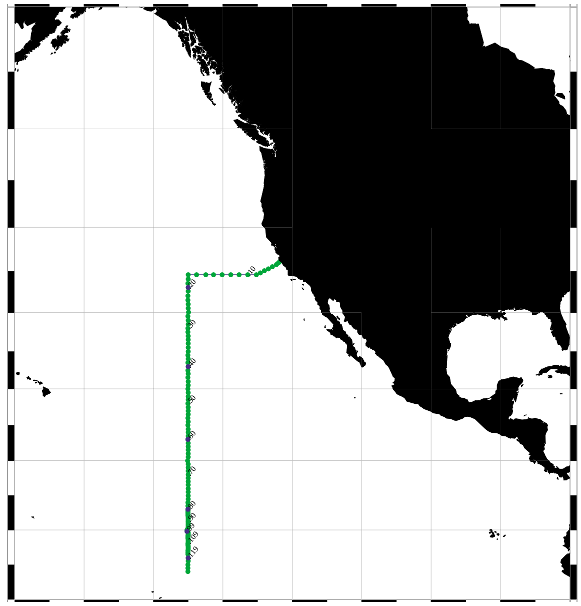
A. CRUISE NARRATIVE

A.1 Highlights



WHP Cruise Summary Information

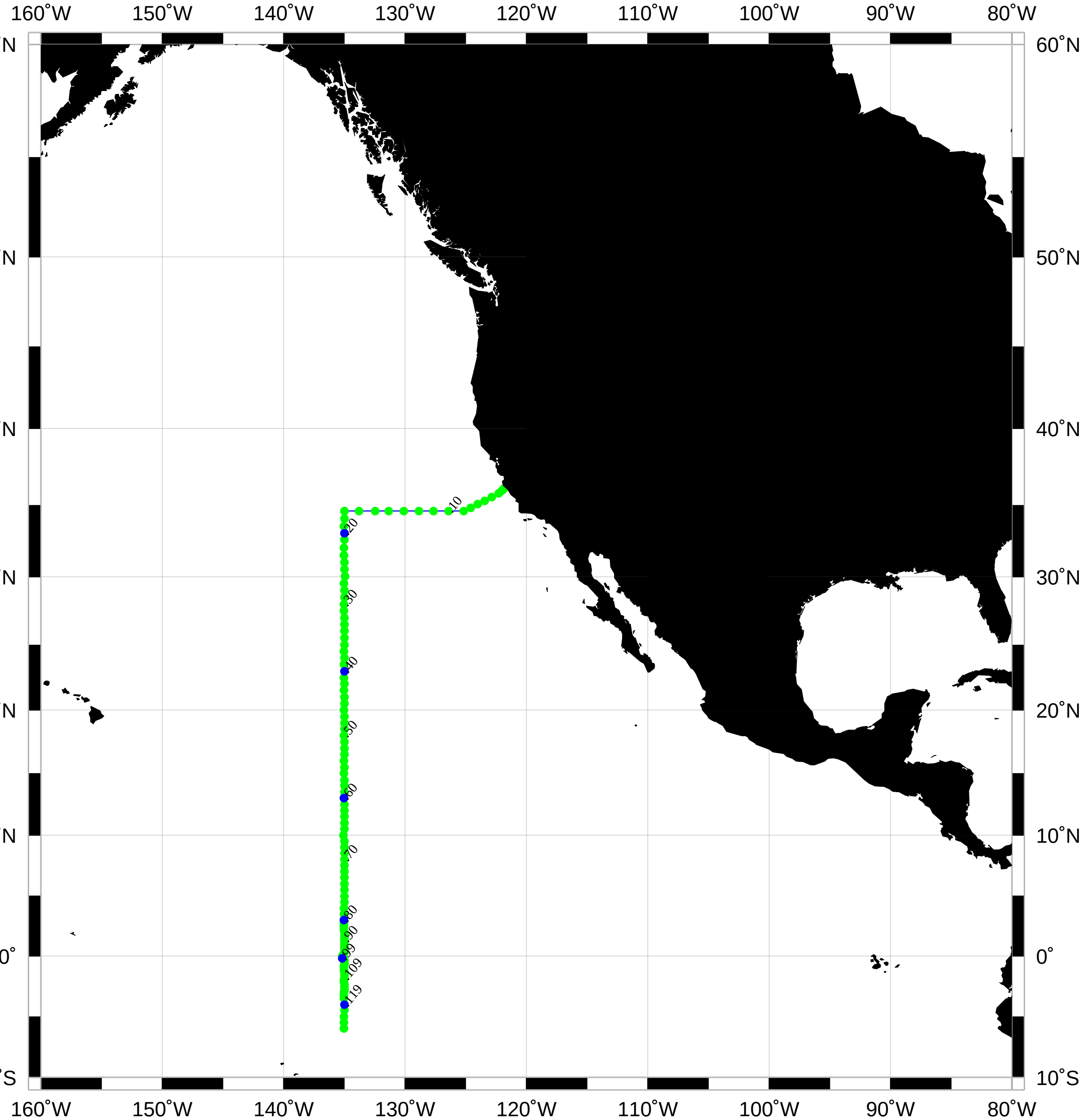
WOCE section designation	**P17C**
Expedition designation (ExpoCode)	**31WTTUNES_1**
Chief Scientist(s) and their affiliation	**Mizuki Tsuchiya, SIO** Scripps Institution of Oceanography University of California San Diego 9500 Gilman Drive La Jolla CA 92093-0230 USA Phone: 858-534-3236 Fax: 858-534-7452
Dates	1991.05.31 - 1991.07.11
Ship	R/V Thomas Washington
Ports of call	San Diego to Papeete, Tahiti with a short stop at Port San Luis, CA
Number of stations	123
Geographic boundaries of the stations	36°10.30'N 135°10.00'W 121°44.10'W 6°01.40'S
Floats and drifters deployed	11 Floats and 4 Drifters
Moorings deployed or recovered	0
Contributing Authors	L.D. Talley, M. Tsuchiya, M. Johnson,
	K.F. Sullivan, K.A. Maillet, F.M. Delahoyde,
	R.T. Williams, A Mantyla, R. Millard, R.M. Key

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
Geographic boundaries of the survey	CTD - pressure
Cruise track (figure)	CTD - temperature
Description of stations	CTD - conductivity/salinity
Description of parameters sampled	CTD - dissolved oxygen
Floats and drifters deployed	Large Volume Sampling
Principal Investigators for all measurements	Salinity
Cruise Participants	Oxygen
Problems and goals not achieved	Nutrients
	CFCs
Underway Data Information	
	DQE Reports
Navigation	
Acoustic Doppler Current Profiler (ADCP)	CTD
Meteorological observations	S/O2/nutrients
Bathymetry (figures)	CFCs 1st report 2nd report
Acknowledgments	14C lv 14C ams
References: CTD LVS AMS 14C	**Data Status Notes**

Station locations for P17C



Produced from .sum file by WHPO-SIO

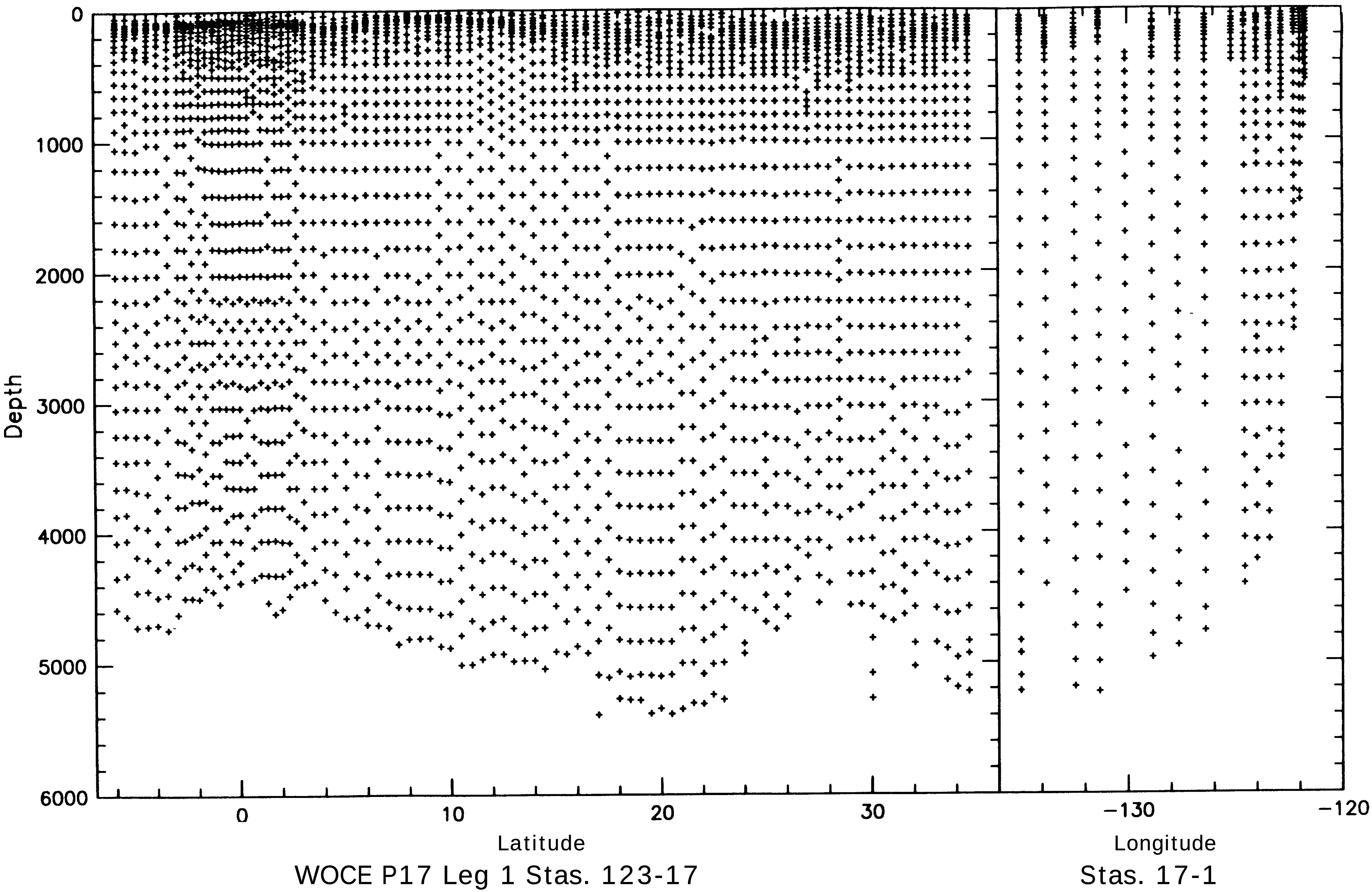
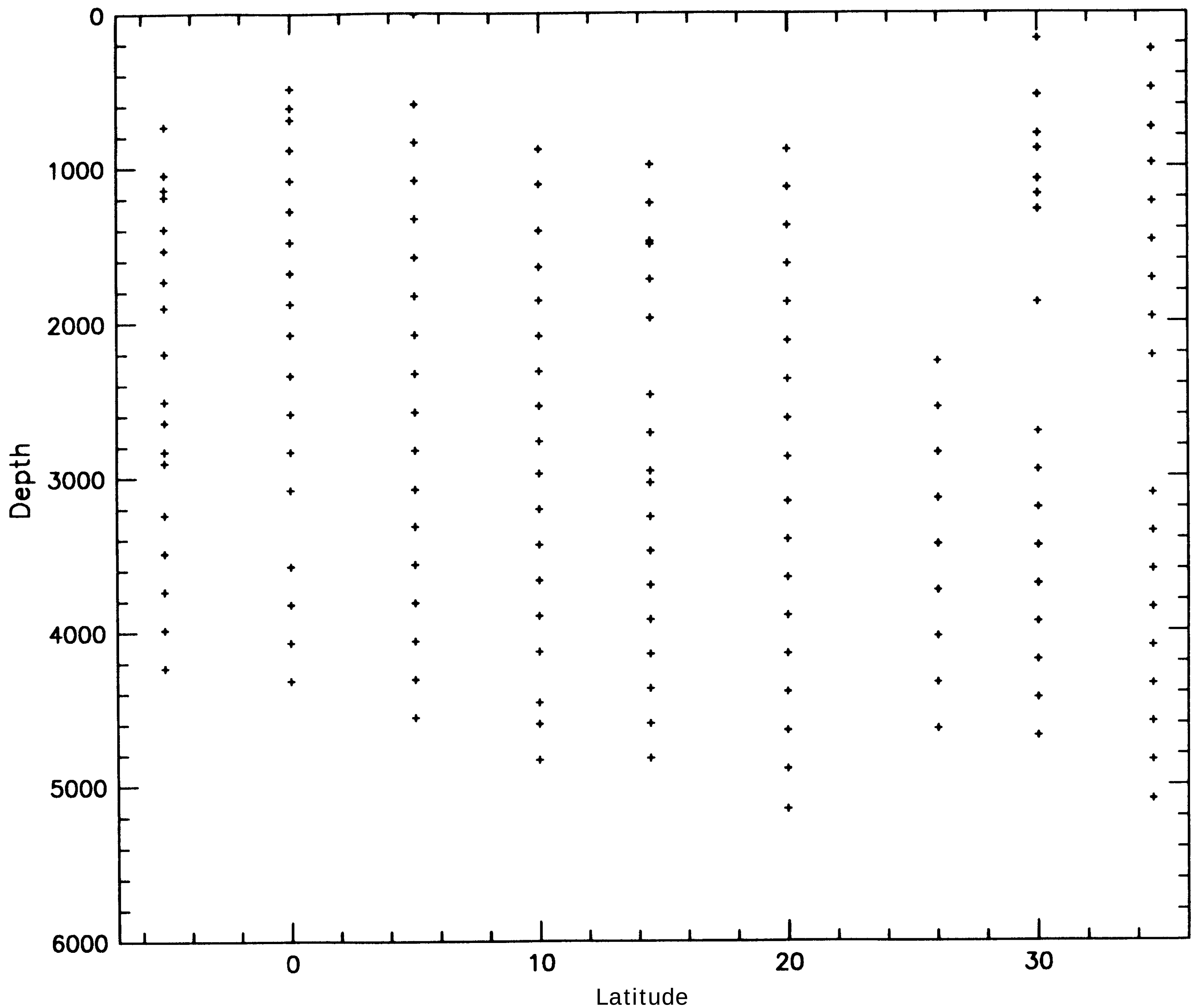


Figure 2. Vertical section along the cruise track showing the bottle-depth distribution. Station 1 is at right and Station 123 at left.



WOCE P17 Leg 1 Large Volume Stations

Figure 3. Vertical section along the cruise track showing the large-volume sampling depths.

A.2. CRUISE SUMMARY

A.2.a. Cruise Track

R/V Thomas Washington departed San Diego on May 31, 1991 and occupied a test station north of Pt. Conception with the main purpose of testing the heave compensator. After the test station, the ship stopped at Port San Luis to exchange personnel and immediately proceeded northward to Station 1 at 36°10'N, 121°44'W, where it turned to the southwest to make a line of stations roughly normal to the coast as far offshore as 34°35'N, 125°09'W (Station 9). From Station 9, the cruise track ran due west to 135°W (Station 17) and then turned to the south along 135°W. It extended southward across the equator, and the last station was occupied at 6°S, 135°W (Station 123). Near the equator, the track was shifted to the west by 10 nm to avoid a seamount. Thomas Washington arrived in Papeete, Tahiti on July 11.

The stations were spaced at intervals of 30 nm except near the California coast and the equator, where closer spacing was employed to resolve small-scale features. Along 34°35'N, however, the time constraint due to bad weather necessitated coarser spacing (see 4 below). The station locations are shown in Fig. 1.

A.2.b. Sampling

Sampling was done primarily with use of a 36-place 10-liter bottle rosette. Water samples were collected for analyses of salt, oxygen, silicate, phosphate, nitrate, and nitrite on all stations and of CFC-11, CFC-12, ^{3}helium, tritium, AMS ^{14}C, alkalinity, and total dissolved inorganic carbon on selected stations. A smaller rosette with 11 bottles equipped with an ADCP was also used on alternate stations between 3°N and 3°S, where station spacing was 10 nm, but water sampling was limited to salt to calibrate the CTD. Large-volume sampling was made with use of 270-liter Gerard barrels for analyses of ^{14}C, salt, and silicate on 9 stations spaced at intervals of about 50 of latitude along 135°W.

Separate surface water samples were also taken on 37 stations for analyses of ^{226}Ra, ^{228}Ra, and Ba.

In addition to the on-station measurements mentioned above, a shipboard ADCP was continuously operated along the entire cruise track.

A.2.c. The Number of Stations and Station Type

A total of 123 stations were occupied during the cruise. Of these, 104 were regular CTD/rosette stations, and 19 were ADCP/CTD stations within 30 of the equator without water sampling (except for salt samples for CTD calibration). On 9 of the former, Gerard casts were also made for large-volume water sampling.

A.2.d. Floats and Drifters Deployed

Eleven ALACE floats were deployed at 11 locations along 135°W, and 4 surface drifters were deployed at 4 locations near the equator and 135°W.

Sample Code	Sample Identifier	Disp Code	Date	Time UTC	Latitude	Longitude
CMDR	Drogue Drifter 15116	Por	June 23 91	2010	10.480N	135.030W
CDMR	Drogue Drifter 15112	Por	June 27 91	0010	5.000N	135.000W
CDMR	Drogue Drifter 15124	Por	July 01 91	1946	0.001N	135.010W
CDMR	Drogue Drifter 15110	Por	June 07 91	0710	5.013N	135.010W
CMRT	ALACE 58 SAT TRACKd	Por	June 11 91	0752	30.520N	134.960W
CMRT	ALACE 72 SAT TRACKd	Por	June 14 91	1138	26.030N	134.960W
CMRT	ALACE 53 SAT TRACKd	Por	June 16 91	0024	23.060N	135.000W
CMRT	ALACE 54 SAT TRACKd	Por	June 19 91	2153	16.990N	134.980W
CMRT	ALACE 29 SAT TRACKd	Por	June 22 91	1741	12.510N	134.970W
CMRT	ALACE 71 SAT TRACKd	Por	June 25 91	1052	7.995N	134.990W
CMRT	ALACE 60 SAT TRACKd	Por	June 27 91	0844	4.981N	134.940W
CMRT	ALACE 28 SAT TRACKd	Por	June 29 91	0659	2.170N	135.000W
CMRT	ALACE 62 SAT TRACKd	Por	July 01 91	2203	0.001S	135.140W
CMRT	ALACE 73 SAT TRACKd	Por	July 04 91		2.770S	135.003W
CMRT	ALACE 70 SAT TRACKd	Por	July 05 91		2.850S	135.010W

A.3 List of Principal Investigators

Name	Measurement Responsibility	Affiliation*
L. Talley/M. Tsuchiya	CTD/O_2/Nutrients	SIO
R. Fine	CFCs	Univ. of Miami
W. Jenkins	Helium/Tritium	WHOI
J. Lupton	Helium	UCSB
R. Key	$^{14}C/^{226}Ra/^{228}Ra/Ba$	Princeton Univ.
C. Goyet/T. Takahashi	CO_2	WHOI/LDGO
L. Gordon	Nutrients	OSU
C. Keeling	CO_2	SIO
E. Firing	ADCP	Univ. of Hawaii
R. Davis	ALACE Floats	SIO
P. Niiler	Drifters	SIO
	Meterology	SIO
	Thermosalinograph	
R. Fine	Atmospheric Chemistry	RSMAS
	Bathymetry	

A.4 Scientific Programme and Methods

Some of the preliminary results from this cruise are briefly described below:

1) There was an indication of strong upwelling in a narrow strip within 30 km of the California coast. Isopleths of all properties rose toward the shore, and cold, low-oxygen, high-nutrient water apparently upwelled from a depth of about 100 m was observed at the sea surface within this coastal strip. However, the isopycnals (isotherms) below about 150 m deepened toward the coast and suggested the presence of the poleward California Undercurrent.
2) The highest surface temperature exceeding 28°C was observed between 12°N and 2.5°N. Farther south the sea-surface temperature decreased gradually but remained above 27°C all the way to the southern end (6°S) of the section. This surface temperature in the equatorial region is at least 1°C higher than the normal temperature for July.
3) The North Equatorial Countercurrent was clearly indicated by the equatorward deepening of the thermocline from 8°N to 5°N. Farther south, an equatorward dip of the 9-12°C isotherms suggested that the subsurface North Equatorial Countercurrent was well developed. The Equatorial Undercurrent was indicated by a trough of the isotherms in the lower portion of the thermocline at the equator, but there was no evidence of a ridge of the isotherms in the upper portion of the thermocline. The Undercurrent was also associated with an isolated core of high salinity centered at 100 m, 1°S and an isolated core of high oxygen centered at 140 m on the equator. A weak indication of the subsurface South Equatorial Countercurrent was found at 200-400 m near 4°30'S in the temperature distribution.
4) The coldest and densest bottom water (theta=1.006°C, sigma 4=45.900, S=34.695) over the entire section was observed at 18°30'N about 200 km north of the Clarion Fracture Zone. This water was high in salinity and oxygen and low in nutrients and suggested an eastward flow of the bottom water from the Central Pacific Basin. The saltiest (S=34.698) bottom water, also highest in oxygen (O2=4.03 ml/l), was located near 4 S somewhat south of the Galapagos Fracture Zone. Relatively cold, salty, oxygen-rich, nutrient-poor bottom waters were also found at 24 N in the Molokai Fracture Zone and at 6 30'N in the Cilpperton Fracture Zone. On the other hand, the bottom water within about 30 of the equator was relatively warm, low in density and oxygen, and high in nutrients. These meridional differences in the bottom water characteristics may be due in part to the differences in the bottom depth but in greater part appear to reflect the zonal flow pattern of the bottom water.
5) The vertical maximum of silicate, which is the major feature of the silicate distribution in the Pacific Ocean, was observed at about 3000 m throughout the present section. However, many (but not all) stations between 3°N and 3°S exhibited a weak minimum at about 3000 m, thus producing maxima at 2500 m and 3500 m. This double maximum structure of the silicate distribution near the equator appears to be a real feature, but its cause and relation to the circulation are not immediately obvious.

A.5 Major Problems Encountered on the Cruise

During the first week of the cruise, the bad weather that prevailed over the operation area made the handling of the CTD/rosette package difficult and slow. Because of the heavy rolling of the ship, the rosette could not be set up for a cast while underway and could be lowered only at a speed of 15-30 m/min. To avoid falling seriously behind schedule, it was necessary to increase the station spacing along 34°35'N (Stations 9-17) to 60 nm. Thus the WOCE specification of the 30 nm station spacing could not be met for this portion of the section.

The bad weather also was the main cause of a large number of bottle problems on stations 1-34, including bad trips, kinked wire, broken bottles and stopcocks.

A.6 List of Cruise Participants

Name	Responsibility	Affiliation*
M. Tsuchiya	Chief Scientist	SIO
E. Firing	Co-Chief Scientist/ADCP	Univ. of Hawaii
M. Denham	Watch Stander	SIO
D. Muus	MT/Bottle data processing SIO/ODF	SIO/ODF
T. Wells	MT/Salt	SIO/ODF
J. Costello	Oxygen	SIO/ODF
D. Bos	Nutrients	SIO/ODF
L. Lopez	Large volume/Oxygen	SIO/ODF
C. Mattson	Electronic Technician	SIO/ODF
J. Jain	Salt	SIO/ODF
A. Ross	Nutrients	OSU
M. Johnson	CTD processing	SIO/ODF
K. Sullivan	CFCs	Univ. of Miami
K. Casey	CFCs	Univ. of Miami
R. Key	Large volume/AMS ^{14}C	Princeton Univ.
W. Jenkins	Helium/Tritium	WHOI
K. Tedesco	Helium	UCSB
S. Hacker	CO_2	WHOI
D. Breger	CO_2	LDGO
J. Moore	Computer Tech.	SIO/SCG
R. Comer	Resident Tech.	SIO/STS

B. Underway Measurements

B.1 Navigation

B.2 Acoustic Doppler Current Profiler (ADCP)

The ADCP that was run during this leg was an RD-VM150 153-kHz unit manufactured by RD Instruments and owned by Scripps. Raw data were logged on a PC and simultaneously on a SUN workstation. Position fixes provided by a Magnavox 4200 GPS receiver were logged at the endof each 5-minute averaging interval ("ensemble") on the PC, and at a 1-Hz rate on the SUN. The shipe's gyrocompass heading was input to the ADCP via a 1:1 synchro, and used for vector-averaging the velocity profiles in geographical coordinates. Heading error was calculated after the cruise from raw GPS data logged at 1 Hz from each of 2 Magnavox 4200D receivers, together witht he gyrocompass heading. These error calculations were crude and gappy, but did provide useful information that was used in postprocessing. The ADCP itself performed well apart from frequent failures during the first half of the cruise caused by ship's power glitches. The typical ADCP depth range was 300-400m.

The ADCP data have been processed using the Uniersity of Hawaii CODAS software package, as outlined in teh WHP Operations and Methods Manual. Processed data are archived on tampe in CODAS format at UH. Requests may be addressed to Eric Firing (efiring@soest.hawaii.edu: 808-956-7894)

B.3 Meterological Observations

Meterological observations where taken at each station. Information taken at each station included dominant wave direction, wind speed and direction, atmosperhic pressure, air temperature, weather, clouds and visiblity.

C. Hydrographic Measurements

C.1 Description of Measurement Techniques and Calibrations

Extensive comments regarding calibration of both CTDs will be forthcoming from ODF. Sections B.1.1 and B.1.2, on the CTD data collection and processing, are incomplete, premature and possibly inaccurate and are based on notes taken by L.Talley during discussion with M. Johnson, the ODF CTD data processor. Discrete sample analysis text was supplied by ODF. The Oceanographic Data Facility's listing of bottle data comments which is included as section D could be of as much use to the DQEs as it was to us. Sections concerning the other measurements should be obtained from the relevant principal investigators.

C.1.a CTD

(Lynne Talley)

Two NBIS Mark III CTDs were used. The first, designated CTD#1, was used for all stations except the alternate 10 nm stations between 3 N and 3 S. Because of the small station spacing in this zone, the length of time required to draw water from the 36-bottle rosette, and the perceived lack of need for water samples at 10 nm resolution except for calibration of the CTD, the 36- bottle rosette with CTD#1 was alternated with a 12-bottle rosette with CTD#2. Only 11 bottles were used on the second rosette in order for a lowered ADCP to be attached to the rosette frame.

C.1.1 CTD#1

Temperature: two PRT's were mounted on the CTD. PRT1 was used for the temperature data throughout; PRT2 was available to use to check for drift, but this was not actually done. The pre-cruise calibration was 0.0028 C and 0.0023 C warmer (for warm and cold ends of the calibration, respectively) than the post-cruise calibration but it was determined that the drift was not systematic and an average calibration was used. Temperature accuracy is therefore (0.0014 C to 0.0011 C).

Pressure:
One sensor was used throughout. There was a 3 dbar shift from pre to post-cruise calibration with no change in slope, so the difference is probably due only to initial offset in pressure. This is corrected for during calibration of each station, using the initial pressure. Pressure precision is 0.5 dbar after the pressure offset is removed according to the pressure model. In oceanic conditions, with changing temperature, the pressure error is smaller than 5 dbar.

Conductivity:
There was no significant change in slope of conductivity as a function of delta C (difference between bottle and CTD conductivity), so one slope was applied to the whole cruise. There were four groups chosen for offsets:

Stas. 3-8: constant offset, ignoring stations 1,2,6
Stas. 9-30: sloping offset as function of stations, ignoring station 18
Stas. 31-67: constant offset
Stas. 68-123: constant offset

The data were very clean after station 30.

In looking at the data recently, we noted that there is a problem with an 0.001 to 0.002 psu shift on many stations, at about 1.3-1.4 C (potential temperature). Stations which appear to have this after station 30 are: 31, 32, 33, 34, 35, (36,37), 39, 40, 42, 43, 45, 46, 47, 48, 49, 52, 54, (63??), 76, (78?), 80, 84, 86, 88, 90, 92, 94, 98, 102, (118?), (123?). ODF is currently looking at these as part of the final documentation phase.

There are also some remaining bulges and spikes which might not be real: sta. 50 (2638 dbar), 71 (3986 dbar).

C.1.2. CTD#2

CTD#2 was used on the 18 stations with odd numbers stating at 81 and ending at 117. Bottle data to calibrate the casts was quite scanty; in retrospect we would advise concentrating more bottles in the lower 2000 meters, rather than on attempting to get a full profile. No water was collected from the bottles for any purpose other than conductivity calibration. Because the rosette configuration was new (owing to the use of the LADCP), there were many tripping problems caused by fouled lanyards at the start of the group of stations, so the number of calibration points is quite small at the outset.

Temperature:
both PRT1 and PRT2 shifted at some point between pre-cruise calibration and station 183 on the next leg; the problem was first recognized during the following leg on which CTD#2 was used more extensively. (I'm not actually sure that this statement is correct - LDT.) At station 183, thermometers were added to the casts and thereafter helped in sorting out the problems enormously. It was then assumed that all of the PRT2 shift occurred after leg 1 and that there was also a shift in PRT1 between legs. The pre- cruise calibration was applied to PRT1 for the leg 1 data.

Pressure:
the post-cruise calibration was 8 dbar lower than the pre-cruise calibration. There was only a 2 dbar offset during the cruise, so only the pre-cruise calibration was used. (I'm not clear about how this was known or decided.)

Conductivity:
A slope which decreased as a function of station number was applied. Offsets were chosed using stations 99-117 and then extrapolated back. Fairly large individual station offsets were applied to several stations. Conductivity was somewhat noisy and there appears to have been a maintenance problem. The salinity offset problem on CTD#1 was not at all apparent on CTD#2, and this is the main reason for concluding that there was a sensor problem with CTD#1.

C.1.3. Comparison of CTD#1 and CTD#2 data:

Plots of salinity on isotherms and isopycnals shows a significant offset between CTD#1 and CTD#2, which is of the order of 0.001 psu at the cast bottom, and increases to 0.002 psu at about 2000 meters. CTD#1 is fresher than CTD#2 throughout. Most of the change in offset occurs at the point where CTD#1 conductivity has an offset of its own.

Because of the very low vertical gradients of salinity in the deep water, the consistent offset between CTD#1 and CTD#2 is easily apparent in a vertical section. Vertical sections of potential temperature and potential density are not affected.

Statistical differences between CTD#1 and CTD#2 salinities were estimated with

(1) differences in average salinity and pressure on isotherms for the station range 80-118: CTD#1 is .001 to .003psu fresher than CTD#2 for temperatures 1.0 to 2.0 C, with the higher difference at 2.0 C.

(2) differences in average salinity, theta and pressure on isopycnals for the station range 80-118: CTD#1 is 0.0008 to 0.002psu fresher than CTD#2 for the isopycnal range 45.88 to 45.7 sigma 4, with the smaller differences at higher density.

(3) average differences in adjacent stations' salinity and theta on isopycnals 45.88, 45.80 and 45.70 sigma 4: the results are very similar to (2), with CTD#1 0.0008 to 0.002 psu fresher than CTD#1, with the smaller differences at higher density. The difference in theta on these isopycnals is 0.003 to 0.008 C, with the higher difference at lower density.

Given that there is a systematic offset in salinity between CTD#1 and CTD#2 of 0.001 to 0.002 psu below 2000 dbars, what is the effect on geostrophic velocity calculations? Using one station, dynamic height was computed at the surface relative to 4000 dbar with the original salinities, and then adding the same salinity offset to all bottles.

Adding 0.002 psu (i.e. higher salinity) increases the density, decreases the specific volume anomaly, and hence yields lower dynamic height, by 0.013 dynamic meters at the surface relative to 4000 dbar. The change is nearly linear in salinity error, so a 0.001 psu error would create half the dynamic height error. If geostrophic velocities are then calculated using the original station and the altered station, using various station spacings and latitudes, we can produce a table of velocity errors as a function of salinity error, station spacing and latitude.

