03	1.39755e-02	1.38037e-04	-3.46832e-04	-2.61174e-02	9.08910e-07
016/01	1.09453e-03	-1.11974e-02	1.53945e-04	-1.75286e-02	-2.06387e-03	-3.95231e-05

Sta/Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4)	Tscoeff (c5)	OGcoeff (c6)
017/01	1.04971e-03	3.27460e-02	1.34142e-04	3.84706e-03	-2.58747e-02	4.14440e-06
018/01	1.07764e-03	2.01893e-02	1.37114e-04	-2.06611e-04	-2.50394e-02	2.00109e-06
019/02	1.06108e-03	1.95950e-02	1.40372e-04	4.04415e-03	-2.92756e-02	1.74596e-08
020/01	1.12916e-03	-1.25837e-02	1.48747e-04	-2.80048e-02	3.37203e-03	1.67353e-05
021/01	1.02527e-03	4.85565e-02	1.30677e-04	9.13174e-03	-2.94696e-02	-1.10168e-06
022/01	1.03961e-03	8.19471e-02	1.18439e-04	-3.60219e-04	-3.03050e-02	-3.57135e-06
026/01	1.14973e-03	-3.46040e-02	1.54828e-04	-3.15870e-04	-3.16696e-02	5.00345e-07
028/01	1.05500e-03	4.25097e-02	1.29959e-04	7.47930e-03	-3.23297e-02	5.72342e-07
029/01	1.13233e-03	-1.23078e-02	1.48142e-04	-2.01049e-02	4.07455e-04	-6.13678e-06
030/01	1.09274e-03	3.20498e-02	1.28958e-04	1.26377e-02	-3.75734e-02	1.28322e-06
031/01	1.04888e-03	5.91751e-02	1.21641e-04	1.94716e-02	-4.02356e-02	-2.29351e-06
032/01	1.06356e-03	4.01882e-02	1.29506e-04	9.31173e-03	-3.18980e-02	4.76796e-07
033/01	9.96844e-04	8.81736e-02	1.16877e-04	1.72657e-02	-3.68904e-02	-2.81894e-06
034/02	1.12790e-03	-1.99599e-02	1.53900e-04	-1.77995e-02	-1.85747e-03	8.34129e-06
035/01	1.09737e-03	1.49083e-03	1.43153e-04	3.06046e-03	-2.72070e-02	2.10609e-06
036/01	1.06056e-03	3.18971e-02	1.32933e-04	9.66432e-03	-3.08446e-02	5.45092e-06
037/01	1.03457e-03	6.11418e-02	1.23743e-04	8.86598e-03	-3.01142e-02	-6.12908e-06
038/01	1.01191e-03	9.69167e-02	1.10708e-04	9.78107e-03	-3.31072e-02	-3.46440e-06
039/01	1.11487e-03	7.91169e-03	1.35577e-04	5.88182e-03	-2.88365e-02	4.53306e-06
040/01	1.04179e-03	5.38769e-02	1.25007e-04	1.46089e-02	-3.40250e-02	5.09130e-06
041/01	1.07021e-03	3.84660e-02	1.29138e-04	5.45854e-03	-2.80034e-02	4.96443e-06
042/01	1.07780e-03	4.50507e-02	1.26058e-04	1.49393e-03	-2.83568e-02	3.30911e-06
043/01	1.05969e-03	4.26891e-02	1.31762e-04	1.76386e-03	-2.65888e-02	-7.05317e-06
044/01	1.11362e-03	-4.24181e-04	1.43260e-04	-2.27579e-03	-2.34764e-02	6.15926e-06
045/02	1.07643e-03	2.56972e-02	1.34684e-04	6.39435e-03	-2.82407e-02	2.66129e-06
046/01	1.10992e-03	1.96432e-02	1.33187e-04	2.24825e-03	-2.80060e-02	-3.30325e-06
047/01	1.03875e-03	5.36375e-02	1.28035e-04	1.43846e-02	-3.43580e-02	-8.30771e-06
048/01	1.07444e-03	3.52610e-02	1.32459e-04	2.60966e-03	-2.70405e-02	1.58093e-06
049/01	1.08475e-03	1.36808e-02	1.40855e-04	-2.77610e-04	-2.33874e-02	1.07245e-06
050/01	1.07925e-03	1.87165e-02	1.39231e-04	1.91986e-03	-2.39267e-02	3.97049e-06
051/01	1.11181e-03	-1.33249e-02	1.58377e-04	-2.11564e-02	2.23470e-03	-3.08721e-06
052/01	1.11487e-03	-5.78080e-03	1.52333e-04	-2.03764e-02	-3.37521e-04	-1.74867e-05
053/01	1.10827e-03	-1.32925e-02	1.58556e-04	-1.66338e-02	-1.46331e-03	2.98367e-06
054/01	1.07338e-03	2.68165e-03	1.54824e-04	-1.09948e-02	-3.69784e-03	-2.74537e-05
055/01	1.14476e-03	-1.84377e-02	1.48365e-04	-2.82199e-02	5.47269e-03	-6.54936e-05
056/01	1.14507e-03	-3.39756e-02	1.61353e-04	-3.04417e-02	9.24186e-03	-4.83605e-05
057/01	1.16036e-03	-5.13818e-02	1.63458e-04	-2.29068e-02	5.54124e-03	-6.19089e-05
058/01	1.09415e-03	-1.10760e-02	1.58233e-04	-1.65737e-02	3.04584e-05	-5.27419e-05
059/01	1.11154e-03	-1.18706e-03	1.46387e-04	-1.63715e-02	-2.77141e-03	-8.43386e-05
060/01	1.15232e-03	-2.34298e-02	1.53683e-04	-2.94988e-02	6.76001e-03	-3.94896e-05
061/01	1.05372e-03	5.70236e-02	1.24328e-04	4.79415e-03	-2.83709e-02	3.97915e-06
062/01	1.06131e-03	6.22818e-02	1.20965e-04	6.11596e-03	-3.10133e-02	2.01438e-07

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4)	Tscoeff (c5)	OGcoeff (c6)
063/01	1.09000e-03	3.68130e-02	1.29874e-04	1.59031e-03	-2.87365e-02	2.98791e-06
064/01	1.09317e-03	3.51016e-02	1.29437e-04	-9.52549e-04	-2.64244e-02	1.57676e-06
065/01	1.05618e-03	7.46556e-02	1.15404e-04	1.00671e-02	-3.56157e-02	2.50681e-06
066/01	1.05420e-03	6.86719e-02	1.19297e-04	8.37762e-03	-3.29228e-02	-2.38122e-06
067/01	1.05318e-03	7.13729e-02	1.18741e-04	8.59161e-03	-3.43973e-02	-7.91617e-07
068/01	1.08102e-03	5.61838e-02	1.21306e-04	2.04266e-03	-2.97180e-02	7.55149e-07
069/01	1.06632e-03	6.20275e-02	1.20254e-04	8.73764e-03	-3.43457e-02	-8.43408e-08
070/01	1.08560e-03	4.40775e-02	1.26513e-04	-9.77166e-04	-2.65097e-02	-7.43278e-07
071/01	1.10404e-03	2.89917e-02	1.30377e-04	-1.68696e-03	-2.61437e-02	-1.83696e-06
072/01	1.06763e-03	4.40619e-02	1.29177e-04	1.64300e-03	-2.61638e-02	2.04658e-05
073/01	1.05115e-03	5.68925e-02	1.24624e-04	6.12466e-03	-2.91017e-02	-3.54420e-06
074/01	1.09073e-03	3.09143e-02	1.32275e-04	-3.56330e-03	-2.37583e-02	1.09245e-05
075/01	1.10899e-03	1.77374e-02	1.35381e-04	-9.34014e-04	-2.58311e-02	3.92244e-06
076/01	1.08037e-03	3.85523e-02	1.29601e-04	1.42202e-03	-2.64371e-02	5.31299e-04
077/01	1.05763e-03	6.80491e-02	1.18357e-04	-9.87012e-04	-2.56453e-02	3.33924e-05
078/01	1.08278e-03	5.57819e-02	1.21131e-04	-4.32584e-04	-2.82436e-02	7.82324e-06
079/01	1.05570e-03	7.37495e-02	1.15240e-04	2.27661e-03	-2.80800e-02	1.92257e-05
080/01	1.02422e-03	8.89387e-02	1.14873e-04	2.41221e-03	-2.83701e-02	1.59110e-05
081/01	1.07655e-03	6.30161e-02	1.18500e-04	-1.03343e-04	-2.78053e-02	5.49886e-06
082/01	1.12751e-03	2.32548e-02	1.30370e-04	-4.51892e-04	-2.81818e-02	7.82150e-06
083/01	1.04718e-03	6.69058e-02	1.19491e-04	6.91159e-03	-2.91490e-02	2.24125e-06
084/01	1.06002e-03	5.98376e-02	1.21692e-04	5.42146e-03	-2.93440e-02	1.92692e-06
085/01	1.10696e-03	2.71083e-02	1.31806e-04	-3.92033e-03	-2.45216e-02	-9.75694e-06
086/01	1.07758e-03	4.89999e-02	1.24647e-04	4.76916e-03	-2.95702e-02	4.30626e-06
087/01	1.06216e-03	4.88879e-02	1.25714e-04	7.45085e-03	-2.87616e-02	3.36018e-06
088/01	1.04506e-03	7.15894e-02	1.18183e-04	6.43099e-03	-2.93148e-02	2.35137e-06
089/01	1.10095e-03	4.71641e-02	1.22886e-04	2.17843e-04	-2.78862e-02	2.85757e-06
090/01	1.09923e-03	3.77127e-02	1.27111e-04	-1.84633e-03	-2.64841e-02	4.19138e-03
091/01	1.08078e-03	4.94196e-02	1.23635e-04	6.94603e-04	-2.69578e-02	1.46311e-04
092/01	1.09727e-03	4.30209e-02	1.24873e-04	-5.35402e-04	-2.77457e-02	1.36511e-04
093/01	1.06965e-03	6.00754e-02	1.21721e-04	-1.17561e-03	-2.56469e-02	1.76938e-03
094/01	1.08371e-03	4.82665e-02	1.23741e-04	-7.80422e-04	-2.57896e-02	3.99649e-04
095/01	1.09742e-03	3.79705e-02	1.27580e-04	-2.01248e-03	-2.59401e-02	3.13136e-05
096/01	1.07663e-03	4.81784e-02	1.26007e-04	-4.38124e-04	-2.58507e-02	1.41795e-04
097/01	1.08507e-03	4.81088e-02	1.24265e-04	-2.87900e-04	-2.65712e-02	2.21413e-05
098/01	1.08331e-03	4.82321e-02	1.24144e-04	1.93523e-03	-2.80369e-02	2.06987e-05
099/01	1.07926e-03	4.61789e-02	1.25740e-04	1.17761e-03	-2.70995e-02	1.83416e-06
100/01	1.09768e-03	4.18255e-02	1.25278e-04	-3.10529e-03	-2.52685e-02	9.18407e-04
101/01	1.11383e-03	2.88045e-02	1.29197e-04	-2.00909e-03	-2.60982e-02	7.64175e-04
102/01	1.09127e-03	3.80096e-02	1.28086e-04	1.51552e-03	-2.79049e-02	1.28637e-03
103/01	1.09088e-03	3.82587e-02	1.28649e-04	-6.86250e-04	-2.68913e-02	8.54903e-05
104/01	1.11921e-03	2.69493e-02	1.30123e-04	-4.28345e-03	-2.66180e-02	7.30346e-05

Sta/Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4)	Tscoeff (c5)	OGcoeff (c6)
105/01	1.10436e-03	3.44033e-02	1.28632e-04	-6.82857e-04	-2.74532e-02	1.16234e-03
106/01	1.11715e-03	2.88651e-02	1.28173e-04	-2.10176e-03	-2.67813e-02	4.62382e-05
107/01	1.11812e-03	2.87677e-02	1.30109e-04	-3.94333e-03	-2.72308e-02	2.67491e-05
108/02	1.13999e-03	1.83626e-02	1.31858e-04	-1.08084e-02	-2.31847e-02	-6.60242e-06
109/01	1.13271e-03	1.83955e-02	1.32311e-04	-5.34936e-03	-2.63263e-02	4.58368e-06
110/01	1.09096e-03	3.17133e-02	1.31537e-04	-1.33766e-03	-2.53043e-02	-1.00018e-06
111/01	1.09673e-03	5.09006e-02	1.20640e-04	-1.06873e-03	-2.68070e-02	-2.39894e-06
112/01	1.09392e-03	5.07205e-02	1.21433e-04	-1.55660e-03	-2.62221e-02	6.48023e-06
113/01	1.10911e-03	3.54279e-02	1.28061e-04	-3.33455e-03	-2.70678e-02	2.38596e-06
114/01	1.10378e-03	3.55259e-02	1.27060e-04	6.13400e-04	-2.82060e-02	5.39977e-06
115/01	1.08920e-03	3.09038e-02	1.31763e-04	1.65359e-03	-2.65361e-02	4.47684e-06
116/01	1.12846e-03	1.62764e-02	1.33677e-04	-4.86864e-03	-2.55693e-02	7.62140e-06
117/01	1.11166e-03	3.11957e-02	1.28159e-04	4.50267e-05	-2.81224e-02	5.66600e-06
118/01	1.09315e-03	4.92026e-02	1.21487e-04	2.46751e-03	-2.85443e-02	2.39912e-06
119/01	1.09471e-03	3.14643e-02	1.30224e-04	2.70130e-03	-2.77755e-02	-6.88348e-07
120/01	1.11495e-03	3.15251e-02	1.27256e-04	-6.84710e-04	-2.74868e-02	2.62179e-06
121/01	1.10978e-03	2.35763e-02	1.32309e-04	-6.69006e-04	-2.65513e-02	2.44702e-05
122/01	1.10913e-03	2.51215e-02	1.30894e-04	3.16522e-03	-2.86255e-02	7.56748e-06
123/01	1.11399e-03	2.00697e-02	1.33895e-04	-9.81008e-04	-2.75877e-02	7.64693e-07
124/01	1.10716e-03	2.44435e-02	1.33112e-04	-1.86043e-03	-2.58367e-02	-3.39475e-06
125/01	1.09659e-03	3.27396e-02	1.29503e-04	2.41836e-03	-2.76710e-02	2.64467e-06
126/01	1.09791e-03	3.15869e-02	1.29632e-04	4.17514e-03	-2.87746e-02	3.54944e-06
127/01	1.12317e-03	1.14957e-02	1.37843e-04	-2.62984e-03	-2.56908e-02	3.53659e-06
128/01	1.11934e-03	2.67781e-02	1.29823e-04	-1.56059e-03	-2.65359e-02	1.97109e-05
129/01	1.08936e-03	3.46412e-02	1.29726e-04	3.52149e-03	-2.80068e-02	6.92432e-06
130/01	1.12052e-03	2.36521e-02	1.31346e-04	-3.70057e-03	-2.57384e-02	4.18044e-06
131/01	1.11834e-03	3.39767e-02	1.25917e-04	-3.53159e-03	-2.60252e-02	-8.13615e-07
132/01	1.10977e-03	3.17122e-02	1.28097e-04	-1.61218e-05	-2.71542e-02	6.71183e-06
133/01	1.09440e-03	3.28372e-02	1.30887e-04	-3.32523e-04	-2.65327e-02	3.61189e-06
134/01	1.10961e-03	2.84612e-02	1.30303e-04	-2.07621e-03	-2.56633e-02	5.51528e-06
135/01	1.09564e-03	4.21965e-02	1.25936e-04	2.85602e-04	-2.75226e-02	-3.26509e-07
136/01	1.11286e-03	2.77815e-02	1.30144e-04	-2.81025e-03	-2.53492e-02	3.93663e-05
137/01	1.10158e-03	3.13317e-02	1.30002e-04	-7.34345e-04	-2.67262e-02	-3.78371e-06
138/05	1.12636e-03	2.28400e-02	1.31143e-04	-4.49320e-03	-2.49400e-02	2.80854e-06
139/01	1.08936e-03	3.71673e-02	1.29648e-04	1.64556e-04	-2.59489e-02	1.99407e-06
140/01	1.08274e-03	5.21430e-02	1.22431e-04	1.03286e-03	-2.73421e-02	3.62363e-05
141/01	1.08123e-03	3.88109e-02	1.29792e-04	1.63002e-03	-2.64069e-02	8.27915e-07
142/01	1.13083e-03	1.48888e-02	1.34139e-04	-4.87803e-03	-2.53635e-02	-4.39419e-05
143/01	1.11768e-03	1.76151e-02	1.35635e-04	-5.25088e-03	-2.33861e-02	1.94892e-03
144/01	1.10256e-03	2.39162e-02	1.34660e-04	-4.49300e-03	-2.40884e-02	3.13501e-04
145/01	1.06973e-03	4.54529e-02	1.28876e-04	1.29720e-03	-2.58185e-02	4.75400e-06
146/01	1.09769e-03	4.26509e-02	1.25667e-04	-1.73984e-03	-2.59863e-02	6.92400e-06