For .002 deltaS, the velocity error is (incm/sec):						
	1N	5N	10N	20N	30N	40N
60 nm	20	4	2	1	.7	.6
30 nm	40	8	4	2	1.4	1.2
20 nm	60	12	6	3	2.1	1.8
10 nm	123	25	12	6	4.3	1.7

The result is of course exactly inversely proportional to station spacing. It is also nearly linear in delta S.

On transport errors: an error of 1 cm/sec over 1000m over 10nm (18.5 km) is equivalent to 0.185 Sv and a 100 cm/sec error therefore is equivalent to an 18.5 Sv error.

C.2. BOTTLE DATA COLLECTION, ANALYSES, AND PROCESSING

Chief scientist comments: Bottle quality and data quality flags were first assigned by ODF and then examined by the chief scientists. After several iterations, we arrived at the set which are being sent with this documentation. We note that selection of quality flags posed some difficulties. In particular, there is no way to note that comments that there might have been a leak but where salinity, oxygen and nutrient values all appear to be fine; noting the potential problem could be important for the other analyses. The distinction between data quality which is questionable (flag = 3) and which is bad (flag = 4) is also difficult in practice. Generally it was assumed with this data set that "bad" means that there was a fault noted with the actual analysis, and "questionable" means that the value is bad but no fault was noted with the actual analysis.

We, the chief scientists, strongly urge any users of this data to discard ANY value with a bottle data quality flag of 3, and any data quality flag of either 3 or 4. "Questionable" data, flagged "3" does not mean "potentially good", rather it means bad but for unknown reasons. This comment is meant to clarify the comment in the ODF documentation which says that it is up to the scientists to decide whether to use data flagged as 3. When the level 2 data product is written and archived, no data with flags of either 3 or 4 should be archived. All bottle salts with these flags should be replaced with the CTD salts.

C.3 Calibrated Pressure-Series CTD Data Processing Summary and Comments

(Mary C. Johnson)
August 31, 1993

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1. Introduction

The information provided on CTD data collection and processing is for reference to P17c/TUNES1. At times it is necessary to discuss P17S/P16S/TUNES 2 leg because of its relevance to P17c/TUNES 1 leg. As a frame of reference for the reader P17c/TUNES 1 consists of stations 1 through 123.

In this document we discuss CTDO data acquisition, calibration, corrections, and other processing for the TUNES cruise, Legs 1 and 2, on the R/V Thomas Washington. At various times during these legs, the CTD instruments and sensors exhibited more than the usual share of noise, drifts or other problems, making CTD data processing more challenging than usual. We believe that we have greatly reduced the uncertainty in the final reported values via careful examination and application of the pre- and post-cruise calibrations, and by comparison of CTD data with the water sample and thermometric data collected during the CTD casts. Our techniques and calibration data are discussed below.

2. CTD Acquisition and Processing Summary

221 CTD casts and 4 test casts were completed during TUNES Legs 1 and 2. The rosette used was an ODF-designed 36-bottle system with a ring of twelve 10-liter bottles and 12- and 24-place General Oceanics pylons nested inside a ring of twenty-four 10-liter bottles. A CTD, altimeter, pinger and transmissometer were mounted on the bottom of the frame. ODF CTDs #1 and #2 (modified NBIS Mark III-B instruments) were used during both Legs 1 and 2. CTD #10 was used on Leg 2 only.

Each ODF CTD acquired data at a maximum rate of 25 Hz. The data consisted of pressure, temperature, conductivity, dissolved oxygen, second temperature, four CTD voltages, trip confirmation, transmissometer, altimeter and elapsed time. Power to the CTD was optimized by applying the minimum current to attain the CTD voltages required to maintain sensor stability. These voltages were monitored throughout the cast.

An ODF-designed deck unit demodulated the FSK CTD signal to an RS-232 interface. The raw CTD data server allowed the data to be split into three different paths: to be logged in raw digitized form, to be monitored in real time as raw data, and to be processed and plotted. During the TUNES expedition, an Integrated Solutions Inc. (ISI) Optimum V computer served as the real-time data acquisition processor. Additionally, Sun SPARC computers were used during post- cruise processing.

The raw CTD audio signal was recorded on VHS videotape as an ultimate back-up, and all raw binary data were logged on a hard disk and then backed up to magnetic cartridge tape. In addition, all intermediate versions of processed data were backed up to magnetic cartridge tape.

CTD data processing consists of a sequence of steps which is modified as needed. Data can be re-processed from any point in this sequence after the raw data are acquired from the sea cable and recorded on videotape and/or hard disk. Each CTD cast is assigned a correction file, and while the corrections are usually determined for groups of stations, it is possible to fine tune the parameters for even a single station. The acquisition and processing steps are as follows:

- Data are acquired from the CTD sea cable and assembled into consecutive .04-second frames containing all data channels. The data are converted to engineering units.
- The raw pressure, temperature and conductivity data are passed through broad absolute value and gradient filters to eliminate noisy data. The entire frame of raw data is omitted, as opposed to interpolating bad points, if any one of the filters is exceeded. The filters may be adjusted as needed for each cast.

TYPICAL TUNES RAW DATA FILTERS

Raw Data Channel	Minimum	Maximum	Frame-to-Frame Gradient
Pressure	-40	6400	2.0 dbar
Temperature	-8	32.7	.2 to .6°C
Conductivity	0	64.355	.3 to .6 mmho

- Pressure and conductivity are phase-adjusted to match the temperature response, since the temperature sensor responds more slowly to change. Conductivity data are corrected for ceramic compressibility in accordance with the NBIS Mark III-B Reference Manual.
- The data are averaged into 0.5-second blocks. During this step, data falling outside four standard deviations from the mean are rejected and the average is recalculated. Then data falling outside two standard deviations from the new mean are rejected, and the data are re-averaged. The resulting averages, minus second temperature and CTD voltages, are reported as the 0.5-second time series. Secondary temperature data are used to verify the stability of the primary

temperature channel calibration. Secondary temperature data are only filtered, averaged and reported with the time-series data when they are used in place of the primary temperature data due to a sensor malfunction.

- Corrections are applied to the data. The pressure data are corrected using laboratory calibration data. Temperature corrections, typically a quadratic correction as a function of temperature, are based on laboratory calibrations. Conductivity and oxygen corrections are derived from water sample data. Conductivity corrections are typically a linear fit as a function of conductivity. Oxygen data are corrected on an individual cast basis. Uncorrected time-series transmissometer data are forwarded to TAMU for final processing and reporting.

The averaged data are recorded on hard disk and sent to the real-time display system, where the averaged data can be reported and plotted during a cast. The averaging system also communicates with the CTD acquisition computer for detection of bottle trips, almost always occurring during the up casts. A 3- to 4-second average of the CTD data is stored for each detected bottle trip.

A down-cast pressure-series data set is created from the time series by applying a ship-roll filter to the down-cast time-series data, then averaging the data within 2-dbar pressure intervals centered on the reported pressure. The first few seconds of data for each cast are generally excluded from the averages due to sensor adjustment or bubbles during the in-water transition. 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 CTD time series is always the primary CTD data record for the pressure, conductivity and temperature channels. The final corrections to the CTD oxygen data are made by correcting pressure-series CTD oxygen data to match the up-cast oxygen water samples at common isopycnals. The final CTDO pressure-series data are the data reported to the principal investigator and to the WHP Office.

Subsequent sections of this document discuss the laboratory calibrations, data processing and corrections for each CTD used during TUNES Legs 1 and 2.

3. CTD Laboratory Calibrations

3.1. Pressure Transducer Calibration

Each CTD pressure transducer was calibrated in a temperature-controlled bath to the ODF Ruska deadweight-tester (DWT) pressure standards. The mechanical hysteresis loading and unloading curves were measured both pre- and post-cruise at cold temperature (-1.0 to 0.1°C bath) to a maximum of 8830 psi, and at warm temperature (29.4-30.2°C bath) to a maximum of 1730-2030 psi. The CTD-1 pre-cruise calibration also included a cold calibration to 2030 psi as well as a warm calibration to 8830 psi.

CTD #10 was not calibrated post-cruise because it flooded during Leg 2 and was modified during repair. CTD #1 and CTD #2 had parts interchanged during Leg 2; these were put back in their original configurations before their post-cruise calibrations.

CTD pre- and post-cruise pressure calibrations are summarized in Figures 1, 2 and 3.

3.2. PRT Temperature Calibration

All CTD PRT temperature transducers were calibrated in a temperature-controlled bath. CTD temperatures were compared with temperatures calculated from the resistance of a standard platinum resistance thermometer (SPRT) as measured by a NBIS ATB-1250 resistance bridge. The ultimate temperature standards at ODF are water and diphenyl ether triple-point cells and a gallium cell. Six or more calibration temperatures, spaced across the range of -2.0 to 30.2°C, were measured both pre- and post-cruise.

CTD pre- and post-cruise temperature calibrations are summarized in Figures 4, 5 and 6.

4. CTD Data Processing

4.1. Pressure, Temperature and Conductivity/Salinity Corrections

A maximum of 36 salinity and oxygen check samples were collected during each CTD cast. Thermometric temperature data were also measured at 1 or 2 levels per cast for stations 183 through 220 on Leg 2. No thermometric pressure data were collected.

A 3- to 4-second average of the CTD time-series data was calculated for each sample. The resulting data were then used to verify the pre- and post-cruise temperature calibrations, and to derive CTD conductivity/salinity and oxygen corrections.
Two CTDs were traded off during the equatorial section of Leg 1 so that 11-bottle rosette casts with LADCP could alternate with 36-bottle rosette casts. During Leg 2, there were numerous CTD problems and repair attempts that resulted in various sensors and interfaces being shifted from one instrument to another. The following chart clarifies which sensors were being used for any given cast on Leg 1 or Leg 2:

SUMMARY OF CTD SENSORS† USED ON EACH PROCESSED TUNES CAST

CTD	Press.	Temp.	Cond.	STATIONS
1	1	1/PRT-1	1	Leg1: 1-75,84-96even,98/2,100-116even,118-123
				Leg2: 124-133,182,189,193-220
1	1	1s/PRT-1	1	Leg1: 76-80,82
1	1	1/PRT-1	1s	Leg2: 134-136
1	1	1/PRT-1	1.2	Leg2: 190-192
2	2	2/PRT-1	2	Leg1: 81-97odd,98/4,99-117odd
				Leg2: 137-147
2	2	2/PRT-2	2	Leg2: 148-150,183-188
10	10	10/PRT-1	10	Leg2: 151-181

† Exact Sensor Serial numbers appear below:

CTD ID#	Pressure	Temperature		Conductivity
		PRT-1	PRT-2	
1	131910	14304	FSI1319	5902-F117
1s			FSI1320	spare (ser.no.unknown)
1.2				5902-F117 + CTD-2 Cond.interface
2	110188	15766	10680	2172-G147
10	55504	16185	16188	2932-H137

4.1.1. CTD Pressure Corrections

4.1.1.1. CTD #1

CTD #1 pre- and post-cruise pressure calibrations, Figures 1a/b and 1c, were compared. The warm/shallow and cold/deep calibration curves both shifted by about 3 decibars from pre- to post-cruise. The slopes of the warm/shallow pressure calibration curves were nearly identical. The slopes of the cold/deep curves were slightly different: shallower points were 1 decibar closer than deeper points from the two calibrations. Thermometric pressures were not measured during either leg.

An average of the pre- and post-cruise pressure calibrations, Figure 1d, was calculated and applied to the CTD #1 pressure data from both legs.

4.1.1.2. CTD #2

CTD #2 pre- and post-cruise pressure calibrations, Figures 2a and 2b, were compared. The warm/shallow and cold/deep calibration curves both shifted by about 8 decibars from pre- to post-cruise. The slopes of the 2 sets of pressure calibration curves differed by a maximum of 1 decibar over 6000 decibars. Thermometric pressures were not measured during either leg.

CTD #2 surface raw pressure data were compared over the course of both legs to determine when the 8-decibar shift might have occurred. CTD #2 was used on Leg 1 for each LADCP cast: every other station from 81 through 117. There was no apparent shift in the surface raw pressures during this time: all values, down or up cast, were within 1 decibar of each other at equatorial surface temperatures. These raw pressures were approximately halfway between the pre- and post-cruise laboratory calibration values at similar temperatures.

The Leg 2 CTD #2 casts, stations 137-150 and 183-188, were also checked. Down and up cast raw pressures were consistent and an average 2 decibars lower than the Leg 1 values, closer to the pre-cruise calibration than Leg 1. There was no shift in raw pressure values between stations 150 and 183.

The pre-cruise calibration was left in place for the CTD #2 pressure data on both legs because of negligible slope differences between pre- and post-cruise calibrations. Any residual offset was compensated for automatically at each station: as the CTD enters the water, the corrected pressure is adjusted to 0 decibars.

4.1.1.3. CTD #10

CTD #10 could not be calibrated post-cruise: the instrument flooded during the first/aborted cast at station 182 and was subjected to major repairs and adjustments after the cruise. Any calibration data collected after this repair would not apply to the TUNES cruises.

Thermometric pressures were not measured during Leg 2. The pre-cruise pressure calibration, Figure 3, remained in effect for the CTD #10 data on Leg 2.

4.1.2. CTD Temperature Corrections

4.1.2.1. CTD #1

CTD #1 had two temperature sensors: PRT-1 was calibrated pre- and post-cruise; PRT-2 was only calibrated pre-cruise and was used to check for PRT-1 drift during the cruise. A comparison of the pre- and post-cruise laboratory CTD #1 PRT-1 temperature transducer calibrations, Figures 4a and 4b, showed two curves with nearly identical slopes and a +.0025°C temperature shift in the range of 0 to 32°C. An average of the two laboratory calibrations, Figure 4c, was applied to the CTD #1 temperature data.

Thermometric temperature data from Leg 2, stations 189 through 220, were compared to the calibrated CTD #1 temperature data. The average difference between thermometric data and final calibrated CTD data was 0±.0005°C, in good agreement with the average laboratory calibration used.

C.3.4.1.2.2. CTD #2

CTD #2 also had two temperature sensors, each calibrated pre- and post-cruise, Figures 5a/b (PRT-1) and 5c/d (PRT-2). PRT-1, the primary sensor, shifted an average +.044°C between calibrations; PRT-2, the secondary sensor, shifted an average -.011°C. The slopes also shifted by about .004°C each over the 30°C temperature range of the calibrations. The PRT-1 minus PRT-2 difference changed by +.055°C between calibrations at both cold and warm temperatures.

CTD #2 Laboratory Temperature Calibrations

CTD #2 Sensor	Lab.Calib. Temp.	Std.-CTD T (°C)		Change in Corrxn	Avg. Change in CTD T
		Pre-crs	Post-crs		
PRT-1	0°C	-1.486	-1.528	-.042	
	30°C	-1.496	-1.542	-.046	+.044
PRT-2	0°C	-1.497	-1.484	+.013	
	30°C	-1.495	-1.486	+.009	-.011

PRT-1 drifting was first noticed during Leg 2, station 149, as a possible conductivity problem; PRT-1 temperature offsets as large as +.7°C were noted during station 150. After CTD #10 flooded and CTD #1 was under repair for continuing conductivity noise problems, CTD #2 was used again for stations 183-188. The secondary sensor was used for CTD temperature data during these casts, and DSRT thermometer data were collected to monitor any PRT-2 sensor drifting problems.

The two PRTs were monitored shipboard to check for drifting or other problems. At first glance, PRT-1 appeared to be stable throughout the Leg 1 casts for which it was used; but PRT-1 minus PRT-2 differences had already shifted by approximately +.007°C compared to the pre-cruise calibration. Either sensor could have shifted in its pre- to post-cruise direction to cause this change, which was 3 times the WOCE standard.

The two PRTs were compared by lagging the faster PRT-1 raw temperature data by .15 seconds to match the PRT-2 raw data. PRT-1 minus PRT-2 differences were tabulated for Leg 1 and Leg 2 CTD #2 casts to determine when temperature shifts occurred. The PRT-1 data was too unstable to use for the comparison beginning with station 148. The results of the comparison are as follows:

CTD #2 PRT-1 vs PRT-2 Comparisons

	Avg. PRT-1 minus PRT-2		
Stations	Warm/27°C	Cold/1.5°C	Avg. Change
Pre-crs calib.	+.001	-.011	-
Leg1,81-117	+.0075	-.0035	+.0070
Leg2,137-147	+.0285	+.0185	+.0215
Post-crs calib.	+.056	+.044	+.0265

The above comparison is only helpful if it can be determined when each PRT shifted. Two thermometric temperature points per cast were measured on stations 183-188 as a calibration check for PRT-2. The DSRT vs. PRT-2 comparisons indicate agreement with the post-cruise PRT-2 calibration. The average residual DSRT-CTD difference after applying the post-cruise calibration is +.0034°C, the closest difference possible using either of the lab calibrations, or even a combination of the two.

PRT-2 had clearly shifted to the post-cruise temperature calibration by stations 183-188, and corrections were applied accordingly. The rest of the temperature corrections were determined from this information, combined with clues provided by an apparently stable CTD #2 conductivity sensor.

In an attempt to clarify when each sensor shifted, the CTD #2 data from Leg 1 and Leg 2 were block-averaged two ways: using PRT-1 or PRT-2 temperature data to calculate CTD salinity. PRT-2-based salinity corrections for stations 150/183 were comparable using the post-cruise temperature calibration. Using this same PRT-2 calibration for stations 137-150 also showed a smooth salinity picture, indicating that PRT-2 had shifted to its post-cruise calibration by the start of Leg 2.

PRT-2 was used for the primary temperature data for stations 148-150 based on major shifts in conductivity slopes from 147 to 148 when PRT-1 temperature data were used, and because of PRT-1 temperature shifts observed during stations 149-150. PRT-2 was not located as near to the conductivity sensor as PRT-1, so it generated noisier CTD salinity data: it was measuring slightly different water and could not be matched properly to the conductivity sensor response. Because of this, PRT-1 was used for all CTD #2 data prior to station 148, before it began to malfunction.

The PRT-1 minus PRT-2 difference was used to determine the Leg 2 PRT-1 calibration for stations 137-147. The pre-cruise calibration was used, with an offset, because the strange behavior of PRT-1 beginning at station 148 could have affected the post-cruise calibration slope and it would not apply to earlier casts. The average pre- to post-cruise calibration drift for PRT-2 was -.011°C; the average PRT-1 minus PRT-2 change from pre-cruise to stations 137-147, for cold or warm temperatures, was .0285°C. As PRT-2 drifted lower, increasing the difference by .011, PRT-1 had to drift higher; so the PRT-1 pre-cruise calibration curve was decreased by -.0175°C for stations 137-147. A smooth salinity correction for the PRT-1/PRT-2 transition at stations 147-148 verified this decision.

The Leg 1 PRT-1 minus PRT-2 differences shifted an average +.0075°C, cold or warm, compared to the pre-cruise calibrations. No thermometer data was collected during this leg to verify which PRT(s) had changed since the pre-cruise calibration. Salinity differences from the last CTD #2 casts of Leg 1 and the first CTD #2 casts from Leg 2 were compared. When the Leg 1 PRT-1 temperatures were corrected with the pre-cruise calibration and a -.0075°C offset, the Leg 1/Leg 2 salinity differences were within .003 psu, a normal shift after any CTD has been on-deck and sitting idle for several weeks. This PRT-1 correction, which assumes that PRT-2 did its entire shift between Legs 1 and 2, was used for all CTD #2 casts on Leg 1.

After Leg 2 conductivity/salinity corrections were calculated, there was up to a +.005 psu residual surface salinity offset for stations 143-147, indicative of an earlier PRT-1 problem than previously thought. Two options were considered: use PRT-2 for temperature or use PRT-1 with an additional first-order T correction. Because of the noisy salt signal that results from using PRT-2, it was decided to use the added first-order T correction to PRT-1 for stations 143-147. This gave the best deep T/S data while pulling in the surface differences.

A summary of the origin and correction of CTD #2 temperature data is listed below:

CTD #2 Temperature Correction Summary

		CTD #2	Laboratory	Calibration
Leg#	**Stations**	**PRT#**	**Calib. Used**	**Adjustment**
1	81-117odd + 98-4	PRT-1	Pre-cruise	-.0075 offset
2	137-142	PRT-1	Pre-cruise	-.0175 offset
2	143-147	PRT-1	Pre-cruise	-.0175 offset plus
				1st-order T(T) corrxn
2	148-150 + 183-188	PRT-2	Post-cruise	None

4.1.2.3. CTD #10

CTD #10 had two temperature sensors, both calibrated pre-cruise only. CTD #10 could not be calibrated post-cruise: the instrument flooded during the first/aborted cast at station 182 and was subjected to major repairs and adjustments after the cruise. Any calibration data collected after this repair would not apply to the TUNES cruises.

No thermometric temperatures were measured for this CTD. The PRT-1 minus PRT-2 difference shifted -.002°C from the pre-cruise laboratory calibration, Figures 6a/b, to the first TUNES CTD #10 cast. The PRT difference changed by a maximum -.002°C from the first to the last CTD #10 cast (stations 151-181). The conductivity correction shifted by more than .04 psu during this same time, a change 20 times greater than the PRT differences could account for. The pre-cruise calibration notes for CTD #10 indicated that PRT-2 was unstable, so it was assumed that any shift in the PRT difference was due to changes in PRT-2. The pre-cruise PRT-1 temperature calibration, Figure 6a, remained in effect for the CTD #10 data on Leg 2.

4.1.3. CTD Conductivity Corrections

In order to calibrate CTD conductivity, check-sample conductivities were calculated from the bottle salinities using CTD pressures and temperatures. For each cast, the differences between sample and CTD conductivities at all pressures were fit to CTD conductivity using a linear least-squares fit. Values greater than 2 standard deviations from the fits were rejected. The resulting conductivity correction slopes were plotted as a function of station number. The conductivity slopes were grouped by stations, based on common PRT and conductivity sensor combinations, and then fit as a function of station number to generate smoothed slopes for each group. These smoothed slopes were either averages of the slopes in the station group (0-order) or changing by a fixed amount from station to station (1st-order).

Conductivity differences were then calculated for each cast after applying the preliminary conductivity slope corrections. Residual conductivity offsets were computed for each cast and fit to station number. Smoothed offsets were determined by groups as above, based on common PRT and conductivity sensor combinations. The resulting smoothed offsets were then applied to the data. Then conductivity slope as a function of conductivity was re-checked: no changes were warranted.

Some offsets were manually adjusted to account for discontinuous shifts in the conductivity transducer response, or to insure a consistent deep T-S relationship from station to station.

4.1.3.1. Leg 1

CTD #1 and #2 were both used on Leg 1 without any apparent conductivity problems. They were mounted on different rosettes and used for opposite casts during the equatorial stations to allow for adequate sampling time on the larger rosette without loss of ship time. CTD #1 was on the 36-place rosette, while CTD #2 was on a 12-place rosette with the LADCP. Plots of the final Leg 1 conductivity slopes and offsets can be found in Figures 7a and 8a.

Leg 1 Conductivity Correction Summary

Stations	CTD#	Cond.Slopes	Cond.Offsets†
1-3	1	+3.4450e-4	+9.337e-3
4-9	1	+3.4450e-4	+1.0837e-2
9-30	1	+3.4450e-4	-2.2706e-4*sta +1.3643e-2
31-67	1	+3.4450e-4	+4.9702e-5*sta +3.0220e-3
68-96even, 98/2,	1	+3.4450e-4	+7.7941e-3
100-116even, 118-123			
81-117odd,98/4	2	-1.12e-5*sta +1.7936e-3	+3.6617e-4*sta -7.2150e-2

† individual stations were adjusted after this for conductivity sensor shifting or to insure a consistent deep T-S relationship from cast to cast.

4.1.3.2. Leg 2

During Leg 2, the CTD #1 conductivity sensor had downcast noise problems of .005 psu or larger beginning with station 133. The conductivity sensor was switched out for a spare before station 134, but the problem continued and actually tripled in size by station 136. Other CTDs were used until CTD #2's PRT problems and CTD #10's flooding problems required trying CTD #1 again, with its original conductivity sensor, at station 182; the noise problem continued. CTD #2 was again used for several stations until it locked up.

Leg 2 Conductivity Correction Summary

Stations	Conduct. Sensor ID	Conductivity Slopes	Conductivity Offsets†
124-133	1	+2.2324e-4	+4.2845e-4*sta -4.8951e-2
134-136	1s	-1.8377e-4*sta -1.3375e-2	+6.5794e-3*sta -8.7711e-1
137-147	2	-2.5674e-5*sta +3.7912e-3	+1.4006e-3*sta -2.1403e-1
148-150,	2	+2.9952e-6*sta -1.0495e-4	-1.0969e-4*sta -1.9537e-3
183-188			
151-181	10	-1.1894e-5*sta +2.2683e-3	+2.0299e-4*sta -3.1279e-2
182,189,	1	+1.6366e-5*sta -3.7327e-3	-5.0723e-4*sta +1.1454e-1
193-196			
190-192	1.2	+2.0127e-4*sta +1.0515e-2	-6.59775e-3*sta +1.2534
197-220	1	-6.5218e-4	+8.19092e-3

† individual stations were adjusted after this for conductivity sensor shifting or to insure a consistent deep T-S relationship from cast to cast.

CTD #1 was brought back on line at station 189 as a mixture of parts from CTDs #1 and #2. Following numerous repair attempts and part switching, the culprit was discovered to be a coating on the PRT/Conductivity sensor guard that was flaking off and flapping in front of the sensor on the downcasts. The coating was removed and there were no more noise problems beginning with station 197. Because of severe conductivity noise problems on their downcasts, the upcasts were used for stations 133-136, 182, and 189-196. Plots of the final Leg 2 conductivity slopes and offsets can be found in Figures 7b and 8b.

4.1.3.3. Bottle vs. CTD Conductivity Statistical Summary

The TUNES calibrated bottle-minus-CTD conductivity statistics include bottle salinity values with quality 3 or 4. There is approximately a 1:1 correspondence between conductivity and salinity residual differences. The following statistical results were generated from the final bottle data set and the final corrected CTD data:

TUNES Final Bottle-CTD Conductivity Statistics

cruise leg	pressure range(dbars)	mean conductivity difference (bottle-CTD mmho/cm)	standard deviation	#values in mean
TUNES-1	all pressures	-.00053††	.01357	3819
	allp (4,2rej) †	.00033	.00365	3566
	press < 1500	-.00077	.01741	2230
	p<1500(4,2rej)†	.00040	.00609	2081
	press > 1500	-.00019†††	.00412	1589
	p>1500(4,2rej)†	.00012	.00128	1527
TUNES-2	all pressures	.00013††	.03991	3449
	allp (4,2rej) †	.00003	.00355	3310
	press < 1500	.00016	.05191	2036
	p<1500(4,2rej)†	-.00012	.00566	1953
	press > 1500	.00007†††	.00242	1413
	p>1500(4,2rej)†	-.00010	.00084	1359

† "4,2rej" means a 4,2 standard-deviation rejection filter was applied to the differences before generating the results.
†† Plots of these differences can be found in Figures 9a and 9b.
††† Plots of these differences can be found in Figures 10a and 10b.

4.2. CTD Dissolved Oxygen Data

4.2.1. CTD Oxygen Corrections

Dissolved oxygen data were acquired using Sensormedics dissolved oxygen sensors. During TUNES Legs 1 and 2, two oxygen sensors were used. Sensor A was used with all CTDs for every station except 188-192, where it was temporarily replaced with sensor B because of oxygen signal problems.

CTD oxygen data are corrected after pressure, temperature and conductivity corrections have been determined. CTD raw oxygen currents were extracted from the pressure-series data at isopycnals corresponding to the up-cast check samples. Most pressure-series data were from the down casts, where oxygen data are usually smoother than up-cast data because of the more constant lowering rate, avoiding the flow-dependence problems occurring at up-cast bottle stops. However, the TUNES CTD oxygen data were affected with flow-dependence problems, down or up cast, each time a cast was stopped for several minutes around 20 decibars to activate/de-activate the heave compensator.

The CTD oxygen correction coefficients were determined by applying a modified Levenberg-Marquardt nonlinear least squares fitting procedure to residual differences between CTD and bottle oxygen values. Bottle oxygen values were weighted as required to optimize the fitting of CTD oxygen to discrete bottle samples. Some bottle levels were omitted from a fit because of large pressure differences between down- and up-cast CTD data at isopycnals. Deep data points were often weighted more heavily than shallower data due to the higher density of shallow sampling on a typical 36-bottle sampling scheme.

The TUNES surface oxygen data fitting was adversely affected by the long heave compensator stop which, combined with the typical going-in-water bubbles/noise, made it difficult to fit CTD oxygens to the bottle data in the surface mixed layer of many casts.

4.2.2. Bottle vs. CTD Oxygen Statistical Summary

The CTD oxygens are generated by fitting up cast oxygen bottle data to down cast CTD raw oxygen (microamps) measurements along isopycnals. Residual oxygen differences are not generated from these comparisons, so no comparison statistics are shown in this report.

4.3. Additional Processing

A software filter was used on 36 Leg1 casts and 40 Leg2 casts to remove conductivity or temperature spiking problems in about 0.1% of the time-series data frames. Pressure did not require filtering. A fourth of the T/C spiking problems occurred in station 182, and another fourth were concentrated in the CTD-2/PRT-2 casts, where the distance between the secondary PRT and the conductivity sensor resulted in poor signal matchup in high-gradient areas.

Oxygen spikes were filtered out of 2 Leg1 casts and 91 Leg2 casts; software improvements prior to the Leg2 oxygen processing enabled this large difference in oxygen filtering. The filtered oxygen levels affected approximately 2.5% of the time-series data frames. 76% of the filtered oxygen data were shallower than 100 dbars and could be directly related to the stop at the heave compensator activation/de-activation, or bubbles trapped during the going-in-water transition.

The remaining density inversions in high-gradient regions cannot be accounted for by a mis-match of pressure, temperature and conductivity sensor response. Detailed examination of the raw data shows significant mixing occurring in these areas because of ship roll. The ship-roll filter resulted in a reduction in the amount and size of density inversions.

After filtering, the down cast (or up cast - see table below) portion of each time-series was pressure-sequenced into 2-decibar pressure intervals. A ship-roll filter was applied to each cast during pressure sequencing to disallow pressure reversals. The heave compensator installed on the R/V Washington decreased the magnitude of ship roll effects to a level comparable to Melville/Knorr CTD casts.

5. General Comments/Problems

There is one pressure-sequenced CTD data set, to near the ocean floor, for each of 221 casts at 220 station locations. There was an extra CTD cast at station 98, the equator station for Leg 1, to collect LADCP data. There were four additional equipment test casts, plus four casts aborted because of various CTD problems; these were neither processed nor reported. Another CTD cast was done immediately after any aborted cast at the same location.

The data reported is from down casts, excepting the stations listed below:

UP-CAST PRESSURE-SERIES DATA REPORTED

Leg#	Station(s)	Problem with Down Cast Data
1	16	VCR-operator error 800-1100 dbar
		down, data not record- ed/lost; up ok
2	133-136,182,189-196	Conductivity sensor guard coating
		flaking off, causing noisy conductivity
		signal on down casts, much less
		noise on up casts. Problem resolved
		before station 197.

The 0-2 decibar level(s) of some casts were extrapolated using a quadratic fit through the next three deeper levels. Recorded surface values were rejected only when it appeared that the drift was caused by sensors adjusting to the in-water transition; if there were any question that the that the surface values might be real, the original data was reported. Extrapolated surface levels are identified by a count of "1" in the "Number of Raw Frames in Average" reported with each data record on the tapes.

Several shipboard time-series data sets had areas of missing or noisy data. These casts were recovered by re-digitizing the raw signal from analog tape. The top 8 db of one Leg1 cast and 4 non-surface data levels in 2 Leg2 casts were interpolated. The pressures for these interpolated data frames as well as other cast-by-cast shipboard or processing comments are listed in the "CTD Processing Comments" in Appendix D. All interpolated data levels have a count of "1" in the "Number of Raw Frames in Average" column in the data files.

In addition, missing data values, such as CTD oxygens in casts where the sensor failed, are represented as "-9" in the data files. There were two casts (stations 183-184) where the oxygen signal failed only during the top 200 decibars; these are not reported as "-9", but the affected pressures are listed in Appendix D.

The CTD oxygen sensor often requires several seconds in the water before being wet enough to respond properly; this is manifested as low or high CTD oxygen values at the start of some casts. Flow-dependence problems occur when the lowering rate varies, or when the CTD is stopped, as at the cast bottom, bottle trips or the heave-compensator activation, where depletion of oxygen at the sensor causes lower oxygen readings. Station 133 oxygen data demonstrate a typical oxygen depletion effect at each bottle stop. Delays and yoyos during the casts are documented in Appendix D.

C.2 Gerard Bottles

Gerard pressures and temperatures were calculated from Deep-Sea Reversing Thermometer (DSRT) readings. Each DSRT rack normally held 2 protected (temperature) thermometers and 1 unprotected (pressure) thermometer. Thermometers were read by two people, each attempting to read a precision equal to one tenth of the thermometer etching interval. Thus, a thermometer etched at 0.05 degree intervals would be read to the nearest 0.005 degrees. Each temperature value is therefore calculated from the average of four readings provided both protected thermometers function normally.

The temperatures are based on the International Temperature Scale of 1990.

C.3 Salinity

Salinity samples were drawn into 200ml Kimax high-alumina borisilicate bottles with custom-made plastic insert thimbles and Nalgene screw caps. This assembly provides very low container dissolution and sample evaporation. Salinity bottles were rinsed three times before filling. Salinity was determined after sample equilibration to laboratory temperature, usually within about 8-36 hours of collection. Salinity has been calculated according to the equations of the Practical Salinity Scale of 1978 (UNESCO, 1981). This calculation uses the conductivity ratio determined from bottle samples analyzed (minimum of two recorded analyses per sample bottle after flushing) with a Guildline Autosal Model 8400A salinometer. The salinometer was standardized against Wormley P-114 standard seawater, with at least one fresh vial opened per cast.

Accuracy estimates of bottle salinities run at sea are usually better than 0.002 psu relative to the specified batch of standard. Although laboratory precision of the Autosal can be as small as 0.0002 psu when running replicate samples under ideal conditions, at sea the expected precision is about 0.001 psu under normal conditions, with a stable lab temperature.

C.4 Oxygen

Samples were collected for dissolved oxygen analyses soon after the rosette sampler was brought on board and after CFC and Helium were drawn. Nominal 100 or 125 ml volume iodine flasks were rinsed carefully with minimal agitation, then filled via a drawing tube, and allowed to overflow for at least 2 flask volumes. Reagents were added to fix the oxygen before stoppering. The flasks were shaken twice; immediately after drawing, and then again after 20 minutes, to assure thorough dispersion of the $Mn(OH)_2$ precipitate. The samples were analyzed within 4-36 hours.

Dissolved oxygen samples were titrated in the volume-calibrated iodine flasks with a 1 ml microburet, using the whole-bottle Winkler titration following the technique of Carpenter (1965) with modifications by Culberson et. al. (1991). Standardizations were performed with 0.01N potassium iodate solutions prepared from preweighed potassium iodate crystals. Standards were run at the beginning of each session of analyses, which typically included from 1 to 3 stations. Several standards were made up and compared to assure that the results were reproducible, and to preclude basing the entire cruise on one standard, with the possibility of a weighing error. A correction was made for the amount of oxygen added with the reagents. Combined reagent/seawater blanks were determined to account for oxidizing or reducing materials in the reagents, and for a nominal level of natural iodate (Brewer and Wong, 1974) or other oxidizers/reducers in the seawater. These latter corrections are contrary to the recommendations of Culberson et al. (1991), which call for the determination of reagent blanks in distilled water. ODF standard procedures have since been aligned with those recommended by Culberson.

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 Niskin bottle spigot. The temperature of the samples was measured at the time the sample was 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 temperatures provided an additional flag indicating that a bottle may not have tripped properly. Measured sample temperatures from mid-deep water samples were about 4-7°C warmer than in-situ temperature. Converted oxygen values, if this conversion with the measured sample temperature were made, would be about 0.08% higher for a 6°C warming (or about 0.2µm/kg for a 250µm/kg sample.)

C.5 Nutrients

Nutrients (phosphate, silicate, nitrate and nitrite) analyses, reported in micromoles/kilogram, were performed on a Technicon AutoAnalyzer®. The procedures used are described in Hager et al. (1972) and Atlas et al. (1971). Standardizations were performed with solutions prepared aboard ship from preweighed standards; these solutions were used as working standards before and after each cast (approximately 36 samples) to correct for instrumental drift during analyses. Sets of 4-6 different concentrations of shipboard standards were analyzed periodically to determine the linearity of colorimeter response and the resulting correction factors. Phosphate was analyzed using hydrazine reduction of phosphomolybdic acid as described by Bernhardt & Wilhelms (1967). Silicate was analyzed using stannous chloride reduction of silicomolybdic acid. Nitrite was analyzed using diazotization and coupling to form dye; nitrate was reduced by copperized cadmium and then analyzed as nitrite. These three analyses use the methods of Armstrong et al. (1967).

Sampling for nutrients followed that for the tracer gases, CFC's, He, Tritium, and dissolved oxygen. Samples were drawn into ~45 cc high density polyethylene, narrow mouth, screw-capped bottles which were rinsed twice before filling. The samples may have been refrigerated at 2 to 6°C for a maximum of 15 hours.

Nutrients were converted from micromoles per liter to micromoles per kilogram by dividing by sample density calculated at an assumed laboratory temperature of 25°C.

C.6 Chlorofluorocarbons

(Kevin F. Sullivan and Kevin A. Maillet)

Concentrations of the dissolved atmospheric cholorfluorocarbons (CFCs) F-11 and F-12 were measured by shipboard electron-capture gas chromatography according to the methods described by Bullister and Weiss (1988). The measurements were carried out by the group at the University of Miami under the direction of Dr. Rana A. Fine. A total of 1627 water analyses were carried out, 9 of which were duplicate analyses as tabulated in Table B.8.1. The mean value of duplicate analyses are reported in the data file and are assigned a quality byte of 6.

Several times during the cruise, problems with the analytical system required extensive downtime. If samples were drawn, but not analyzed, and the downtime exceeded 6 to 8 hours, some or all of these samples were discarded and fresh samples were drawn on the current station. This situation occurred after stations 16 and 24. In accordance with WHP protocol, the value for these analyses has been reported as -9.000 and they have been assigned a quality byte of 5. After station 46, the analysis of the samples was delayed 3 hours while a problem was eliminated.

On a number of occasions, the CFC analysis appeared routine yet the values obtained were clearly inappropriate based on the depth at which the Niskin was tripped. Upon further inspection it was noticed that there appeared to be problems with other measured quantities from these bottles as well. While the groups reporting hydrography and nutrients have chosen to eliminate the data in these situations, this group will report the data as measured and have assigned a data qulity flag of 4 to the quality byte for that measurement. It is considered that this is more in keeping with the WHP standard protocol that all data should be reported. In our view, the quality byte assigned to the bottle itself should be changed to 4 and the measured data retained. Situations where this occurred were:

S(tation) 6, N(iskin) 5; S 7, N 1; S 9, N 5 & 6; S 10, N 5 & 6; S 31, N 6.

The following analyses are suspect in relation to the surrounding values and have been flagged as bad data (quality byte 4):

S 10, N 33, F11; S 14, N 33, F11; S 61, N 6 & 7, F12; S 98, N 23, F12; S 122, N 18, F11.

A combination bottle and handling blank was used to correct for contamination from the Niskin bottles and from the collection and storage of the samples. This blank was estimated by analyzing samples from Niskins after they were tripped in what is believed to be CFC-free water. Since it is common for the blank arising from the Niskin bottles to be higher at the beginning of a cruise and to become progressively lower throughout the cruise, blanks were estimated over ranges of stations and applied to water analyses occurring during these ranges. In cases where the bottle/handling blank is greater than the measured concentration, a negative concentration is reported in the data file. A list of all Niskins and their bottle/handling blanks over the entire cruise is included in Table B.8.2.

Measurements of the atmospheric concentration of F-11 and F-12 were carried out regularly during the cruise. Air samples were pumped through a Decabond tubing air line run along the railing of the ship and up the mast at the bow. Air measurements were usually carried out while on station when the bow of the ship was heading into the wind to avoid contamination from the stack. Usually, three to six air measurements were carried out in sequence. The mean values of replicate air analyses are tabulated in Table B.8.3

Table B.8.1. Duplicate water analyses from P17c/TUNES 1 cruise on R/V Thomas Washington, June/July 1991 (duplicate syringes drawn on same niskin)

Stn#	Nsk#	Dpth	pM12/kg	pM11/kg	AvgF12 StdDev	AvgF11 StdDev
6	11	250	0.889	2.026	0.8897	2.0235
6	11	250	0.890	2.021	0.0008	0.0030
6	36	4082	0.034	0.008	0.0334	0.0080
6	36	4082	0.032	0.008	0.0011	0.0001
20	15	600	0.071	0.133	0.0717	0.1336
20	15	600	0.072	0.134	0.0002	0.0002
26	13	600	0.149	0.268	0.1414	0.2573
26	13	600	0.133	0.247	0.0079	0.0103
37	14	500	0.102	0.180	0.1040	0.1800
37	14	500	0.106	0.180	0.0022	0.0003
63	11	350	0.029	0.025	0.0283	0.0258
63	11	350	0.028	0.026	0.0005	0.0005
82	13	300	0.133	0.247	0.1329	0.2461
82	13	300	0.132	0.246	0.0005	0.0005
104	13	350	0.051	0.088	0.0507	0.0881
104	13	350	0.050	0.089	0.0006	0.0006
112	12	300	0.124	0.211	0.1230	0.2102
112	12	300	0.122	0.209	0.0014	0.0012

Table B.8.2. Bottle/handling blanks applied to P17c/TUNES 1 water analyses

CFC 11 P17c/TUNES 1 Station #					***CFC 12*** P17c/TUNES 1 Station #				
Niskin	1 - 9	10 - 26	27 - 45	46 - 123	Niskin	1 - 9	10 - 26	27 - 45	46 - 123
1	0.003	0.003	0.003	0.003	1	0	0	0	0
2	0.005	0.005	0.005	0.005	2	0.002	0.002	0.002	0.002
3	0.003	0.003	0.003	0.003	3	0	0	0	0
4	0.003	0.003	0.003	0.003	4	0.002	0.002	0.002	0.002
5	0.003	0.003	0.003	0.003	5	0.003	0.003	0.003	0.003
6	0.003	0.003	0.003	0.003	6	0.003	0.003	0.003	0.003
7	0.005	0.005	0.005	0.005	7	0.003	0.003	0.003	0.003
8	0.003	0.003	0.003	0.003	8	0	0	0	0
9	0.003	0.003	0.003	0.003	9	0	0	0	0
10	0.003	0.003	0.003	0.003	10	0	0	0	0
11	0.004	0.004	0.004	0.004	11	0	0	0	0
12	0.003	0.003	0.003	0.003	12	0.003	0.003	0.003	0.003
13	0.006	0.003	0.003	0.002	13	0.004	0.002	0.002	0.002
14	0.006	0.003	0.003	0.002	14	0.004	0.002	0.002	0.002
15	0.006	0.003	0.003	0.002	15	0.004	0.002	0.002	0.002
16	0.006	0.004	0.004	0.003	16	0.004	0.003	0.003	0.003
17	0.006	0.004	0.004	0.003	17	0.004	0.003	0.003	0.002
18	0.006	0.003	0.003	0.002	18	0.004	0.002	0.002	0.002
19	0.006	0.003	0.003	0.002	19	0.004	0.002	0.002	0.002
20	0.009	0.005	0.005	0.004	20	0.006	0.004	0.003	0.003
21	0.009	0.005	0.002	0.002	21	0.006	0.004	0	0
22	0.009	0.005	0.003	0.003	22	0.006	0	0	0
23	0.009	0.005	0.003	0.003	23	0.006	0	0	0
24	0.009	0.005	0.003	0.003	24	0.006	0	0	0
25	0.009	0.004	0.002	0.002	25	0.006	0	0	0
26	0.009	0.004	0.002	0.002	26	0.006	0	0	0
27	0.009	0.004	0.002	0.002	27	0.006	0	0	0
28	0.009	0.004	0.002	0.002	28	0.006	0	0	0
29	0.009	0.003	0.003	0.002	29	0.006	0	0	0
30	0.009	0.003	0.003	0.002	30	0.006	0	0	0
31	0.009	0.004	0.004	0.003	31	0.006	0	0	0
32	0.009	0.003	0.003	0.002	32	0.006	0	0	0
33	0.009	0.004	0.002	0.002	33	0.006	0.004	0	0
34	0.009	0.004	0.004	0.002	34	0.006	0.004	0	0
35	0.009	0.005	0.004	0.002	35	0.006	0.005	0	0
36	0.009	0.005	0.004	0.003	36	0.006	0.005	0	0

Table B.8.3. Air analyses carried out during P17c/TUNES1

Lat. along 135W	ppt F12	ppt F11
34.1 N	490.9	274.9
30.5 N	489.4	271.5
30.0	492.8	274.1
26.5 N	503.8	277.0
26.0	501.7	276.0
22.5 N	500.0	275.5
22.0	496.2	274.2
18.0 N	494.8	272.6
16.5	498.6	276.8
14.0 N	486.9	271.3
12.5	497.5	279.9
9.5 N	495.3	271.6
6.5	486.6	269.5
4.0 N	495.2	268.3
2.7	478.9	266.4
1.3 N	483.0	266.1
0.3 S	481.2	270.3
2.0 S	481.3	267.8
3.0 S	474.1	265.1
3.5 S	476.6	268.4
16.2 S 148.1 W	483.3	262.6

C.7 BOTTLE DATA COMPARISONS AND COMMENTS

The oxygen and nutrient data were compared by ODF with those from the adjacent station. Dr. Mizuki Tsuchiya and Dr. Lynne Talley did comparisons with historical data sets.

Cruise 31WTTUNES/1 had several start-up problems, due to moderately rough weather, pylon problems, and the close spacing of the initial run of stations. Until the pylon problems were sorted out, there were substantial portions of the water column without verifiable water samples. Most closure problems were solved by the time the vessel began the WOCE run along 135°W.

Post cruise assessment revealed that the practice of renumbering replacement Niskin bottles (to keep numbers in sequence), was at least occasionally followed on this cruise leg. This goes against ODF and WOCE policy. it may be possible to reconstruct bottle numbering history for this cruise leg, but at significant cost (the deck log is occasionally vague on this point), and so no changes have yet been made to the bottle numbers as reported from the shipboard data file.

D. REFERENCES AND UNCITED SUPPORTING DOCUMENTATION

Armstrong, F. A. J., C. R. Stearns, and J. D. H. Strickland, 1967. The measurement of upwelling and subsequent biological processes by means of the Technicon Autoanalyzer and associated equipment, Deep-Sea Research 14, 381-389.

Atlas, E. L., S. W. Hager, L. I. Gordon and P. K. Park, 1971. A Practical Manual for Use of the Technicon(R) AutoAnalyzer(R) in Seawater Nutrient Analyses; Revised. Technical Report 215, Reference 71-22. Oregon State University, Department of Oceanography. 49 pp.

Bernhardt, H. and A. Wilhelms, 1967. The continuous determination of low level iron, soluble phosphate and total phosphate with the AutoAnalyzer, Technicon Symposia, Volume I, 385-389.

Brewer, P. G. and G. T. F. Wong, 1974. The determination and distribution of iodate in South Atlantic waters. Journal of Marine Research, 32,1:25-36.

Bryden, H. L., 1973. New Polynomials for Thermal Expansion, Adiabatic Temperature Gradient, Deep-Sea Research 20, 401-408.

Bullister, J.L. and R.F. Weiss, 1988. Determination of CCl3F and CCl2F2 in seawater and air. Deep-Sea Research, 35, 839-853.

Carpenter, J. H., 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method, Limnology and Oceanography 10, 141-143.

Carter, D. J. T., 1980 (Third Edition). Echo-Sounding Correction Tables, Hydrographic Department, Ministry of Defence, Taunton Somerset.

Chen, C.-T. and F. J. Millero, 1977. Speed of sound in seawater at high pressures. Journal Acoustical Society of America, Volume 62, No. 5, 1129-1135.

Culberson, C. H., Williams, R. T., et al,August, 1991. A comparison of methods for the determination of dissolved oxygen in seawater, WHP Office Report WHPO 91-2.

Fofonoff, N. P., 1977. Computation of Potential Temperature of Seawater for an Arbitrary Reference Pressure. Deep-Sea Research 24, 489-491.

Fofonoff, N. P. and R. C. Millard, 1983. Algorithms for Computation of Fundamental Properties of Seawater. UNESCO Report No. 44, 15-24.

Hager, S. W., E. L. Atlas, L. D. Gordon, A. W. Mantyla, and P. K. Park, 1972. A comparison at sea of manual and autoanalyzer analyses of phosphate, nitrate, and silicate. Limnology and Oceanography 17 931-937.

Lewis, E. L., 1980. The Practical Salinity Scale 1978 and Its Antecedents. IEEE Journal of Oceanographic Engineering, OE-5, 3-8.

Mantyla, A. W., 1982-1983. Private correspondence.

Millero, F. J., C.-T. Chen, A. Bradshaw and K. Schleicher, 1980. A New High Pressure Equation of State for Seawater. Deep-Sea Research 27A, 255-264.

Saunders, P. M., 1981. Practical Conversion of Pressure to Depth. Journal of Physical Oceanography 11, 573-574.

Sverdrup, H. U., M. W. Johnson, and R. H. Fleming, 1942. The Oceans, Their Physics, Chemistry and General Biology, Prentice-Hall, Inc., Englewood Cliff, N.J.

UNESCO, 1981. Background papers and supporting data on the Practical Salinity Scale, 1978. UNESCO Technical Papers in Marine Science, No. 37, 144 p.

Joyce, T.M. and C. Corry, Ed., 1994, Requirements for WOCE Hydrographic Programme Data Reporting, WHPO 90-1, WOCE Report No. 67/91.

Joyce, T.M., Ed., 1991, WHP Operations and Methods, WHPO 91-1, WOCE Report No. 68/91.

Unesco, 1983. International Oceanographic tables. Unesco Technical Papers in Marine Science, No. 44.

Unesco, 1991. Processing of Oceanographic Station Data. Unesco memorgraph By JPOTS editorial panel.

E. BOTTLE DATA COMMENTS

Remarks for deleted or missing samples from TUNES/WOCE Pacific 91, P17C. Investigation of data may include comparison of bottle salinity and oxygen with CTD data, review of data plots of station profile and adjoining stations, rereading of charts (ie. nutrients). Comments from the Sample Logs and ODF's results of investigation are included in this report.

Station 001

122 @ 42db	Sample log: Spring needs tightening. All water samples look good at 42m.
131 @ 293db	Delta-S .010 low at 343db. Calc ok. No notes. All water samples have same value as NB30 at level above. CTDO traces show smoother gradient this area Assume closed at NB30 level (292db). Changed trip file made 31 same trip info as 30. Used 292.7 vs. 343.2 CTD trip data for NB31.
133 @ 443db	Delta-S .050 low at 442db. Calc ok. No notes. Other water samples ok. Same value as NB32 at level above. Assume dupe draw. Footnote salinity uncertain, ODF recommends deletion.
134 @ 492db	Salinity same value as 33 at level above. Assume dupe draw. Footnote salinity uncertain, ODF recommends deletion.
135 @ 519db	Sample log: Leaking from bottom end cap. Delta-S .003 high at 519db. Other water samples also look ok.
136 @ 519db	Delta-S .026 low at 550db. Calc ok. No notes. All water samples have same values as NB35 at level above. CTDO salinity and oxygen traces show definite change between NB35 level at 519db and NB36 level. Assume NB36 closed at 519db level. Changed trip file made 36 same trip info as 35. Used 518.9 vs. 550.3 CTD trip data for NB36.

Station 002

113	Bottle was closed but not intended as a sample. NBs 14 thru 17 were open as intended and ramp shaft in correct position. Water samples same as NB36 so assume NB 13 closed at first trip. This level is not reported.
129 @ 303db	Sample Log: "Air vent open" Delta-S -0.007 at 303db, in line with all other offsets on this station. O2 agrees with CTDO.
130 @ 353db	Sample Log: "Air vent open" Delta-S -0.006 at 353db, in line with all other offsets on this station. O2 agrees with CTDO.

Station 003

136 @1473db	Sample log: Spigot on deck, bottom end cap lanyard broken. Didn't see what happened. No water samples.

Station 004

111 @ 77db Sample log: Stepped on lanyard - let out some water. O2 appears to follow CTDO trace well. Other water samples also ok.

114 @ 149db Sample log: Leaking out of bottom. Delta-S .03 low at 148db. Calc ok. High gradient, down differs from up, CTD temp also bumpy this area. Other water samples look reasonable.

117 @ 298db Sample log: Leaker. Not specific. Delta-S .000 at 297db. Other water samples also ok.

135 @2397db Sample log: Water valve cracked. Delta-S .000 at 2396db. Other samples also okay.

Station 005

106 @ 143db Sample log: Closed top late in sampling. Spigot is tight. Spigot difficult to close. Delta-S .032 high at 143db. Calc ok. High gradient. Other water samples look ok near CTDO inversion.

109 @ 210db Sample log: Air vent partially open. Delta-S .02 low at 210 db. Calc ok. Other water also indicate possible leaker but in area of change.

110 @ 261db Sample log: Air vent partially open. Delta-S .013 low at 261db. Calc ok. Other water samples look ok.

117 @ 605db Sample log: Air leak. Delta-S .000 at 604db. Other water samples look ok.

118 @ 655db Delta-S .074 high at 655db. Calc ok. No notes. Other water samples ok. Same value as NB20 2 level deeper. Smooth CTD S trace. Possibly bad draw or bad run. Footnote salinity uncertain, ODF recommends deletion.

121 @ 909db Bottle oxy appears .1 low at 909db. Calc ok. CTDO trace smooth, although unclear from CTDO whether 121 is low or 119 & 120 are a little high. Footnote o2 uncertain.

128 @2019db Bottle oxy appears .1 high at 2019db. Calc ok. CTDO trace smooth, footnote o2 uncertain. Delta-S .002 low.

129 @2219db Sample log: Disc off while sampling. Samples look reasonable. Okay as is.

134 @3251db Final Delta-S .003 high at 3251db. Calc ok. Smooth CTD gradient. Tsuchiya: "Is this o2 max real? It looks either o2 at 134 is too high or o2 at 135 and 136 is too low." Calc okay, CTDO indicates 135 & 136 too low.

135 @3356db Bottle oxy appears .1 low. Calc ok. Footnote o2 uncertain. CTDO trace has slight jog this way but not .1. Other water samples & CTD traces have smooth gradient. Final Delta-S .005 high at 3356db. Calc ok. Smooth CTD gradient.

136 @3446db Bottle oxy appears .1 low. Calc ok. Footnote o2 uncertain. CTDO trace has slight jog this way but not .1. Other water samples & CTD traces have smooth gradient. Final Delta-S .005 high at 3446db. Found entry error, new hydro salt gives final Delta-S .0027 high.

Station 006

105 @ 90db	Not sure what happened here. No notes on Sample Log. Samples indicate bottle tripped at ~1200-1450db. Delete salinity, o2, sil, no3, no2, po4, 34.4980 39.7 133.65 42.76 0.01 3.05, respectively. Footnote bottle leaking.
107 @ 149db	Sample log: Air vent not completely closed. Delta-S .009 high at 150db. Other water look ok.
109 @ 200db	Sample log: Air vent partially open. Delta-S .005 low at 201 db. Other water samples also ok.
110 @ 226db	Sample log: Air vent partially open. Delta-S .004 at 228 db. Other water samples also ok.
112 @ 297db	Sample log: Bottom cap knocked open. Tsuchiya: "O2 too high?" Delta-S .002 high at 297db. Discrete O2 .7 high, calc ok. Nutrients look ok. Footnote oxygen bad. Oxygen seems to be affected by note from sample log, may also have affected other gas samples.
113	Sample log: Moved freon to bottle 22. No water samples. See 134.
114 @ 350db	Changed trip file, scheduled trip 410.
115 @ 399db	Changed trip file, scheduled trip 463.
116 @ 452db	Changed trip file, scheduled trip 509.
117 @ 499db	Sample log: Valve not completely closed. Delta-S .001 low at 500db. Other water samples also ok. Changed trip file, scheduled trip 612.
118 @ 603db	Changed trip file, scheduled trip 716.
119 @ 704db	Changed trip file, scheduled trip 820. Delta-S .090 high at 706db. Calc ok. Same value as NB20. Other water samples ok. Assume bad draw or run. Footnote salinity bad, ODF recommends deletion.
120 @ 808db	Changed trip file, scheduled trip 922.
121 @ 909db	Changed trip file, scheduled trip 1024.
122 @1009db	Changed trip file, scheduled trip 1227.
123 @1212db	Changed trip file, scheduled trip 1431.
124 @1414db	Changed trip file, scheduled trip 1636.
125 @1621db	Changed trip file, scheduled trip 1838.
126 @1825db	Changed trip file, scheduled trip 2033.
127 @2018db	Changed trip file, scheduled trip 2237.
128 @2223db	Changed trip file, scheduled trip 2451. Delta-S at 2223db is .004.
129 @2435db	Changed trip file, scheduled trip 2652. Delta-S at 2435db is .0048. Salinity a little noisy for entire trace. Footnote salinity uncertain.
130 @2435db	Delta-S .008 low at 2637.9db. Calc ok. All water samples same as 129 at 2436.4db. Assume trip problem, nothing tripped at 2637.9db and both NBs 29 & 30 tripped at 2436.4db. Used 2436.4 vs. 2636.5 CTD trip data for NB30. Changed trip file, scheduled trip 2852. Silicate: Couldn't read peak. Peak very jagged between .990 and 1.000.
131 @2840db	Changed trip file, scheduled trip 3046.
132 @3034db	Delta-S at 3034db is .004. Changed trip file, scheduled trip 3250.
133 @3238db	Changed trip file, scheduled trip 3460.
134 @3451db	Changed trip file, scheduled trip 3673. Delta-S at 3451db is .003. Console Ops Log: "13 still open. No trigger at 34. Delta-Ss on 34 thru

14 give good agreement if all samples moved up one level from intended level.

Station 007

1sil Tsuchiya: "Is the increase in sil level in deep layer (>~2000db) from Station 6 to 7 is real." Samples 125- 136,Calc appears to be okay, no problems noted.

101 @ 2db Delta-S 1.9 high at 1db. Calc ok. All water samples indicate bottle closed deep. NO2 unreadable peak, footnote no2 lost. Footnote bottle leaking. Delete salinity, o2, sil, no3, po4, 34.6273 118.6 166.28 38.16 2.65 , respectively.

105 @ 104db Nutrient: no2 unreadable peak.

108 @ 180db Sample log: Top was out of frame. Trip rod out of top plate, replaced trip rod later, found broken rod had been used and was too short. Samples look ok.

117 @ 812db Sample log: Slight air leak. Oxygen looks good. Leave as is.

118 @1006db Delta-S .02 high at 897db. Calc ok. All water samples indicate bottle closed closer to NB19 at 1005db. Talley: "Footnote salinity as questionable." Salinity sheet notes indicate analyst had to bring in the cast. Delta-S -.0112 at 1006 db. Suspect that he was distracted and this salinity is incorrect footnote salinity bad, ODF recommends deletion. Change trip file, scheduled 897.

120 @1006db Delta-S .02 low at 1110db. Calc ok. All water samples indicate bottle closed at NB19 at 1005db. Change trip file.

129 @2641db Sample log: Broken in half - destroyed. No samples.

130 @2849db Sample log: Broken spigot. No samples.

131 @3034db Delta-S at 3034db is -.005, calc ok. Footnote salinity uncertain. O2 .02 low compared to CTDO, calc ok. Footnote o2 uncertain. Nutrients have more normal gradient.

134 @3555db Delta-S .007 low at 3821db. Calc ok. Same as 133 salt at level above. NO3 & PO4 also same as 133 but Sil & O2 show some gradient. Sil has poor peak that could be interpreted as same as 133. O2 titrated by LTL who had several overtitrations early in the cruise. Suspect tripping problem and NB34 closed at NB33 level. Used 3554db CTD trip data for NB34. Changed trip file made 34 same trip info as 33.

136 @4227db Sample log: Air leak - vent closed - possible bottle crack? Delta-S .002 low at 4226db. Nutrients for 35 & 36 lower than other deep bottles but subsequent deep stations show same feature NB 36 ok on subsequent stations. Oxygen okay.

Station 008

1no3 Tsuchiya: "The lower level (relative to neighboring stations) of NO3 at the NO3 max and below (>~100db) is real?" Calc and peaks okay, no analytical problems noted. Samples 119-136.

101 @ 2db Sample log: Leaker. Final Delta-S .002 at 2db. Other water samples also look ok.

105 @ 113db Delta-S .866 high at 113db. All water samples indicate bottle closed deeper, probably about 375db. Footnote bottle leaking. Delete salinity, o2, sil, no3, no2, po4. 34.1821 48.4 85.34 36.82 0.00 2.75, respectively.

109 @ 203db Sample log: Leaker. Delta-S .004 low at 203db. Other water samples also look ok.

110 @ 249db Sample log: Leaker. Delta-S .17 high at 249db. Nutrients also appear to be from deeper water. O2 looks ok. Delete salinity, o2, sil, no3, no2, po4, 34.209 2.37 97.5 36.4 0.00 2.70, respectively.

112 @ 354db Delta-S .125 high at 354db. Calc ok. Nutrients also appear to be from deeper water, but O2 looks reasonable. No notes. Footnote bottle leaking. Delete salinity, o2, sil, no3, no2, po4, 34.1991 68.9 90.37 37.92 0.00 2.76, respectively.

117 @ 809db Sample log: Leaking. Delta-S .001 low at 809db. Other water samples also ok.

120 @1012db Delta-S .053 low at 1215db. Calc ok. All water samples have same value as NB19 at level above. CTDO shows smooth gradient this area. Assume NB20 closed at NB19 level(1011db). Changed trip file made 20 same trip info as 19. Used 1012.0 vs. 1215.8 CTD trip data for NB20. Tsuchiya: "PO4 looks slightly too high." Calculations and peak okay.

121 @1417db Tsuchiya: "PO4 looks slightly too high." Calculations and peak okay.

122 @1616db Sample log: Leaking (bottom seal). Delta-S 1.6 low at 1615db. Other water samples also indicate near surface water. Delete salinity, o2, sil, no3, no2, po4, 32.9269 248.0 7.73 2.38 0.00 0.61, respectively.

123 @1825db Tsuchiya: "PO4 looks slightly too high." Calculations and peak okay.

124 @1825db Delta-S .017 low at 2028db. Calc ok. All water samples have same value as NB23 at level above. CTDO shows smooth gradient this area. Suspect NB24 closed at NB23 level(1825db). Changed trip file made 24 same trip info as 23. Used 1824.7 vs. 2028.3 CTD trip data for NB24.

126 @2424db Silicate too high, calc okay, footnote silicate uncertain.

127 @2634db Sil appears 4 low at 2634db. Calc & peak ok. Footnote sil uncertain.

128 @2634db Delta-S .006 low at 2842db. Calc ok. All water samples have same value as NB27 at level above. CTDO shows smooth gradient this area. Assume NB28 closed at NB27 level(2634db) Changed trip file made 28 same trip info as 27. Used 2634.4 vs. 2841.8 CTD trip data for NB28.