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4)	Tscoeff (c5)	OGcoeff (c6)
147/01	1.12565e-03	1.82108e-02	1.33804e-04	-6.47537e-03	-2.32238e-02	1.75608e-03
148/01	1.08352e-03	4.59697e-02	1.26350e-04	-2.09639e-03	-2.55767e-02	3.46164e-05
149/01	1.06634e-03	4.27532e-02	1.31359e-04	3.59482e-03	-2.72124e-02	3.20013e-06
150/01	1.06606e-03	5.04342e-02	1.29152e-04	-1.27753e-03	-2.55891e-02	3.60381e-06
151/01	1.08694e-03	4.01518e-02	1.29203e-04	-2.01622e-03	-2.57089e-02	4.30555e-06
152/01	1.19856e-03	1.00389e-02	1.10141e-04	-4.89236e-05	-3.00097e-02	4.01124e-06
153/01	1.58601e-03	-1.25557e-01	6.80779e-05	7.76426e-03	-4.35249e-02	1.15007e-05

Appendix C

WOCE94-A15/AR15: CTD Shipboard and Processing Comments

Key to Problem/Comment Abbreviations	
CD	CTD #10 conductivity digitizer card going bad; non- linear drift in CTD conductivity values
CS	deep -.001-2 mmho/cm conductivity discontinuity at raw value 32767 rising to 32768; NBIS digitizing problem when all 16 bits flip at once
DG	density gradient in top 10db, data consistent/smooth in time-series CTD; possibly real
DI	density inversion in top 10db, data consistent/smooth in time-series CTD; possibly real
OB	bottom ctdoxy signal drop coincides with slowdown for bottom approach
OD	up-cast, deep/bottom ctdoxy drifts high, won't fit correctly
OL	ctdoxy fit low near surface: either slow cast start or low ctdoxy signal
OS	up-cast surface ctdoxy fit off: btl stops, slowdown for surface approach
SS	probable sea slime on conductivity sensor
WS	winch stopped to check possible winch problem; potential shift in ctdoxy signal
Key to Solution/Action Abbreviations	
CO	offset deep conductivity for raw values 32768 and higher to negate effect of digitizing problem
NA	no action taken, use default quality code 2
NR	cast not processed, not reported with final data
O3	quality code 3 oxygen in .ctd file for pressures specified
O4	quality code 4 oxygen in .ctd file for pressures specified
PC	matched up-cast CTD conductivity to up-cast bottles; applied 4th-order pressure correction to CTD #10 conductivity
S3/T3	quality code 3 salinity/temperature in .ctd file for pressures specified
T3	quality code 3 temperature in .ctd file for pressures specified
UP	used up-cast data for final pressure-series data

Cast	Problem/Comment	Solution/Action
998/01	start with CTD #10, Port winch; TEST cast	NR
001/01	CTD P/T1/T2/C went crazy199-215db down-cast	UP
	OD	O4 184-230db
002/01	OL	O3 0-30db
004/01	DI .010	NA
006/01	DG .12 down-cast only, .01 density drop 12-14db	NA, time-series data consistent
008/01	DG .15, both down- and up-cast	NA
	OB; part of drop may be real	O3 3840-3856db
009/01	OB, 1-min. pause at 3848db: drop in ctdoxy	O3 3848-3874db
010/01	ABORT cast at 1523db: too shallow/wrong position	report cast anyways
	no bottle samples taken	stas 9+11 btloxys used for ctdoxy fit
012/01	WS 7 mins. at 858db: spike in ctdoxy	O3 858db
013/01	.007 density drop 6db	NA, time-series data consistent
	WS 4 mins. at 2110db: drop in ctdoxy 2108-2124db	NA, corresponds with rise in S
014/01	WS 2-8 mins. at 299/2928/2944db	NA, no shift noted
	WS 2-4 mins. at 3206/3326db: drop in ctdoxy	O3 3326-3350db
	WS 2-10 mins. at 4059/4482/4519db: ctdoxy fits high	O3 4060-4522db
015/01	.007 density drop 2db	NA, time-series data consistent
	WS 5 mins. at 1224db: spike in ctdoxy	O3 1222db
016/01	switch to Stbd. winch beginning this cast; SS: -.002	UP
	PSU offset near bottom of down-cast, shifts back at bottom	
	surface btloxy value questionable	stas 15+17 surface btloxys used for ctdoxy fit
	OS	O3 0-34db
	OD	O3 4110-4410db, O4 4412-4582db
019/01	ABORT cast at 105m - winch noise	NR
019/02	back to Port winch; WS 16 mins. at 542db: rise in ctdoxy	O3 542-556db
	CTD T/C signal erratic top 8m, density inversion	T3/S3 0-8db
020/01	SS -.005 PSU offset mid down- cast, up ok	UP
	~2-min. stops at 4598,4494,4392db btls; OD	O3 3988-4470db, O4 4472-4600db
026/01	all btls tripped at bottom	sta 28 btloxys used for ctdoxy fit
029/01	-.003 PSU down vs up, up matches btls/nearby casts	UP
	6.5-min. btl stop/therm soak at 4566db, OD	O3 3946-4158db, O4 4160-4662db
	CS	CO 4660-4662db down/up, 4570-4566db up
031/01	WS 8 mins. at 2970db, 2 mins. at	NA, no shift noted 3080db
032/01	DI .014; CS	NA; CO 4782-4918db down/up
033/01	DI .021; CS	NA; CO 4772-4816db down/up
	yoyo 4775-4765db down: rise in ctdoxy	O3 4776-4816db
034/01	ABORT cast at 520db after 2 long winch stops	NR

Cast	Problem/Comment	Solution/Action
034/02	WS 3-mins. 38-48db/thermocline down, SS multiple +/-.002 PSU offsets down-cast	UP
	OD; CS	O4 3756-4930db; CO 4758-4930db down, 4930-4754db up
035/01	CS	CO 4818-4904db down/up
036/01	DI .019; CS	NA; CO 4824-4992db down/up
037/01	CS	CO 4810-5086db down/up
038/01	DG .12, up-cast gradient smaller; CS	NA; CO 4724-5182db down, 5182-4726db up
039/01	DG .22, up-cast gradient smaller	NA
	WS 2.5-mins. at 1947db: ctdoxy shifts, fit off	O3 1862-2350db
	CS	CO 4710-5190db down/up
040/01	no surface btloxy value	stas 39+41 surface btloxys used for ctdoxy fit
	DI .009; CS	NA; CO 4632-4654 +4670-4678db down, 4654-4630db up
042/01	CS 4670db down to bottom to 4702db up	not changed: S3 4670-4756db
044/01	Romanche Fracture Zone, bottom depth exceeds CTD sensor limits	bottom of cast at 6100db
045/02	DI .013	NA
046/01	WS 9 mins. at 3693db, drop in ctdoxy	O3 3692-3734db
047/01	DG .31, up-cast gradient smaller	NA
049/01	no surface btloxy value	stas 48+50 surface btloxys used for ctdoxy fit
	WS 8 mins. at 4416db, drop in ctdoxy	O3 4418-4472db
051/01	CD; up-cast ctdoxy deep fit off, bottom ok	UP/PC; O3 3910-4550db
052/01	CD; OS, noisy signal, 1.5-min. btl stop at 36db	UP/PC; O4 0-36db
	OD	O3 4472-4570db, O4 4572-4820db
053/01	CD; 8-min. btl stop/therm soak at 5106db, OD	UP/PC; O4 4906-5312db
054/01	CD; OS, 2-min. stop at 2db	UP/PC; O3 0-50db
	yoyo/btl trip at 5013-5032db up, OD	O4 4660-5102db
055/01	CD; OS; OD	UP/PC; O4 0-40db; O3 3900-4008db, O4 4010-4028db
056/01	CD; OS	UP/PC: cleaned conductivity sensor after cast; O4 0-52db
	6-min. btl stop/therm soak at 4464db, OD	O4 4470-4630db
057/01	CD; OS	UP/PC; O4 0-44db
	6-min. btl stop/therm soak at 4160db, OD	O3 4164-4260db, O4 4262-4278db
058/01	CD; OS; OD	UP/PC; O4 0-42db; O4 4570-4820db
059/01	CD; OS	UP/PC; O4 0-42db
	6-min. btl stop/therm soak at 4206db, OD	O4 4218-4312db
060/01	CD; OS	UP/PC; O4 0-32db
	WS/btl stop 17 mins. at 4312db up to grease winch, OD	O4 4316-4466db

Cast	Problem/Comment	Solution/Action
061/01	conductivity drifting too much on CTD #10	CTD #4 used beginning this cast
062/01	DI .015	NA
072/01	OL	O4 0-90db
073/01	DI .013	NA
075/01	DI .010	NA
076/01	DI .018; OL	NA; O4 0-50db
077/01	DI .016; OL	NA; O4 0-60db
078/01	DI .007	NA
079/01	OL	O4 0-22db
080/01	DI .012; OL, WS 2 mins. at 30db down while turning ship	NA; O4 0-32db
083/01	DI .016	NA
084/01	surface btloxy value questionable	stas 82+83+86 surface btloxys used for ctdoxy fit
085/01	surface btloxy value questionable	stas 83+86 surface btloxys used for ctdoxy fit
086/01	DI .020	NA
087/01	DI .018 (.026 with 0-db extrapolated level included)	NA
088/01	DI .012	NA
	pinger died, slow altimeter response	slow/careful bottom approach
	WS 2 mins. at 4598db, 5 mins. at 4644db	NA, ctdoxy effect less than .02 ml/l
089/01	DG .14, down- and up-cast	NA
090/01	DG .18, down-cast only; OL	NA; O4 0-88db
091/01	DI .016; OL	NA; O4 0-92db
092/01	OL	O4 0-80db
093/01	+.005 density bulge 2-4db	NA, time-series data consistent
	OL	O4 0-74db
094/01	OL	O4 0-74db
095/01	OL	O4 0-80db
096/01	OL	O4 0-70db
097/01	OL	O4 0-72db
098/01	OL	O4 0-70db
099/01	DI .020	NA
100/01	DI .010	NA
	OL; no btloxy at 104db btl	O4 0-104db; stas 99+101 btloxys used for near- surface ctdoxy fit
101/01	OL	O4 0-100db
102/01	DI .010; OL	NA; O4 0-90db
103/01	DI .020	NA
	OL; no btloxy values between 6-174db	O4 0-94db; stas 102+105 btloxys used for near- surface ctdoxy fit
104/01	OL; 99db btloxy questionable	O4 0-100db; stas 102+105 btloxys used for near- surface ctdoxy fit
105/01	+.008 density bulge 2-4db	NA, time-series data consistent

Cast	Problem/Comment	Solution/Action
	OL	O4 0-70db
106/01	OL	O4 0-78db
107/01	OL	O4 0-72db
108/01	ABORT after launch: knot in tag line	NR
777/01	TEST new CTD #10 C-sensor	NR
110/01	new PRT2 sensor for CTD #4; black coating on conductivity sensor housing removed prior to cast, cond. shifted	PRT2/cond. corrections adjusted
	Stbd. winch; pkg may have touched bottom	NA, no evidence data affected
113/01	WS 4 mins. at 154db - brake trouble	NA, no shift noted
115/01	DI .008	NA
116/01	back to Port winch	
117/01	+.007 density bulge 4db	NA, time-series data consistent
121/01	OL	O4 0-94db
778/01	TEST CTD #10: defective C sensor flooded turret, PRT1/C sensors ruined	NR
126/01	WS 2 mins. at 5083db for winch inspection; drop in ctdoxy	O3 5084-5128db
128/01	switch to Stbd. winch: odd noise/level wind trouble	
	3-min. stop at 16-20db distorted surface fit	O4 0-20db
129/01	back to Port winch at engineer's request; DI .016	NA
136/01	OL	O4 0-104db
137/01	Port winch has sheave/counter problems	used repaired Stbd. winch this cast
	DI .012	NA
138/01	ABORT - Stbd. winch problems	NR
138/02	ABORT - Stbd. winch problems	NR
138/04	ABORT - left sensor caps on; used repaired Port winch starting this cast	NR
140/01	OL	O4 0-80db
142/01	DI .008; ctdoxy signal/ctdoxy fit high near surface	NA; O4 0-100db
143/01	OL	O4 0-84db
144/01	OL	O4 0-84db
145/01	DI .010	NA
	deep ctdoxy ~high relative to btls/nearby CTD casts	O3 3818-3970db
147/01	DI .008; OL	NA; O4 0-90db
148/01	DI .009; OL	NA; O4 0-94db
151/01	back to Stbd. winch; DG .04, down- and up-cast	NA
153/01	OB	O3 490-566db

Appendix D

WOCE94-A15/AR15: Bottle Quality Comments

Remarks for deleted samples, missing samples, PI data comments, and WOCE codes other than 2 from WOCE A15/AR15 Deep Basin Experiment. 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, and Phosphate. The first number before the comment is the cast number (CASTNO) times 100 plus the bottle number (BTLNBR).

STATION 001
136   Sample Log: "Top o-ring problem." See 121 and 124 tripping and bottle comment.
135   See 121 tripping comment. No samples were drawn.
134   Sample Log: "Top o-ring problem." See 121 and 124 tripping and bottle comment.
130-133 All tripped at surface to check bottle integrity; not sampled.
129   Sample Log: "Top o-ring problem." See 121 and 124 tripping and bottle comment.
127-128 All tripped at surface to check bottle integrity; not sampled.
126   Sample Log: "Top o-ring problem." See 121 and 124 tripping and bottle comment.
125   See 121 tripping comment. No samples were drawn.
124   Sample Log: "Top o-ring problem." See 121 tripping comment. No samples were drawn.
121-123 All tripped at surface to check bottle integrity; not sampled.
120   Sample Log: "Top o-ring problem." Samples are acceptable.
118   Sample Log: "O-ring problem, top and bottom-no water in bottle."
117   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 37db is 0.0581. Salinity high compared with next stations, footnote salinity questionable.
113   Sample Log: "Top o-ring problem." Samples are acceptable.
112   Sample Log: "Valve open prior to oxy sample." Note: freon sample taken first according to log, valve should be open. Data should be okay.
110   Sample Log: "Top o-ring problem." Samples are acceptable.
108   PI: "CTD-Bottle salt diffs very high, sharp gradient." Delta-S at 159db is 0.4905. PI: "Footnote salinity bad."
107   PI: "CTD-Bottle salt diffs very high, sharp gradient." Delta-S at 159db is 0.1729. This was a duplicate trip with 8, both of these are higher than adjoining stations. Footnote salinity bad.
102-104 CTDO Processor: "Sh/upcast; bottom drifts high, won't fit correctly." Code 184-230db CTDO bad.
101   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks okay." See 102-104 CTD Oxygen comment; code CTDO bad.

STATION 002

135-136 CTDO Processor: "Low raw surface signal, bad fit." Code 0-30db CTDO bad.

134 Sample Log: "Top o-ring out." Oxygen not drawn. Salinity not drawn. Bad nuts, bottle leaked Footnote bottle leaking, samples bad.

130 Sample Log: "Bottom o-ring out." Oxygen not drawn. Salinity not drawn. Footnote bottle no samples were drawn.

129 Sample Log: "Top o-ring out." Oxygen not drawn. Salinity not drawn. Bad nuts, bottle leaked Footnote bottle leaking, samples bad.

120 Sample Log: "Top o-ring out." Delta-S at 505db is 0.2247. Bad salts, bottle leaked. Oxygen not drawn. Bad nuts, bottle leaked Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

117 Sample Log: "Top o-ring out." Delta-S at 727db is 0.0992. Bad salt, bottle leaked. Bad oxy, bottle leaked. Bad nuts, bottle leaked. Footnote bottle leaking, samples bad.

116 CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 727db is 0.012. Footnote salinity questionable.

114 CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 808db is 0.018. Footnote salinity questionable.

112 CTD Processor: "Bottle salt slightly high compared to CTD."Delta-S at 908db is 0.0144. Salinity run shows erratictimes to analyze samples. This indicates analyst hadtrouble getting a good reading, even though it is notindicated what that problem is. There was also a duplicatetrip at this level and this salinity disagrees by 0.011,another indication there is a problem. Other water samplesare acceptable. Footnote salinity bad.

101 NO2 value does not fit trend, possible contamination. Footnote NO2 bad.

STATION 003

136 Sample Log: "Top o-ring off." Oxygen as well as other data are acceptable.

135 Sample Log: "Broken end cap." No samples were drawn.

134 Sample Log: "Top o-ring off." Delta-S at 52db is 0.0434. CTD Processor: "Bottle salt slightly high compared to CTD." Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

131 CTD Processor: "Bottle salt slightly low compared to CTD."PI: "Salinity looks okay." Delta-S at 174db is -0.0527.Variation in CTD salinity uptrace at this sampling point,because the package has stopped to trip a bottle. FootnoteCTD salinity bad, value is probably good on its own meritjust not to compare with the bottle data. No CTDO iscalculated because the CTD Salinity is coded bad.

130 CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 241db is -0.0291. CTD Processor: "CTD Salinity is acceptable."