130 @3040db Sample log: Leaking. Delta-S .004 low at 3247db. Calc ok. All water samples have same value as NB29 at level above. CTDO shows smooth gradient this area. Assume NB30 closed at or near NB29 level(3040db). Changed trip file made 30 same trip info as 29. Used 3039.9 vs. 3247.0 CTD trip data for NB30.

136 @4411db Delta-S at 4411db is -.003. Looks like 36 tripped with 35. No action taken on this, just leave as is.

Station 009

102 @ 75db	Delta-S .132 high at 37db. Calc ok. All water samples indicate NB2 closed one level below intended level, 75db vs 37db. See samples 103 & 104 also. Used CTD trip info at 75db for 102.
103 @ 98db	Delta-S .076 high at 75db. Calc ok. All water samples indicate NB3 closed one level below intended level, 98db vs 75db. See samples 102 & 104 also. Used CTD trip info at 98db for 103.
104 @ 126db	Delta-S .303 high at 98db. Calc ok. All water samples indicate NB4 closed one level below intended level, 125db vs 98db. See samples 102 & 103 also. Used CTD trip info at 125db for 104.
105 @ 152db	Delta-S 1.03 high at 125db. All water samples appear to be from deeper water. Not consistent with one level. Delete salinity, o2, sil, no3, no2, po4, 34.2898 43.6 123.08 41.54 0.01 3.00, respectively. Footnote bottle leaking.
106 @ 176db	Delta-S 1.06 high at 151db. All water samples appear to be from deeper water. Not consistent with one level. Delete salinity, o2, sil, no3, no2, po4, 34.4949 102.7 153.71 38.68 0.00 2.73, respectively. Footnote bottle leaking.
107 @ 201db	Delta-S .132 high at 176db. Calc ok. All water samples indicate NB7 closed one level below intended level, 201db vs 176db. See samples 102 & 103 also. Used CTD trip info at 201db for 107.
108 @ 250db	Sample log: Dripping through spigot. Delta-S .120 high at 200db. Calc ok. All water samples indicate NB8 closed one level below intended level, 250db vs 200db. See samples 102 & 103 also. Final Delta-S .043 low at 250db. Other water samples look ok. Up & Down T&S differ, with hydro S & O2 closer to down trace than up trace. Normal gradient. Used CTD trip info at 250db for 108. Footnote bottle leaking and salinity bad.
109 @ 301db	Sample log: Had broken block and one end cap open. No water samples.
110 @ 353db	Sample log: No spigot. No water samples.
111 @ 401db	Delta-S .014 high at 353db. Calc ok. All water samples look better at level below, 401db vs intended depth. Used NB11 water samples with 401db trip data.
112 @ 1db	ConOps log: "Extra trip on pylon 1 before changing to pylon 2. Delta-S 1.3 low at 400db. Other water samples indicate NB12 closed at surface. All water samples very similar to those from NB1. Used NB 12 water samples with surface trip data.
113-136	Sample log: "Came up open." Console Ops log: "Wire jumped sheave at ~20m, was discovered and put back at 60m." No confirms on outer ring trips. Bad conductor to outer ring pylon. No water samples.

Station 010

1Deep	Salt-All deep salinities about .002 lower than adjacent stations according to vertical sections and final Delta-Ss. Salinometer data look ok, no drift, standard same as other stations this Autosal. Console ops: new end termination before this cast, also some wire slippage

noted by wire out at end of cast. Footnote salinity uncertain. O2-Some scatter (.01) on deep hydro O2s. Calc ok. CTDO trace smooth. Footnote o2 uncertain.

101 @ 2db Sample log: Air leak. Final Delta-S .007 low at 1db. Other samples look ok for surface.

105 @ 111db Delta-S .9 high at 110db. All water samples appear to be from deeper water. Not consistent with one level. Footnote bottle leaking. Delete salinity, o2, sil, no3, no2, po4, 33.9442 25.8 54.17 31.72 0.00 2.24, respectively.

106 @ 136db Delta-S 1.19 high at 135db. All water samples appear to be from deeper water. Looks like from about 750db. Footnote bottle leaking. Delete salinity, o2, sil, no3, no2, po4, 34.3519 15.9 109.95 43.34 0.00 3.09, respectively.

110 @ 253db Sample log: valve opened on deck. Delta-S .004 low at 253db. Other water samples also look ok.

117 @ 807db Sample log: Air leaker. Delta-S .000 at 806db. Other water samples also look ok.

120 @1011db Delta-S .05 low at 1204db. All water samples appear to have tripped at level above, 1010db. Changed trip file made 20 same trip info as 19.

124 @1822db Delta-S .020 low at 2021db. All water samples appear to have tripped at level above, 1821db. Changed trip file made 24 same trip info as 23.

125 @2226db See 1Deep comments, footnote salinity and o2 uncertain.

126 @2425db Delta-S at 2425db is -0.004. See 1Deep comments, footnote salinity and o2 uncertain.

127 @2635db Delta-S at 2635db is -0.006. See 1Deep comments, footnote salinity and o2 uncertain.

128 @2833db Delta-S at 2833db is -0.003. See 1Deep comments, footnote salinity and o2 uncertain.

129 @3040db Delta-S at 3040db is -0.006. See 1Deep comments, footnote salinity and o2 uncertain.

130 @3040db Sample Log: Collar came off while drawing oxygen. Delta-S .007 low at 3288db. All water samples appear to have tripped near level above, 3039db. Changed trip file made 30 same trip info as 29. See 1Deep comments, footnote salinity and o2 uncertain. Delta-S at 3040db is -0.005.

131 @3552db Sample log: Valve broken off. No water samples

132 @3799db Sample log: Opened to air on deck. Delta-S .001 high at 3799db. Other water samples including O2 ok. See 1Deep comments, footnote salinity and o2 uncertain.

133 @4059db Delta-S at 4059db is -0.004 See 1Deep comments, footnote salinity and o2 uncertain.

134 @4059db Delta-S at 4322db is -.0068. See 1Deep comments, footnote salinity and o2 uncertain. Sil appears high. Changed trip file made 34 same trip info as 33. Delta-S at 4059db is -.0058, and silicate fits station profile much better.

135 @4602db Delta-S at 4602db is -0.0043 See 1Deep comments, footnote salinity and o2 uncertain.
136 @4766db Delta-S at 4766db is -0.0047 See 1Deep comments, footnote salinity and o2 uncertain.

Station 011

1nut Nutrient: "PO4 will be bad" New tart acid. Nutrients whole run - looks like someone put silicone grease on Niskins!. End Stds off PO4 NO3 use beg f1s for end. System kaput!" PO4 about .15 higher than adjacent stations. NO3 about 1.3 higher than adjacent stations. SIL also high. Talley: "Put nutrients back in footnote bad measurement."
1slt There was a large drift on this salinity run and it looks like the analyst had problems getting two conductivity readings to agree. Footnote salinity uncertain.
101 @ 2db See 1nut nutrients comment.
102 @ 50db See 1nut nutrients comment.
103 @ 104db See 1nut nutrients comment.
104 @ 125db see 1nut nutrients comment.
105 @ 150db see 1nut nutrients comment. Delta-S .2 low at 150db. Calc ok. High gradient.
106 @ 175db See 1nut nutrients comment.
107 @ 201db See 1nut nutrients comment.
108 @ 226db See 1nut nutrients comment.
109 @ 254db See 1nut nutrients comment.
110 @ 304db Sample log: Leaking from bottom end cap - out of water at CO2 Delete high oxygen (166.0 um/kg), obvious bottle leaking problem. Footnote bottle leaking.
111 @ 354db Delta-S .01 low at 354db. Calc ok. Normal gradient. No notes. See 1nut nutrients comment.
112 @ 402db See 1nut nutrients comment.
113 @4877db See 1nut nutrients comment. Delta-S .57 high at 505db. Calc ok. Delta-S at 4877db is -.0045. All water samples indicate NB closed near bottom rather than 505db. No water samples from 506db. Used bottom CTD trip data for NB13.
114 @ 603db Delta-S at 603db is -.0119. See 1nut nutrients comment.
115 @ 708db See 1nut nutrients comment.
116 @ 811db Delta-S at 811db is -.0136. See 1nut nutrients comment.
117 @ 909db See 1nut nutrients comment.
118 @1013db Delta-S at 1013db is -.0060. See 1nut nutrients comment.
119 @1109db Delta-S at 1109db is -.0093. See 1nut nutrients comment. See 1slt salinity comment.
120 @1109db Delta-S .04 low at 1320db. Calc ok. All water samples indicate bottle closed at level above (1108db) with NB 19. Changed trip file made 20 same trip info as 19. Used 1108.9 vs. 1311.0 CTD trip data for NB20. See 1nut nutrients comment.

121 @1515db Delta-S at 1515db is -.0123. See 1nut nutrients comment. See 1slt salinity comment.
122 @1718db Delta-S at 1718db is -.0130. See 1nut nutrients comment. See 1slt salinity comment.
123 @1922db Delta-S at 1922db is -.0092. See 1nut nutrients comment. See 1slt salinity comment.
124 @2119db Delta-S .04 low at 2118db. Calc ok. All water samples indicate NB closed at level above (1921db) with NB 23. Oxygen not the same as 23 nor is silicate or salinity, this station had many analysis and tripping problems, but it also appears there were drawing errors. Oxygen would fit better if it came from bottle 23 and vice versa. Leave data at 2119db and footnote samples as uncertain. See 1nut nutrients comment.
125 @2330db NO2 unreadable peak. See 1nut nutrients comment.
126 @2529db Delta-S at 2529db is -.0051. See 1nut nutrients comment.
127 @2529db NO2 unreadable peak. Delta-S at 2529db is -.0070, Calc ok. Salt & nutrients same as NB26 from level above. Hydro O2 is .12 lower than NB26 whereas gradient is higher with depth. All bottles lower than 27 also have Delta-S indicating they tripped one level higher than intended. Possibly NB13 closed on 1st trigger, then all bottles closed one level higher than intended up to NB26. NB26 & NB27 closed at the same level (2528db). Cause unknown. No notes re ramp shaft or tripping problems. Used 2528db CTD trip data for NB27 as well as NB26. See 1nut nutrients comment.
128 @2740db Delta-S .012 low at 2935db & .001 low at 2740db. See 127 above. Other water samples look reasonable at level above intended level. Used 2740db CTD trip data. See 1nut nutrients comment.
129 @2936db Sample log: Air leak. Delta-S .010 low at 3145db & .002 low at 2936db. See 127 above. Other water samples look reasonable at level above intended level. Used 2936db CTD trip data. See 1nut nutrients comment.
130 @2936db Sample log: Oxygen drawn first. Delta-S .018 low at 3400db. Calc ok. All water samples indicate NB closed 2 levels above (2936db) with NB 29. NB30 appears to have pylon problem plus problem described in 127 above. See 1nut nutrients comment.
131 @3401db Delta-S .011 low at 3653db & .002 low at 3401db. See 127 above. Hydro O2 is .1 low at 3401db and .1 high at 3653db. O2 calc ok. sil looks reasonable at 3653; NO3 & PO4 no good. Used 3401db CTD trip data See 1nut nutrients comment.
132 @3654db Delta-S .007 low at 3909db & .000 at 3654db. See 127 above. O2 matches CTDO and lower bottle O2s using 3543db. Used 3654db CTD trip data See 1nut nutrients comment.
133 @3910db Delta-S .006 low at 4167db & .000 at 3910db. See 127 above. O2 good at 3543db. Used 3910db CTD trip data See 1nut nutrients comment.
134 @4168db Delta-S .004 low at 4420db & .002 low at 4168db. See 127 above. O2 good @4168db Used 4168db CTD trip data See 1nut nutrients comment.
135 @4421db Delta-S .003 low at 4683db & .000 at 4421db. See 127 above. O2 good at 4421db. Used 4421db CTD trip data See 1nut nutrients comment.

136 @4684db Delta-S .015 low at 4876db & .010 low at 4684db. See 127 above. O2 good @4684db. Salinity Calc ok. Used 4684db CTD trip data See 1nut nutrients comment.

Station 012

101 @ 2db Sample log: Air leak. Delta-S .003 high at 2db. Other water samples are good surface values.

110 @ 313db Sample log: Bad water leak. O2 not drawn. Delta-S .024 low at 312db. Calc ok. Normal S gradient. Nutrients look ok.

113 @ 608db Delta-S .09 high at 502db. Calc ok. All data indicate ramp shaft off one place on outer ring and NB35 tripped 1st and NB36 tripped last at NB13 intended level. NB13 Delta-S .001 at level below, 608db. Used 608db CTD trip data.

114 @ 709db Delta-S .08 high at 607db. See 113. Delta-S .003 low at 708db. Used 708db CTD trip data.

115 @ 810db Delta-S .074 high at 708db. See 113. Used 810db CTD trip data. Delta-S .003 low at 810db.

116 @ 908db Delta-S .072 high at 810db. See 113. Delta-S .003 low at 908db. Used 908db CTD trip data.

117 @1009db Delta-S .06 high at 908db. See 113. Delta-S .001 low at 1009db. Used 1009db CTD trip data.

118 @1206db Delta-S .053 high at 1009db. See 113. Delta-S .001 high at 1206db. Used 1206db CTD trip data.

119 @1415db Sample log: Petcock pushed in. Delta-S .08 high at 1205db. See 113. Delta-S .000 at 1415db. Other water samples also ok at 1415db Used 1415db CTD trip data.

120 @1415db Delta-S .002 low at 1415db. Other water samples similar to NB19 and match well at new NB19 level. Assume trip problem as on NB20 other stations before pylon changed, and NB20 triggered at 1616db & closed at 1415db. Oxygen .08 too high, footnote oxygen bad analysis. Changed trip file made 20 same trip info as 19.

121 @1817db Delta-S .02 high at 1615db. See 113. Delta-S .000 at 1817db. Used 1817db CTD trip data.

122 @2020db Delta-S .016 high at 1817db. See 113 above. Used 2020db CTD trip data. Delta-S at 2020db is -.003.

123 @2223db Delta-S .012 high at 2020db. See 113. Delta-S .001 low at 2222db. Used 2222db CTD trip data.

124 @2429db Delta-S .006 high at 2222db. See 113. Delta-S .003 low at 2429db. Used 2429db CTD trip data.

125 @2631db Delta-S .006 high at 2429db. See 113. Delta-S .002 low at 2631db. Used 2631db CTD trip data.

126 @2838db Delta-S .004 high at 2631db. See 113. Delta-S .002 low at 2838db. Used 2838db CTD trip data.

127 @3041db Delta-S .002 high at 2838db. See 113. Delta-S .001 low at 3041db. Used 3041db CTD trip data.

128 @3293db Delta-S .004 high at 3041db. See 113 above. Delta-S .001 high at 3293db. Used 3293db CTD trip data.

129 @3552db Delta-S .005 high at 3293db. See 113 above. Delta-S .000 at 3552db. Used 3552db CTD trip data.

130 @3552db Sample log: Air leak. Delta-S .002 low at 3552db. Other water samples similar to NB29 and match well at new NB29 level. Assume trip problem as on NB30 other stations before pylon changed, and NB30 triggered at 3815db & closed at 3552db. Changed trip file made 30 same trip info as 29.

131 @4059db Delta-S .001 high at 3815db. See 113. Delta-S .000 at 4059db. Used 4059db CTD trip data.

132 @4323db Delta-S .001 low at 4058db. See 113. Delta-S .001 low at 4322db Used 4322db CTD trip data.

133 @4575db Delta-S .002 low at 4322db. See 113 above. Delta-S .002 low at 4575db. Used 4575db CTD trip data.

134 @4795db Delta-S .003 low at 4575db. See 113 above. Delta-S .001 low at 4795db. Used 4795db CTD trip data.

135 @4972db Delta-S .001 high at 4795db. See 113. Delta-S .002 high at 4972db. Used 4972db CTD trip data.

136 @ 503db Delta-S .626 low at 4972db. See 113. Delta-S .004 high at 503db. Other water samples match well at 503db. Used 503db CTD trip data.

Station 013

101-112 Sample log: "did not trip" Sample log: "Package hit bottom" Wire kinked, 12-place pylon electronics bad. No water samples, and no trip information.

105 See 101 comment. Sample log: Bottom end cap closed - tied knot in bottom lanyard.

120 @ 909db Delta-S .095 low at 1112db. All water samples same as NB19 at level above. Changed trip file made 20 same trip info as 19. Oxygen .06 high, footnote o2 bad analysis.

124 @1717db Delta-S .021 low at 1919db. All water samples same as NB23 at level above. Changed trip file made 24 same trip info as 23.

128 @2533db Delta-S .009 low at 2533db. All water samples same as NB27 at level above. Changed trip file made 28 same trip info as 27. Oxygen .08 high, footnote o2 bad.

130 @2941db Delta-S .007 low at 2941db. All water samples same as NB29 at level above. Changed trip file made 30 same trip info as 29. Oxygen .02 high, footnote o2 bad.

131 @3154db Delta-S .004 low at 3358db. All water samples appear to be from level above (3154db, NB30 intended level). Delta-S .001 high at 3154db.

135 @4253db Hydro o2 appears .05 high at 4253db compared to CTDO trace. Calc ok. Footnote oxygen uncertain. Delta-S .003 high at 4253db. Nutrients look ok.

136 @4469db	Hydro o2 appears .05 low at 4469db compared to adjacent stations but looks ok compared to CTDO trace. See 135 above. Other water samples look ok. Footnote oxygen uncertain.

Station 014

1slt	Salinity analyst had problems getting the conductivities to agree, specifically bottles 2,13,15,17,24,25,27,36. Samples 116 thru 123, 796 to 2055db, all have low hydro salinities(.011 to .018). Deeper hydro salts 128 thru 136 are also low(.002 to .009). Autosal run looks ok, no drift, std dial, SBY no. & air temp ok, footnote salinity bad.
101 @ 3db	Sample log: "Air Leaker" Delta-S .005 low at 3db. Other water samples ok at surface.
107 @ 138db	Sample log: "nipple broken on retrieval but no water leak. Sample log: salt, nutrient & C14 drawn only." Delta-S .011 low at 138db. Calc ok. High gradient.
110 @ 232db	Sample log: "air leak again" Delta-S .010 high at 232db. High gradient, inversion. Other water samples ok, o2 minimum.
113 @5225db	Delta-S .63 high at 502db. Calc ok. All water samples appear to be from bottom. Delta-S at bottom level, 5225db is .010 low. o2 & nuts same as NB36. Changed trip file made 13 same trip info as 36.
116 @ 797db	Delta-S .018 low at 796db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad.
117 @ 901db	Sample log: "vent cock leak" Delta-S .018 low at 901db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad. Other water samples ok.
118 @ 994db	Delta-S .012 low at 994db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad.
119 @1203db	Delta-S .011 low at 1203db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad.
120 @1203db	Delta-S .051 low at 1400db. All water samples same as NB19 at level above. See 1slt comment, footnote salinity bad. Changed trip file made 20 same trip info as 19.
121 @1611db	Delta-S .016 low at 1610db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad. Tsuchiya: "Sil too high in comparison with adjoining stations." Calc okay, peaks fair.
122 @1807db	Sample log: "cap off plug" Don't know what this means. Delta-S .018 low at 1807db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad. Other water samples ok. Tsuchiya: "Sil too high in comparison with adjoining stations." Calc okay, peaks fair.
123 @2054db	Delta-S .013 low at 2054db. Calc ok. Normal gradient. See 1slt comment, footnote salinity bad. Tsuchiya: "Sil too high in comparison with adjoining stations." Calc okay, peaks fair.
124 @2054db	Delta-S .027 low at 2054db. All water samples same as NB23 at level above. Changed trip file made 24 same trip info as 23. See 1slt comment, footnote salinity bad.

127 @2919db	Sample log: "air leak. Not fully closed on top when brought on board. Found top lanyard from 26 in end cap 27 prior Sta 15." Delete salinity, o2, sil, no3, no2, po4, 34.6423 106.6 173.71 39.46 0.03 2.74, respectively.
128 @3185db	Delta-S .007 low at 3185db. Calc ok. See 116 above. Final CTD deep ts has good agreement with adjacent stations. See 1slt comment, footnote salinity bad.
129 @3439db	Delta-S .005 low at 3439db. Calc ok. See 128 above. See 1slt comment, footnote salinity bad.
130 @3439db	Sample log: "air leak" Delta-S .013 low at 3701db. All water samples same as NB29 at level above. See 1slt comment, footnote salinity bad. Changed trip file made 30 same trip info as 29.
131 @3702db	Delta-S .009 low at 3960db. Calc ok. See 128 above. All water samples indicate slight leak or late close. Changed trip file made 31 same trip info as expected trip of 30 (~3700db). See 1slt comment, footnote salinity bad.
132 @4212db	Delta-S .005 low at 4212db. Calc ok. See 128 above. See 1slt comment, footnote salinity bad.
133 @4578db	Delta-S .007 low at 4578db. Calc ok. See 128 above. See 1slt comment, footnote salinity bad.
134 @4578db	Delta-S .014 low at 4734db. All water samples same as NB33 at level above. See 1slt comment, footnote salinity bad. Changed trip file made 34 same trip info as 33.
135 @4998db	Delta-S .003 low at 4998db. Calc ok. See 128 above. See 1slt comment, footnote salinity bad.
136 @5225db	Delta-S .004 low at 5225db. Calc ok. See 128 above. See 1slt comment, footnote salinity bad.

Station 015

109 @ 270db	Sample log: "bottom end cap hung up - no water"
113	Sample log: "No trip" No water samples. No confirm at NB15 intended level at 827db (o2 min) so assumed no samples at 827db and NBs 15&14 each tripped at level above intended level. Computer trip info confirms.
114 @ 606db	Changed trip file, scheduled trip 720.
115 @ 709db	Changed trip file, scheduled trip 827.
120 @1316db	Delta-S .038 low at 1511db. All water samples indicate NB20 closed at level above. Changed trip file made 20 same trip info as 19.
122 @1920db	Sample log: "Stop cock off @ oxy" Means spigot disk came off before o2 drawn. Water samples look ok.
124 @2126db	Delta-S .015 low at 2332db. All water samples indicate NB24 closed at level above. Changed trip file made 24 same trip info as 23.
129 @3450db	Sample log: "Air Leak - vent not tight." Delta-S .002 high at 3450db. Other water samples ok.

130 @3450db Delta-S .007 low at 3706db. All water samples indicate NB30 closed at level above. Changed trip file made 30 same trip info as 29.
131 @3963db Hydro o2 .1 low at 3963db. Calc ok. Smooth CTDO trace, footnote o2 uncertain.
133 @4477db Hydro o2 .05 high at 4477db. Calc ok. Smooth CTDO trace, footnote o2 uncertain.
136 @5189db Sample log: "Air Leak" Delta-S .000 at 5189db. Other water samples also ok.

Station 016

102 @ 58db Sample log: "Slow air leak" Delta-S .008 at 58db. Other water samples also ok.
105 @ 120db Sample log:"Small air leak, top not set well" Delta-S .064 low at 120db. Calc ok.
108 @ 209db Sample log:"Tag is missing" Don't know what this means. Delta-S .013 high at 209db. Calc ok. Other water samples ok.
109 @ 230db Sample log:"Bottom end piece caught on altimeter - No sample."
110 @ 256db Sample log:"Small air leak" Delta-S .001 high at 256db. Other water samples also ok.
117 @ 704db Sample log:"Slow air leak" Delta-S .002 low at 704db. Other water samples also ok.
119 @ 913db Tsuchiya: "PO4 too low." Poor peaks, calc okay, footnote po4 bad. Talley: "PO4 all too low, 19-35, 36 okay." Footnote po4 bad.
120 @1007db Footnote po4 bad, per 119 Talley's request.
121 @1210db Footnote po4 bad, per 119 Talley's request.
122 @1412db Footnote po4 bad, per 119 Talley's request.
123 @1616db Footnote po4 bad, per 119 Talley's request.
124 @1819db Footnote po4 bad, per 119 Talley's request.
125 @2023db Sample log:"opened, to remove lanyard, on deck"See 127 below. Delta-S .002 low at 2022db. PO4 about .03 high but other water samples look ok. Delete salinity, o2, sil, no3, no2, po4, 34.6037 72.3 168.47 41.02 0.00 2.87, respectively.
126 @2227db Footnote po4 bad, per 119 Talley's request.
127 @2430db Sample log:"open-lanyard caught in top of 25" No water samples.
128 @2634db Footnote po4 bad, per 119 Talley's request.
129 @2833db Delta-S at 2833db is -.0034. Footnote po4 bad, per 119 Talley's request.
130 @2833db Sample log:"air leak" Delta-S .006 low at 3042db. All water samples same as NB29 at level above. Footnote po4 bad, per 119 Talley's request.
131 @3042db Delta-S .004 low at 3244db, and Delta-S .000 at level above (3042db). Other water samples have smoother gradient using 3042db trip data for NB31. Used 3042db CTD trip data for NB31. Assumed no samples at 3245db. Footnote po4 bad, per 119 Talley's request.
132 @3449db Footnote po4 bad, per 119 Talley's request.

133 @3658db Delta-S at 3658db is -.0039. Salinity a little low compared with CTD, footnote salinity uncertain. Footnote po4 bad, per 119 Talley's request.
134 @3856db Footnote po4 bad, per 119 Talley's request.
135 @4084db Footnote po4 bad, per 119 Talley's request.
136 @4409db Tsuchiya: "PO4 and NO3 too high (downward increases seem doubtful)" PO4 appears .05 high at 4409db. Orig had bad peak. Used rerun after standards, footnote po4 bad. NO3 peaks okay. Talley: "po4 okay."

Station 017

201 @ 1db Sample log:"Slow leak"."Spigot ring off" Delta-S .003 high at 1db. Other water samples also ok.
202 @ 53db Sample log: "Slight air leak - top cap" Delta-S .003 low at 53db. Other water samples also look ok.
217 @ 907db Sample log: "Slow leak" Delta-S .004 low at 907db. Other water samples also ok.
220 @1212db Delta-S .042 low at 1413db. All water samples indicate NB20 closed at level above (1212db). Changed trip file made 20 same trip info as 19.
227 @3041db Sample log: "Empty" Bottom lanyard snap hook hung up on top lanyard. No water samples.
230 @3552db Sample log: "Air leak and spigot washer came off." Delta-S .005 low at 3807db. All water samples indicate NB30 Closed at level above (3552db). Changed trip file made 30 same trip info as 29.
231 @3808db Hydro o2 about .1 low at 4068db. Calc ok. Nutrients high, also indicating sample is from higher in water column. Delta-S .000 but very small salinity gradient. Assuming NB31 closed at intended NB30 level (see 230 above), o2 in good agreement with CTDO and nutrients have smoother profile. Delta-S at higher level is .001 high. Used 3808db CTD trip data for NB31.
232 @4068db Hydro o2 about .1 low at 4323db. Calc ok. Nutrients high, also indicating sample is from higher in water column. Delta-S .001 but very small salinity gradient. Assuming NB32 closed at intended NB31 level (see 231 above), o2 in good agreement with CTDO and nutrients have smoother profile. Delta-S at higher level is .002 high. Used 4068db CTD trip data for NB32.
233 @4578db PO4 .03 high at 4578db. Calc ok. Original peak was bad and rerun used, footnote po4 bad.
235 @5103db Delta-S .003 high at 5103db. Calc ok. No notes. CTD trace shows S increase below 235 whereas hydro S decreases. Possible salt sample mix-up between NB 35 & NB 36. Footnote salinity uncertain.
236 @5222db Delta-S .0042 low at 5222db. Calc ok. No notes. CTD trace shows S increase below 235 whereas hydro S decreases. Possible salt sample mix-up between NB 35 & NB 36. Footnote salinity uncertain.

Station 018

101 @ 2db Sample log:"Air leak" Final Delta-S .005 high at 2db. Other water samples ok.

112 @ 402db Sample log:"Pet cock valve open" Final Delta-S .005 high at 402db. Other water samples ok.

113 @5189db Delta-S .680 high at 504db. All water samples appear to be from bottom of water column at NB36 level. Changed trip file made 13 same trip info as 36. Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

117 @ 905db Sample log:"Air leak, pet cock" Delta-S .001 high at 905db. Other water samples also ok.

119 @1211db Sample log:"Possible head space, water came out bottom when rosette was landed." Delta-S .002 low at 1211db. Other water samples also ok.

120 @1211db Delta-S .054 low at 1413db. All water samples same as NB19 at level above. Changed trip file made 20 same trip info as 19.

121 @1414db Delta-S .038 low at 1616db. All water samples appear to be from intended NB20 level above (1414db). Delta-S at 1414db is .003 high, hydro o2 agrees with CTDO, and nutrients have smooth gradient. Use 1414db CTD trip data for NB21. 910610/dm

122 @1825db Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

123 @2028db Delta-S at 2028db is .0034. Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

124 @2227db Sample log:"Bottom end cap open, metal crimp sleave caught on snap hook." No water samples.

125 @2428db Delta-S at 2428db is .0045. Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

126 @2637db Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

127 @2841db Sample log:"Lanyard from Bottle 28 caught in top of 27" Samples contaminated. Delete salinity, o2, sil, no3, no2, po4, 34.6248 88.5 171.70 39.94 0.01 2.81, respectively.

130 @3352db Delta-S .005 low at 3602db. All water samples same as level above except oxygen. Changed trip file made 30 same trip info as 29. Oxygen low compared with CTDO and duplicate sample. Footnote oxygen bad. Scheduled trip 3602db.

133 @4371db Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

134 @4623db Talley: "Silicate looks a little high, 22,23,25,26 33,34,35,36,13, maybe not enough to worry about." Footnote sil uncertain.

135 @4962db sil appears a little low (or 136 sil is high). Calc ok, but poor peaks, footnote sil uncertain.

136 @5189db sil appears a little high(or 135 sil is low). Calc ok, but poor peaks, footnote sil uncertain.

Station 019

101 @ 2db Sample log: "Air leak" Delta-S .000 at 2db. Other water sample also ok.
120 @1210db Delta-S .052 low at 1414db. All water samples same as NB19 at level above. Changed trip file made 20 same trip info as 19. Oxygen a little high, footnote o2 uncertain.
121 @1415db Delta-S .035 low at 1619db. All water samples look good at level above, intended NB20 level. Final Delta-S at 1415db is .000. Use CTD trip data at 1415db for NB21 samples. 920611/dm
124 @2021db Delta-S .017 low at 2226db. All water samples same at NB23 at level above. Changed trip file made 24 same trip info as 23.
125 @2435db Tsuchiya: "Salinity seems low by ~.003 than neighboring stations." Calculations okay, leave as is.
126 @2637db Tsuchiya: "Salinity seems low by ~.003 than neighboring stations." Calculations okay, leave as is.
127 @2844db Tsuchiya: "Salinity seems low by ~.003 than neighboring stations." Calculations okay, leave as is.
128 @3097db Tsuchiya: "Salinity seems low by ~.003 than neighboring stations." Calculations okay, leave as is.
129 @3354db Tsuchiya: "Salinity seems low by ~.003 than neighboring stations." Calculations okay, leave as is.
130 @3354db Delta-S .006 low at 3605db. All water samples same as NB29 at level above.
131 @3606db Delta-S .005 low at 3859db. All water samples indicate leak or late close. Changed trip file made 31 same trip info as 30.
113 @5134db Delta-S .685 high at 503db. All water samples same as bottom bottle (NB36 at 5134db). Changed trip file made 13 same trip info as 36.
136 @5134db Either this bottle or 13 leaked or had a late closure. Since 13 is footnoted, leave this as is.

Station 020

103 @ 117db Sample log:"Did not close" No water samples.
106 @ 175db Sample log: Nipple not full out. Samples appear to be okay.
120 @1009db Delta-S .07 low at 1206db. All water samples same as NB19 at level above. Changed trip file made 20 same trip info as 19.
130 @3046db Delta-S .008 low at 3296db. All water samples same as NB29 at level above. Sample log: Air leak. Samples appear to be okay @3045db. Changed trip file made 30 same trip info as 29.
131 @3297db Delta-S .007 low at 3560db. All water samples fit well at level above (intended NB30 level). Final Delta-S at 3297db is .005 high but agrees with adjacent Delta-Ss. See 132 below. Use CTD trip data at 3297db for NB31 water samples.
134 @4086db Hydro o2 appears .1 low at 4327db. All water samples same as NB33 at level above but CTD indicates no gradient in salinity. Delta-S .000.