126 Sample Log: "Bottom o-ring off." No samples were drawn.

121 Sample Log: "Vent o-ring problem, air leak." Delta-S at 647db is 0.0127. Bad salts, bottle leaked. Bad oxy, bottle leaked. Bad nuts, bottle leaked. Footnote bottle leaking, samples bad.

116 Sample Log: "Slow flow." Samples are acceptable.

106-107 PI: "PO4 value appears too high." Nutrient analyst: "PO4 value looks odd on nuts chart also." Footnote PO4 bad.

103 Sample Log: "Slow flow." Oxygen as well as other samples are acceptable.

STATION 004

Cast 1　There were many problems with this salinity run. It appears that the first 11 salinity samples are acceptable (01-11), but the rest of the cast had many retries before the operator either gave up or was about to run out of sample. If there is poor agreement with the CTD data, these will be coded bad.

135　Sample Log: "Top and bottom o-ring unseated/air leak." No samples were drawn.

134　Sample Log: "Top o-ring unseated/air leak." Delta-S at 54db is 0.0728. salts: "Sample analyzed, sample log says no sample taken." Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

130　Sample Log: "Top o-ring unseated/air leak." Delta-S at 207db is 0.0961. Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

128　CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Looks ok" Delta-S at 307db is -0.0473. Autosal took 3 tries to get readings to agree, this is usually an indication that the salinity would be bad. Autosal diagnostics indicate some kind of stability problem. Code salinity bad.

127　CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Looks ok" Delta-S at 406db is -0.0287. Autosal diagnostics indicate some kind of stability problem. See Cast 1 salinity comment; code salinity bad.

122　Sample Log: "Top o-ring unseated/air leak." Delta-S at 700db is 0.0148. Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

120　Delta-S at 897db is 0.0105. Took 7 readings before salinity value was obtained. Code salinity bad.

118　PI: "Oxygen much too high." High compared to CTD trace. Footnote O2 bad, based on PI comment. Delta-S at 1046db is 0.0083. Took 5 readings before salinity value was obtained. Code salinity and oxygen bad.

117　Delta-S at 1196db is 0.0112. Took 6 readings before salinity value was obtained. Code salinity bad.

116　Sample Log: "Flows slowly."

109　Delta-S at 2105db is 0.0036. Took 3 readings before salinity value was obtained. Code salinity bad.

107　Delta-S at 2403db is 0.0039. Suspect that it is just the inexperience of personnel which were not ODF personnel. See Cast 1 salinity comment; code salinity bad.

105　salts: "Bottle 5 NG" Salinity not reported, not enough sample. Must not have been drawn.

STATION 005

Cast 1　Salts: "11-min. delay between 1st worm and sample 1; low stby number during 1st worm; high std dial (+27) and high drift (+16)." Subtracted 0.00015 from sample conductivity ratios; assume no drift. This results in a -0.003 offset to the salinity, and is correct as reported. Data acquisition system was not receiving confirmation that the bottle tripped. Operator kept trying for the first 5 bottles. Bottles 3 through 5 were skipped, not tripped. Electronic Technician reset pylon to position 6 and continued tripping bottles. Code all bottles did not trip as scheduled, data appears acceptable as pressures are assigned, unless otherwise noted.

136　Sample Log: "Top o-ring off." No samples were drawn.

135	Sample Log: "Bottom o-ring off." Oxygen: "Air bubble in flask." Salinity and nutrients were not drawn. Footnote bottle leaking, salinity not drawn, oxygen bad, and nutrients not drawn.
134	CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 53db is 0.0993. Gradient area, however salinity does not agree with adjoining stations. PO4 is a little high, but within the specs of the measurement. Oxygen: "Odd endpoint." Oxygen is acceptable. See Cast 1 tripping comments, code bottles did not trip as scheduled, and salinity questionable.
121-133	See Cast 1 tripping comments, code bottles did not trip as scheduled.
120	Sample Log: "Top o-ring off." No samples were drawn.
116-119	See Cast 1 tripping comments, code bottles did not trip as scheduled.
115	Oxygen: "Paper in flask." Oxygen is high, other data are acceptable. See Cast 1 tripping comments, code bottles did not trip as scheduled, and oxygen bad.
114	See Cast 1 tripping comments, code bottles did not trip as scheduled.
113	Sample Log: "Top o-ring off." Delta-S at 1860db is 0.099. Bad salts, bottle leaked. Oxygen not drawn. Bad nuts, bottle leaked. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.
111-112	See Cast 1 tripping comments, code bottles did not trip as scheduled.
110	Oxygen: "Dosimat base malfunction, lost sample - changed base." See Cast 1 tripping comments, code bottles did not trip as scheduled.
107-109	See Cast 1 tripping comments, code bottles did not trip as scheduled.
106	Oxygen: "Paper in flask." Oxygen as well as other data are acceptable. Delta-S at 2879db is -0.0032. This is out of spec for WOCE standards. Suspect that it is just the inexperience of personnel which were not ODF personnel. Code salinity as questionable. See Cast 1 tripping comments, code bottles did not trip as scheduled.
103-105	Sample Log: "Did not trip." No samples (3-5) as scheduled.
101-102	See Cast 1 tripping comments, code bottles did not trip as as scheduled.

STATION 006

136	Sample Log: "Top o-ring." No samples were drawn.
134	Sample Log: "Top o-ring." No samples were drawn.
133	CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 87db is -0.0857. Large gradient, does following adjoining stations trend. Suspect is salinity acceptable.
132	Sample Log: "Bottom o-ring." No samples were drawn.
130	Sample Log: "Top o-ring." No samples were drawn.
115	Sample Log: "Recorded o2 temp may be higher than reality - forgot to read, had to re-check using minimal water."
114	CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 1870db is 0.0103. Autosal took 5 readings before two agreed. This is an indication of some kind of contamination, probably a salt crystal. Footnote salinity bad.
102	CTD Processor: "Bottle oxy high." PI: "Bottle oxy prob. ok, same trend seen in nuts."

STATION 007

135	Sample Log: "Bottom o-ring unseated." No samples were drawn.
134	Sample Log: "Top o-ring unseated." No samples were drawn.
129-130	Sample Log: "Top o-ring unseated." No samples were drawn.

| 109 | PI: "SiO3/O2 low, salt/NO3/PO4 high." No notes re: leak on deck, normal trip confirmation possible lanyard hangup or o- ring problem? Delta-S at 2780db is 0.0187. Footnote bottle leaking, samples bad. |

108   Oxygen: "Air bubble in flask." PI: "Footnote oxygen bad." PO4 appears high compared with station profile and adjoining stations. A feature is seen in the other nutrients, oxygen and the CTD salinity.

102   Oxygen: "No good - bubble." PI: "Footnote oxygen bad."

STATION 008

136   Sample Log: "Top o-ring problem." Salinity and oxygen not drawn. Nutrients may be a little high. Footnote bottle leaking, salinity and oxygen not drawn, and nutrients bad.

138   Sample Log: "Replaces bottle 34 beginning this cast."

131   See 129 PI PO4 & NO3 comment. Footnote NO3 and PO4 questionable.

137   Sample Log: "Replaces bottle 30 beginning this cast." See 129 PI PO4 & NO3 comment. Footnote NO3 and PO4 questionable.

129   PI: "PO4 and NO3 follows unusual trend." Nutrient analyst: "Checked nut charts, trend appears real." Footnote NO3 and PO4 questionable.

124   PI: "Oxygen seems high, check against CTD oxy." Looks ok w/ prelim CTDOXY. Leave oxygen as is, no code.

123   Sample Log: "TCO2 sampled before oxygen." Oxygen is acceptable.

121   Sample Log: "Oxygen sampled before freon."

117   Sample Log: "Bottom o-ring leaked, not unseated. Apparently salts/nuts sampled even though crossed off." Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

116   Sample Log: "Bottom latched by recovery hook bringing aboard, apparently salts/nuts sampled even though crossed off." Oxygen was not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

114   Sample Log: "Top o-ring problem. Apparently salts/nuts sampled even though crossed off." Delta-S at 1970db is 0.1012. Oxygen was not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

101   CTDO Processor: "Bottom signal drop coincides w/slowdown for bottom approach; part of drop may be real." Code 3840-3856 db CTDO questionable.

STATION 009

139   PI: "Nuts all too high, salt/oxy ok." Nutrient analyst: "All peaks match extra surface sample, do not match bottle 35 at same depth." Suspect misdrawn from bottle 37 - 1st sta with bottle numbers > 36. Sample Log: "Replaces bottle 36 beginning this cast." Footnote nutrients bad.

133   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 105db is 0.0544. Variation in CTD salinity uptrace at this sampling point, because the package has stopped to trip a bottle. Footnote CTD salinity bad, value is probably good on its own merit just not to compare with the bottle data. No CTDO is calculated because the CTD Salinity is coded bad.

137   See 128 PI PO4 and NO3 comment. Footnote NO3 and PO4 questionable.

129   See 128 PI PO4 and NO3 comment. Footnote NO3 and PO4 questionable.

128   PI: "PO4 follows unusual trend." Nutrient analyst: "Checked nuts chart, trend appears real." PI: "NO3 follows unusual trend." Nutrient analyst: "Checked nuts chart, trend appears real." Footnote NO3 and PO4 questionable.

121   Sample Log: "Top o-ring. Apparently nuts/salts sampled even though crossed off." Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.
118   Sample Log: "Bottom o-ring. Delta-S at 1665db is -0.014. Apparently nuts/salts sampled even though crossed off." Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.
116   Sample Log: "Slow flow." Oxygen as well as other data are acceptable.
107   Sample Log: "Lanyard stuck under top end cap, but no air leak." Delta-S at 3034db is 0.0044. Samples are acceptable. There is a feature here that is also seen in the CTD data.
101   CTDO Processor: "1-min. pause at 3848db, drop in ctdoxy." Code CTDO questionable.

STATION 010

Cast 1   co log: "Abort cast at 1456mwo, too far from seamount; no bottles tripped."

STATION 011

131-132   PI: "PO4 follows unusual trend. PO4 probably okay." Nutrient analyst: "Checked nut charts, trend appears real." PI: "NO3 follows unusual trend. NO3 probably okay." Nutrient analyst: "Checked nut charts, trend appears real."
131   Oxygen: "Splinter in sample flask." salts: "31 skip" - analyst said numbers bounced between 51/54 and program did not accept. Numbers not hand-recorded. Will write down both numbers next time this happens." Footnote salinity lost.
137   PI: "PO4 follows unusual trend. Probably okay." Nutrient analyst: "Checked nut charts, trend appears real." PI: "NO3 follows unusual trend. Probably okay." Nutrient analyst: "Checked nut charts, trend appears real."
125   Sample Log: "TCO2 and oxy taken out of sequence. Oxy sampled more than 20 mins. after freon." Oxygen appears to be okay, since there are no comments from CTDO Processor.
120-123   Sample Log: "Oxy sampled more than 20 mins. after freon." Oxygen appears to be okay, since there are no comments from CTDO Processor.
116   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 2276db is 0.0069. Autosal took 3 tries before getting a good reading. Salinity 0.002 higher than adjoining stations vs. pressure. Footnote salinity bad.
113   Delta-S at 2785db is 0.0043. Autosal took 6 tries before getting a good reading. Salinity is also low compared with adjoining stations. Footnote salinity bad.
103   CTD Processor: "Oxy value low compared to CTD trace." CTDO Processor: "Looks like a dup draw of 102, low compared to CTDOXY at this level." Footnote O2 bad.

STATION 012

138   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Variation in CTD salinity uptrace at this sampling point, because the package has stopped to trip a bottle. Footnote CTD salinity bad, value is probably good on its own merit just not to compare with the bottle data. No CTDO is calculated because the CTD Salinity is coded bad.
126   CTDO Processor: "7 minute pause at 858db: spike in ctdoxy." Code CTDO questionable.
125   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 984db is 0.0141.
118   Sample Log: "Bottom o-ring." No samples were drawn.

STATION 013
Cast 1   Sample Log: "TCO2 collected in larger volume for ALK as well." sample log says box "C" for salts; asal output says box "Z"

135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Looks ok." Delta-S at 82db is -0.031. Salinity agrees with adjoining stations.

138   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Looks ok." Delta-S at 138db is 0.0478. Salinity agrees with adjoining stations. Feature in the CTD trace, both salinities are acceptable.

137   Sample Log: "Vent leak." Oxygen as well as other samples are acceptable. Salinity is a little low compared with adjoining stations, but agrees with CTD.

128   Delta-S at 670db is 0.0101. No analytical problem noticed. Agrees with adjoining stations, salinity is acceptable.

123   Sample Log: "Very stiff vent." Data are acceptable.

119   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 1871db is 0.008. Does not agree with adjoining stations, footnote salinity bad.

118   Delta-S at 2023db is 0.0036. Autosal took 3 tries before getting two readings to agree. Suspect salinity is high by ~0.001. Footnote salinity bad.

117   Delta-S at 2175db is 0.0041. Autosal took 3 tries before getting two readings to agree. Suspect salinity is high by ~0.001 to 0.002. Footnote salinity bad.

116   Delta-S at 2378db is 0.0041. Autosal took 5 tries before getting two readings to agree. Suspect salinity is high by ~0.001 to 0.002. Salinity is also high compared with adjoining stations. Footnote salinity bad.

107   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 3853db is 0.0075. Autosal took 4 tries before getting two readings to agree. Suspect salinity is high by ~0.004 to 0.005. High compared with adjoining stations. Footnote salinity bad.

105   Delta-S at 4057db is 0.0035. Autosal diagnostics indicate there is a problem with this sample. Suspect salinity is high by ~0.001 to 0.002. Appears a little high compared with adjoining stations. Footnote salinity bad.

STATION 014
139   Oxygen: "Sample no good?: analyst possibly added some thio when loading sample without adding acid, so oxy may be low." oxy ok, ml/l same as duplicate (135).

116   Sample Log: "Flowing slowly." Oxygen as well as other data appear acceptable.

112   Nuts values look too high, no obvious reason. Feature shows in salinity and oxygen as well as CTD data.

101-105 CTDO Processor: "2-10 minute pause at 4059/4482/4519db: ctdoxy fits high to bottom." Code CTDO questionable.

101   Sample Log: "Oxy flask number 1084 has cracked neck." Oxygen as well as other data appear acceptable. See 101 CTDO comment, code CTDO questionable.

STATION 015
Cast 1   Sample Log: "Tritium box Q006." Sample Log: "131 oxy drawn after 128 oxy, then 129,133,135,136."

131   Sample Log: "Freon drawn after 25, then 27 drawn, then dup freon drawn from 31."

118   Sample Log: "Top o-ring." No samples were drawn.

113   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 2878db is -0.0066. Autosal diagnostics indicate there is a problem with this sample. Footnote salinity bad.

112   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 3081db is -0.0047. Autosal diagnostics indicate there is a problem with this sample. Footnote salinity bad.
111   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 3233db is -0.0068. Autosal diagnostics indicate there is a problem with this sample. Footnote salinity bad.
110   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 3385db is -0.0062. Autosal diagnostics indicate there is a problem with this sample. Footnote salinity bad.

STATION 016
Cast 1   Sample Log: "No comments."
139   CTDO Processor: "Surface bottle o2 much higher than surrounding casts, before or after." No obvious analytical problem, could be drawing error. CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-39 db CTDO and bottle oxygen questionable.
126   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 861db is 0.0629. PI indicates in data processing notes to delete salinity. Footnote salinity bad.
125   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 987db is -0.0324. PI indicates in data processing notes to delete salinity. Footnote salinity bad.
115   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 2580db is -0.0101. Suspect this is the same salinity sample as 14. Either it was drawn incorrectly or inexperienced (non-ODF) salinity operator made a mistake. Footnote salinity bad.
112   Nuts values look high; no obvious reason. Oxy value looks low. Looks ok - see CTD trace. Bottle-CTD salt difference high compared to nearby bottles. CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 3189db is 0.0076. No analytical problem noted. Footnote salinity bad.
106   Salts: "Stby number noisy." Other Delta-S's are slightly negative, salinity appears low. See 103 CTDO comment; code CTDO questionable and salinity bad.
105   Delta-S at 4221db is -0.0037. Autosal took 3 tries before getting a good reading. See 103 CTDO comment; code CTDO questionable and salinity bad.
104   See 103 CTDO comment; code CTDO questionable.
103   Delta-S at 4398db is -0.0045. Autosal took 3 tries before getting a good reading. CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4110-4410 db (103-106) CTDO questionable. Footnote CTDO questionable and salinity bad.
101-102 CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4412-4582 db CTDO bad.

STATION 017
Cast 1   Sample Log: "No comments."
135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Looks ok." Delta-S at 85db is -0.0462. No analytical problem noted, salinity is acceptable.
118   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 2022db is 0.0062. Autosal took 5 tries before getting a good reading. Footnote salinity bad.

STATION 018

Cast 1   Sample Log: "TCO2 and ALK collected in same bottle." salts: "Change sample tube at sample 8." Three standard seawater run at end of salinity run. Suspect beginning seawater vial incorrect, applied an offset to entire station and assumed no drift. Data appears much better, agrees with CTD.

135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Looks ok." Delta-S at 83db is -0.0318. No analytical problem noted, salinity is acceptable.

137   PI: "PO4 value appears too high. Probably okay." Nutrient analyst: "Checked nut charts and computer reading, value appears real."

123   PO4: deformed peak, questionable, poss bubble in flowcell. Code PO4 questionable.

113   PI: "PO4 value appears too high. Probably okay." Nutrient analyst: "Checked nut charts and computer reading, value appears real."

110   PI: "PO4 value appears too high. Probably okay." Nutrient analyst: "Checked nut charts and computer reading, value appears real."

108   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 3851db is 0.0045. See Cast 1 salinity comment, this could have effected the sample, but even if the salinity bottle were open, the time until the sample was analyzed was minimal. Footnote salinity questionable.

STATION 019

Cast 2   Sample Log: "Start draw 2030z / end draw 2225z."

231   Sample Log: "Freon took several tries to avoid bubbles; spigot close to pinger."

224   Sample Log: "Top o-ring unseated." No samples were drawn.

219-223   Sample Log: "New tritium box 0036 beginning sample 219."

219   Oxygen: "Low endpoint." PI: "Oxy conc. appears ok."

STATION 020

Cast 1   Sample Log: "Start draw 0150z / end draw 0310z."

127   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 670db is 0.021. Autosal took 3 tries to get readings to agree. Based on PI data processing notes, and analytical problem, footnote salinity bad.

126   Sample Log: "Bottom o-ring." No samples were drawn.

120   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 1568db is 0.0053. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

113   Sample Log: "Top o-ring." No samples were drawn.

104-106   See 103 CTDO comment; footnote CTDO questionable.

103   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 4395db is 0.0053. Autosal took 7 tries before getting a good reading. CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 3988-4470 db (103-106) CTDO questionable and salinity bad.

102   No nuts drawn, sampling error.

101-102   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4472-4600 db CTDO bad.

STATION 021

118   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 2093db is 0.0063. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

102   Sample Log: "Top o-ring; salts/nuts not recorded on log, but samples apparently drawn anyway." Delta-S at 4404db is 0.1127. Oxygen not drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

STATION 022

Cast 1   Sample Log: "Start draw 1910z / end draw 2015z."

102   Sample Log: "Switched with bottle 39 this cast (surface bottle) top o-ring unseated; freon/o2 samples taken shortly after rosette retrieval." Oxygen is a little low compared with adjacent stations, but would be high if there were a bottle problem.

135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 76db is -0.0686.

138   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."

132   Sample Log: "Bottom o-ring unseated." No samples were drawn.

122   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 1295db is -0.0153. Autosal diagnostics indicate there is a problem with this sample. Footnote salinity bad.

104   Oxygen: "Air bubble." O2 value very slightly high. PI: "Code 4, oxygen bad." Delta-S at 4017db is -0.003.

139   Sample Log: "Switched with bottle 2 this cast to get freon blank on white bottle number 39 in deep water."

101   Delta-S at 4226db is 0.0032. Problem with getting a good reading is indicated on salinity run. Salinity is out of spec, does not indicate a problem with the bottle. Other data are acceptable. Footnote salinity bad.

STATION 026

Cast 1   Sample Log: "All bottles tripped at 3750 Meters." Salts: "Samples first run on asal 48-266 - use these values re-run on asal 48-263 for asal check - some samples ran out of water; use asal 48-263 for next few casts."

138   Sample Log: "Duplicate oxy with flask 1423 to check flask factor."

141   Marine tech log: "Bottle number 41 replaces number 32." CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 3794db is 0.0054. Suspect an analytical problem, this sample could not be rerun. Footnote salinity bad.

112   PI: "PO4 too high." Nutrient analyst: "No obvious analytical error." PI: "Footnote PO4 bad."

110   Sample Log: "Top o-ring unseated." Delta-S at 3795db is 0.0209. salt too high compared with all other salts at same level. sil value low, PO4 value high. PI: "Delete nuts." Oxygen never drawn. Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

108   Sample Log: "Valve hard to open." Oxygen as well as other data are acceptable.

102   Sample Log: "Duplicate oxy with flask 786 / stopper 1215(call flask 9786) to check flask factor."

STATION 028

Cast 1   Sample Log: "TCO2/ALK sampled together (ALK before nuts/salts)." salts: switch to autosal 48-263

135   Sample Log: "Bottom o-ring leak." Marine tech log: "Top o- ring leak, lanyard stuck." No samples were drawn.

131   Sample Log: "Top o-ring unseated." No samples were drawn.

129   Sample Log: "Air leak, top o-ring leak." No samples were drawn.

128   Sample Log: "Bottom lid cracked; try sampling anyways." Oxygen appears a little low compared with adjoining stations, but would be high if there were a leak. Other data are acceptable.

STATION 029

Cast 1   PI: "PO4 may be slightly low for station; appears too low when comparing theta/PO4 to theta/NO3 plots." PI: "Omitting this station for PO4 vertical section results in better agreement with NO3 vertical sections." Footnote PO4 questionable. Analyst: "PO4 baselines corrected, data ok now."

135   Sample Log: "Leaking/gushing out the bottom." No samples were drawn.

113   PI: "O2 slightly high relative to vertical trend. Check for bad analysis or draw temp." Oxygen analyst found flask mix- up, after correction data much better.

104-105 CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 3946-4158 db CTDO questionable.

101-103 CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4160-4662 db CTDO bad.

STATION 030

119   Sample Log: "Lanyard caught in cap, no samples taken." No samples were drawn.

STATION 031

Cast 1   Oxygen: "Oxygen system hung up during debubbling buret between samples 14/15; no samples lost.

135   Sample Log: "Lanyard problem." No samples were drawn.

106   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 3753db is 0.0073. Autosal took 3 tries to get readings to agree. Based on PI data processing notes and analytical problem, footnote salinity bad.

104   Sample Log: "No sample in nuts tube no.4 - drew sample from salt btl number 4 ~30 mins. after end collection time." Salinity and nutrients appear to be okay.

STATION 032

Cast 1   PI: "PO4 too high by about 0.1uM/kg when comparing theta/PO4 to theta/NO3 plots." Nutrient analyst: "No obvious analytical error. Hand recorded data also evaluated, shows same trend. PO4 Data not recoverable." PI: "Omitting this station from PO4 vertical section results in better agreement with NO3 vertical section." Footnote PO4 bad. salts: "Abort first run after worm and 1/2 101 used up." Problem with suppression switch on 48-263 asal where you can get 2 ranges confused (i.e. 1.9 to 2.0 switch).

139   Nuts: "39 collected/run - not recorded on sample log." See Cast 1 PO4 comment; code PO4 bad.

135   CTD Processor: "Bottle salt slightly low compared to CTD." Spike in CTD up trace. Bottle salinity agrees with Station 034, next station sampled at same pressure. No CTDO is calculated because the CTD Salinity is coded bad. See Cast 1 PO4 comment. Code CTD Salinity bad, CTD Oxygen not reported, and PO4 bad.

138   See Cast 1 PO4 comment; code PO4 bad.

133   See Cast 1 PO4 comment; code PO4 bad.

141   See Cast 1 PO4 comment; code PO4 bad.

131   See Cast 1 PO4 comment; code PO4 bad.

137   See Cast 1 PO4 comment; code PO4 bad.

119-129 See Cast 1 PO4 comment; code PO4 bad.

140   See Cast 1 PO4 comment; code PO4 bad.

112-117 See Cast 1 PO4 comment; code PO4 bad.
111   Delta-S at 3038db is 0.0037. Autosal took 3 tries before getting a good reading. Footnote salinity, PO4 bad.
109-110 See Cast 1 PO4 comment; code PO4 bad.
108   Delta-S at 3648db is 0.0041. Autosal took 3 tries before getting a good reading. Footnote salinity, PO4 bad.
106-107 See Cast 1 PO4 comment; code PO4 bad.
105   Delta-S at 4262db is 0.0036. Autosal took 5 tries before getting a good reading. Footnote salinity, PO4 bad.
104   Delta-S at 4416db is 0.0044. Autosal took 5 tries before getting a good reading. Footnote salinity, PO4 bad.
102-103 See Cast 1 PO4 comment; code PO4 bad.
101   Delta-S at 4918db is 0.0114. salts: "Sample half used up in aborted run before analysis." Salt value high compared to CTD, other deep salts; see Cast 1 comment, operator aborted the analysis to discuss the problem with the salinometer expert. Footnote salinity, PO4 bad.

STATION 033
Cast 1   PI: "PO4 too high by ~0.1uM/kg when comparing theta/PO4 to theta/NO3 plots." Nutrient analyst: "No obvious analytical error, hand recorded data also evaluated, shows the same trend. PO4 data not recoverable." PI: "Omitting this station from PO4 vertical section results in better agreement with NO3 vertical section." Sample Log: "Start draw 1127z/end draw 1310z." Footnote PO4 bad.
139   See Cast 1 PO4 comments, code PO4 bad.
135   Sample Log: "Bottom o-ring." No samples were drawn.
138   See Cast 1 PO4 comments, code PO4 bad.
133   See Cast 1 PO4 comments, code PO4 bad.
141   See Cast 1 PO4 comments, code PO4 bad.
131   See Cast 1 PO4 comments, code PO4 bad.
137   See Cast 1 PO4 comments, code PO4 bad.
129   See Cast 1 PO4 comments, code PO4 bad.
128   PI: "Nuts look low, dip at 450m on vertical section plots also." Nutrient analyst: "No obvious analytical error." Nutrient analyst: "NO3/sil/PO4 values look low, no obvious problem." Footnote nutrients bad, PI suggests deletion. Footnote PO4 bad, see Cast 1 PO4 comment.
119-127 See Cast 1 PO4 comments, code PO4 bad.
140   See Cast 1 PO4 comments, code PO4 bad.
104-117 See Cast 1 PO4 comments, code PO4 bad.
103   Sample Log: "Lanyard caught; apparently salts drawn even though not recorded on log." Delta-S at 4569db is 0.0115. salts: "Bottle 3 only 1/2 full - ?? sample." Salt value high compared to CTD, other deep salts; leaky bottle. Oxygen and nutrients were not drawn. Footnote bottle leaking, salinity bad, oxygen and nutrients not drawn.
102   PI: "O2 value high compared to CTD trace, nearby oxys." Oxy flask/drawT/voltage appear to be fine. Oxygen analyst: "No obvious analytical reason for high O2 value." See Cast 1 PO4 comments. Footnote oxygen and PO4 bad.
101   See Cast 1 PO4 comments, code PO4 bad. CTDO Processor: "yoyo 4775-4765db down; rise in ctdoxy." Code CTDO questionable.

STATION 034

Cast 2   CO log: "Cast 1 aborted cast at 500m/restart from surface as cast 2 - too many unscheduled/long winch stops."

242   No sample in tube number 35, sampler error. Nutrients were not drawn.

226   Sample Log: "Top/bottom o-rings both unseated." No samples were drawn.

203-207 See 201 CTDO comment; footnote CTDO bad.

202   CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 4777db is -0.0065. Salinometer took 4 readings before two agreed. Other data are acceptable. See 201 CTDO comment; footnote CTDO bad and salinity bad.

201   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 3756-4930 db (201-207) CTDO bad.

STATION 035

138   Sample Log: "Redrew oxy sample immediately after 1st draw - forgot to pickle sample first time."

142   Sample Log: "Lanyard in top cap, no good." No samples were drawn.

115   Delta-S at 2165db is -0.004. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

111   Delta-S at 2887db is -0.0037. No analytical problem noted. Salinity is acceptable.

109   Delta-S at 3294db is 0.0049. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

108   Shipboard Processor: "Circle at 3450m on sigma theta vertical section; sigma4 plot ok, salt value looks ok. Delta-S at 3498db is 0.0033. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

STATION 036

Cast 1   Sample Log: "Start draw 0620z/end draw 0750z."

131   Sample Log: "Top end cap problem." No samples were drawn.

129   Sample Log: "Top o-ring." No samples were drawn.

108   CO log/Sample Log: "Operator error, fired on the fly - do not sample (8)."

STATION 037

Cast 1   Sample Log: "Start draw 1230z TCO2/ALK drawn together (ALK before nuts/salt)."

142   Sample Log: "Vent not closed tightly." Marine tech log: "Number 42 air vent not tight enough." Samples were not collected per sampling schedule.

115   PI: "O2 slightly high." Footnote O2 questionable.

114   PI: "SIL is high relative to adjacent stations. Identical to the value for 13, NO3 and PO4 one also identical, but are in a low vertical gradient region. It appears that nutrients for bottle 14 were drawn from 13." Footnote nutrients bad.

113   Sample Log: "No nut sample collected from NB number 13; took some from salt sample."

106   PI: "O2 slightly high." Footnote O2 questionable.

STATION 038

142   Marine tech log: "Lanyard in top cap." CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok". Delta-S at 45db is -0.0308. Autosal took 3 tries before getting a good reading. This bottle appears to have had a problem on several stations. Oxygen could be a little high, nutrients appear acceptable for shallow data. Low salinity and high oxygen are consistent with a leak. But since PI notes indicate that salinity is okay, leave data as acceptable.

129	CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 549db is -0.0124. No analytical problem noted. Salinity agrees with adjoining stations. Salinity is acceptable.
128	Sample Log: "Bottom o-ring." No samples were drawn.
124	Sample Log: "Top o-ring." No samples were drawn.
102	PI: "O2 low." Footnote O2 questionable.

STATION 039

Cast 1	Sample Log: "Finished drawing 0340z."
142	Sample Log: "Lanyard in top cap." No samples were drawn.
123	PI: "Nuts too high - delete IF value stands as bad analysis." Nutrient analyst: "No obvious analytical reason for high nuts." Nuts appear as circle on vertical section. Footnote nutrients questionable.
119	CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 1869db is 0.0069. Autosal took 6 tries before getting a good reading. PI notes indicate salinity is okay, ODF would footnote this salinity bad, but PI says this salinity is okay. Salinity is also higher than adjoining stations. See 117 CTDOXY comment; code CTDO questionable.
140	Delta-S at 2022db is 0.0038. Salinity is acceptable, agrees with adjoining stations. See 117 CTDOXY comment; code CTDO questionable.
117	CTDO Processor: "2.5-min. stop at 1944-1950db, raw signal shifts; nearby area bad fit to T/C feature." Code 1862-2350 db CTDO questionable.
113	CTD Processor: "O2 value high compared to CTD trace, also on stas 40,43." Oxygen Analyst: "No obvious analytical reason for high O2 value." flask/drawT/voltage look ok. Suspect bottle 13 - fixed prior to sta 47. Footnote oxygen bad as PI asked it to be deleted.
112	Delta-S at 3240db is 0.0059. Autosal took 3 tries before getting a good reading. Does not agree with adjoining stations. Footnote salinity bad.
111	Delta-S at 3444db is 0.0035. Autosal took 5 tries before getting a good reading. Does not agree with adjoining stations. Footnote salinity bad.
110	CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 3648db is 0.0063. Autosal took 4 tries before getting a good reading. PI notes indicate salinity is okay, ODF would footnote this salinity bad, but PI says this salinity is okay. Footnote salinity questionable.

STATION 040

139	Sample Log: "Lanyard of bottle 1 in top cap; draw anyway." Oxygen not drawn. Data are acceptable.
142	Sample Log: "Question re: whether leaked vs outside condensation." CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks okay." No analytical problem noted.
129	Sample Log: "Lanyard of bottle 28 in top cap." No samples were drawn.
113	CTD Processor: "Oxy value high compared to CTD trace, also on stas 39,43." Oxygen analyst: "Oxy no obvious analytical reason for high O2 value." PI: "Footnote oxygen bad." Suspect bottle 13 - fixed prior to sta 47.

STATION 041

Cast 1	Sample Log: "Draw started about 1250z."

139   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 9db is -0.0344. Autosal took 3 readings before getting an agreement. Based on PI comment, salinity is acceptable.

142   CTD Processor: "Circle on prelim nuts/salt vertical sections at 50m; nuts look high compared with other nearby casts; delta-S is huge (-.746 prelim) even in high gradient area; oxy seems ok, but sigma for CTDOXY fit improves by 3x when value removed and then trace resembles nearby casts; note in 052/quality says bottle 42 replaced by 35 because leaky." PI: "All values bad." Delta-S at 51db is -0.532. Footnote bottle leaking, samples bad.

123   Delta-S at 1315db is 0.0071. No analytical problem noted. Salinity is acceptable.

112   Sample Log: "Oxy flask 856 is cracking on the top. Should not affect the sample."

STATION 042

Cast 1   Sample Log: "No comments."

115   CTD Processor: "Oxy value high compared to CTD trace." Oxy no obvious analytical reason for high O2 value. PI: "Footnote oxygen bad."

104   CTD Processor: "intermittent conductivity discontinuity not changed; 4670db down to bottom to 4702db up." No CTDO is calculated because the CTD Salinity is coded bad. Code CTD salinity bad and CTD oxygen not reported.