Nutrients do have gradient and indicate mistrip. Changed trip file made 34 same trip info as 33.

Station 021

101 @ 2db	Sample log:"Leaking water from nipple - air leak - nipple was partly open." Delta-S .004 at 2db. Other water samples look ok. This is only sample in mixed layer.
117 @ 711db	Hydro o2 about .1 high at 711db compared to adjacent stations. Calc ok. No notes, footnote o2 uncertain. Other water samples ok.
118 @ 809db	Hydro o2 about .1 high at 809db compared to adjacent stations. Calc ok. No notes, footnote o2 uncertain. Other water samples ok.
126 @2230db	Hydro o2 about .1 high @2230db compared to adjacent stations. Calc ok. No notes, footnote o2 uncertain. Other water samples ok. Delta-S at 2230db is .0041.
128 @2637db	Hydro o2 about .1 high at 2637db compared to adjacent stations. Calc ok. No notes. Other water samples ok, footnote o2 uncertain.
129 @2836db	Hydro o2 about .1 high at 809db compared to adjacent stations. Calc ok. No notes, footnote o2 uncertain. Other water samples ok.
130 @3045db	Sample log:"Air leak" Delta-S .001 high at 3045db. Hydro o2 about .1 high compared to adjacent stations. Calc ok. No notes. Other water samples ok. Duplicate trip only .003 lower, so these samples probably okay.
131 @3045db	Delta-S .002 low at 3139db. All water samples same as NB30 at level above. Assume tripping problem. Changed trip file made 31 same trip info as 30.
132 @3454db	o2 .1 high at 3454db compared to CTDO & adjacent stations. Calc ok. No notes, footnote o2 uncertain. Other water samples ok. Delta-S at 3454db is .0035.
134 @3657db	Delta-S .003 low at 3856db. All water samples same as NB33 at level above. Assume tripping problem. Changed trip file made 34 same trip info as 33.
135 @4052db	o2 .1 high at 4052db compared to CTDO & adjacent stations. Calc ok. No notes, footnote o2 uncertain. Other water samples ok.

Station 022

101 @ 1db	Sample log: "Air leak" Surface sample appears okay.
107 @ 197db	Sample log: "Loose air vent" Delta-S .002 low at 197db. Other water samples also ok.
123 @2023db	Delta-S .004 low at 2023db. Calc ok. Other water samples ok Normal CTD gradient. No notes. Footnote uncertain, it is just not within the accuracy of the measurement, but just to let users realize there may be a problem.
129 @3296db	Duplicate trip with 130, Oxygen seems .02 high compared with CTD profile. Footnote o2 uncertain.

130 @3296db	Sample log: "Slight air leak" Delta-S .004 low at 3552db. All water samples same as NB29 at level above. Oxygen fit the CTD profile, 129 seems .02 high. Changed trip file made 30 same trip info as 29.
131 @3553db	Delta-S .004 low at 3805db. All bottle samples have break in gradient at 3805db whereas CTD has smooth traces. Bottle samples appear to fit much better at intended NB30 level (3553db). Use 3553db CTD trip data for NB31 and no water samples at 3805db.
134 @4578db	Hydro o2 .03 low at 4578db. Calc ok. Delta-S .001 low & other water samples also ok. No notes, footnote o2 uncertain.

Station 023

101 @ 1db	Sample log:"Slight air leak" Delta-S .001 at 1db. Other water samples also ok.
130 @3451db	Sample log: "Slight air leak" Delta-S .000 at 3451db. Other water samples also ok.
131 @3451db	Delta-S .004 low at 3657db. All water samples same as NB30 at level above. Changed trip file made 31 same trip info as 30.
134 @4268db	o2 .04 low at 4268db. Calc ok. Delta-S .000 but salts and nutrients have essentially no gradient at bottom. CTD o2 sensor not working this cast. o2 is same as NB33 above so possibly NB34 tripped at NB33 level. Sil is slightly high, no3 slightly high. Footnote sil and no3 uncertain.

Station 024

104 @2636db	Tsuchiya: "O2 looks too high." Calc okay, no notes other water samples okay. Footnote o2 uncertain.

Station 025

1slt	Sample log: Box O left in rosette room - four bottles 36-33 drawn. Box Z - redraw 36-33 then continue. The salinity samples 133-136 were mistakenly thrown out before they were analyzed.
101 @ 1db	Sample log: "Air leak" Delta-S .003 high at 1db. Other water sample also ok.
133 @4435db	Sample log: "Bottom 4 smpls lost when used for Sta 26- 2: salt box left in ros rm ~12 hours." No hydro salinity. Console Ops: "Confirms every other trip, ISI gets multiple level each trip. Data indicate all triggers are tripping whether they confirm or not. NB33 tripped at same level as NB34. Oxygen .033 ml/l low. Footnote o2 uncertain.
134 @4431db	Sample log: "Bottom 4 smpls lost when used for Sta 26- 2: salt box left in ros rm ~12 hours." No hydro salinity.
135 @4656db	Sample log: "Bottom 4 smpls lost when used for Sta 26- 2: salt box left in ros rm ~12 hours." No hydro salinity. "Water leak out of bottom cap when air valve opened." Console Ops: "Confirms every other trip, ISI gets multiple level each trip. Data indicate all triggers are tripping

whether they confirm or not. NB35 tripped at same level as NB36. No Delta-S, other water samples look ok.

136 @4658db Sample log: "Bottom 4 smpls lost when used for Sta 26- 2: salt box left in ros rm ~12 hours." No hydro salinity.

Station 026

2nut Nutrients: Too much CO2 in SW. PO4 bubbles get too big, get sucked into flow cell. Suspect the problem was in the line, since all 4 channels indicate a problem.

2sil Sil peaks uncertain 23-36, and reruns of many samples did not give any better results. Sil 23-36 3.+ too high, footnote sil bad or lost if peaks could not be obtained.

217 @1016db PO4 high, footnote bad, see 2nut comment.

218 @1213db Sample log: Oxygen stopper fell - rerinsed. Oxygen fits station profile and CTDO. Nutrients: Too much CO2 in SW. No po4 peak read.

219 @1413db Nutrients: Too much CO2 in SW. No po4 peak read.

220 @1621db PO4 high, footnote bad, see 2nut comment.

221 @1827db PO4 high, footnote bad, see 2nut comment.

222 @2029db PO4 high, footnote bad, see 2nut comment. Oxygen high, footnote uncertain, compared to CTDO and adjoining stations.

223 @2231db Nutrients: Too much CO2 in SW. No po4 peak read. See 2sil comments, footnote sil bad.

224 @2432db Nutrients: Too much CO2 in SW. No po4 peak read, no sil peak read.

225 @2642db Nutrients: Too much CO2 in SW. No po4 peak read. See 2sil comments, footnote sil bad.

226 @2841db Nutrients: Too much CO2 in SW. No po4 peak read. See 2sil comments, footnote sil bad.

227 @3041db Nutrients: Too much CO2 in SW. See 2sil comments, footnote sil bad.

228 @3297db See 2sil comments, footnote sil bad.

229 @3548db Nutrients: Too much CO2 in SW. No po4 peak read, no sil peak read.

230 @3704db PO4 high, footnote bad, see 2nut comment. See 2sil comments, footnote sil bad.

231 @4054db See 2sil comments, footnote sil bad.

232 @4312db See 2sil comments, footnote sil bad.

233 @4577db See 2sil comments, footnote sil bad.

234 @4814db See 2sil comments, footnote sil bad.

235 @5081db See 2sil comments, footnote sil bad.

236 @5271db Sample log: Leaky before vent. Oxygen high, footnote o2 bad, compared to CTDO. Footnote bottle leaking to caution shorebased users. Appears that leak effected gas sample. See 2sil comments, footnote sil bad.

Station 027

101 @ 1db Sample log: Loose air vent. Samples appear to be okay.

115 @ 510db NO2 peak very "glitchy" and jumped to .65+, unreadable peak.
116 @ 607db NO2 peak very "glitchy" and jumped to .65+, unreadable peak.
127 @2432db Tsuchiya: "PO4 too high." Calc okay, reruns, poor peaks, which indicates some contamination in the sample. Footnote po4 bad.
128 @2632db Tsuchiya: "PO4 too high." Calc okay, reruns, poor peaks, which indicates some contamination in the sample. Footnote po4 bad.
129 @2833db Tsuchiya: "PO4 too high." Calc okay, reruns, poor peaks, which indicates some contamination in the sample. Footnote po4 bad.
130 @3036db PO4 peak very "glitchy" , unreadable peak.
133 @3803db PO4 peak very "glitchy", unreadable peak.

Station 028

101 @ 2db Sample log: Air leak. Oxygen agrees with adjacent stations.
108 @ 233db NO2 unreadable peak, see 1nut comments.
110 @ 294db NO2 unreadable peak, see 1nut comments.
111 @ 334db NO2 unreadable peak, see 1nut comments.
112 @ 393db NO2 unreadable peak, see 1nut comments.
113 @ 455db NO2 unreadable peak, see 1nut comments.
114 @ 505db NO2 unreadable peak, see 1nut comments.
115 @ 557db NO2 unreadable peak, see 1nut comments.
116 @ 628db NO2 unreadable peak, see 1nut comments.
117 @ 708db NO2 unreadable peak, see 1nut comments.
126 @2230db NO2 unreadable peak, see 1nut comments.
127 @2427db NO2 unreadable peak, see 1nut comments.
128 @2634db NO2 unreadable peak, see 1nut comments.
129 @2836db NO2 unreadable peak, see 1nut comments.
133 @3834db NO2 unreadable peak, see 1nut comments.
134 @4068db NO2 unreadable peak, see 1nut comments.
136 @4564db PO4 spiky, unreadable peak.

Station 029

101 @ 2db Sample log: Air leak. Sample log: Top knocked during removal c/o w. Samples agree with adjacent stations, so okay for surface sample.
120 @1316db Sample log: Needs new snap hook. Samples appear to be okay.
135 @3659db Sample log: Need inner lanyards tightened. Samples appear to be okay.

Station 030

1nut Tsuchiya: "Deep NO3 looks too high." Tsuchiya: "Deep SiO3 higher than adjoining stations." Nutrients: End no3 DDW SW Screwy. High drift no2 Cleaned system. Repeak no3, po4. New no2 draw tube. New photo tube no3 (????) Silicate appears high from about 1500m down. Trace is close to 026-02. Calc okay, peaks fair. Footnote sil uncertain 123-136.

107 @ 176db Sample log: Air leak. Delta-S at 176db is -.0729. Other samples look reasonable.
111 @ 304db Tsuchiya: "PO4 and NO3 too high." Calc and peaks okay.
112 @ 356db Delta-S at 356db is .1319. Analyst indicated radio interference. Could have occurred on this sample though not specifically noted. Sample log: Air valve and spigot open. Oxygen ~.18 ml/l high. Salinity is way out of line. Delete salinity, o2, sil, no3, no2, po4, 34.1596 175.8 30.01 20.37 0.01 1.46, respectively. Footnote bottle leaking.
116 @ 604db Talley: "Footnote silicate as uncertain since these are also quite high." Sil high, See 1nut comments, footnote sil uncertain.
117 @ 713db Talley: "Footnote silicate as uncertain since these are also quite high." Sil high, See 1nut comments, footnote sil uncertain.
118 @ 810db Talley: "Footnote silicate as uncertain since these are also quite high." Sil high, See 1nut comments, footnote sil uncertain.
119 @ 913db Talley: "Footnote silicate as uncertain since these are also quite high." Sil high, See 1nut comments, footnote sil uncertain.
120 @1011db Talley: "Footnote silicate as uncertain since these are also quite high." Sil high, See 1nut comments, footnote sil uncertain. NO3 high, see 1nut, calc okay, footnote no3 uncertain.
121 @1210db Talley: "Footnote silicate as uncertain since these are also quite high." Sil high, See 1nut comments, footnote sil uncertain. NO3 high, see 1nut, calc okay, footnote no3 uncertain.
122 @1416db Talley: "Footnote silicate as uncertain since these are also quite high." Sample log: Broken lanyard. Samples look reasonable. NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
123 @1618db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
124 @1823db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
125 @2030db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
126 @2231db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
127 @2431db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
128 @2632db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
129 @2832db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
130 @3039db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
131 @3248db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
132 @3449db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.

133 @3658db NO3 low compared with other high values, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
134 @3858db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
135 @4128db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.
136 @4392db NO3 high, see 1nut, calc okay, footnote no3 uncertain. Sil high, See 1nut comments, footnote sil uncertain.

Station 031

104 @ 141db Delta-S at 141db is -.0495. Salinity appears low compared to adjacent stations. No analysis problems noted, footnote salinity uncertain. Other samples appear to be okay.
106 @ 191db Delta-S .07 low at 191db. Calc ok. All water samples appear to be from about 300db. No notes. Footnote bottle leaking for other sample investigators. Delete salinity, o2, sil, no3, no2, po4, 34.0328 169.7 29.81 20.58 0.00 1.47, respectively.
113 @ 443db Tsuchiya: "O2 too high." Calc okay, CTDO inversion, leave for now.
115 @ 556db Sample log: Spigots broken off on side of ship - no water.
116 @ 607db Sample log: Spigots broken off on side of ship - no water.
118 @ 811db NO2 unreadable peak.
128 @2626db NO2 unreadable peak.
134 @4068db Nutrients: Samples mistakenly missed.

Station 032

115 @ 641db Silicate appears a little high, footnote sil uncertain.
116 @ 704db Sample log: Drip at spigot with air vent open. Samples appear to be okay.

Station 034

206 @3297db Sample log: Top cracked open on removal - no leaks. Oxygen water temp. +-.4. First check was 6.4? Second check was 5.9 after sampling. Oxygen slightly high, suspect there was an air leak. Footnote bottle leaking, o2 bad.
207 @3554db Sample log: Top cracked open on removal - no leaks. Samples appear to be okay.
210 @4276db Not sure what happened, but oxygen unreasonably low. Footnote oxygen uncertain, ODF recommends deletion.
211 @4483db Not sure what happened, but oxygen unreasonably low. Footnote oxygen uncertain, ODF recommends deletion.
212 @4650db Not sure what happened, but oxygen unreasonably low. Footnote oxygen uncertain, ODF recommends deletion.
227 @ 603db Not sure what happened, but oxygen unreasonably low. Footnote oxygen uncertain, ODF recommends deletion.

Station 035

107 @ 232db Sample log: Spigot hard to operate. Data looks okay.

Station 036

126 @2519db Sample log: Leaky - air vent open, never closed. Data looks good.

Station 037

108 @ 237db Sample log: Slight air leak. Doesn't seem to have affected oxygen, agrees with CTDO.
124 @2028db Delta-S at 2028db is .0052. No notes. No problems noted, footnote salinity uncertain. Other samples appear to be okay.
128 @2642db Oxygen high doesn't fit station profile or CTDO. No notes regarding problems. Footnote oxygen uncertain, ODF recommends deletion.
133 @3801db Tsuchiya: "O2 too high?" Oxygen high doesn't fit station profile or CTDO. No notes regarding problems. Footnote oxygen uncertain, ODF recommends deletion.

Station 039

108 @ 228db Sample log: Air leak. Oxygen a little high compared with CTDO, okay vs. adjoining stations. Footnote oxygen bad, bottle leaking.
112 @ 351db Oxygen appears a little low as compared with CTDO and adjoining stations. Footnote oxygen uncertain.
132 @3550db PO4 .01 looks a little high, but well within the accuracy of the measurement. Reread chart and if it is .001 too high then so is 131. Footnote po4 uncertain.

Station 040

1nut Nutrients: PO4-Peaks poor; shift between 24 & 25 real. Reason unknown. Cleaned system with RBS, rinsed with DiH20. Replenish hydrazine. Nutrients: DW baseline high at end. May be all shifted after 24, samples 124- 136. Footnote po4 uncertain.
104 @ 109db Sample log: Slight air leak - valve not tight enough. Samples appear to be okay, agree with adjoining stations.
117 @ 907db Sample log: Air leak. Samples appear to be okay, agree with adjoining stations.
125 @2427db Footnote po4 bad, see 1nut comment.
126 @2680db Footnote po4 bad, see 1nut comment.
127 @2939db Footnote po4 bad, see 1nut comment.

128 @3195db	Sample log: Broken top lanyard - broke while separating rosettes. Samples appear to be okay, agree with adjoining stations. Footnote po4 bad, see 1nut comment.
129 @3445db	Footnote po4 bad, see 1nut comment.
130 @3704db	Footnote po4 bad, see 1nut comment.
131 @3959db	Footnote po4 bad, see 1nut comment.
132 @4214db	Footnote po4 bad, see 1nut comment.
133 @4474db	Footnote po4 bad, see 1nut comment.
134 @4730db	Footnote po4 bad, see 1nut comment.
135 @4997db	Footnote po4 bad, see 1nut comment.
136 @5278db	Footnote po4 bad, see 1nut comment. Appears that 36 tripped with 35, leave as is but footnote samples uncertain.

Station 041

1nut	Tsuchiya: "Deep PO4 level looks slightly low. Calc okay, ragged end baseline.
117 @ 921db	Oxygen appears high as compared with adjoining stations. Footnote o2 uncertain.
119 @1220db	Oxygen appears high as compared with adjoining stations. Footnote o2 uncertain.
124 @2333db	Oxygen appears high as compared with adjoining stations. Footnote o2 uncertain.
126 @2735db	Oxygen appears high as compared with adjoining stations. Footnote o2 uncertain.
130 @3759db	Sample log: Slight air leak, helium redraw. Oxygen appears to be okay.
134 @4787db	Oxygen appears high as compared with adjoining stations. Footnote o2 uncertain.
136 @5240db	Sample log: Air leak. Oxygen appears to be okay.

Station 042

101 @ 1db	Sample log: Slight air leak. Samples appear to be okay, agree with adjoining stations and CTD data.
106 @ 195db	Sample log: Colder? The samples indicate this bottle mistripped and leaked, water samples fit the station profile between 800-1800 db. The oxygen draw temperature is 7.5 which indicates water at 800db and sil at 1600-1800db. Delete salinity, o2, sil, no3, no2, po4, 34.5793 85.6 145.01 39.51 0.01 2.75, respectively.
108 @ 254db	Sample log: Slight air leak. Samples appear to be okay, fit station profile.
112 @ 509db	Sample log: Top valve open. Samples appear to be okay, o2 agrees with Station 43 and CTDO.
113 @ 606db	The samples indicate this bottle mistripped and leaked, water samples fit the station profile shallower than scheduled. Delete salinity, o2, sil, no3, no2, po4, 34.8888 230.3 3.81 0.66 0.01 0.18, respectively.

122 @2025db Oxygen appears high, calc okay, uncertain.
126 @2834db Oxygen appears high, calc okay, uncertain.
130 @3800db Sample log: Slight air leak. Samples appear to be okay, o2 agrees with CTDO.

Station 044

108 @ 201db Sample log: Air leak. Samples appear to be okay, oxygen agrees with CTDO.
115 @ 708db Tsuchiya: "O2 too high." Footnote oxygen uncertain, .1 high compared with CTDO.
116 @ 811db Tsuchiya: "O2 too low. Okay compared with CTDO.
117 @ 914db Sample log: Air leak. Samples appear to be okay, oxygen agrees with Sta 042, but .1 high compared with CTDO. Footnote bottle air leak and footnote o2 bad, for other gas investigators. Tsuchiya: "O2 too high."
118 @1011db Suspect buret not zeroed before fill, footnote bad ODF recommends deletion.
131 @3959db Sample log: Air leak. Samples appear to be okay, o2 agrees with adjoining stations.
136 @5348db Oxygen high footnote bad, other samples appear to be okay.

Station 045

101 @ 2db Sample log: Slight air leak. Samples appear to be okay.
109 @ 355db Sample log: Vent open. Oxygen high, salinity low as compared with adjacent stations, oxygen agrees with Stas. 040 and 041. Footnote salinity and oxygen bad, bottle leaking.
116 @ 914db Oxygen low as compared with adjacent stations and CTDO. Footnote o2 uncertain.
130 @3805db Sample log: Slight air leak. Samples appear to be okay.
136 @5385db Sample log: Air leak. Samples appear to be okay.

Station 046

1no3 NO3 agrees with Station 043, the analyst on these stations were the same. This same analysts did the analysis on Station 048. Station 048 agrees with the other analyst's results. No analytical problems were found. The no3 ending standard is a little low compared to two adjoining stations, but no problem was found. Footnote 17-36 as uncertain per Talley request.
217 @ 909db Talley: "Nitrate looks too high, 17-36." See 1no3 comments, footnote no3 uncertain.
218 @1006db See 217 comment, footnote no3 uncertain.
219 @1212db See 217 comments, footnote no3 uncertain.
220 @1412db See 217 comments, footnote no3 uncertain.
221 @1618db See 217 comments, footnote no3 uncertain.

222 @1819db See 217 comments, footnote no3 uncertain.
223 @2020db See 217 comments, footnote no3 uncertain.
224 @2273db See 217 comments, footnote no3 uncertain.
225 @2532db See 217 comments, footnote no3 uncertain.
226 @2786db See 217 comments, footnote no3 uncertain.
227 @3039db See 217 comments, footnote no3 uncertain.
228 @3299db See 217 comments, footnote no3 uncertain.
229 @3548db See 217 comments, footnote no3 uncertain.
230 @3808db Sample log: Slow leak. Samples appear to be okay. See 217 comments, footnote no3 uncertain.
231 @4062db See 217 comments, footnote no3 uncertain.
232 @4316db See 217 comments, footnote no3 uncertain.
233 @4577db See 217 comments, footnote no3 uncertain.
234 @4838db See 217 comments, footnote no3 uncertain.
235 @5099db See 217 comments, footnote no3 uncertain.
236 @5345db See 217 comments, footnote no3 uncertain.

Station 047

112 @ 505db Sample log: Air vent open. Samples appear to be okay.
123 @2228db Tsuchiya: PO4 too high? Calc and peaks okay.

Station 048

107 @ 234db Sample log: Air leak. Oxygen appears high compared with adjoining stations and CTDO. Footnote bottle leaking, and footnote o2 bad.
118 @1415db Sample log: Lanyard broke, endcap popped during separation. Samples appear to be okay.
122 @2199db Suspect that salinity was drawn incorrectly. Suspect a bottle leak that may have only been detected in salinity since it is the last parameter drawn from a bottle, footnote salinity bad, ODF recommends deletion of salinity, and caution to other sample investigators. Suspect this bottle had a slight leak. Intermittent problems were found in the data from this station to 77, when the bottle was changed. Sometimes the data was not effected. Oxygen was investigated on each of these stations. All samples except salinity look okay. At Station 74 per a note in the deck log the spring was changed on the bottle, but the salts are still low and don't agree with the CTD until Station 078 at which time the bottle was replaced.
132 @4316db NO3 poor peak. Data agrees with overlay plot of adjoining stations.
134 @4837db NO3 poor peak. Data agrees with overlay plot of adjoining stations.

Station 049

115 @ 704db Oxygen a little low compared with CTDO, footnote o2 uncertain.

122 @1819db See station 048 comment regarding leaking bottle. Samples appear to be okay, however see Station 048 leaking bottle comment.

Station 050

1po4 Tsuchiya: "Deep po4 level too low?" Adjustment made for std/baseline problem. End sw is .106 but .096 used. Beginning and ending standards unlike surrounding stations. Bad Beginning baseline, bad seawater, Phosphate data unreliable, footnote bad.
101 @ 0db Sample log: Air leak. Samples appear to be okay. See 1po4 comment, footnote po4 bad.
102 @ 26db See 1po4 comment, footnote po4 bad.
103 @ 114db See 1po4 comment, footnote po4 bad.
104 @ 154db See 1po4 comment, footnote po4 bad. Delta-S at 154db is -.0563. Calc okay.
105 @ 180db See 1po4 comment, footnote po4 bad.
106 @ 204db See 1po4 comment, footnote po4 bad.
107 @ 232db See 1po4 comment, footnote po4 bad.
108 @ 263db See 1po4 comment, footnote po4 bad. Sample log: Slight air leak. Oxygen appears high compared to station profile. Footnote bottle leaking, o2 bad.
109 @ 303db See 1po4 comment, footnote po4 bad.
110 @ 354db See 1po4 comment, footnote po4 bad.
111 @ 405db See 1po4 comment, footnote po4 bad.
112 @ 504db See 1po4 comment, footnote po4 bad.
113 @ 607db See 1po4 comment, footnote po4 bad.
114 @ 713db See 1po4 comment, footnote po4 bad.
115 @ 814db See 1po4 comment, footnote po4 bad.
116 @ 900db See 1po4 comment, footnote po4 bad.
117 @1009db See 1po4 comment, footnote po4 bad.
118 @1215db See 1po4 comment, footnote po4 bad.
119 @1417db See 1po4 comment, footnote po4 bad.
120 @1627db See 1po4 comment, footnote po4 bad.
121 @1828db See 1po4 comment, footnote po4 bad.
122 @2029db See 1po4 comment, footnote po4 bad. Delta-S at 2029db is -.0037. Samples appear to be okay, however see Station 048 leaking bottle comment.
123 @2231db See 1po4 comment, footnote po4 bad.
124 @2434db See 1po4 comment, footnote po4 bad.
125 @2640db See 1po4 comment, footnote po4 bad.
126 @2833db See 1po4 comment, footnote po4 bad.
127 @3038db See 1po4 comment, footnote po4 bad.
128 @3298db See 1po4 comment, footnote po4 bad.
129 @3541db See 1po4 comment, footnote po4 bad.
130 @3797db See 1po4 comment, footnote po4 bad. Sample log: Air leak. Samples appear to be okay.

131 @4044db See 1po4 comment, footnote po4 bad.
132 @4303db See 1po4 comment, footnote po4 bad.
133 @4564db See 1po4 comment, footnote po4 bad.
134 @4823db Oxygen appears to be slightly high. Footnote oxygen uncertain. See 1po4 comment, footnote po4 bad.
135 @5065db See 1po4 comment, footnote po4 bad.
136 @5269db See 1po4 comment, footnote po4 bad.

Station 051

106 @ 141db Delta-S at 141db is -.0605. Salinity inversion could be real. Footnote salinity uncertain.
122 @1718db Samples appear to be okay, however see Station 048 leaking bottle comment.
130 @3451db Sample log: Slight air leak. Samples appear to be okay, fit adjoining station and CTDO very well.

Station 052

101 @ 0db Sample log: Slight air leak. Samples agree with adjoining stations and CTD.
108 @ 258db Sample log: Slight air leak. Samples appear to be okay.
122 @2023db Samples appear to be okay, however see Station 048 leaking bottle comment.
126 @2837db Oxygen high does not agree with CTDO or adjoining stations, footnote o2 uncertain.
129 @3549db Delta-S at 3549db is -.0033. Calc okay, footnote o2 uncertain.
136 @5392db Sample log: Air leak - caps large. Samples appear to be okay agrees with Sta 047 and CTD.

Station 053

119 @1217db Tsuchiya: "PO4 too high?" Calc okay, peaks fair.
122 @1825db Tsuchiya: "NO3 too low?" Calc okay, peaks good. Samples appear to be okay, however see Station 048 leaking bottle comment.
123 @2030db Tsuchiya: "NO3 too low?" Calc okay, peaks good.
124 @2227db Tsuchiya: "NO3 too low?" Calc okay, peaks good.
125 @2428db Tsuchiya: "NO3 too low?" Calc okay, peaks good.
126 @2631db Tsuchiya: "NO3 too low?" Calc okay, peaks good.
127 @2834db Tsuchiya: "NO3 too low?" Calc okay, peaks good.
128 @3039db Tsuchiya: "NO3 too low?" Calc okay, peaks fair.
135 @4694db Sil slightly low, poor peak. Footnote sil bad analysis.
136 @4924db Sample log: Air leak. NO3 .2 too high, sil 3. too high, both had poor peaks. Oxygen agrees with adjoining station and CTDO. Footnote no3 bad analysis, footnote sil bad analysis.

Station 054

106 @ 176db Nutrients low, no problems noted, peaks reasonable. Footnote nuts uncertain.
122 @1819db Footnote salinity bad, bottle leaking. See Station 048 comments.
130 @3294db Sample log: Slight air leak. Oxygen slightly low compared with adjacent stations, does agree with CTDO, footnote oxygen bad, bottle leaking. Other samples appear to be okay.

Station 055

101 @ 1db Sample log: Slight air leak. Samples agree with adjoining stations.
107 @ 198db Sample log: Air leak. Oxygen appears to be okay as well as other samples.
108 @ 229db Sample log: Slight air leak. Oxygen low on CTDO trace. Footnote bottle air leak, and footnote o2 bad.
115 @ 605db Tsuchiya: "PO4 too low?" Calc okay, peaks fair.
116 @ 708db Tsuchiya: "PO4 too low?" Calc okay, peaks fair.
122 @1720db Samples appear to be okay, however see Station 048 leaking bottle comment.
126 @2527db Oxygen high, may have been a duplicate draw with 27. Footnote oxygen uncertain, ODF recommends deletion.
130 @3405db Sample log: Slight air leak. Oxygen agrees with CTDO and adjoining station.

Station 056

108 @ 205db Sample log: Slight air leak. Samples agree with Station 057.
122 @1818db Samples appear to be okay, however see Station 048 leaking bottle comment.
129 @3243db Sample log: Red sea slime on spout. Samples agree with adjoining station.

Station 057

2nut Tsuchiya: "Verify that the increase in all nutrients below about 2000db from Station 057 to 058 is real." Calc and peaks okay. 057 similar to 059. Nutrients: New "B" std used "WOCE B" jun 21
217 @1011db Sample log: Slow leak. Samples agree with adjoining stations.
222 @2020db Footnote salinity bad, bottle leaking. See Station 048 comments.
230 @3462db Sample log: Slow leak. Samples agree with adjoining stations.
233 @4217db Sample log: Oxygen? Bubble in cannula. Oxygen agrees with adjoining stations, okay as is.

Station 058

1nut	Tsuchiya: "Verify that the increase in all nutrients below about 2000db from Station 057 to 058 is real." Calc and peaks okay.
1sil	Silicate F1 (B and E) are higher than adjoining stations. Footnote sil uncertain.
101 @ 0db	Sample log: Small air leak. Samples appear to be okay, fit station profile.
108 @ 170db	Sample log: Small air leak. Salinity low compared to CTD, but samples appear to fit station profile.
117 @ 812db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
118 @ 908db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
119 @1113db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
120 @1315db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
121 @1515db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
122 @1722db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain. Samples appear to be okay, however see Station 048 leaking bottle comment.
123 @1923db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
124 @2124db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
125 @2325db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
126 @2526db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
127 @2733db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
128 @2936db	Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
129 @3195db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
130 @3448db	Sample log: Air leak. Samples appear to be okay. Talley: "Sil looks a little high, 29-36." see 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
131 @3702db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
132 @3963db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
133 @4212db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
134 @4472db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
135 @4733db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.
136 @4978db	Talley: "Sil looks a little high, 29-36." See 1sil comment, footnote uncertain. Talley: "Nitrate looks too high, 17-36." Footnote no3 uncertain.

Station 059

1all	Sample log: 3-4-7-5-6-8. This was the order on rosette. Bottles were put on rosette out of sequence.
1nut	Nutrients: New NO2 IO std; new cd column conditioned. Cd column may need a little more conditioning-it will get better. Footnote no3 uncertain.