STATION 043

Cast 1   Sample Log: "Start draw 0202z; end draw 0410z ALK drawn with TCO2/same bottle for both."

125   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 1062db is 0.0098. No analytical problem noted. Salinity agrees with adjoining stations.

117   Delta-S at 2174db is 0.0031. No analytical problem noted. Salinity is acceptable.

113   CTD Processor: "Oxy value high compared to CTD trace, also on stas 39,40." oxy no obvious analytical reason for high O2 value. flask/drawT (in-line w/freon draw order)/voltage look ok. Suspect bottle 13 - fixed prior to sta 47. PI: "Code oxygen bad."

105   Sample log: "No nutrient sample drawn for number 5, got sample from salt bottle." Oxygen: "Bubble." Oxy value high (offscale) compared to CTD trace. Delta-S at 3904db is 0.0027. Autosal took 3 tries before getting a good reading. Salinity is acceptable, code oxygen bad.

STATION 044

101   Sample Log: "Oxygen sampled late." Oxygen appears acceptable.

STATION 045

Cast 2   Sample Log: "500ml sample taken for TCO2 to include ALK."

240   CTD Processor: "Oxy slightly high compared to CTD trace." PI: "Code oxygen bad."

225   Sample Log: "Drain cock open." Oxygen as well as other data are acceptable.

216   Oxygen: "Clump of kimwipe in sample during analysis oxy high compared to CTD trace." Footnote oxygen bad.

214-217 PI: "Rise in sigma4/theta on vertical section at 2600-3000m; circle/dip in vertical section for sigmatheta/salinity at 2700m. Data looks ok on property plots, Bottle-CTD delta-S values look good."

201   CTDO Processor: "Oxy slightly low compared to CTD trace." CTDO Processor: "Bottom bottle (O2) looks low compared to nearby casts. No structure at bottom visible in T/S." No analytical problem noted, but oxygen does not appear acceptable. Oxygen low by ~0.03 to 0.05 ml/l. Footnote oxygen bad.

STATION 046

120   Sample Log: "Air valve may not have been closed tightly." CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 2124db is 0.0047. No analytical problem noted.

117   PI: "High bottle salt (Delta-S +.040) compared to nearby bottles/ctd." Delta-S at 2733db is 0.0487. Footnote salinity bad.

101   Sample Log: "Forgot to purge oxy reagents before pickling 1." Oxygen is acceptable.

STATION 047

Cast 1   Sample Log: "Start draw 0705z; end 0910z TCO2 and ALK drawn in same bottle."

139   Sample Log: "1st keeling started 0857z."

133   CTD Processor: "Circle at 200m on prelim sigma theta vertical section plot; prelim delta-S is +.573 - high even for gradient area. Salinity matches salt value for bottle 138 (one up) - mis-draw? Delta-S at 175db is 0.5594. Footnote salinity bad.

129   Sample Log: "Lanyard in upper cap." No samples were drawn.

140   Delta-S at 2047db is 0.0037. PO4: "Bubble stuck in flow cell." Could not get a good peak reading. Footnote PO4 lost.

114-117 PO4: "Suspect bubble stuck in flow cell." Footnote PO4 lost.

113   Sample Log: "Drain valve and air vent replaced before this cast, to fix problem w/high oxy values on earlier stas."

111   Sample Log: "Replaced drain valve/air vent prior to cast 2nd keeling started 1756z/finished 0801z."

108   Sample Log: "Replaced drain valve/air vent prior to cast."

101   Sample Log: "Replaced drain valve/air vent prior to cast."

STATION 048

Cast 1   CO log: "double pdr trace at start, bottom reading uncertain." Sample Log: "Many very tiny bubbles coming out of MnCl2 for oxy; solns cold/inside to very hot outside air. Soln purged well."

139   Oxygen: "Bubble." PI: "O2 appears ok even though bubble in flask."

142   Oxygen: "Bubble." PI: "O2 appears ok even though bubble in flask."

131   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 335db is 0.0291. No analytical problem noted. There is a significant difference between the down and up trace CTD. Salinity is acceptable.

119   Nutrient Analyst: "Suspect bubble stuck in flow cell." Could not get a good peak reading. Footnote PO4 lost.

112   CTD Processor: "Bottle oxy high compared to CTD trace." flask/drawT ok; voltage 1.3 (vs 1.0 on other flasks or this flask on other station runs). Oxygen Analyst: "Air bubbles in MnCl2 could possibly cause high O2, no other analytical reason for high O2." Footnote oxygen bad.

102   Sample Log: "Oxy had to be drawn twice - bubbles in MnCl2."

101   Sample Log: "Oxy had to be drawn twice - drain cock loose, would not stay open."

STATION 049

Cast 1   Sample Log: "Begin draw 2300z/end draw about 0100z." Bottles were tripped in a special sequence for freon checks. The trip sequences, deepest to shallowest, were bottles 7-17, 40, 19-29, 37, 31, 41, 33, 38, 42, 39, and 1-6.

142   NO3/PO4 values look low, no obvious reason. SiO3 and other data appear to be okay. Oxygen is a little higher than adjoining stations. Data are acceptable.

137	CTD Processor: "Bottle oxy high compared to CTD trace." PI: "O2 appears high relative to CTD, but looks ok - does follow trend in high gradient region."
128	PI: "Oxygen appears high relative to adjacent stations. NO3 slightly low. CTD oxygen shows aa max at this level, so data is ok."
120	CTD Processor: "Bottle oxy high compared to CTD trace." Oxygen: "No obvious analytical reason for high O2 value." flask number/drawT/voltage look ok. PI: "Footnote oxygen bad."
112-113	CTDO Processor: "8 minute pause at 4416db, drop in ctdoxy." Code CTDO questionable.
106	Sample Log: "Bottom o-ring leak, no gases taken - tried to get salts/nuts, but no water left at drawing time." No samples were drawn.

STATION 050

139	Oxygen: "Dirt in sample." PI: "Oxygen seems ok."
142	Sample Log: "Possible leak?." PI: "Samples appear ok."
125	Nuts values look high, similar to bottle number 27, misdraw? PI: "Nuts too high, flag as bad." Dip in vertical section for nuts at this level.
119	Delta-S at 2024db is 0.0029. No analytical problem noted. Salinity agrees with adjoining stations.
117	Delta-S at 2429db is -0.0026. No analytical problem noted. Salinity agrees with adjoining stations. CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.
116	CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.
115	Delta-S at 2835db is -0.0037. No analytical problem noted. Salinity agrees with adjoining stations. CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.
114	Delta-S at 3039db is -0.0041. No analytical problem noted. Salinity agrees with adjoining stations. CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.
113	Delta-S at 3243db is -0.0049. No analytical problem noted. Salinity agrees with adjoining stations. CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.
112	CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Bottle salinity is high compared with station profile and adjoining stations vs. Potemp, but agrees with Station 051 and 052 vs. Pressure. No CTDO is calculated because the CTD Salinity is coded questionable. Footnote CTD salinity questionable, CTD Oxygen not reported, and bottle salinity questionable.
111	Delta-S at 3651db is -0.0052. No analytical problem noted. Salinity agrees with adjoining stations. CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.

110   Delta-S at 3855db is -0.0051. No analytical problem noted. Salinity agrees with adjoining stations. CTD Processor: "The upcast is offset from the downcast; suspect a problem with the CTD." Code CTD salinity questionable. No CTDO is calculated because the CTD Salinity is coded questionable.

101   CTD Processor: "Bottle oxy looks a little high compared to CTD trace." PI: "O2 probably ok." Wrong oxygen flask entered in data file. Oxygen is acceptable after correction.

STATION 051

Cast 1   Sample Log: "TCO2/ALK drawn in same bottle." Comments regarding PDR info: "352 more m of wire out than pdr depth w/no wire angle."

142   Sample Log: "Has a leak in upper cap." No samples were drawn. Marine tech log: "42 leaks from top valve."

140   Delta-S at 2125db is 0.0352. salts: "Low-volume sample." Circle on sigma theta/salinity vertical section at 2100m. 0.027 higher Bottle-CTD delta-S than nearby bottles. High oxy. PI: "O2 value probably real, no flag." PI: "Code salinity bad."

116   Sample Log: "Oxy drawn before freon." Delta-S at 2531db is0.032. Circle on sigmatheta/salinity vertical section at 2500m. 0.027 higher Bottle-CTD delta-S than nearby bottles. PI: "Code salinity bad."

112   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."

105   Marine tech log: "Sticky valve." Sample Log: "Check endpoint."

104-106   CTDO Processor: "Upcast; won't fit correctly." Code 3910-4550 db CTDO questionable.

101-103   CTDO Processor: "Bottom 3 bottles (O2) look high compared to nearby casts, but line up well with each other." No analytical problem noted. PO4 and salinity are slightly lower than adjoining stations and NO3 and SiO3 are very slightly higher. Draw temperature for bottle 01 does appear ~0.2 high. Oxygen is acceptable.

101   No salinity analytical problem noted. Salinity is acceptable.

STATION 052

Cast 1   Marine tech log: "Mer cast simultaneously." Sample Log: "Assume nuts/salts drawn even though not logged. Oxy flask number messup on sample log, posns 7-22. Sample cop could have helped keep this straight."

139   CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach; noisy signal." Code 0-36 db CTDO bad.

135   CO log/Sample Log: "Bottle 35 replaces 42 beginning this cast." CO log: "Bottle 42 was leaky." See 139 CTDO comment; code CTDO bad.

123   Sample Log: "Lanyard in upper cap." No samples were drawn.

110   CTD Processor: "Bottle oxy looks high compared to CTD trace." flask/drawT/voltage all look ok (despite flask number confusion on Sample Log - Sample Log probably corrected ok). Oxygen: "Lab temperature rose 3 to 5 degrees during this station run. No other obvious analytical reasons for high O2 value." PI: "Code oxygen bad."

103   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4472-4570 db CTDO questionable.

101-102   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4572-4820 db CTDO bad.

STATION 053

Cast 1   Sample Log: "Start drawing after 0050z/end drawing about 0300z."

135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 41db is -0.054. No analytical problem noted.

137   PI: "NO3 appears slightly high; suspect trend real." Nutrient analyst: "Trend also seen in other stas."
129   Sample Log: "Lanyard in top cap." No samples were drawn.
116   CTD Processor: "Bottle oxy looks low compared to up/down CTD trace." PI: "CTD vertical trend is in agreement w/nut profile here." Oxygen: "No obvious analytical reason for low O2, some variation in lab temperature." PI: "Code oxygen bad."
112   Sample Log: "Bottom o-ring." No samples were drawn.
101-102 CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4906-5312 db CTDO bad.

STATION 054
Cast 1   Sample Log: "No sampler initials, no nuts/salts logged, no bottle number's updated on form."
139   CTDO Processor: "Upcast; slowdown near surface, won't fit correctly." Code 0-50 db CTDO questionable.
135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." See 139 CTDO comment; code CTDO questionable.
129   Sample Log: "Lanyard from 28 caught in top end cap." No samples were drawn.
101-104 CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4660-5102 db CTDO bad.

STATION 055
Cast 1   Sample Log: "500ml TCO2 samples include water for TALK."
139   CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-40 db CTDO bad.
135   Sample Log: "Bottom o-ring." No samples were drawn.
124   Delta-S at 1062db is 0.005. Autosal took 3 tries before getting a good reading. Footnote salinity bad.
140   CTD Processor: "Bottle oxy looks slightly high compared to CTD trace." flask ok; drawT high, may be due to odd draw order w/freons; voltage 1.4 vs 1.0 on nearby flasks; odd voltage on runs before and after this one for same flask. Oxygen: "Check flask 739 for odd voltage/ O2 values, may be bad glass for UV endpoint. No other analytical reason for high O2 value." PI: "Code oxygen bad."
114   CTD Processor: "Circle on oxy vertical section; ok vs CTD - oxy bends out here." PI: "Salt and oxy slightly low, nuts slightly high. Appears as an anomaly on vertical sections. Possibly leak, check against CTD salts." PI: "CTD trace indicates feature is real."
101   PI: "Bend in sigma4 at bottom of vertical section plot - looks ok." CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4010-4028 db CTDO bad.

STATION 056
139   CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-52 db CTDO bad.
122   Sample Log: "Lanyard problem." No samples were drawn.
121   Sample Log: "Lanyard problem." No samples were drawn. Marine tech log: "22's bottom lanyard caught in 21's top."
101   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4470-4630 db CTDO bad.

STATION 057

Cast 1   Sample Log: "Start draw 0445z;end draw about 0645z oxy draw on 3-5,8 done after 1-2 and 9-10."

139   CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-44 db CTDO bad.

135   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 46db is 0.0284. No analytical problem noted.

133   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."

128   Sample Log: "Bottom end cap leak." No samples were drawn.

113   Delta-S at 2479db is 0.0041. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

112   Sample Log: "Draw temp for oxy taken just after flask pickled."

105   Delta-S at 3753db is 0.0032. Salinity is out of specifications, but usable. Code salinity questionable.

101   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4262-4278 db CTDO bad.

STATION 058

139   CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-42 db CTDO bad.

135   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."

123   Sample Log: "Therm rack lanyard from 24 stuck in top end cap." No samples were drawn.

119   CTD Processor: "Bottle oxy looks slightly high compared to CTD trace." flask/drawT/voltage look ok. Oxygen:" no obvious analytical reason for high O2 value." PI: "Code oxygen bad."

105   PI: "Salt too low - bad analysis?" CTD Processor: "No notes on salt run, definitely low compared to CTD; maybe cap on salt sample bottle not sealed properly? Circle on vertical section plot in sigmatheta/sigma4 at 4100m; large/-.046 delta-S (vs near-0 for other bottles)." Delta-S at 4156db is -0.056. No analytical problem noted. PI: "Code salinity bad."

101-102 CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4570-4820 db CTDO bad.

STATION 059

139   CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-42 db CTDO bad.

135   Sample Log: "Open vent." No samples were drawn.

138   Sample Log: "2-liter sample for bio-optics."

133   Sample Log: "Bottom o-ring." No samples were drawn.

124   Sample Log: "Therm did not reverse."

123   Sample Log: "Therm rack lanyard caught in top end cap, leaked." No samples were drawn.

101   CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4218-4312 db CTDO bad.

STATION 060

Cast 1   Sample Log: "No comments."

139	CTDO Processor: "Upcast; surface fit off - bottle stops/surface approach." Code 0-32 db CTDO bad.
135	CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."
133	CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."
109	CTD Processor: "Inflection on sigmatheta vertical section plot at 3100m+ slightly low delta-S (-.008 compared with nearby bottles)." Delta-S at 3191db is -0.0109. Autosal diagnostics indicate there is a problem with this sample. PI: "Code salinity bad."
106	CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." No salinity analytical problem noted.
101	CTDO Processor: "Upcast; bottom drifts high, won't fit correctly." Code 4316-4466 db CTDO bad.

STATION 061

Cast 1	Marine tech log: "Replaced CTD number 10 with CTD number 4." Sample Log: "Start draw 0500; end draw 0645."
135	CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 51db is 0.03.
138	CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 85db is -0.0292. No analytical problems noted. Salinity appears to agree with trend of next couple of stations.
109	Sample Log: "Air vent open." No samples were drawn.

STATION 062

Cast 1	Sample Log: "Start draw abt. 1050z; end draw abt. 1230z TCO2/ALK sampled in same bottle."
133	PI: "High bottle salt in high gradient region, probably ok." Nothing unusual noted re: sampling, salt run or this btl. CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 126db is 0.1207. No analytical problem noted. Salinity follows trend of Station 063.
140	See 110 PI PO4 comment. Footnote PO4 questionable.
111-117	See 110 PI PO4 comment. Footnote PO4 questionable.
110	PI: "PO4 appears low by .03uM/kg when comparing theta/PO4 to theta/NO3 plots." Nutrient analyst: "No obvious bubble problems; these PO4 values appear to not line up w/NO3. Baselines are jagged as if bubble possibly in flow cell for entire run, but no bubbles came through. Footnote PO4 questionable.

STATION 063

| 138 | Sample Log: "2 liters drawn for bio-optics/CK." |

STATION 064

Cast 1	Sample Log: "Start draw 2300z, end draw about 0050z draw order for oxy samples also recorded TCO2/ALK drawn in sequence, before nuts/salts."
112-115	See 108 PO4 comment; code PO4 bad.
111	Sample Log: "May have had a lanyard in top end cap - discovered when cocking rosette for next cast." salts high, oxy/nuts low - assume bottle leaked per above comment Delta- S at 2681db is 0.1477. See 108 PO4 comment; code PO4 bad. Footnote bottle leaking, samples bad.

110 Delta-S at 2884db is 0.0035. Autosal took 3 tries before getting a good reading. CTD Processor: "Bottle oxy looks high compared to CTD trace." flask/drawT/voltage look ok. Oxygen: "Voltage slightly low compared to other samples, but no other obvious analytical reason for high O2 value." PI: "Code oxygen bad." See 108 PO4 comment; code PO4 bad. Code salinity questionable, oxygen and PO4 bad.