101 @ 0db Sample log: Air leak. Samples appear to be okay, agree with adjoining stations and CTD.
108 @ 151db Sample log: Air leak. Samples appear to be okay, agree with adjoining stations and CTD.
114 @ 554db Oxygen appears high. Calc okay, no problems noted. Footnote o2 uncertain.
117 @ 855db Sample log: Air leak. Samples appear to be okay, agree with adjoining stations and CTD.
118 @1011db Talley: "Nitrate high, 118-136." See comments made by nutrient analyst, footnote no3 uncertain.
119 @1213db See 118 comments, footnote no3 uncertain.
120 @1412db See 118 comments, footnote no3 uncertain.
121 @1633db See 118 comments, footnote no3 uncertain.
122 @1881db Delta-S -.009, other samples agree with station profile and adjoining stations. Footnote salinity bad, bottle leaking. See Station 048 comments. See 118 comments, footnote no3 uncertain.
123 @2129db See 118 comments, footnote no3 uncertain.
124 @2326db See 118 comments, footnote no3 uncertain.
125 @2532db See 118 comments, footnote no3 uncertain.
126 @2740db See 118 comments, footnote no3 uncertain.
127 @2940db See 118 comments, footnote no3 uncertain.
128 @3143db See 118 comments, footnote no3 uncertain.
129 @3346db See 118 comments, footnote no3 uncertain.
130 @3548db Sample log: Air leak. Samples appear to be okay, agree with adjoining stations and CTD. See 118 comments, footnote no3 uncertain.
131 @3752db See 118 comments, footnote no3 uncertain.
132 @4008db See 118 comments, footnote no3 uncertain.
133 @4264db See 118 comments, footnote no3 uncertain.
134 @4521db See 118 comments, footnote no3 uncertain.
135 @4779db See 118 comments, footnote no3 uncertain.
136 @4978db See 118 comments, footnote no3 uncertain.

Station 060

106 @ 117db Sample log: Vent valve open. Samples appear to be okay for shallow water.
122 @1613db Samples appear to be okay, however see Station 048 leaking bottle comment.
130 @3444db Sample log: Slight air leak. Samples appear to be okay, agree with adjoining stations and station profile.

Station 061

1all Console ops: Pylon 2 first for freon bottle blanks. Tripped 12-1 then 36-13.

106 @3400db No problems noted, other samples appear to be okay, appears to be a drawing problem. Footnote o2 uncertain, ODF recommends deletion.
122 @ 353db Delta-S is -.2081. No notes, calc okay, but salinity obviously wrong. Other samples appear to be okay. See Station 048 comments. Footnote bottle leaking, salinity bad.
134 @2078db Sample log: Bottom end cap popped during separation-no water.
136 @2377db Sample log: Leaking from bottom end cap after vent open. Oxygen as well as other samples appear to be okay.

Station 062

119 @1212db The oxygen is low, nitrate is high, phosphate is high, silicate is high, salinity and oxygen agree with CTD trace. leave as is, footnote o2 uncertain, no3, po4, sil, and no2 uncertain.
122 @1818db Sample log: Broken lanyard - empty bottle.

Station 063

101 @ 0db Sample log: Slight air leak. Samples appear to be okay.
112 @ 458db Sample log: Vent cock wide open. Oxygen high compared with CTD and salinity low. Other samples appear to be okay, footnote bottle leaking, footnote salinity and o2 bad.
117 @1010db Sample log: Vent cock not tight. Samples appear to be okay.
122 @2026db Delta-S at 2026db is -.0062. All samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
129 @3245db Sample log: Spigot broken on recovery (nuts and salts taken), no o2 drawn.
130 @3449db Sample log: Spigot broken on recovery (nuts and salts taken), no o2 drawn.
131 @3704db Sample log: Spigot broken on recovery (nuts and salts taken), no o2 drawn.

Station 064

122 @1719db Delta-S at 1719db is -.0093. All samples except salinity look okay. Footnote salinity bad, bottle leaking. ODF recommends deletion of salinity. See Station 048 comments.
128 @2941db Sample log: Air leak. Oxygen low compared with CTDO, but agrees with adjoining station. Sil high compared with adjoining station. Other samples appear to be okay. Footnote o2 bad, footnote silicate bad, footnote bottle leaking.
130 @3397db Sample log: Slight air leak. Oxygen low compared with CTDO, but agrees with adjoining station. Other samples appear to be okay. Footnote o2 bad, bottle leaking, may have effected all gas samples.

Station 065

108 @ 202db Sample log: Leak. Salinity and Oxygen agree with CTD. Other samples also appear to be okay.
122 @2021db Delta-S at 2021db is -.0074. Oxygen draw temp a little high, but all samples except salinity look okay. Footnote salinity bad, bottle leaking. ODF recommends deletion of salinity. See Station 048 comments.
127 @2868db Silicate appears high, poor peak, footnote sil bad.
128 @3041db Silicate appears low, poor sil peak, sample rerun, and not improved, footnote sil bad.
130 @3498db Sample log: Leak. Delta-S at 3498db is -.0030, but deep samples are a little low compared to CTD. Oxygen agrees with CTD. Other samples appear to be okay. Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.
131 @3755db Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.
132 @4014db Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.
133 @4268db Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.
134 @4523db Delta-S at 4523db is -.0036. Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.
135 @4787db Delta-S at 4787db is -.0031. Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.
136 @5011db Delta-S at 5011db is -.0035. Talley: Footnote salinity uncertain. Salinity is slightly lower than CTD and adjoining stations. No analytical problems noted.

Station 066

207 @ 128db Sample log: Air leak. Salinity and oxygen agree with CTD, other samples also look okay.
208 @ 153db Sample log: Slight air leak. Salinity and oxygen agree with CTD, other samples also look okay.
222 @1615db Delta-S at 1615db is -.0082. Footnote salinity bad, bottle leaking. See Station 048 comments.
230 @3350db Sample log: Slow air leak. Salinity and oxygen agree with CTD, other samples also look okay.

Station 067

117 @ 806db Tsuchiya: "PO4 too low? (A small minimum in the major maximum looks strange.)" Calc okay, peaks fair.
118 @ 909db Tsuchiya: "PO4 too low? (A small minimum in the major maximum looks strange.)" Calc okay, peaks fair. Nutrients: 18 & 20 in rack wrong,

	18 must be 20 otherwise N&P max not right. Sil, no3 look okay so however analyst arranged samples must be okay.
122 @1718db	Delta-S at 1718db is -.0092. Footnote salinity bad, bottle leaking. See Station 048 comments.
128 @2905db	PO4 high, footnote po4 uncertain.
129 @3087db	Sample log: "Spigot broken off during recovery - drew nuts & salts, no o2 drawn." Delta-S at 3087db is -.0032. Samples appear to be okay.
130 @3345db	Sample log: "Spigot broken off during recovery - drew nuts & salts, no o2 drawn." PO4 is slightly high compared with adjoining station, but there seems to be a feature displayed in the shallower and deeper PO4 samples.

Station 068

1po4	Tsuchiya: "Deep (>800m) po4 level is higher than neighboring stations." Calc okay, peaks fair to good. Leave as is.
1sil	Nutrients: Sil end sw odd. Tsuchiya: "Deep sil level is higher than neighboring stations." Calc okay, peaks fair to good. Leave as is.
101 @ 0db	Sample log: Leaky air. Salinity and oxygen agree with CTD, other samples also appear to be okay.
108 @ 128db	Sample log: "Slight air leak." Oxygen trace is different between adjoining stations and oxygen is high compared with CTD. Leave as is.
122 @1619db	Delta-S at 1619db is -.0033. All samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
136 @4806db	Sample log: Air leak. Salinity and oxygen agree with CTD, other samples also appear to be okay.

Station 069

1po4	Tsuchiya: "Deep (>800m) po4 level is higher than neighboring stations." Calc okay, peaks fair to good. Leave as is.
1sil	Tsuchiya: "Deep sil level is higher than neighboring stations." Calc okay, peaks fair to good. Leave as is.
101 @ 0db	Sample log: Slight air leak. Salinity and oxygen agree with CTD, other samples also appear to be okay.
108 @ 152db	Sample log: Slight air leak. Oxygen a little high compared with CTD, other samples also appear to be okay.
113 @ 507db	Sample log: Dribbling from bottom cap. Salinity and oxygen agree with CTD, other samples also appear to be okay.
117 @ 911db	Sample log: Slight air leak - vent cock not tight. Oxygen appears a little high compared with CTD, other samples appear to be okay. Leave as is.
122 @1817db	Delta-S at 1817db is -.0055. All samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
127 @2687db	Oxygen too high, suspect drawing or analyst error, footnote oxygen uncertain. ODF recommends deletion of oxygen.

130 @3301db Sample log: Air leaker. Salinity and oxygen agree with CTD, other samples also appear to be okay.
136 @4807db Sample log: Major air leak. Salinity and oxygen agree with CTD, other samples also appear to be okay.

Station 070

107 @ 77db Sample log: Bottle didn't close, no water.
111 @ 243db Sample log: Bottle didn't close, no water.
122 @1618db Delta-S is -.0039. Footnote salinity bad, bottle leaking. ODF recommends deletion of salinity. See Station 048 comments.
130 @3298db Sample log: Slight air leak. Salinity and oxygen agree with CTD, sil appears a little high as compared with adjoining station, but suspect analysis before bottle problem.

Station 071

1all Sample log: Split sampling crew.
101 @ 0db Sample log: Air leak. Samples appear to be okay.
115 @ 708db Sample log: TCO2 sampler late.
116 @ 807db Sample log: TCO2 sampler late.
122 @1820db Delta-S at 1820db is -.0343. ODF recommends deletion of salinity. Oxygen draw temp a little low, but all samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.

Station 072

108 @ 161db Sample log: Air leak. Salinity and oxygen agree with CTD, other samples are also okay.
112 @ 356db Sample log: Air valve open. Salinity and oxygen agree with CTD, other samples are also okay.
122 @1613db Delta-S at 1613db is -.0060. ODF recommends deletion. Suspect a problem with this bottle. Oxygen draw temp a little high, but all samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
129 @3040db Sample log: Water leak around spigot. Salinity and oxygen agree with CTD, other samples are also okay.
130 @3291db Sample log: Air leak. Salinity and oxygen agree with CTD, other samples are also okay.

Station 073

1po4 Tsuchiya: "Deep (>800m) po4 level is higher than neighboring stations." Calc okay, peaks fair to good. Leave as is.
101 @ 0db Sample log: Dribble leaker out of spigot. Delta-S at 0db is .0516. Samples appear to be okay for surface sample.

104 @ 77db	Sample log: Water leak from bottom. Samples appear to be okay.
122 @1620db	Delta-S at 1620db is -.0206. ODF recommends deletion. Suspect a problem with this bottle. All samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
129 @2984db	Sample log: Water leak out of bottom and stopper. Samples appear to be okay.
130 @3190db	Sample log: Air leak. Samples appear to be okay.

Station 074

1no3	Tsuchiya: "Near-bottom no3 slightly too high?" Nutrients: Serious no3 drift-looks linear. Make no3 ddw same as sw begin & end.
106 @ 88db	Bottle reversed early, footnote bottle leaking. Delete salinity, o2, sil, no3, no2, po4, 34.6952 86.7 73.95 28.16 0.29 1.97, respectively.
122 @1615db	Delta-S at 1615db is -.0221. ODF recommends deletion. All samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
130 @3290db	Sample log: Slight air leak. Oxygen appears high compared with two adjoining stations, but okay as compared with 7 other stations. Footnote o2 bad, footnote bottle leaking. Other samples appear okay.
135 @4586db	Oxygen low, footnote o2 uncertain.

Station 075

1no3	Tsuchiya: "Near-bottom no3 slightly too high?" Nutrients: New photo tube-no3. Cleaned cd column.
1nut	Tsuchiya: "All three nuts in deep water (>1000m) decrease from Station 075 to 076." Calc and peaks okay. Leave for now.
101 @ 0db	Sample log: Slow leak. Oxygen high vs. CTD and Sta 074.
116 @ 704db	Sample log: Dripping from spigot. Salinity and oxygen agree with CTD, but oxygen low compared with adjoining stations.
122 @1623db	Delta-S at 1623db is -.0218. Oxygen draw temp a little high, but all samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
129 @2870db	Oxygen low compared with CTD and adjoining station. Footnote o2 uncertain.
130 @3044db	Sample log: Leaker from tap. Salinity and oxygen agree with CTD, other samples also appear to be okay.

Station 076

2nut	Tsuchiya: "All three nuts in deep water (>1000m) decrease from Station 075 to 076." Nutrients: New working Sncl2 & ss molyb. Calc and peaks okay. Leave for now.
201 @ 0db	Sample log: Slight air leak. Salinity low compared with adjoining stations, but okay compared with CTD. Oxygen high compared with CTD, but okay with adjoining stations.
203 @ 81db	Sample log: Tiny bubbles. Samples appear to be okay.
219 @1015db	Sample log: Oxygen bubbles from NaI cannula. Oxygen profile looks okay.
222 @1620db	Delta-S at 1620db is -.0218. ODF recommends deletion. Oxygen draw temp a little high, but all samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
225 @2225db	Sample log: Spigot hit ship. Sample log: Water came out - sampled first for oxygen. Oxygen a little high compared with CTD, footnote oxygen bad, bottle leaking, may have effected other samples. Other samples appear to be okay.
227 @2629db	Sample log: Tiny bubbles. Oxygen agrees with CTD, other samples appear to be okay.
230 @3241db	Sample log: Slight air leak. Oxygen agrees with CTD, other samples appear to be okay.

Station 077

1all	Sample log: New battery in oxygen thermometer Sample log: NaI/NaOH had bad bubble problem. Deep station profile is a little higher than adjoining stations, footnote o2 uncertain as station comparisons indicate.
101 @ 0db	Sample log: Air leak. Salinity and oxygen agree with CTD, other samples appear okay.
120 @1006db	Oxygen too high, looks like a drawing error with 21. Footnote oxygen uncertain, ODF recommends deletion.
122 @1410db	Sample log: Leaking from bottom end cap. Delta-S at 1410db is -.0218. ODF recommends deletion. Oxygen agrees with CTD. Oxygen draw temp a little high, but all samples except salinity look okay. Footnote salinity bad, bottle leaking. See Station 048 comments.
124 @1821db	Footnote o2 uncertain, see 1all comment. Talley: "Leave oxygen as okay. Plots with stations 75-80 show that numbers fall within range and oxygen is going through a fairly strong horizontal gradient." Leave oxygen as good.
125 @2026db	Footnote o2 uncertain, see 1all comment. Leave oxygen as good. See 124 Talley comment.
126 @2227db	Footnote o2 uncertain, see 1all comment. Leave oxygen as good. See 124 Talley comment.
127 @2430db	Tsuchiya: "O2 slightly too high, could be correct." Footnote o2 uncertain, see 1all comment. Leave oxygen as good. See 124 Talley comment.

128 @2632db Tsuchiya: "O2 slightly too low, could be correct." Footnote o2 uncertain, see 1all comment. Leave oxygen as good. See 124 Talley comment.
131 @3299db Footnote o2 uncertain, see 1all comment. Leave oxygen as good. See 124 Talley comment.
132 @3551db Footnote o2 uncertain, see 1all comment. Leave oxygen as good. See 124 Talley comment.

Station 078

101 @ 0db Sample log: Vent cock was not tight. Samples appear to be okay.
108 @ 195db Sample log: Slight leaker. Samples appear to be okay.
111 @ 303db Sample log: Leaking water out of bottom during sampling. Samples appear to be okay.
112 @ 352db Sample log: Leaking water out of bottom. Samples appear to be okay.
119 @1009db Sample log: Valve open (air). Samples appear to be okay.
120 @1210db Sample log: Valve open (air). Samples appear to be okay.
121 @1422db Sample log: Valve open (air). Footnote bottle as leaking, it may only effect gas samples. Talley: "Leave oxygen in data set and footnote bad." Done as per Talley comment.
122 @1613db Sample log: Valve open but not leaking. Samples appear to be okay.

Station 079

1sil Tsuchiya: "SiO3 values in the major max (double maximum) at ~3000m are slightly higher than those at neighboring stations." Calc okay, peaks fair.
101 @ 0db Sample log: Dribbled water from spigot. Samples appear to be okay.
104 @ 112db Sample log: Water leaker from bottom. Samples appear to be okay.
131 @3245db Sample log: 100+ orange biology over top half of bottle. Samples appear to be okay.

Station 080

1po4 Tsuchiya: Deep (>~1000m PO4 values systematically too low. Calc okay, peaks fair.
101 @ 0db Sample Log: Air leak. Oxygen agrees with adjoining stations and CTDO.
108 @ 152db Sample Log: Slight air leak. Oxygen agrees with CTDO, other samples appear to be okay.
112 @ 310db Oxygen too high, footnote oxygen uncertain, ODF recommends deletion.
115 @ 537db Sample log: Broken spigot, probably during launch. No water samples.
130 @2959db Sample Log: Slight air leak. Samples appear to be okay, agree with adjoining stations and CTD.

Station 081

161 @ 2db	Oxygen and nutrients were not drawn per sampling schedule.
162 @ 36db	Oxygen and nutrients were not drawn per sampling schedule.
163 @ 227db	Sample Log: Bottom end cap hung up.
164 @ 236db	Oxygen and nutrients were not drawn per sampling schedule.
165 @ 700db	Sample Log: Bottom end cap hung up.
166 @ 797db	Oxygen and nutrients were not drawn per sampling schedule.
167 @ 892db	Sample Log: Bottom end cap hung up. Too short.
168 @2606db	Delta-S at 2606db is -.0038. Oxygen and nutrients were not drawn per sampling schedule.
169 @3525db	Oxygen and nutrients were not drawn per sampling schedule.
170 @3978db	Sample Log: Bottom end cap hung up. Too short.
171 @4392db	Oxygen and nutrients were not drawn per sampling schedule.

Station 082

108 @ 135db	Sample Log: Small air leak. Samples appear to be okay.

Station 083

1all	Suspect 68 closed at 3037db and remaining bottles closed one level lower than intended. No indication of two trips from computer. Possibly crossed lanyard problem and extra trip. Footnote bottles, did not trip correctly.
161 @ 26db	See 1all comment, oxygen and nutrients were not drawn per sampling schedule.
162 @ 209db	See 1all comment, oxygen and nutrients were not drawn per sampling schedule.
163 @ 414db	Delta-S at 414db is .0694, suspect tripping problem. Footnote bottle leaking and salinity as bad, ODF recommends deletion. See 1all comment, oxygen and nutrients were not drawn per sampling schedule.
164 @ 606db	See 1all comment, oxygen and nutrients were not drawn per sampling schedule.
165 @ 810db	See 1all comment, oxygen and nutrients were not drawn per sampling schedule.
166 @1013db	See 1all comment, oxygen and nutrients were not drawn per sampling schedule. Talley: Footnote salinity uncertain. Many problems with these LADCP stations, suspect this is another bottle or tripping problem and not the analysis.
167 @2019db	Delta-S at 2019db is -.0319. Suspect bottle leaking or tripping (tripped between scheduled trip and next level). Footnote bottle leaking and salinity as bad, ODF recommends deletion. See 1all comment, oxygen and nutrients were not drawn per sampling schedule.
168 @3037db	See 1all comment, oxygen and nutrients were not drawn per sampling schedule.

169 @3037db Delta-S at 3037db is .0825. Suspect bottle leaking or tripping (tripped between scheduled trip and next level). Footnote bottle leaking and salinity as bad, ODF recommends deletion. Oxygen and nutrients were not drawn per sampling schedule.
170 @4060db Oxygen and nutrients were not drawn per sampling schedule.
171 @4434db Oxygen and nutrients were not drawn per sampling schedule.

Station 084

1no3 NO3 high by about 3%, calculations good. Footnote no3 uncertain.
1nut Tsuchiya: "Deep PO4, NO3, & SiO3 values too high relative to nearby stations." PO4 stds (F1) averaged with adjoining stations standard affected the samples incorrectly per AWM. Station profile comparison now looks good for po4. Nutrients: New imid buffer.
101 @ 30db Sample Log: Air leak. Samples appear to be okay.
102 @ 72db See 112
103 @ 92db See 112
104 @ 103db See 112
105 @ 113db See 112
106 @ 130db See 112
107 @ 155db See 112
108 @ 207db Sample Log: Slight air leak. Samples appear to be okay. See 112
109 @ 257db See 112
110 @ 307db See 112
111 @ 352db See 112
112 @ 1db 11 was tripped first through to 1 then 12 was tripped at the surface, footnote bottles 1-12 did not trip correctly. ODF is submitting the data in the proper sequence, just not as originally scheduled.
119 @1011db See 1nut & 1no3 comment, footnote no3 uncertain.
120 @1213db See 1nut & 1no3 comment, footnote no3 uncertain.
121 @1413db See 1nut & 1no3 comment, footnote no3 uncertain.
122 @1615db See 1nut & 1no3 comment, footnote no3 uncertain.
123 @1818db See 1nut & 1no3 comment, footnote no3 uncertain.
124 @2024db See 1nut & 1no3 comment, footnote no3 uncertain.
125 @2225db See 1nut & 1no3 comment, footnote no3 uncertain.
126 @2431db See 1nut & 1no3 comment, footnote no3 uncertain.
127 @2637db See 1nut & 1no3 comment, footnote no3 uncertain.
128 @2833db See 1nut & 1no3 comment, footnote no3 uncertain.
129 @3037db See 1nut & 1no3 comment, footnote no3 uncertain.
130 @3242db Sample Log: Slight air leak. Samples appear to be okay. See 1nut & 1no3 comment, footnote no3 uncertain.
131 @3451db See 1nut & 1no3 comment, footnote no3 uncertain.
132 @3655db See 1nut & 1no3 comment, footnote no3 uncertain.
133 @3869db Delta-S at 3869db is -.0033. See 1nut & 1no3 comment, footnote no3 uncertain.
134 @4071db See 1nut & 1no3 comment, footnote no3 uncertain.

135 @4288db See 1nut & 1no3 comment, footnote no3 uncertain.
136 @4482db See 1nut & 1no3 comment, footnote no3 uncertain.

Station 085

161 @ 35db Oxygen and nutrients were not drawn per sampling schedule.
162 @ 208db Oxygen and nutrients were not drawn per sampling schedule.
163 @ 414db Delta-S is 112.7. Suspect bottle tripping problem, Footnote bottle 3 did not trip correctly, salinity bad. ODF recommends deletion of salinity.
164 @ 614db Oxygen and nutrients were not drawn per sampling schedule.
165 @ 820db Oxygen and nutrients were not drawn per sampling schedule.
166 @1027db Oxygen and nutrients were not drawn per sampling schedule.
167 @2008db Oxygen and nutrients were not drawn per sampling schedule.
168 @3022db Sample Log: Hung up, sliding bottom lanyard hooked over junction on top lanyard.
169 @4043db Delta-S is 73.0. Suspect bottle tripping problem. Footnote bottle leaking and salinity bad. ODF recommends deletion of salinity.
170 @4508db Oxygen and nutrients were not drawn per sampling schedule.
171 @ 2db Sample Log: Not put on rosette - still in rack during cast.

Station 086

101 @ 66db Sample Log: Air leak. Salinity and oxygen agree with CTD.
102 @ 82db Delta-S at 82db is -.0774. Salinity the same as 103. Slight inversion on CTD profile. Other shallow samples appear reasonable.
103 @ 92db See 112 comment.
104 @ 103db See 112 comment.
105 @ 119db See 112 comment.
106 @ 159db See 112 comment.
107 @ 178db See 112 comment.
108 @ 209db See 112 comment.
109 @ 262db See 112 comment.
110 @ 324db See 112 comment.
111 @ 385db See 112 comment.
112 @ 0db 11 was tripped first through to 1 then 12 was tripped at the surface. ODF is submitting the data in the proper sequence, just not as originally scheduled.
130 @3033db Sample Log: Slight air leak. Samples appear to be okay.

Station 087

161 @ 3db Oxygen and nutrients were not drawn per sampling schedule.
162 @ 30db Oxygen and nutrients were not drawn per sampling schedule.
163 @ 187db Oxygen and nutrients were not drawn per sampling schedule.
164 @ 207db Oxygen and nutrients were not drawn per sampling schedule.
165 @ 259db Oxygen and nutrients were not drawn per sampling schedule.

166 @ 820db Oxygen and nutrients were not drawn per sampling schedule.
167 @ 921db Oxygen and nutrients were not drawn per sampling schedule.
168 @2054db Oxygen and nutrients were not drawn per sampling schedule.
169 @3089db Delta-S is -78.3. Suspect bottle tripped incorrectly. Footnote bottle leaking and salinity bad, ODF recommends deletion. Oxygen and nutrients were not drawn per sampling schedule.
170 @4128db Talley: "Footnote salinity questionable. Maybe it is a bottle problem." Footnote bottle leaking, footnote salinity bad. Oxygen and nutrients were not drawn per sampling schedule.
171 @4627db Oxygen and nutrients were not drawn per sampling schedule.

Station 088

108 @ 155db Sample Log: Slight air leak. Salinity and oxygen agree with CTD.

Station 089

161 @ 3db Oxygen and nutrients were not drawn per sampling schedule.
162 @ 36db Oxygen and nutrients were not drawn per sampling schedule.
163 @ 209db Oxygen and nutrients were not drawn per sampling schedule.
164 @ 414db Oxygen and nutrients were not drawn per sampling schedule.
165 @ 608db Oxygen and nutrients were not drawn per sampling schedule.
166 @ 813db Oxygen and nutrients were not drawn per sampling schedule.
167 @1012db Oxygen and nutrients were not drawn per sampling schedule.
168 @2008db Oxygen and nutrients were not drawn per sampling schedule.
169 @3039db Delta-S is -.0350. Suspect bottle tripped incorrectly. Footnote bottle leaking and salinity bad, ODF recommends deletion. Oxygen and nutrients were not drawn per sampling schedule.
170 @4050db Oxygen and nutrients were not drawn per sampling schedule.
171 @4538db Delta-S is -.0914. Suspect bottle tripped incorrectly. Footnote bottle leaking and salinity bad, ODF recommends deletion. Oxygen and nutrients were not drawn per sampling schedule.

Station 090

101 @ 0db Sample Log: Air leak. Salinity and oxygen agree with CTD.
102 @ 0db Suspect console operator did not trip properly. Should have been at 30db.
130 @3044db Sample Log: Slight air leak. Oxygen and salinity agree with CTD, samples agree with adjoining stations.

Station 091

161 @ 3db Oxygen and nutrients were not drawn per sampling schedule.
162 @ 25db Oxygen and nutrients were not drawn per sampling schedule.
163 @ 217db Oxygen and nutrients were not drawn per sampling schedule.

164 @ 711db Oxygen and nutrients were not drawn per sampling schedule.
165 @ 815db Oxygen and nutrients were not drawn per sampling schedule.
166 @ 917db Oxygen and nutrients were not drawn per sampling schedule. Oxygen and nutrients were not drawn per sampling schedule.
167 @2027db Sample Log: Empty but closed - must have hung up until out of water.
168 @2540db Oxygen and nutrients were not drawn per sampling schedule.
169 @3057db Delta-S is -7.5, suspect that bottle either tripped with 68 or that sample drawing error. Footnote bottle leaking, salinity bad. Oxygen and nutrients were not drawn per sampling schedule.
170 @4094db Oxygen and nutrients were not drawn per sampling schedule.
171 @4446db Oxygen and nutrients were not drawn per sampling schedule.

Station 092

1sil Tsuchiya: "Lower Sil values near the Sil max real?" Calc and peaks okay. Tsuchiya may have made his comment before entry was corrected. Entry error on f1(e) sil.
108 @ 133db Sample Log: Slight air leak. Salinity and oxygen agree with CTD, other samples appear to be okay.
127 @2223db 0xygen high, suspect duplicate draw with 28. Footnote oxygen uncertain, ODF recommends deletion.
133 @3548db Sil looks high, peak okay, leave as is, Adjoining stations also show sil max.

Station 093

161 @ 3db Sample log: Assume duplicate nuts tubes drawn. (2 samples run at end of station 92). Oxygen differs by .021, nuts are okay.
162 @ 56db Oxygen and nutrients were not drawn per sampling schedule.
163 @ 197db Oxygen and nutrients were not drawn per sampling schedule.
164 @ 213db Oxygen and nutrients were not drawn per sampling schedule.
165 @ 244db Oxygen and nutrients were not drawn per sampling schedule.
166 @ 820db Oxygen and nutrients were not drawn per sampling schedule.
167 @ 922db Delta-S .024, salinity is the only sample taken, bottle may have tripped incorrectly or leaked. Footnote bottle leaking and salinity bad. Oxygen and nutrients were not drawn per sampling schedule.
168 @2040db Delta-S at 2040db is .0030. Oxygen and nutrients were not drawn per sampling schedule.
169 @3058db Oxygen and nutrients were not drawn per sampling schedule.
170 @4095db Oxygen and nutrients were not drawn per sampling schedule.
171 @4381db Sample log: Drain valve open. Salinity agrees with CTD. Oxygen and nutrients were not drawn per sampling schedule.

Station 094

1nut	Tsuchiya: "Is the sudden decrease in deep PO4 values real?" Calc and peaks okay. Nutrients: Fresh hydrazine, new tartacid. Clean system with dil rbs. Notes by nutrient analyst indicate that decrease is probably not real. Footnote po4 uncertain 119-136. Talley: "These look okay." Had footnoted these uncertain, change to okay.

Station 095

161 @ 2db	Oxygen and nutrients not drawn.
162 @ 35db	Oxygen and nutrients not drawn.
163 @ 206db	Oxygen and nutrients not drawn.
164 @ 412db	Oxygen and nutrients not drawn.
165 @ 613db	Oxygen and nutrients not drawn.
166 @ 816db	Oxygen and nutrients not drawn.
167 @1025db	Oxygen and nutrients not drawn.
168 @2046db	Delta-S at 2046db is .0036. Oxygen and nutrients not drawn.
169 @3081db	Delta-S is -.006. This bottle has been a problem, footnote bottle leaking and salinity bad, ODF recommends deletion. Oxygen and nutrients not drawn.
170 @4116db	Oxygen and nutrients not drawn.
171 @4272db	Oxygen and nutrients not drawn.

Station 096

101 @ 0db	Sample Log: Big time air leak. Oxygen agrees with CTD and adjoining station, other samples okay.
107 @ 111db	Sample Log: Air vent loose. Oxygen agrees with CTD and adjoining station, other samples okay.
108 @ 125db	Sample Log: Slight air leak. Oxygen agrees with CTD and adjoining station, salinity a little high compared to CTD, other samples okay. Delta-S at 125db is -.0414.

Station 097

161 @ 3db	Oxygen and nutrients were not drawn.
162 @ 19db	Oxygen and nutrients were not drawn.
163 @ 258db	Oxygen and nutrients were not drawn.
164 @ 820db	Oxygen and nutrients were not drawn.
165 @ 922db	Oxygen and nutrients were not drawn.
166 @1025db	Oxygen and nutrients were not drawn.
167 @1536db	Oxygen and nutrients were not drawn.
168 @2044db	Oxygen and nutrients were not drawn.
169 @2558db	Oxygen and nutrients were not drawn.
170 @3076db	Oxygen and nutrients were not drawn.

171 @3444db Oxygen and nutrients were not drawn.

Station 098

207 @ 177db Sample log: A little air leak. Samples okay @177db.
229 @3042db Oxygen high, may be a drawing error with 28. Footnote oxygen uncertain.
2all Sample log: Oxygen draw temperature not accurate.
461 @ 3db Nutrients not drawn per sampling schedule.
462 @1106db Sample log: Air leak. Oxygen .13 too high, air leak appears to have effected sample. Footnote bottle leaking, o2 bad. Nutrients not drawn per sampling schedule.
463 @1310db Nutrients not drawn per sampling schedule.
464 @1569db Nutrients not drawn per sampling schedule.
465 @1771db Nutrients not drawn per sampling schedule.
466 @1943db Nutrients not drawn per sampling schedule.
467 @2118db Nutrients not drawn per sampling schedule. Sample log: Bottles are reversed in the rack. Salinity and oxygen okay.
468 @2205db Sample log: Bottles are reversed in the rack. Delta-S at 2205db is .0035. Salinity and oxygen okay. Nutrients not drawn per sampling schedule.
469 @2293db Salinity and oxygen low @2293db. No analytical notes, but usual hangup Footnote bottle leaking and salinity and oxygen bad, ODF recommends deletion. Nutrients not drawn per sampling schedule.
470 @2433db Sample log: Put down with air valve open. Salinity high, oxygen okay Footnote salinity bad, ODF recommends deletion. Nutrients not drawn per sampling schedule.
471 @4380db Nutrients not drawn per sampling schedule.