108-109 PO4 appears low by .06uM/kg when comparing theta/PO4 to theta/NO3 plots. Possible bubble in flow cell. Footnote PO4 (108-115) bad.

STATION 065

Cast 1   Sample Log: "Begin draw 0450z; end draw 0600z."

133   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."

125   Sample Log: "Bottom o-ring." No samples were drawn.

STATION 066

Cast 1   Sample Log: "No box ids written down start draw about 1015z; end draw 1151z TCO2/ALK drawn in same bottle all oxys sampled immediately after freon sampled." Oxygen: "No second shake on samples added MnCl2 and NaOH/NaI before this station."

133   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok." Delta-S at 155db is 0.03. No analytical problem noted.

112   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 2629db is 0.0057. Autosal took 3 tries before getting a good reading. This would account for the higher salinity Code salinity bad.

STATION 067

139   Sample Log: "Possible oxy flask mixup near end: drew extra samples from 39 in case 35 drawn 2x and 39 was missed."

140   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 1920db is 0.0054. Autosal took 4 tries to get readings to agree, this is usually an indication that the salinity would be bad. Footnote salinity bad.

114   Sample Log: "Tripped on the fly, do not sample."

111   inflection in sigmatheta vertical section at 2900-m. slightly high delta-S (.006) compared with nearby bottles.
       Could possible be a drawing error with bottle 12. Delta-S at 2881db is 0.0062. PI: "Footnote salinity bad."

STATION 068

Cast 1   Sample Log: "Single 500ml samples taken for TCO2/ALK."

139   Sample Log: "Bottle (39) did not trip."

135   See 131 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

138   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 77db is -0.0268. Variation in CTD salinity uptrace at this sampling point, because the package has stopped to trip a bottle. Value is probably good on its own merit just not to compare with the bottle data. CTD Processor: "Note shiproll 'noise' in conductivity signal-actually seeing different water in thermocline." No CTDO is calculated because the CTD Salinity is coded bad. See 131 bottle tripping comment; code bottle did not trip correctly, CTD salinity bad and CTD Oxygen lost; bottle data is acceptable.

133   See 131 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

141   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." See 131 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

131   It appears that a bottle (31) should have been tripped at400db and it was not. There should have been 36 bottles tripped and there were only 35. Therefore, bottles 31, 41, 33, 38, and 35 were all tripped one level shallower than originally intended and bottle 39 was not tripped at all. Code bottle did not trip correctly, but all data is acceptable as pressure reassigned.

125   Sample Log: " therm lanyard from 24 caught under top cap." No samples were drawn.

STATION 069

Cast 1   Sample Log: "Start draw 0540z; end draw 0700z."

121   Sample Log: "Noticeable leak, lanyard from 20 in top end cap." No samples were drawn.

STATION 070

131   Sample Log: "Bottom o-ring/cap not seated." No samples were drawn. Marine tech log: "Top end cap not seated."

STATION 071

131   Sample log/Marine tech log: "Bottom o-ring unseated, crack in cap." No samples were drawn.

111   Delta-S at 3550db is 0.1545. Nutrients: "Sil value looks very low, reran, value appears real." Plot shows ALL nut values are off. Oxy low/salt high compared to CTD - bottle mistripped? Footnote bottle leaking, samples bad.

STATION 072

Cast 1   Sample Log: "Start draw 0340z/end draw 1520z."

138-139 CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-90 db CTDO bad.

135   Sample Log: "Leak in top end cap, o-ring problem." No samples were drawn. See 138-139 CTDO comment; code CTDO bad.

105   CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 3905db is 0.0047. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

STATION 073

Cast 1   Sample Log: "Start draw 0950z/end draw ?."

102-116 See 101 PI PO4 comment. Data OK now.

101   PI: "PO4 appears 0.06uM/kg too low for deep water relative to NO3 on PO4 and NO3 vs theta plots." Nutrient analyst: "Stds high for this run, data ok after stds adjusted." Data OK now.

STATION 074

Cast 1   salts: labT jumped 20.5 to 25.0 mid-run when a/c turned off returned to 22.2 by end-run. +8 drift. Rerun? (bath was still cycling during the temp. change). salts vs CTD - look normal, ok as-is, rerun not necessary. Sample Log: "500 ml samples for Total CO2, includes TALK."

122   Sample Log: "Bottle leaked due to suspect bottom o-ring seal." No samples were drawn. Marine tech log: "Lanyard hung up."

105   CTD Processor: "Bottle oxy high compared to CTD (down or up trace)." Oxygen Analyst: "No obvious analytical problem." PI: "Code oxygen bad."

STATION 075

126   Sample Log: "O2 sample from second draw, bad pickling on 1st try."

STATION 076

Cast 1   Sample Log: "Start draw 0727z; end draw ?." Salt Box L had consistent problems with loose salt bottle inserts. Box "retired" after station 109.

139   CTDO Processor: "Slow start at surface, signal looks low." Code 0-50 db CTDO bad.

124   Analyst error running sample, not enough to rerun, no data. Footnote nutrients lost.

116   PI: "SIL appears too high; all nuts from bottles 15/16 are identical, suggesting that sample 16 was misdrawn from bottle 15." Nutrient analyst: "No obvious analytical error." PI: "Code nutrients bad."

113   CTD Processor: "Salt slightly high relative to CTD." Salts: "3 flushes to get 2 readings, no other analysis problems." Delta-S at 2502db is 0.008. PI: "Code salinity bad."

103   Data Processor: "Salt slightly high relative to CTD." Salts: "6 flushes to get 2 readings due to unstable/decreasing labT." Delta-S at 4287db is 0.006. Footnote salinity bad.

101-103 Salts: "Abort 1st run after sample 3: room T/cell-fill problems: asal 48-266/24 degC. Room T dropped 1 degC in first 3 samples. Reran entire box on asal 48-263, (preset at 21 degC for several days)." Use 1st run values: end worm/sample. Values look ok.

STATION 077

139   CO log/Sample Log: "Bottle (39) not tripped/never triggered."

135   CO log: "CTD trip info is not from time of trip, but from failed trip attempt several minutes before. Bottle was triggered directly from pylon deck unit." Sample Log: "Extra nuts sample taken on number 35." CTDO Processor: "Slow start at surface, signal looks low." Code 0-60 db CTDO bad. See 137 tripping comment, code bottle did not trip as scheduled, and CTDO bad.

138   See 137 tripping comment, code bottle did not trip as scheduled.

133   See 137 tripping comment, code bottle did not trip as scheduled.

141   Oxygen: "Cardboard in water bath around flask during analysis." Oxygen appears to be okay. See 137 tripping comment, code bottle did not trip as scheduled.

131   See 137 tripping comment, code bottle did not trip as scheduled.

137   Two levels were skipped, 461db and 385db. Code bottles (37, 31, 41, 33, 38, and 35) did not trip as scheduled, data appears acceptable as pressures are assigned, unless otherwise noted.

129   CO log: "Bottle (29) not tripped - bad confirm, skipped over position using pylon diagnostics window."

111   Sample Log: "Lanyard hung up in end cap." No samples were drawn.

STATION 078

Cast 1   Sample Log: "500 ml sample taken for TCO2 - includes TALK aliquot start draw ~2100Z/end ~2245Z (O2 drawn after freon) draw order 40-1,36-19 (40 surface, 19 bottom)." PI: "PO4 appears slightly high compared to NO3 on PO4 and NO3 vs theta plots." PI: "Ignore, less than 1% error."

125   CTD Processor: "Bottle oxy slightly high compared to CTD." Oxygen: "No obvious analytical problem." PI: "Oxygen too high relative to CTD and does not follow oxygen and nutrient vertical trend. Code as 4."

113   Sample Log: "Top oring problem." No samples were drawn.

STATION 079

Cast 1   Sample Log: " draw time starts 0402z, ends 0520z." CTD Processor: "Entire profile of bottle salts low relative to CTD." Changing area, could be okay. Standby number changed by 5 units, this would affect the salinity (if incorrect) by0.0005 and does not account for the difference here. Footnote salinity questionable.

139   CTDO Processor: "Slow start at surface, signal looks low." Code 0-22 db CTDO bad. See Cast 1 salinity comment, footnote salinity questionable.

135   See Cast 1 salinity comment, footnote salinity questionable.

138	See Cast 1 salinity comment, footnote salinity questionable.
133	Autosal took 3 tries before getting a good reading. Delta-S at 214db is -0.0045. Footnote salinity bad.
141	See Cast 1 salinity comment, footnote salinity questionable.
131	See Cast 1 salinity comment, footnote salinity questionable.
137	See Cast 1 salinity comment, footnote salinity questionable.
129	See Cast 1 salinity comment, footnote salinity questionable.
128	Autosal took 3 tries before getting a good reading. Delta-S at 697db is -0.0015. Footnote salinity bad.
124-127	See Cast 1 salinity comment, footnote salinity questionable.
123	Delta-S at 1252db is -0.0083. See Cast 1 salinity comment, footnote salinity questionable.
122	See Cast 1 salinity comment, footnote salinity questionable.
121	Delta-S at 1499db is -0.006. Autosal took 3 tries before getting a good reading. Footnote salinity bad.
119-120	See Cast 1 salinity comment, footnote salinity questionable.
140	See Cast 1 salinity comment, footnote salinity questionable.
117	salts: "Manual entry - cell fill problem, ran out of sample." Delta-S at 2097db is -0.0055. Autosal took 3 tries before getting a good reading. Footnote salinity bad.
116	See Cast 1 salinity comment, footnote salinity questionable.
115	Delta-S at 2376db is -0.0037. Autosal took 4 tries before getting a good reading. Footnote salinity bad.
114	Delta-S at 2503db is -0.0051. See Cast 1 salinity comment, footnote salinity questionable.
113	Delta-S at 2654db is -0.0034. See Cast 1 salinity comment, footnote salinity questionable.
112	See Cast 1 salinity comment, footnote salinity questionable.
111	Delta-S at 3011db is -0.0034. Autosal took 3 tries before getting a good reading. Footnote salinity bad.
110	Delta-S at 3214db is -0.0061. See Cast 1 salinity comment, footnote salinity questionable.
109	Delta-S at 3392db is -0.0049. Autosal took 3 tries before getting a good reading. Footnote salinity bad.
108	Delta-S at 3469db is -0.0064. See Cast 1 salinity comment, footnote salinity questionable.
107	Delta-S at 3648db is -0.0049. See Cast 1 salinity comment, footnote salinity questionable.
106	See Cast 1 salinity comment, footnote salinity questionable.
105	Delta-S at 4057db is -0.0039. See Cast 1 salinity comment, footnote salinity questionable.
104	See Cast 1 salinity comment, footnote salinity questionable.
103	Delta-S at 4467db is -0.0047. See Cast 1 salinity comment, footnote salinity questionable.
102	Delta-S at 4672db is -0.0036. See Cast 1 salinity comment, footnote salinity questionable.
101	See Cast 1 salinity comment, footnote salinity questionable.

STATION 080

Cast 1   Sample Log: "Sampling order followed freon more or less see sample log for draw order. Drawing started at ~1030Z, and ended ~1210Z." CTD Processor: "Entire profile of bottle salts low relative to CTD." Changing area, could be okay. Standby number changed by 4 units from the next run, this would affect the salinity (if incorrect) by 0.0004, which would make little effect. Suspect this is operator inexperience and salinity is just not within specs, not a problem with the bottles. There were many multiple readings by the salinometer. Footnote salinity questionable. Console Ops: "Two bottles were open at surface check, one was subsequently tripped making only 35 bottles for this cast. Reviewed tripping file and found that bottle 26 did not trip as intended, but did trip later." Footnote bottles 26-29,37,31,41,33,38, and 35 did not trip as scheduled. Bottles and data are correct at reassigned pressures.

139   CO log: "Bottle (39) not tripped/never triggered." There was a tripping problem, and there will be only 35 bottles.

135   CTDO Processor: "2-min. stop at 28-32db distorted surface fit." Code 0-32 db CTDO bad. See Cast 1 bottle and salinity comment. Footnote bottle did not trip as scheduled; CTDO bad, and salinity questionable.

138   See Cast 1 bottle and salinity comments. Code bottle did not trip as scheduled and salinity questionable.

133   See Cast 1 bottle and salinity comments. Code bottle did not trip as scheduled and salinity questionable.

141   See Cast 1 bottle and salinity comments. Code bottle did not trip as scheduled and salinity questionable.

131   Sample Log: "Top o-ring problem." Marine tech log: "Top end cap cracked." No samples were drawn.

137   See Cast 1 bottle and salinity comments. Code bottle did not trip as scheduled and salinity questionable.

129   Delta-S at 380db is -0.0031. Autosal took 4 tries before getting a good reading. Footnote salinity bad.

128   Delta-S at 455db is -0.0027. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

124-127 See Cast 1 salinity comment; footnote salinity questionable.

123   Delta-S at 1070db is -0.0041. Autosal took 4 tries before getting a good reading. Footnote salinity bad.

122   See Cast 1 salinity comment; footnote salinity questionable.

121   Delta-S at 1374db is -0.0047. Autosal took 4 tries before getting a good reading. Footnote salinity bad.

120   See Cast 1 salinity comment; footnote salinity questionable.

119   Delta-S at 1615db is -0.0008. Autosal took 4 tries before getting a good reading. Footnote salinity bad.

140   See Cast 1 salinity comment; footnote salinity questionable.

117   See Cast 1 salinity comment; footnote salinity questionable.

116   Delta-S at 1969db is -0.0062. Autosal took 5 tries before getting a good reading. Footnote salinity bad.

115   Delta-S at 2071db is -0.0047. See Cast 1 salinity comment; footnote salinity questionable.

114   Delta-S at 2173db is -0.0056. See Cast 1 salinity comment; footnote salinity questionable.

112-113 See Cast 1 salinity comment; footnote salinity questionable.

111 Sample Log: "Lanyard in top lid." No samples were drawn.

110 Delta-S at 2705db is -0.0027. Autosal took 3 tries before getting a good reading. Code salinity bad.

109 Delta-S at 2832db is -0.0062. See Cast 1 salinity comment; footnote salinity questionable.

108 Nuts: "Nut tubes 8 & 9 were in reverse order in the nuts rack after sampling." Nutrients are acceptable. Delta-S at 2985db is -0.0044. See Cast 1 salinity comment; footnote salinity questionable.

107 See Cast 1 salinity comment; footnote salinity questionable.

106 Sample Log: "Very small bubble in freon syringe 5569." See Cast 1 salinity comment; footnote salinity questionable.

104-105 See Cast 1 salinity comment; footnote salinity questionable.

103 Delta-S at 3698db is -0.0037. Autosal took 3 tries before getting a good reading. Code salinity bad.

101-102 See Cast 1 salinity comment; footnote salinity questionable.

STATION 081
Cast 1 Sample Log: "No comments."

STATION 082
Cast 1 Sample Log: "50 ml aliquot taken for TCO2 to include TALK."

138 Sample Log: "Bottom end cap did not seat well." Oxygen appears slightly high compared with adjoining stations. However, it does appear to agree with CTDO. Data are acceptable.

125 Sample Log: "Lanyard in top cap." No samples were drawn.

112 Sample Log: "Bottom o-ring problems." No samples were drawn.

STATION 083
Cast 1 Sample Log: "Drawing started ~0600Z, ended ~0725Z." Salt Box L prone to loose salt bottle inserts - box "retired" after station 109.

119 PI: "Salt value high relative to CTD." Salts: "3 unit diffc in C-ratio readings, 3 flushes for 2 readings." Delta-S at 2092db is 0.009. Footnote salinity bad.

107 PI: "Salt value slightly high relative to CTD." No obvious analysis problem. Delta-S at 3953db is 0.0053. Footnote salinity questionable.

102 Delta-S at 4774db is 0.0033. Autosal took 3 tries before getting a good reading. Footnote salinity bad.

STATION 084
Cast 1 Sample Log: "Drawing started abt. 1145z. Exact draw order within oxy, nuts, salts sampling also recorded." Analyst: New cd column installed, samples run before column stable." Footnote NO3 questionable. Comments from PDR watchstander: "pdr bottom depth dropped during upcast."

139 See Cast 1 nutrient comments; code NO3 questionable.

135 Salinity analyst: "Low sample volume." Salt value same as Sta 77 bottle 35, last time box P used and low sample volume= perhaps sample was never drawn. Salinity not drawn, error in sampling. See Cast 1 nutrient comments; code NO3 questionable.