Station 099

161 @ 2db Oxygen and nutrients not drawn per sampling schedule.
162 @ 26db Oxygen and nutrients not drawn per sampling schedule.
163 @ 205db Oxygen and nutrients not drawn per sampling schedule.
164 @ 409db Oxygen and nutrients not drawn per sampling schedule.
165 @ 605db Oxygen and nutrients not drawn per sampling schedule.
166 @ 792db Oxygen and nutrients not drawn per sampling schedule.
167 @1001db Oxygen and nutrients not drawn per sampling schedule. Delta-S at 1001db is .0238. No analytical problems noted, suspect bottle leaking. Footnote bottle leaking and salinity bad.
168 @2006db Oxygen and nutrients not drawn per sampling schedule.
169 @3032db Oxygen and nutrients not drawn per sampling schedule. Delta-S is -.015, either tripping problem or leaking bottle. Footnote bottle leaking and salinity bad, ODF recommends deletion.
170 @4057db Oxygen and nutrients not drawn per sampling schedule.
171 @4286db Oxygen and nutrients not drawn per sampling schedule.

Station 101

161 @ 3db Oxygen and nutrients not drawn per sampling schedule.
162 @ 34db Oxygen and nutrients not drawn per sampling schedule.
163 @ 250db Oxygen and nutrients not drawn per sampling schedule. Sample Log: Air leak. Salinity looks okay.
164 @ 502db Oxygen and nutrients not drawn per sampling schedule.
165 @ 902db Oxygen and nutrients not drawn per sampling schedule.
166 @1006db Oxygen and nutrients not drawn per sampling schedule.
167 @1509db Oxygen and nutrients not drawn per sampling schedule.
168 @2012db Oxygen and nutrients not drawn per sampling schedule.
169 @3022db Oxygen and nutrients not drawn per sampling schedule.
170 @4056db Oxygen and nutrients not drawn per sampling schedule.
171 @4367db Oxygen and nutrients not drawn per sampling schedule.

Station 102

1all Sample Log: Oxygen therm not working. Tsuchiya: "Deep (>~1000m) NO3 & Sil look too low, relative to adjoining stations." Calc and peaks okay.
104 @ 72db Sample Log: Pet cock was open, air leak. Samples look okay.
108 @ 169db Sample Log: Air leak. Samples look okay.
120 @1217db Talley: "NO3 looks too low, 120-136." No analytical problems noted, footnote no3 uncertain.
121 @1418db Footnote no3 uncertain, see 120 comment.
122 @1625db Sample Log: Lanyard caught, empty.
123 @1827db Footnote no3 uncertain, see 120 comment.
124 @2024db Footnote no3 uncertain, see 120 comment.
125 @2195db Footnote no3 uncertain, see 120 comment.
126 @2368db Footnote no3 uncertain, see 120 comment.
127 @2531db Footnote no3 uncertain, see 120 comment.
128 @2688db Footnote no3 uncertain, see 120 comment.
129 @2861db Footnote no3 uncertain, see 120 comment.
130 @3039db Footnote no3 uncertain, see 120 comment.
131 @3245db Footnote no3 uncertain, see 120 comment.
132 @3442db Footnote no3 uncertain, see 120 comment.
133 @3646db Footnote no3 uncertain, see 120 comment.
134 @3904db Footnote no3 uncertain, see 120 comment.
135 @4154db Footnote no3 uncertain, see 120 comment.
136 @4404db Footnote no3 uncertain, see 120 comment.

Station 103

161 @ 3db Oxygen and nutrients not drawn per sampling schedule.
162 @ 36db Oxygen and nutrients not drawn per sampling schedule.
163 @ 205db Oxygen and nutrients not drawn per sampling schedule.

164 @ 406db Oxygen and nutrients not drawn per sampling schedule.
165 @ 610db Oxygen and nutrients not drawn per sampling schedule.
166 @ 812db Oxygen and nutrients not drawn per sampling schedule.
167 @1019db Oxygen and nutrients not drawn per sampling schedule.
168 @2049db Oxygen and nutrients not drawn per sampling schedule.
169 @3080db Oxygen and nutrients not drawn per sampling schedule. Salinity too low @3080db. Shipboard data analyst indicates this bottle caused continuing problems. Footnote bottle leaking and salinity bad, ODF recommends deletion.
170 @4116db Oxygen and nutrients not drawn per sampling schedule.
171 @4358db Oxygen and nutrients not drawn per sampling schedule.

Station 104

108 @ 178db Sample Log: Slight leak. Gradient area @178db, leave as is.
130 @3036db Delta-S at 3036db is .0038. Suspect drawing error, sample taken from 31. Footnote salinity uncertain, ODF recommends deletion.

Station 105

161 @ 2db Oxygen and nutrients not drawn per sampling schedule.
162 @ 35db Oxygen and nutrients not drawn per sampling schedule.
163 @ 232db Oxygen and nutrients not drawn per sampling schedule.
164 @ 403db Oxygen and nutrients not drawn per sampling schedule.
165 @ 595db Oxygen and nutrients not drawn per sampling schedule.
166 @ 895db Oxygen and nutrients not drawn per sampling schedule.
167 @1024db Oxygen and nutrients not drawn per sampling schedule.
168 @1901db Oxygen and nutrients not drawn per sampling schedule.
169 @2894db Oxygen and nutrients not drawn per sampling schedule. Salinity too low @2894db. Delta-S is -6.1 Footnote bottle leaking and salinity bad, ODF recommends deletion. Shipboard data analyst indicates this bottle caused continuing problems.
170 @3923db Oxygen and nutrients not drawn per sampling schedule.
171 @4554db Oxygen and nutrients not drawn per sampling schedule.

Station 106

101 @ 0db Sample Log: Air leak. Samples appear to be okay.
108 @ 176db Sample Log: Air leak. Samples appear to be okay.

Station 107

161 @ 2db Oxygen and nutrients not drawn per sampling schedule.
162 @ 29db Sample Log: Slight air leak. Salinity sample agrees with CTD. Oxygen and nutrients not drawn per sampling schedule.
163 @ 92db Oxygen and nutrients not drawn per sampling schedule.

164 @ 242db Oxygen and nutrients not drawn per sampling schedule.
165 @ 319db Oxygen and nutrients not drawn per sampling schedule.
166 @ 879db Oxygen and nutrients not drawn per sampling schedule.
167 @1085db Oxygen and nutrients not drawn per sampling schedule.
168 @1980db Oxygen and nutrients not drawn per sampling schedule.
169 @2980db Oxygen and nutrients not drawn per sampling schedule.
170 @4013db Oxygen and nutrients not drawn per sampling schedule.
171 @4459db Oxygen and nutrients not drawn per sampling schedule.

Station 108

101 @ 0db Sample Log: Slight leaker. Samples appear to be okay.
108 @ 145db Sample Log: Slight leaker. Oxygen appears low as compared to adjoining stations. Footnote bottle leaking, oxygen bad. Leaking comment appears to have effected gas sample. Other samples appear okay.
125 @2130db Sample Log: Retake for He.
131 @3382db Sample Log: Retake for He. Delta-S at 3382db is -.0030. Oxygen low, and no3, po4, sil high. Footnote o2 and nutrients uncertain.
132 @3608db Sample Log: Retake for He.

Station 109

161 @ 3db Oxygen and nutrients not drawn per sampling schedule.
162 @ 232db Oxygen and nutrients not drawn per sampling schedule.
163 @ 509db Oxygen and nutrients not drawn per sampling schedule.
164 @ 606db Oxygen and nutrients not drawn per sampling schedule.
165 @ 898db Oxygen and nutrients not drawn per sampling schedule.
166 @1513db Oxygen and nutrients not drawn per sampling schedule.
167 @1813db Oxygen and nutrients not drawn per sampling schedule.
168 @2526db Oxygen and nutrients not drawn per sampling schedule.
169 @3040db Oxygen and nutrients not drawn per sampling schedule.
170 @4037db Oxygen and nutrients not drawn per sampling schedule.
171 @4348db Oxygen and nutrients not drawn per sampling schedule.

Station 110

101 @ 0db Sample Log: Slight air leaker. Samples appear to be okay.
108 @ 179db Sample Log: Slight air leaker. Samples appear to be okay.
130 @3036db Sample Log: Redo He.

Station 111

161 @ 2db Oxygen and nutrients not drawn per sampling schedule.
162 @ 34db Sample Log: Small air leak. Salinity agrees with CTD. Oxygen and nutrients not drawn per sampling schedule.

163 @ 237db Oxygen and nutrients not drawn per sampling schedule.
164 @ 411db Oxygen and nutrients not drawn per sampling schedule.
165 @ 616db Oxygen and nutrients not drawn per sampling schedule.
166 @ 819db Oxygen and nutrients not drawn per sampling schedule.
167 @1018db Oxygen and nutrients not drawn per sampling schedule.
168 @1958db Oxygen and nutrients not drawn per sampling schedule.
169 @2961db Oxygen and nutrients not drawn per sampling schedule.
170 @3991db Oxygen and nutrients not drawn per sampling schedule.
171 @4417db Oxygen and nutrients not drawn per sampling schedule.

Station 112

1all Tsuchiya: "Deep (>1000m) PO4 too low." Nutrients: Fresh hydrazine. Calc and peaks okay. Use mean of standards from Stations 110 and 114. Station comparisons much better.
108 @ 145db Sample Log: Slight air leak. Samples appear to be okay.

Station 113

161 @ 2db Oxygen and nutrients not drawn per sampling schedule.
162 @ 35db Oxygen and nutrients not drawn per sampling schedule. Sample Log: Slight air leak. Salinity agrees with CTD.
163 @ 304db Oxygen and nutrients not drawn per sampling schedule.
164 @ 705db Oxygen and nutrients not drawn per sampling schedule.
165 @ 905db Oxygen and nutrients not drawn per sampling schedule.
166 @1203db Oxygen and nutrients not drawn per sampling schedule.
167 @1508db Oxygen and nutrients not drawn per sampling schedule.
168 @2016db Oxygen and nutrients not drawn per sampling schedule.
169 @3016db Oxygen and nutrients not drawn per sampling schedule.
170 @4041db Oxygen and nutrients not drawn per sampling schedule.
171 @4464db Oxygen and nutrients not drawn per sampling schedule.

Station 114

1all Tsuchiya: "Deep (>~1000m) NO3 too high." Calc and peaks okay.
101 @ 0db Sample Log: Slight leaker. Samples appear to be okay.
108 @ 152db Sample Log: Slight leaker. Samples appear to be okay.
117 @ 712db Sample Log: Slight air leak, vent cock. Samples appear to be okay. Talley: "NO3 looks too high, 117-136." No analytical problems noted, footnote no3 uncertain.
118 @ 811db Footnote no3 uncertain, see 117 comment.
119 @ 910db Footnote no3 uncertain, see 117 comment.
120 @1015db Footnote no3 uncertain, see 117 comment.
121 @1225db Footnote no3 uncertain, see 117 comment.
122 @1427db Footnote no3 uncertain, see 117 comment.
123 @1622db Footnote no3 uncertain, see 117 comment.

124 @1822db Footnote no3 uncertain, see 117 comment.
125 @2024db Footnote no3 uncertain, see 117 comment.
126 @2224db Footnote no3 uncertain, see 117 comment.
127 @2432db Footnote no3 uncertain, see 117 comment.
128 @2637db Footnote no3 uncertain, see 117 comment.
129 @2831db Footnote no3 uncertain, see 117 comment.
130 @3038db Footnote no3 uncertain, see 117 comment.
131 @3296db Footnote no3 uncertain, see 117 comment.
132 @3542db Footnote no3 uncertain, see 117 comment.
133 @3793db Sample Log: Broken valve, nutrients and salinity were drawn. Oxygen was not drawn. Salinity agrees with CTD, nutrients seem to be okay. Footnote no3 uncertain, see 117 comment.
134 @4050db Sample Log: Broken valve. No samples.
135 @4260db Footnote no3 uncertain, see 117 comment.
136 @4497db Footnote no3 uncertain, see 117 comment.

Station 115

161 @ 3db Oxygen and nutrients not drawn per sampling schedule.
162 @ 35db Oxygen and nutrients not drawn per sampling schedule.
163 @ 216db Oxygen and nutrients not drawn per sampling schedule.
164 @ 409db Oxygen and nutrients not drawn per sampling schedule.
165 @ 613db Oxygen and nutrients not drawn per sampling schedule.
166 @ 815db Oxygen and nutrients not drawn per sampling schedule.
167 @1015db Oxygen and nutrients not drawn per sampling schedule.
168 @2032db Oxygen and nutrients not drawn per sampling schedule.
169 @3069db Oxygen and nutrients not drawn per sampling schedule.
170 @4115db Oxygen and nutrients not drawn per sampling schedule.
171 @4562db Oxygen and nutrients not drawn per sampling schedule.

Station 116

1all Tsuchiya: "Are the decrease in deep PO4 and NO3 values from Station 114 to 116 real?" Calc and peaks okay. Nutrients: New imidazole buffer, replenish hydrazine. End PO4 stds low, begin stds may be off on chart. Use mean of PO4 standards from Stations 114 and 118. PO4 station comparison much better.
101 @ 0db Sample Log: Broken lanyard. Sample agree with CTD and with adjoining station.
103 @ 61db Delta-S is -.1173, appears that salinity was not drawn, and the water is from Station 112 which was the last time the salinity bottle was used. Footnote salinity uncertain, ODF recommends deletion.
108 @ 180db Sample Log: Slight leak. Samples appear to be okay.
122 @1610db Sample Log: Slow leak out of tap. Samples appear to be okay.
134 @4059db Sample Log: Pin bent on valve.

136 @4622db Sample Log: Valve broken. Salinity and nutrients drawn. Samples appear to be okay. Oxygen was not drawn.

Station 117

161 @ 2db Oxygen and nutrients not drawn per sampling schedule.
162 @ 55db Oxygen and nutrients not drawn per sampling schedule. Sample Log: Air leak. Salinity appears to be okay.
163 @ 55db Oxygen and nutrients not drawn per sampling schedule.
164 @ 259db Oxygen and nutrients not drawn per sampling schedule.
165 @ 816db Oxygen and nutrients not drawn per sampling schedule.
166 @1013db Oxygen and nutrients not drawn per sampling schedule.
167 @1492db Sample Log: Air leak, vent not closed tight. Salinity appears to be okay. Oxygen and nutrients not drawn per sampling schedule.
168 @1982db Oxygen and nutrients not drawn per sampling schedule.
169 @3019db Oxygen and nutrients not drawn per sampling schedule.
170 @3975db Oxygen and nutrients not drawn per sampling schedule.
171 @4674db Oxygen and nutrients not drawn per sampling schedule.

Station 118

117 @ 708db Sample Log: Air leak. Oxygen appears a little high compared to CTDO, but agrees with adjoining stations. Footnote bottle leaking, and o2 bad, appears that leaking comment may have effected gas sample.
132 @3711db Sil appears to be high, peak looks good. Footnote sil uncertain.

Station 119

1nut Tsuchiya: "Sil level at the maximum is slightly lower than adjoining station. Is this real?" Calc and peaks okay. Nutrients: Sil channel cleaned with RBS before station.
101 @ 0db Sample Log: Valve open. Samples agree with adjoining station.
116 @ 810db Oxygen appears to be high. Footnote o2 uncertain.
125 @2372db Silicate appears to be high. Footnote sil uncertain. Oxygen appears low, footnote o2 uncertain.
131 @3558db Sample Log: Small leak from spigot. Oxygen agrees with CTDO, other samples appear to be okay, salinity .001 low.

Station 120

1all Sample Log: Inner rosette tripped first.
1nut Tsuchiya: "Verify the alternate decrease and in all deep (>1000m) nutrients from Station 120 (high) to Station 123 (low)." Station 122 is only station with comments from nutrient analyst.
101 @2227db Sample Log: Air leak. Delta-S at 2227db is .0042. Oxygen agrees with CTDO and adjoining station.

108 @3690db	Sample Log: Slight drip. Oxygen is a little high compared with CTDO. Footnote bottle leaking, o2 bad. Appears that gas sample was effected.

Station 121

1all	Sample Log: O2 delay due to jammed valve in NaI cannula. Oxygen looks reasonable.
1nut	Tsuchiya: "Verify the alternate decrease and in all deep (>1000m) nutrients from Station 120 (high) to Station 123 (low)." Station 122 is only station with comments from nutrient analyst.
101 @ 0db	Sample Log: Salinity taken via tritium outflow, nutrient sampled after tritium.
108 @ 162db	Sample Log: Very slight air leak. Samples appear to be okay.
109 @ 193db	Sample Log: Significant air leak. Oxygen and nutrients appear to be okay.
130 @3251db	Sample Log: Lid popped. Samples appear to be okay.

Station 122

1nut	Tsuchiya: "Verify the alternate decrease and in all deep (>1000m) nutrients from Station 120 (high) to Station 123 (low)." Nutrients: Replenish hydrazine, po4 begin baselines odd. PO4 bubble pattern not good,-now pump purge (sp?) Air bar tubing faulty. Restart @2331. PO4 bubble pattern good now.
101 @ 0db	Sample Log: Leaker Samples appear to be okay.
104 @ 119db	Sample Log: Air leaker Samples appear to be okay.
108 @ 180db	Sample Log: Slight leak Samples appear to be okay.
136 @4635db	Sample Log: Water leaker out of spout Samples appear to be okay.

Station 123

1nut	Tsuchiya: "Verify the alternate decrease and in all deep (>1000m) nutrients from Station 120 (high) to Station 123 (low)." Station 122 is only station with comments from nutrient analyst.
101 @ 0db	Sample Log: Air leak Samples appear to be okay.
110 @ 262db	Sample Log: Slight air leak Oxygen appears a little high compared to adjoining station, but agrees with CTDO. Footnote bottle leaking and o2 uncertain. Appears that gas sample was effected.
136 @4582db	Sample Log: Air leak Oxygen a little low compared with CTDO, other samples appear to be okay. Footnote o2 bad, footnote bottle leaking.