138 See Cast 1 nutrient comments; code NO3 questionable.

133 See Cast 1 nutrient comments; code NO3 questionable.

141 See Cast 1 nutrient comments; code NO3 questionable.

131 See Cast 1 nutrient comments; code NO3 questionable.

137   See Cast 1 nutrient comments; code NO3 questionable.
119-129 See Cast 1 nutrient comments; code NO3 questionable.
140   See Cast 1 nutrient comments; code NO3 questionable.
101-117 See Cast 1 nutrient comments; code NO3 questionable.
STATION 085
Cast 1   Sample Log: "Start draw 1855z/end draw 1925z." Nutrient Analyst: "Samples run before new cd column was stable." Footnote NO3 questionable.
139   See Cast 1 nutrient comments; code NO3 questionable.
135   CTDO Processor: "Surface bottle looks high on overlays compared to nearby casts." No analytical problem noted. Code O2 questionable. See Cast 1 nutrient comments; code NO3 questionable.
138   See Cast 1 nutrient comments; code NO3 questionable.
133   See Cast 1 nutrient comments; code NO3 questionable.
141   See Cast 1 nutrient comments; code NO3 questionable.
131   See Cast 1 nutrient comments; code NO3 questionable.
137   See Cast 1 nutrient comments; code NO3 questionable.
119-129 See Cast 1 nutrient comments; code NO3 questionable.
140   See Cast 1 nutrient comments; code NO3 questionable.
101-117 See Cast 1 nutrient comments; code NO3 questionable.
STATION 086
Cast 1   Sample Log: "Start draw at 2350z 500ml volumes taken for TCO2/inc. TALK aliquot."
STATION 087
Cast 1   Sample Log: "Draw started abt 0545z; ended abt 0730z."
STATION 088
Cast 1   Marine tech log: "Pinger died? very slow ping on deck upon recovery."
139   Sample Log: "Hg thermometer check on oxy draw temp - same T leaks/bottom o-ring (or upper o-ring?) oxy/nuts/salts apparently drawn anyways." PI: "Although bottle leaked from bottom when vent opened, samples are ok since this was a surface bottle."
138   Sample Log: "Leaks, top wasn't seated - o-ring?." No samples were drawn.
123   Sample Log: "Open vent." No samples were drawn.
122   CTD Processor: "Bottle oxy high compared to CTD trace; maybe dup draw from 120." PI: "Code oxygen bad." Sample Log: "Hg thermometer check on oxy draw temp - same T." Footnote oxygen bad.
120-122 Oxygen: "Flask order different in box than on sample log used flask/drawT on log with sample number on log. Number off flask used during analysis; oxy samples run out of box sequence, but 120-122 definitely mixed up."
114   Sample Log: "Hg thermometer check on oxy draw temp - same T."
113   PI: "PO4 appears slightly high - also seen in NO3/ignore." Nutrient analyst: "No obvious analytical error."
108   Sample Log: "Hg thermometer check on oxy draw temp - same T."
106   PI: "Salt slightly high." No obvious analysis problem. Delta-S at 4007db is 0.0038. Footnote salinity questionable.
102   Sample Log: "Hg thermometer check on oxy draw temp - same T."
STATION 089
135   CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Salinity looks ok."

| 133 | Sample Log: "Tiny bubble in oxy flask 1196 after pickling." PI: "Low salt relative to CTD." No obvious analysis problem. PI: "Salinity probably okay, no flag." |
| 131 | Shipboard Data Processor: "Low salt relative to CTD." No obvious analysis problem. PI: "Salinity probably okay, no flag." |

STATION 090

Cast 1	Sample Log: "No comments."
139	CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-88 db CTDO bad.
133	CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok."

STATION 091

Cast 1	Sample Log: "No comments."
139	CTDO Processor: "Slow start at surface, signal looks low." Code 0-92 db CTDO bad.
116	Salinity: "Sample container dropped/broke just before analysis." Salinity not reported.
109	CTD Processor: "Bottle oxy slightly high compared with CTD trace." Oxygen: "No obvious analytical problem, flask will be recalibrated at ODF. The problem is a loose fit between flask and stopper, flask number 1356." Recalibration will not fix the problem. This flask was also used on Station 093, 095 and 104 where the results agreed with CTDO and adjoining stations. On Station 097 and 099 The oxygen data was coded bad. After Station 104, the flask was resigned. Footnote oxygen bad.

STATION 092

Cast 1	Sample Log: "Drawing order within oxy/nuts/salts samples noted."
139	CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-80 db CTDO bad.
135	See 139 CTDO comment; code CTDO bad.
127	CTD Processor: "Bottle oxy high compared to CTD trace - matches value for 128. Possible misdraw." Footnote oxygen bad.
125	Bottle oxy high compared to CTD trace - matches value for123. On Sample Log, flask 1197 originally written in slot for bottle 23, then erased/replaced with flask 1096. Assume both drawn from 23. Footnote oxygen bad.
120	PI: "O2 slightly high." Footnote O2 questionable.

STATION 093

139	CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-74 db CTDO bad.
135	See 139 CTDO comment; code CTDO bad.
108	CTD Processor: "Bottle oxy looks high." PI: "Bottle O2 ok."
105	CTD Processor: "Bottle oxy high compared with CTD trace." Oxygen: "Also does not follow nutrient trend." PI: "Code oxygen bad."
103	CTD Processor: "Bottle oxy slightly low compared to CTD trace." Oxygen: "No obvious analytical problem." PI: "Code oxygen bad."

STATION 094

Cast 1	Sample Log: "Draw order altered to accommodate Freons."
139	Marine tech log: "Dripping @ bottom o-ring." PI: "Sample dripped slowly at bottom o-ring, but should be ok since it is surface sample." CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-74 db CTDO bad.
135	See 139 CTDO comment; code CTDO bad.
111	Marine tech log: "Lanyard hangup, no sample." No samples were drawn.
103	Sample Log: "Nuts drawn before TALK & TCO2."

STATION 095

| Cast 1 | Sample Log: "No comments." |

139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-80 db CTDO bad.
STATION 096
Cast 1   Sample Log: "No comments."
139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-70 db CTDO bad.
135   See 139 CTDO comments; code CTDO bad.
104   CTD Processor: "Bottle oxy slightly low compared with CTD trace." Oxygen: "No obvious analytical problem." PI: "Flag oxygen as questionable."

STATION 097
Cast 1   Sample Log: "Sample cop sampling oxy and recording numbers." PI: "PO4: There appears to be a shift in calibration between samples 6 and 7. PO4 vs theta does not agree with NO3 vs theta." Nutrient analyst: "Dipper hung up during run. Disruption in run may have affected ending PO4 stds and drift calculations." Footnote PO4 bad.
139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-72 db CTDO bad. See Cast 1 PO4 comment; code PO4 bad.
135   See Cast 1 PO4 comment; code PO4 bad.
138   See Cast 1 PO4 comment; code PO4 bad.
133   See Cast 1 PO4 comment; code PO4 bad.
141   See Cast 1 PO4 comment; code PO4 bad.
131   See Cast 1 PO4 comment; code PO4 bad.
137   See Cast 1 PO4 comment; code PO4 bad.
119-129 See Cast 1 PO4 comment; code PO4 bad.
140   See Cast 1 PO4 comment; code PO4 bad.
117   PI: "O2 high." No oxygen analytical problem noted. See Cast 1 PO4 comment. Footnote oxygen questionable and PO4 bad.
110-116 See Cast 1 PO4 comment; code PO4 bad.
109   Oxygen: "Big air bubble in sample." Bottle oxy high compared to CTD (3140 db) trace. Box 10/ flask 1356. Oxygen: see stas 91, 99 - same problem. Oxygen: "Flask 1356, loose fit between flask and stopper." See Cast 1 PO4 comment. Footnote oxygen and PO4 bad.
102-108 See Cast 1 PO4 comment; code PO4 bad.
101   CTD Processor: "Bottle oxy looks high compared to CTD trace." Oxygen: "SF6 draw before oxy; no obvious analytical problem." See Cast 1 PO4 comment. Footnote oxygen and PO4 bad.

STATION 098
Cast 1   Sample Log: "TCO2 and ALK samples from single draw, one bottle for both."
139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-70 db CTDO bad.
138   Sample Log: "Air leak." No samples were drawn.
129   Sample Log: "Bad seal upper cap." No samples were drawn.
128   Sample Log: "Bottom endcap askew, half-cocked." No samples were drawn.
113   Sample Log: "Top o-ring problem." No samples were drawn.
112   Sample Log: "Bottom o-ring unseated." No samples were drawn.

STATION 099
Cast 1   Sample Log: "No comments." Comments from PDR watchstander: "2 strong bottoms on pdr."

109   CTD Processor: "Bottle oxy slightly high compared with CTD oxy (2985 db)." Oxygen box 10, flask 1356, see stas 91, 97, same problem. Oxygen: "Flask 1356 has loose fit of flask and stopper. No other obvious analytical problems." Footnote oxygen bad.

STATION 100

139   CTDO Processor: "Low surface raw oxy signal, fit looks low; no bottle oxy at 104db bottle." Code 0-104 db CTDO bad.

138   Sample Log: "Leaker." No samples were drawn. See 139 CTD Oxygen comment; code CTDO bad.

129   Sample Log: "Leaker." No samples were drawn.

111   CTD Processor: "Bottle oxy slightly hi compared to CTD oxy trace." Oxygen: "No analytical problem." PI: "Bottle O2 OK, follows nutrient trend."

STATION 101

139   CTDO Processor: "Slow start at surface, signal looks low." Code 0-100 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

120   Sample Log: "Oxy flasks for samples 20 & 21 were in reverse order in the flask box. Based on the draw temps, the order in the box may be correct." Oxygen is acceptable.

STATION 102

Cast 1   Sample Log: "TCO3 and ALK - one bottle draw for both." CTD Processor: "Entire profile of bottle salts low relative to CTD." No obvious reason for all salts to be low. Salinity agrees with adjoining stations.

139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-90 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

138   See 139 CTDO comment; code CTDO bad.

109   Salts: "Manual entry: cell fill problems, insufficient sample." Delta-S at 3240db is -0.0047. Footnote salinity bad.

103   CTD Processor: "Bottle salt low relative to CTD." No obvious analysis problem. Delta-S at 4160db is -0.0068. Low compared with adjoining stations, could be a drawing error. Footnote salinity bad.

STATION 103

139   CTDO Processor: "Slow start at surface, signal looks low." Code 0-94 db CTDO bad.

135   Sample Log: "Bad bottom seal." No samples were drawn. See 139 CTD comment; code CTDO bad.

138   Sample Log: "Lanyard from 41 in top end cap." No samples were drawn.

107   Data Processor: "Bottle salt high relative to CTD." No obvious analysis problem. Box L had history of loose salt bottle inserts, box "retired" after station 109. Delta-S at 3470db is 0.0088. Footnote salinity bad.

103   Salts: "Insufficient sample in bottle 3: was sample collected?" Footnote salinity lost.

STATION 104

Cast 1   Sample Log: "No comments."

139   CTDO Processor: "Slow start at surface, signal looks low." Code 0-100 db (139, 135 and 138) CTDO bad.

135   See 139 CTDO comment, code CTDO bad.

138   CTDO Processor: "Bottle at 99db is low: this is max area, and value matches deeper and shallower bottles, but not the shape of nearby casts or CTD data at this level. The draw T matches that of bottle (33) at 175db and is 3 degrees lower than in-situ temp for 138. Suspect dup draw of 175db bottle is the value we see here." See 139 CTDO comment. Code CTDO bad and bottle oxygen bad.

STATION 105
139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-70 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

133   Sample Log: "Lanyard hung up in top end cap." No samples were drawn.

137   Sample Log: "Suspect leak from bottom endcap." PI: "Samples appear to be ok despite suspected leak."

127   PI: "Bottle salt low relative to CTD; looks ok." 4-unit diffc between 2 c-ratio readings; otherwise no obvious analysis problem.

121   Sample Log: "Lanyard hung up in top end cap." No samples were drawn.

STATION 106
Cast 1   Sample Log: "TCO2/ALK drawn together in one bottle."

139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-78 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

138   Sample Log: "Nuts/salts drawn before TCO2 could be drawn." salts: small sample volume: was sample taken? No sample. Draw error. No nutrients drawn. See 139 CTDO comment; code CTDO bad, salinity bad, nutrients not drawn.

101   Delta-S at 4146db is 0.0037. No analytical problem noted. Footnote salinity questionable.

STATION 107
139   CTDO Processor: "Slow start at surface, signal looks low." Code 0-72 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

131   Sample Log: "Oxy flask has small air bubble." Oxygen is acceptable.

128   PI: "Salt low relative to CTD, probably ok, no flag." No obvious analysis problem. Delta-S at 556db is -0.011.

101   Sample Log: "Oxy redrawn because of air bubble; drawT from second draw."

STATION 108
Cast 1   CO log: "Aborted cast (1) at surface down due to knot in tag line."

233   Sample Log: "Bottle has small leak, sampled anyway." Oxygen as well as other data are acceptable.

228   Sample Log: "Top o-ring." No samples were drawn.

204   CTD Processor: "Bottle oxy slightly high compared to CTD trace." Oxygen: "No obvious analytical problem." PI: "Flag oxygen as questionable, may be usable."

STATION 109
Cast 1   Salts: "8x3 tries on various salt samples during run(usually 2)." Sample Log: "500ml sample taken for TCO2/includes TALK aliquot." Salt box L had a history of loose bottle inserts, box L "retired" after this cast.

117   Oxygen: "Air bubble in sample." CTD Processor: "Bottle oxy high compared to CTD trace." Footnote oxygen bad.

116   CTD Processor: "Bottle oxy low compared to CTD trace." Oxygen: "No obvious analytical problem." PI: "Footnote oxygen bad."

114   PI: "Salt slightly high relative to CTD." no obvious analysis problem/see box L note above. PI: "Leave as is, probably ok." Delta-S at 2257db is 0.0053.

111   Delta-S at 2653db is 0.0594. Bottle oxy slightly low compared to CTD trace. Oxygen: "No obvious analytical problem." Footnote bottle leaking, samples bad.

110-111 nuts appear to be reversed for these samples (see above note). this would mean that low nuts value for 110 is assoc. w/high salt/low oxy on 111. This is consistent with bottle 11 leaking.

110   Switched the way it was suppose to be, tube 10 sampled from bottle 10, and tube 11 sampled from bottle 11. Nutrients are acceptable with this arrangement. See 110-111 nutrient comment.

103   Delta-S at 3713db is 0.0051. PI: "Salt slightly high relative to CTD." No obvious analysis problem/see box L note above. PI: "Leave as is, probably ok."

102   Delta-S at 3856db is 0.0032. No analytical problem noted. Footnote salinity questionable.

STATION 110

Cast 1   Sample Log: "No Comment."

141   Oxygen: "Bad endpoint, crud in water bath, low voltage (0.987)." Footnote oxygen bad.

STATION 111

133   Sample Log: "Top o-ring problems, water leak, bad seal." No samples were drawn.

STATION 112

128   Delta-S at 708db is 0.4667. Salt/oxy/sil high, NO3/PO4 low - same as deeper/bottle 111 values probable mistrip. PI: "All parameters way out of line, bottle apparently pretripped." Footnote bottle leaking, samples bad.

STATION 113

Cast 1   No comments on Sample Log.

STATION 114

105-107 Sample Log: "O2 flasks 1354(position number 5) and 975(position number 7) were switched in the sample box." Oxygen is acceptable.

102   CO log: "Bottle fired on the fly just above bottom trip/op. error." Data are acceptable.

STATION 115

Cast 1   No comments on Sample Log.

STATION 116

138   Sample Log: "Upper end cap not seated." No samples were drawn.

STATION 117

111   Sample Log: "Slow leak." No samples were drawn.

STATION 118

126   Sample Log: "Nuts and salts drawn before TCO2 & ALK."

114   CO log/Sample Log: "Open bottle, no trip even though confirmed ok." No samples.

102-110 See 101 PI NO3 comment. Leave data as is, no code.

101   PI: "NO3 appears slightly low in comparing NO3/theta to PO4/theta plots for samples 01 to 10." Nutrient analyst: "No obvious analytical error."

STATION 119

Cast 1   No comments on Sample Log.

STATION 120

141   Sample Log: "Leaks on bottom, collected anyway." Oxygen as well as other data are acceptable.

117   Sample Log: "Lanyard in top end cap." No samples were drawn.

110   CTD Processor: "Bottle oxy slightly higher than CTD." Very slight. Oxygen is a slightly higher than Station 121. Oxygen is acceptable.

STATION 121
Cast 1 Sample Log: "No comments."
139 CTDO Processor: "Slow start at surface, signal looks low." Code 0-94 db CTDO bad.
135 See 139 CTDO comment; code CTDO bad.
138 CTD Processor: "Bottle salt much too low." Nothing apparent on salt run or logs; does not match salt value from previous time salt box Y used. Delta-S at 95db is -0.2773. Variation in CTD salinity uptrace at this sampling point, because the package has stopped to trip a bottle. Salinity appears low compared with adjacent stations vs. theta, but sampling was not performed at this potential temperature. PI: "Flag salinity bad."
133 CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Agrees with adjoining station. Delta-S at 206db is -0.0308. CTD salinity is acceptable. CTD Processor: "Note back down in pressure-not spiking, but into top thermocline. CTD salinity is acceptable."
108 Oxygen: "Air bubble in sample." CTD Processor: "Bottle oxy slightly high relative to CTD trace; also bubble." Footnote oxygen bad.
STATION 122
Cast 1 CTD Processor: "Bottle salts high compared to CTD trace." The salinities may be 0.001 higher than adjoining stations, suspect this is just a noise level and does not indicate a problem with the bottles.
121 Sample Log: "Oxy T from 2nd draw - NaOH dispenser problem 1st."
115-116 Nutrient: "Bubble stuck in flowcell, lost NO2 data."
111 Sample Log: "Oxy flask 961 has hair line crack redraw oxygen in flask 1435 (w/questionable labcal)." Oxygen: "Flask 1435 had air bubble." Value high. Used flask 961 value, more in-line than flask 1435. Flask was recalibrated and oxygen data is acceptable.
STATION 123
Cast 1 Marine tech log: "4 styrofoam cups taped to rosette near bottle number 1. Okayed by PI. He will sample number 1 to see if it causes any contamination."
138 CTD Processor: "Bottle salt slightly high compared to CTD." PI: "Looks ok." Delta-S at 206db is 0.0317. No analytical problem noted. CTD Processor: "CTD salinity is acceptable."
123 Sample Log: "Top lanyard." No samples were drawn.
102-110 See 101 PI NO3 comment. Leave data as is, acceptable.
101 PI: "NO3 is low in comparing NO3/theta to PO4/theta plots." Nutrient analyst: "No obvious analytical error." Leave data as is, acceptable.
STATION 124
105 Delta-S at 4366db is 0.0037. No analytical problem noted. Salinity agrees with adjoining stations.
STATION 125
106 Marine tech log: "Large orange tentacle on lanyard, no obvious evidence of contamination in bottle."
STATION 126
141 Sample Log: "O2 value from draw 2."
STATION 127
Cast 1 No comments on Sample Log.

STATION 128

139   CTDO Processor: "3-min. stop at 16-20db distorted surface fit." Code 0-20 db CTDO bad.

138   CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." Delta-S at 187db is -0.0276. No analytical problem noted. CTD Processor: "CTD salinity is acceptable."

STATION 129

Cast 1   Marine tech log: "Changed winches again." CTD Processor: "Bottle salts high compared to CTD." Whatever the problem was it seems to be okay for final data.

139   NO2: "Oscillation in baseline, value bad." Oscillation during shallow water samples, footnote NO2 bad.

135   NO2: "Oscillation in baseline, value bad." Oscillation during shallow water samples, footnote NO2 bad.

138   NO2: "Oscillation in baseline, value bad." Oscillation during shallow water samples, footnote NO2 bad.

133   NO2: "Oscillation in baseline, value bad." Oscillation during shallow water samples, footnote NO2 bad.

141   NO2: "Oscillation in baseline, value bad." Oscillation during shallow water samples, footnote NO2 bad.

131   NO2: "Oscillation in baseline, value bad." Oscillation during shallow water samples, footnote NO2 bad.

120   Delta-S at 2123db is -0.003. No analytical problem noted. Salinity appears slightly low compared with adjoining stations, however, there are changes in this area. Code salinity questionable.

109   Delta-S at 4007db is -0.0037. No analytical problem noted. Salinity appears slightly low compared with adjoining station. Code salinity questionable.

106   Sample Log: "Top o-ring failed to seal." No samples were drawn.

STATION 130

Cast 1   Sample Log: "TCO2/ALK sampled simultaneously."

137   Sample Log: "Bottom leaked, but sampled anyways." Marine tech log: "Bottom o-ring leak, stopped when pressed on bottom lid." Oxygen as well as other data are acceptable.

125   Sample Log: "Bottom o-ring." No samples were drawn.

101-109 PI: "NO3 appears 1.0-1.5uM/kg high comparing NO3/theta to PO4/theta plots." Nutrient analyst: "No obvious analytical error." NO3 is low compared with next stations and high compared with previous stations. Footnote NO3 questionable.

STATION 131

Cast 1   Sample Log: "No comments."

STATION 132

Cast 1   Sample Log: "500 ml volumes taken for TCO2- includes TALK aliquot."

139   Marine tech log: "Bottom o-ring problems." Sample Log: "Leaking from bottom-endcap reseated once on deck."

129   Sample Log: "Lanyard in top end cap." Delta-S at 769db is 0.2924. Oxygen not drawn. nuts: "Sample drawn despite lanyard problem." PO4/NO3 look low; salt definitely high. salts: "Sample drawn despite lanyard problem." Footnote bottle leaking, salinity bad, oxygen not drawn, and nutrients bad.

128   Sample Log: "O2 flask recorded as 1147, actual 1149."

119   Sample Log: "Vent open; nuts/salts drawn anyways." Oxygen not drawn. PI: "Salt and nuts ok even though vent was open."

114-117 Nutrient samples were not drawn-sampler error.

111   PI: "Bottle salt slightly high." 3 units diff between 2 conductivity ratios. Delta-S at 3599db is 0.0045. Footnote salinity questionable.

105   PI: "Bottle salt slightly high." Delta-S at 4519db is 0.0035. No analytical problem noted. Footnote salinity questionable.

101   PI: "Bottle salt slightly high." Analyst: "Standby value 4 units higher than surrounding samples." Delta-S at 5046db is 0.0056. Footnote salinity bad.

STATION 133

Cast 1   CTD Processor: "Bottle salts high compared to CTD." Whatever the problem was, the salinities are okay now.

139   Oscillation during shallow water samples, footnote NO2 bad.

135   Oscillation during shallow water samples, footnote NO2 bad.

138   Oscillation during shallow water samples, footnote NO2 bad.

133   Sample Log: "Top end cap did not seat properly." No samples were drawn.

141   Oscillation during shallow water samples, footnote NO2 bad.

131   Oscillation during shallow water samples, footnote NO2 bad.

116   Delta-S at 2577db is -0.0037. No analytical problem noted. Code salinity questionable.

115   Delta-S at 2728db is -0.0043. Autosal took 4 tries before getting a good reading. Code salinity bad.

114   Delta-S at 2879db is -0.0031. No analytical problem noted. Salinity does appear lower than adjoining stations, and so do the next (shallower) 2 samples. Footnote salinity questionable.

113   Sample Log: "Top endcap has lanyard from 12 slightly in it. No apparent air leak. Re-sampled o2 after cleaning MnCl2 dispenser."

105   Sample Log: "Broken bottom hose clamp needs to be replaced." Data are acceptable.

STATION 134

139   Sample Log: "Bottle inadvertently dumped before salts drawn."

141   Sample Log: "Freon syringe 9895 recorded for both 32 and 34, syringe C355 used to redraw 32 "just in case"."

117   Sample Log: "Lanyard in top end cap, leaked." No samples were drawn.

107   Sample Log: "Lanyard in top end cap, leaked." No samples were drawn.

STATION 135

133   PI: "Low bottle salt, maybe real, high salt gradient." Analyst: "No obvious analytical error." Delta-S at 257db is -0.0431. CTD Processor: "CTD salinity is acceptable."

117   Sample Log: "Top lanyard." No samples were drawn.

STATION 136

139   CTDO Processor: "Raw surface signal low compared to nearby casts and bottle data." Code 0-104 db CTDO bad.

133   PI: "Low bottle salt, may be real, high salt gradient." Analyst: "No obvious analytical error."

STATION 137

Cast 1   CTD Processor: "Bottle salts high compared to CTD." This salinity analyst has had a few runs that have not agreed well with the other data sets. Suspect that this is due to inexperience. Salinities are within specs, and the inconsistency is not due to a bottle or tripping therefore, salinities are acceptable unless otherwise noted. Comments from PDR watchstander: "Winch trouble delayed launch by 4 hrs; co2 chemicals dumped over side shortly before cast."

141   Sample Log: "Leaking bottom o-ring, nuts and salts drawn." No gas samples were drawn, other data are acceptable.

121   Delta-S at 1696db is -0.0054. Autosal took 4 tries to get readings to agree, this is usually an indication that the salinity would be bad. Footnote salinity bad.

115   Delta-S at 2581db is -0.003. No analytical problem noted.

108   Delta-S at 3650db is -0.0047. Autosal took 3 tries to get readings to agree, this is usually an indication that the salinity would be bad. Footnote salinity bad. Other data are acceptable.

STATION 138

Cast 5   Sample Log: "No comments."

538   PI: "Low bottle salt, may be real, high salt gradient. Analyst: "No obvious analytical error." Delta-S at 177db is " -0.0264. CTD Processor: "CTD salinity is acceptable."

523   PI: "Slightly high bottle salt." Analyst: "No obvious analytical error." Delta-S at 1516db is 0.0074. Footnote salinity questionable.

STATION 139

Cast 1   Sample Log: "No comments."

138   PI: "Low bottle salt, high salt gradient area, may be real." Analyst: "No obvious analytical error." CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks okay." Delta-S at 187db is -0.0491. CTD Processor: "CTD salinity is acceptable."

STATION 140

Cast 1   Sample Log: "No comments."

139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-80 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

STATION 141

Cast 1   Sample Log: "No comments."

108   Delta-S at 3517db is -0.0034. No analytical problem noted. Salinity is out of specification, but usable.

STATION 142

139   CTDO Processor: "High surface raw oxy signal, bad fit." Code 0-100 db CTDO bad.

135   See 139 CTDO comment; code CTDO bad.

141   nuts: "Sample not drawn, sampler error; sample taken from salt bottle." salts: "Reopened 45 mins. after sample collection to take nuts sample."

137   nuts: "Sample not drawn, sampler error; sample taken from salt bottle." salts: "Reopened 45 mins. after sample collection to take nuts sample."

129   PI: "Bottle salt high, appears to have been drawn from bottle 41." Delta-S at 481db is 0.4963. Footnote salinity bad.

102-117 See 101 PI PO4 comments. Leave PO4 and NO3 as acceptable.

101   PI: "PO4 appears low by about 0.02uM/kg when comparing PO4/theta and NO3/theta plots." Nutrient analyst: "No obvious analytical error." Leave PO4 and NO3 as acceptable.

STATION 143
139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-84 db CTDO bad.
135   See 139 CTDO comment; code CTDO bad.

STATION 144
139   Sample Log: "Leaked from the bottom, sampled anyways/surface." Oxygen as well as other data are acceptable. CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-84 db CTDO bad.
133   Sample Log: "Bad top o-ring seal." No samples were drawn.
122   Sample Log: "Bad o-ring seal." No samples were drawn.

STATION 145
Cast 1   Sample Log: "Some bottles exposed to sun, even though cart pulled far back/door lowered - sun was low." Comments from PDR watchstander: "Second/shallower bottom appeared on pdr at cast start."
124   Sample Log: "Rosette bottle exposed to sun - see note above."
122   Sample Log: "Rosette bottle exposed to sun - see note above."
120   Sample Log: "Rosette bottle exposed to sun - see note above."
119   Sample Log: "Lower o-ring leak problem." No samples were drawn. Marine tech log: "Reseated o-ring."
140   Sample Log: "Rosette bottle exposed to sun - see note above."
116   Sample Log: "Rosette bottle exposed to sun - see note above."
114   Sample Log: "Rosette bottle exposed to sun - see note above."
112   Sample Log: "Flask 856 has a crack." PI: "O2 ok although flask has a crack." Oxygen analyst: "No analytical error."
102   CTD Processor: "Bottle oxy looks slightly low compared to CTD trace. Oxygen analyst: "No analytical error." PI: "O2 low relative to CTD trace, but it is in agreement with nutrient vertical profile, do not flag." CTD Processor: "Bottle salt slightly low compared to CTD." Delta-S at 3901db is -0.006. No analytical problem noted. CTDO Processor: "Looks ~high relative to nearby CTD casts and own bottles." Code 3818-3970 db CTDO questionable. Footnote salinity bad.

STATION 146
Cast 1   Sample Log: "No comments." Comments from PDR watchstander: "Strong subsurface current - ship had to steam east at 0.7kn to maintain good wire angle; up/especially top 1000m may not sample same water as down cast CTD."
140   PI: "Bottle oxy looks low compared to CTD trace-probable dup draw on bottle 119 (shallower); nuts look ok." Oxygen analyst: "No analytical error." Footnote oxygen bad.
102   CTD Processor: "Bottle oxy looks slightly low compared to CTD trace." PI: "Bottle oxy slightly lower than CTD trace, but in agreement with nutrient vertical profile. Do not flag." oxy analyst: "No analytical error."

STATION 147
139   CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-90 db CTDO bad.
135   See 139 CTDO comment; code CTDO bad.
137   Sample Log: "Slow leak at bottom o-ring when vent was opened." Oxygen as well as other data are acceptable.

STATION 148

139 CTDO Processor: "Low surface raw oxy signal, fit looks low." Code 0-94 db CTDO bad.

135 CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks ok." See 139 CTDO comment; code CTDO bad.

125 Sample Log: "Bottom o-ring seal leaked." No samples were drawn.

105 PI: "Bottle salt high." No obvious analytical error. Delta-S at 3444db is 0.0096. Bottle salinity appears high compared with CTD, but seems to agree with adjoining stations. Since PI indicated the salinity was high, footnote as questionable. Footnote salinity questionable.

STATION 149

133 Sample Log: "Bad bottom o-ring seat." No samples were drawn.

128 Sample Log: "O2 flask 1221 replaced with 1082 prior to drawing of sample."

STATION 150

Cast 1 Marine tech log: "Trip arm between 35 & 36 (Bottle 39). Winchman came to surface and back down 10 before deck watch check for 1 open bottle. Winchman said only one bottle open, but evidence shows 2 were open, one still open when came on board. Need to change pinger!"

139 CO log/Sample Log: "Bottle (39) open, not tripped/never triggered."

135 See 137 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

138 See 137 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

142 CO log: "New bottle 42 replaces 33 beginning this cast. Oxygen analyst: "Bottle oxygen missing due to computer problem at analysis." Footnote oxygen lost. See 137 bottle tripping comment; code bottle did not trip correctly, oxygen lost, other data are acceptable.

141 See 137 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

131 See 137 bottle tripping comment; code bottle did not trip correctly, data is acceptable.

137 It appears that a bottle (37) should have been tripped at 526 db and it was not. There should have been 36 bottles tripped and there were only 35. Therefore, bottles 37, 31, 41, 42, 38, and 35 were all tripped one level shallower than originally intended and bottle 39 was not tripped at all. Code bottle did not trip correctly, but all data is acceptable as pressure reassigned.

105 Delta-S at 3127db is 0.0035. No analytical problem noted. Salinity is changing fairly rapidly in this area. Salinity is acceptable.

STATION 151

135 CTD Processor: "Bottle salt slightly low compared to CTD." PI: "Salinity looks okay." Delta-S at 59db is -0.0262. CTD Processor: "CTD salinity is acceptable."

142 Delta-S at 165db is -0.4734. See 141 bottle comments. Footnote bottle leaking and samples bad.

141 Suspect malfunction/interaction between bottle 41,42. Possible lanyard hung up due to position of bottle 42. CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 255db is 0.2751. Footnote bottle leaking and samples bad.

122 PI: "Bottle salt too high, other measurements appear ok." No obvious analytical error. Delta-S at 1111db is 0.0179. Footnote salinity questionable.

109 Sample Log: "Top o-ring problems." No samples were drawn.

STATION 152

142   CTD Processor: "Bottle salt slightly low compared to CTD." See 141 comments. Delta-S at 169db is -0.2011. Footnote bottle leaking, samples bad.

141   Suspect malfunction/interaction between bottle 41,42. Possible lanyard hung up due to position of bottle 42. CTD Processor: "Bottle salt slightly high compared to CTD." Delta-S at 254db is 0.1358. Footnote bottle leaking, samples bad.

STATION 153

Cast 1   Sample Log: "Bottles 1-18(40), 35, 36(39) sampled this cast."

138   No samples collected as per sampling schedule.

142   No samples collected as per sampling schedule.

141   No samples collected as per sampling schedule.

131   No samples collected as per sampling schedule.

137   No samples collected as per sampling schedule.

119-129 No samples collected as per sampling schedule.

113   PI: "Bottle salt low, high salt gradient area." Delta-S at 142db is -0.0348. CTD value is probably good on its own merit just not to compare with the bottle data. No CTDO is calculated because the CTD Salinity is coded bad. Code CTD salinity bad and CTD oxygen not reported.

104   No nutrient samples taken. Sampler error.

101-102 CTDO Processor: "Bottom 2 bottles look high, but match a T/S trend; they are probably fine and the CTD Oxygen have been coded as questionable. Shallow casts are traditionally hard to fit anyways, although the signal is absolutely straight for a long distance here." CTDO Processor: "Bottom of cast may be low because of slowdown for approach, or bottles may be hi." Code 490-566 db CTDO questionable.

316N1423
A15
Smethie, Swift, Jenkins
4/3-5/21/94
R/V Knorr

Three sections:
A15 at 19W (stations 109 to 28)
A15N at 36W (stations 1 to 22)
AR15 at 18S (stations 110 to 153)

Data status:
----
sum:
no format errors detected by sumchk
----
hyd:
no format errors detected by wocecvt
----
ctd:
wct files acquired from WHPO and zipped
no format errors detected in files.

1999.01.22: (SCD) A15 Hyd and CTD public (per Bill Smethie)