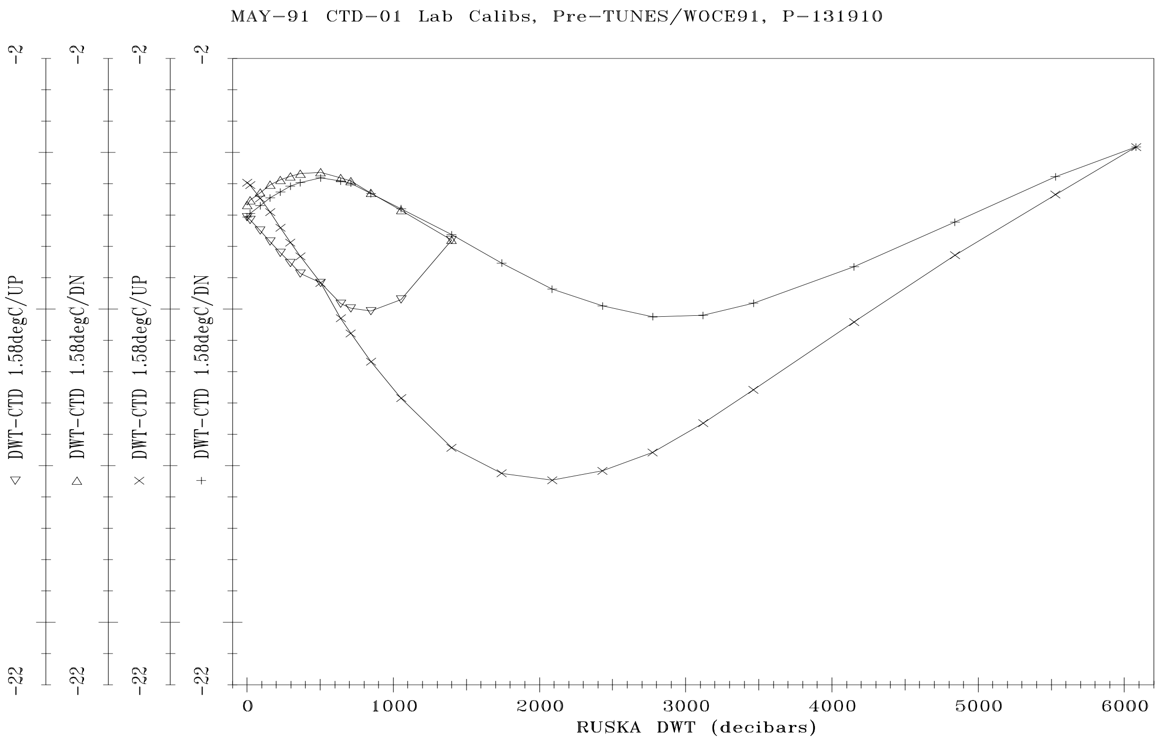

Figure 1a: CTD #1 Pre-cruise Cold Pressure Calibration

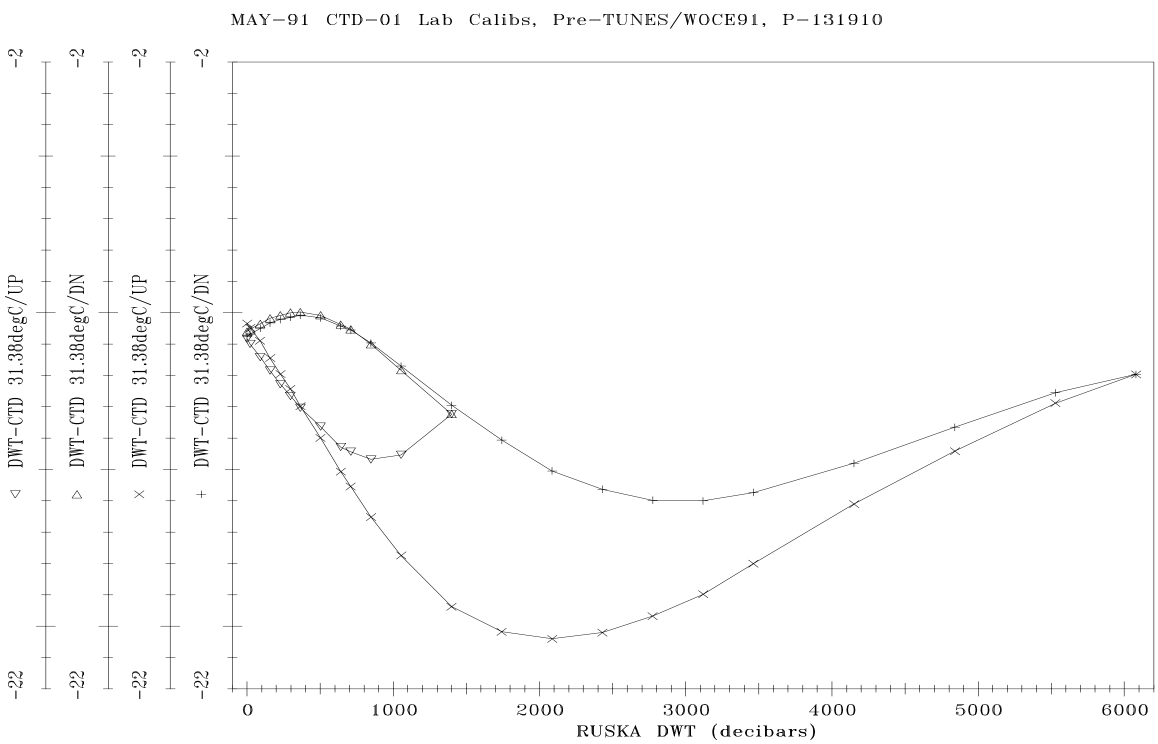

Figure 1b: CTD #1 Pre-cruise Warm Pressure Calibration

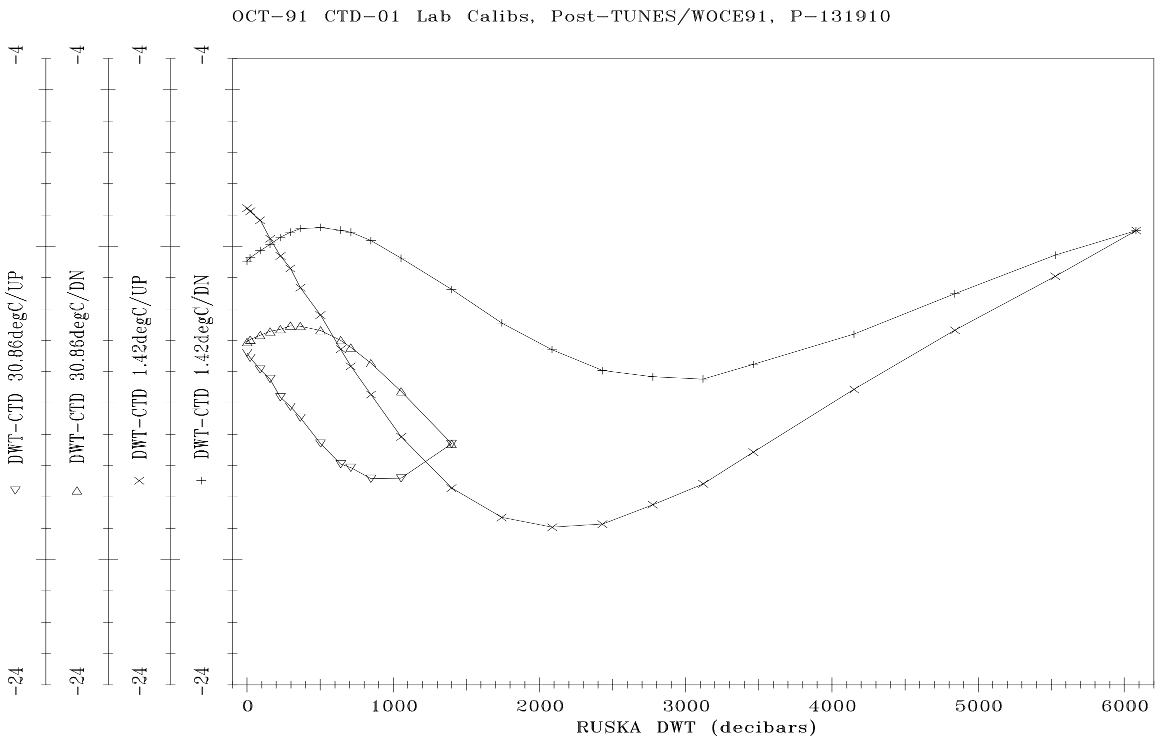

Figure 1c: CTD #1 Post-cruise Pressure Calibration

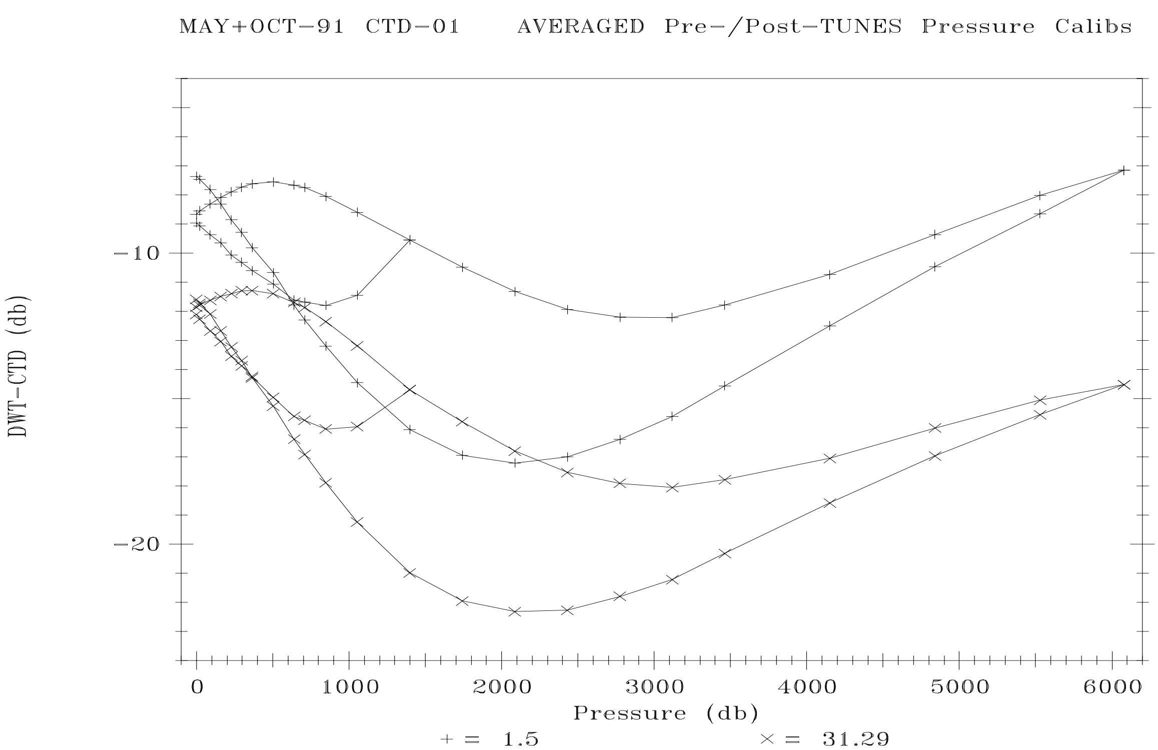

Figure 1d: CTD #1 Averaged Pre-/Post-cruise Pressure Calibration

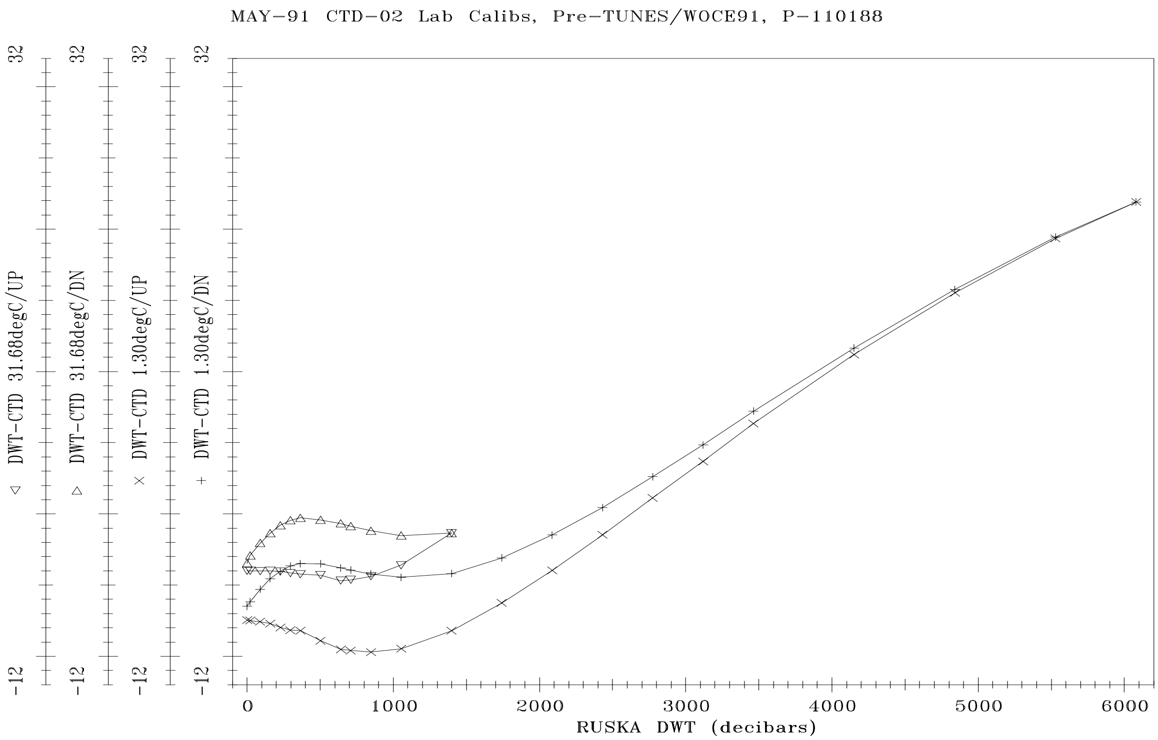

Figure 2a: CTD #2 Pre-cruise Pressure Calibration

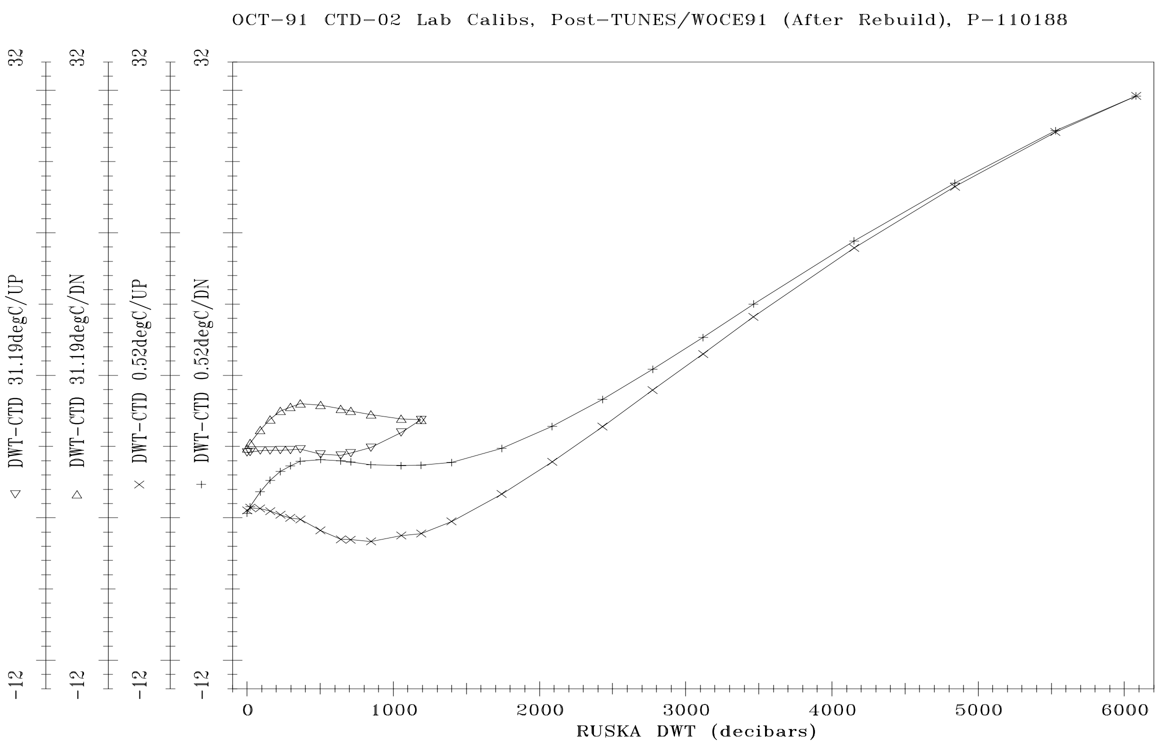

Figure 2b: CTD #2 Post-cruise Pressure Calibration

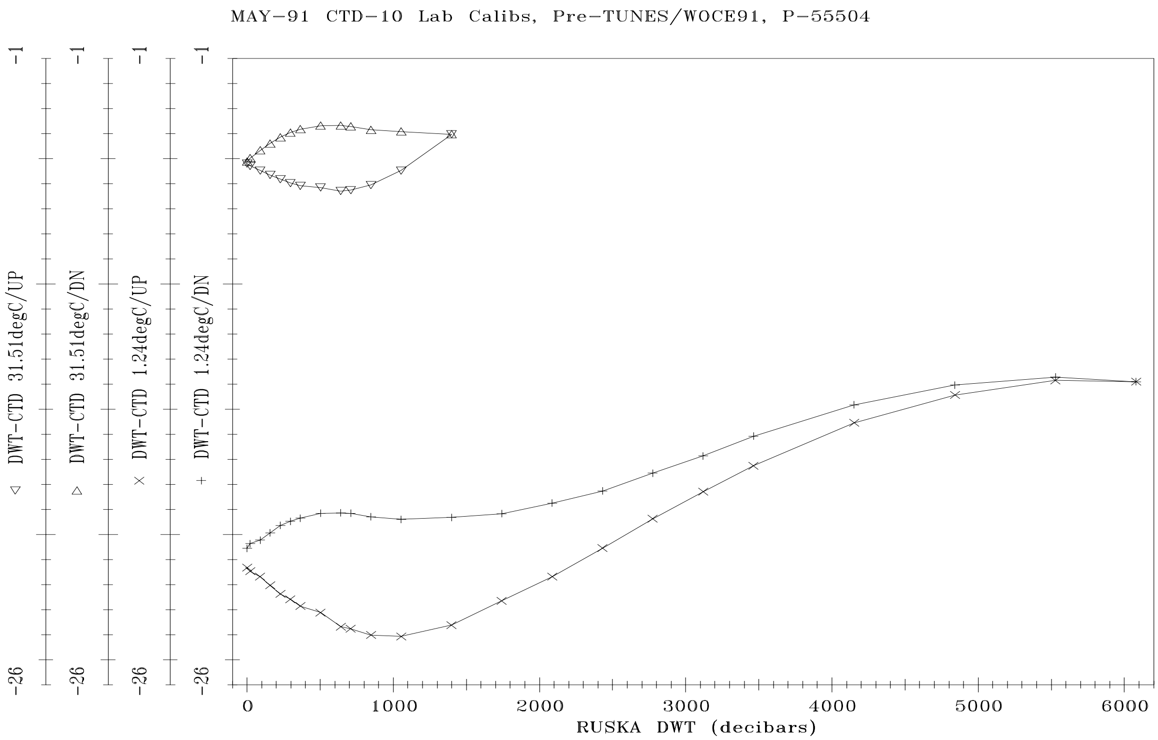

Figure 3: CTD #10 Pre-cruise Pressure Calibration

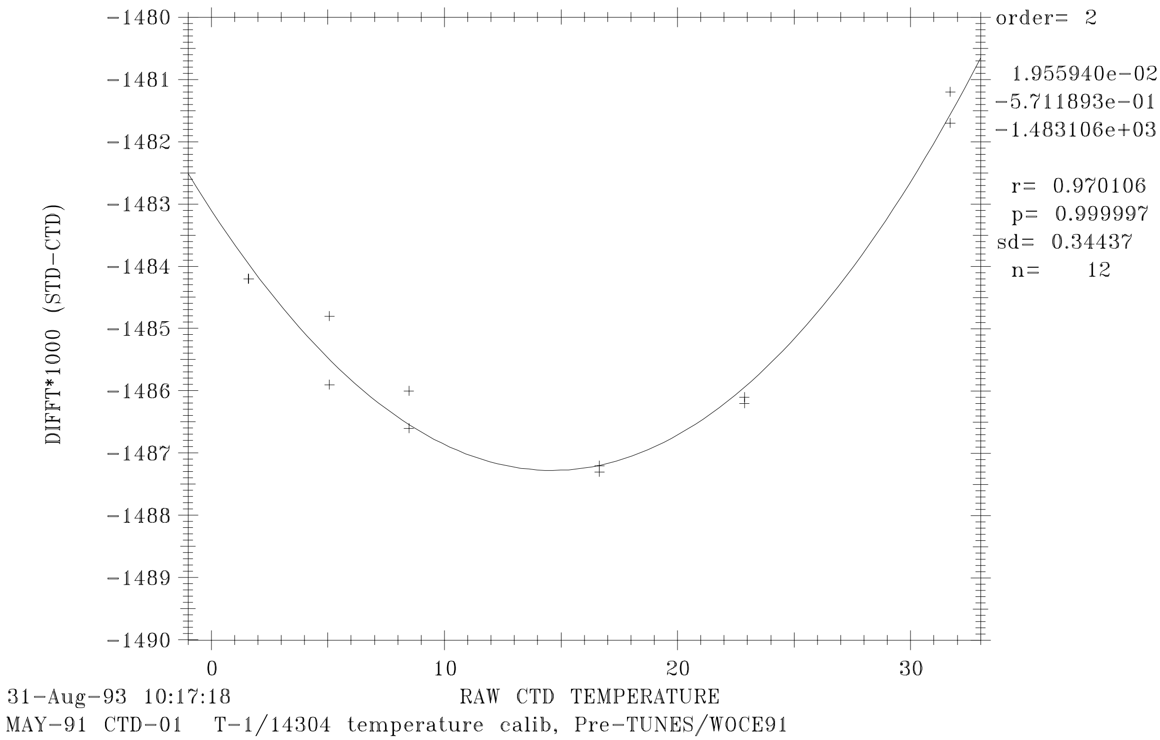

Figure 4a: CTD #1 Pre-cruise PRT-1 Temperature Calibration

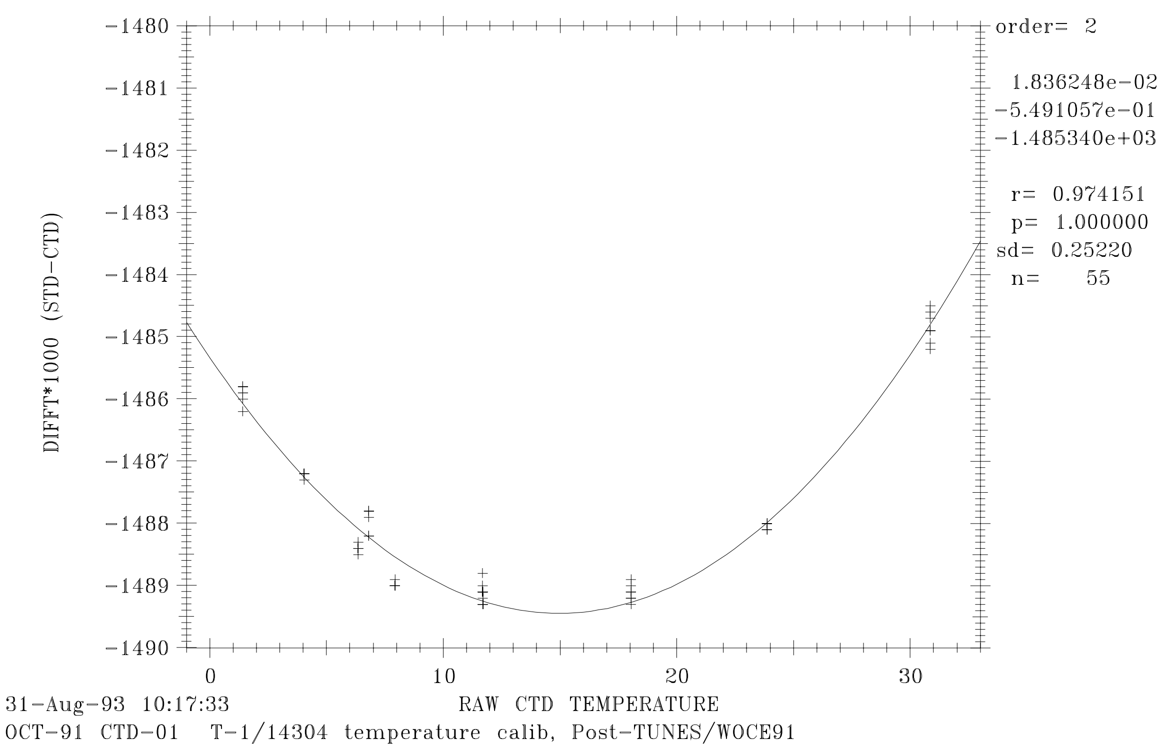

Figure 4b: CTD #1 Post-cruise PRT-1 Temperature Calibration

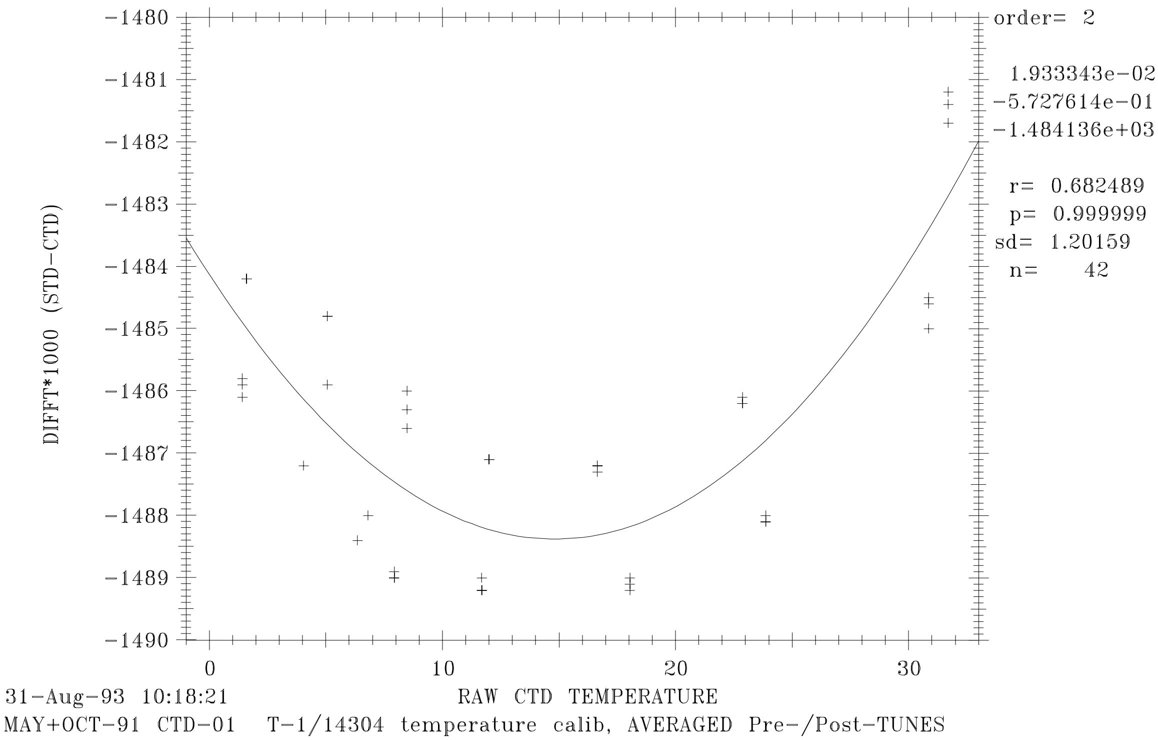

Figure 4c: CTD #1 Averaged Pre-/Post-cruise PRT-1 Temperature Calibration

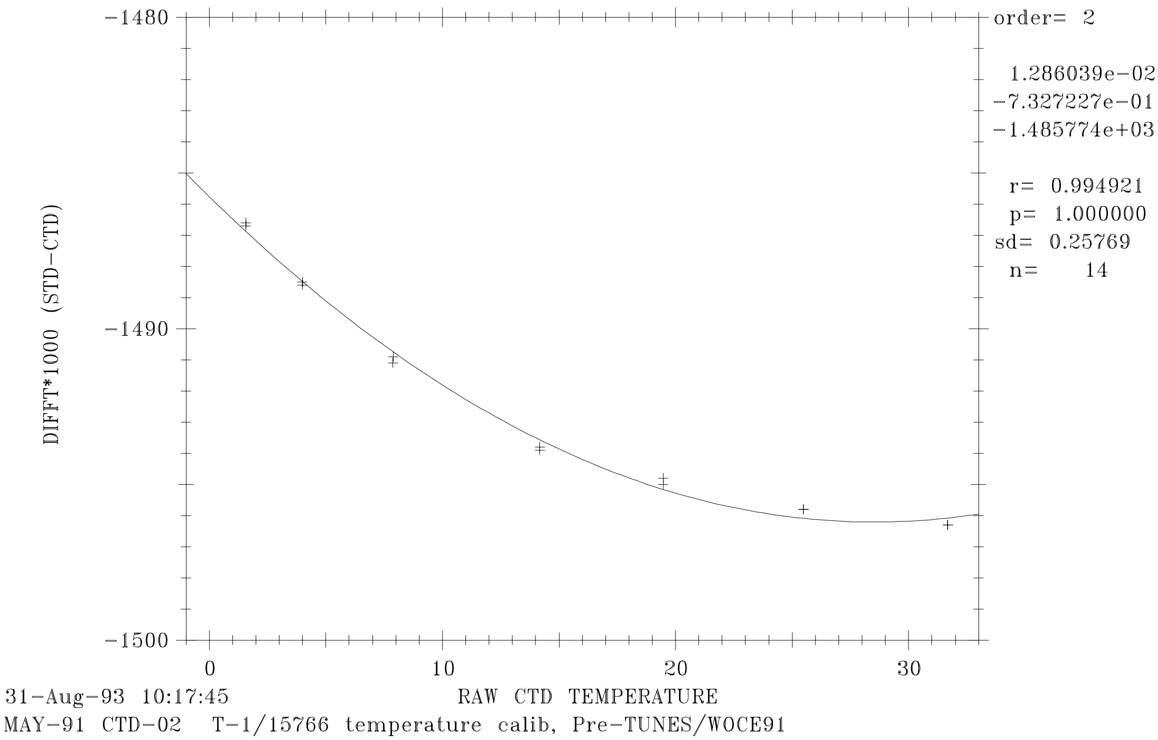

Figure 5a: CTD #2 Pre-cruise PRT-1 Temperature Calibration

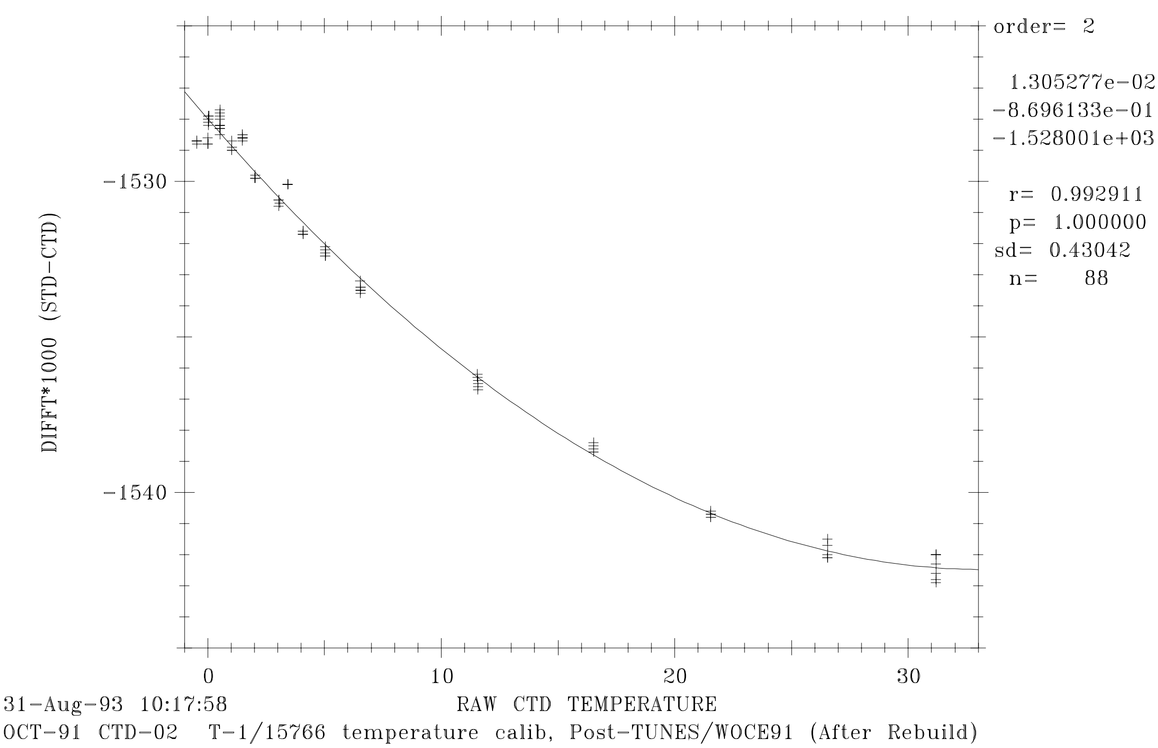

Figure 5b: CTD #2 Post-cruise PRT-1 Temperature Calibration

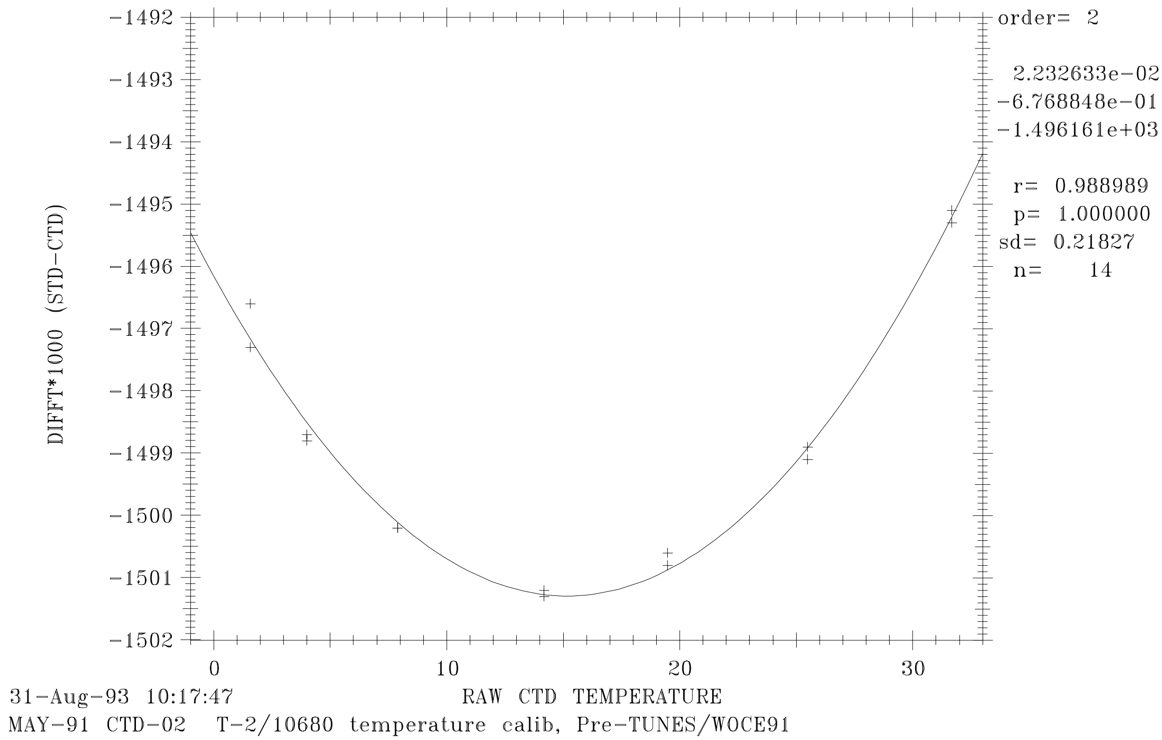

Figure 5c: CTD #2 Pre-cruise PRT-2 Temperature Calibration

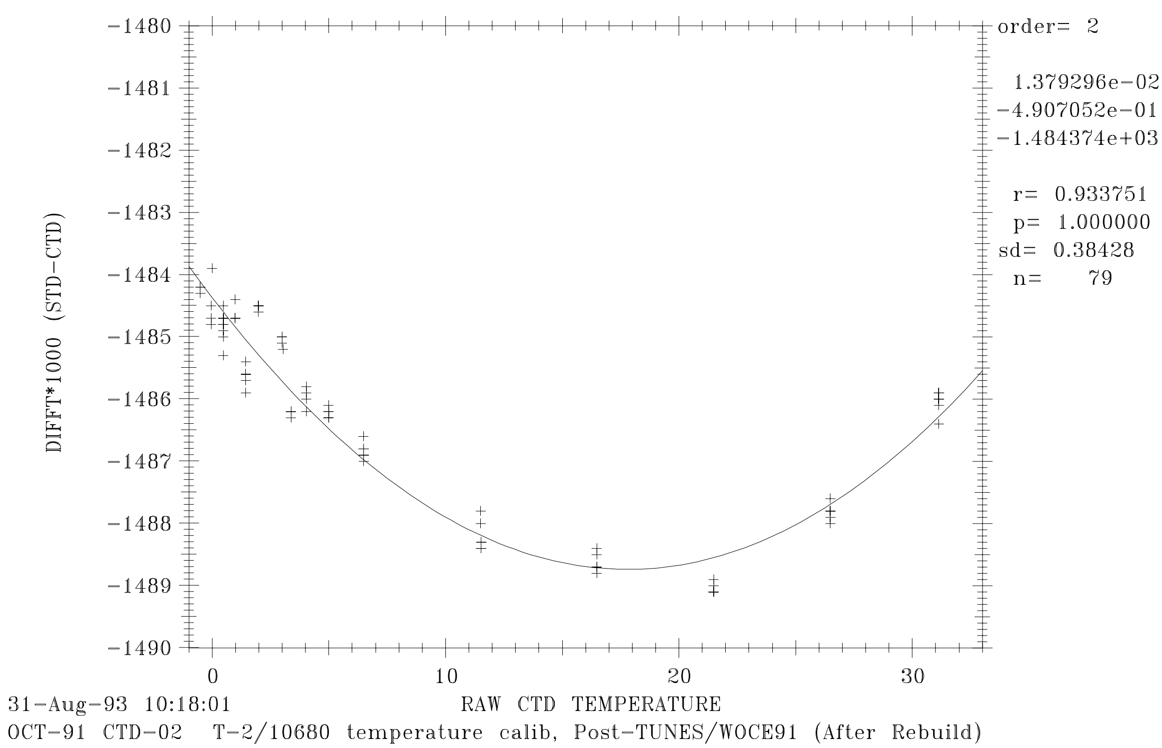

Figure 5d: CTD #2 Post-cruise PRT-2 Temperature Calibration

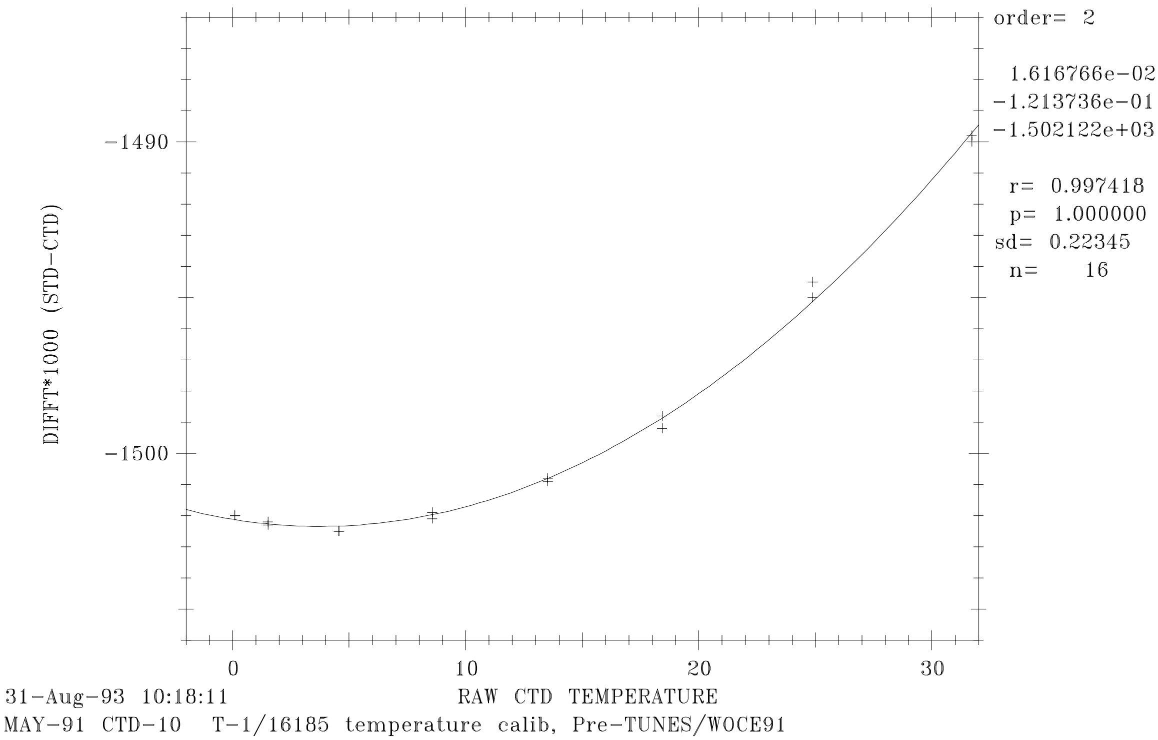

Figure 6a: CTD #10 Pre-cruise PRT-1 Temperature Calibration

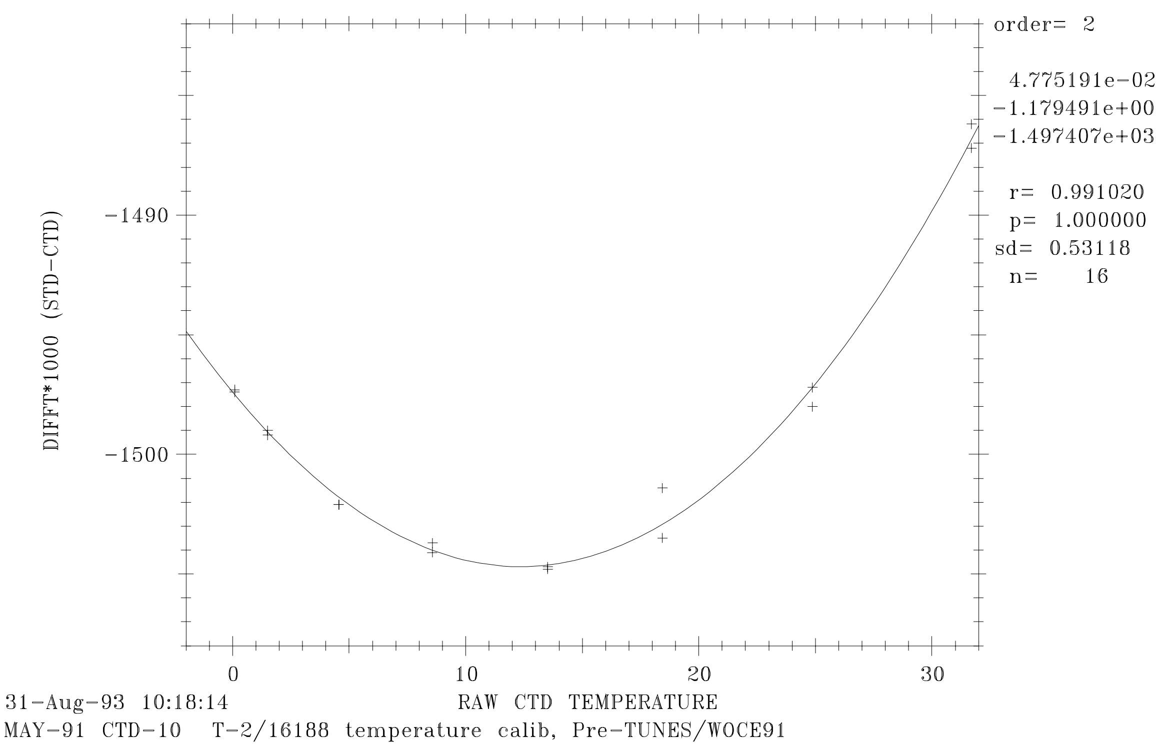

Figure 6b: CTD #10 Pre-cruise PRT-2 Temperature Calibration

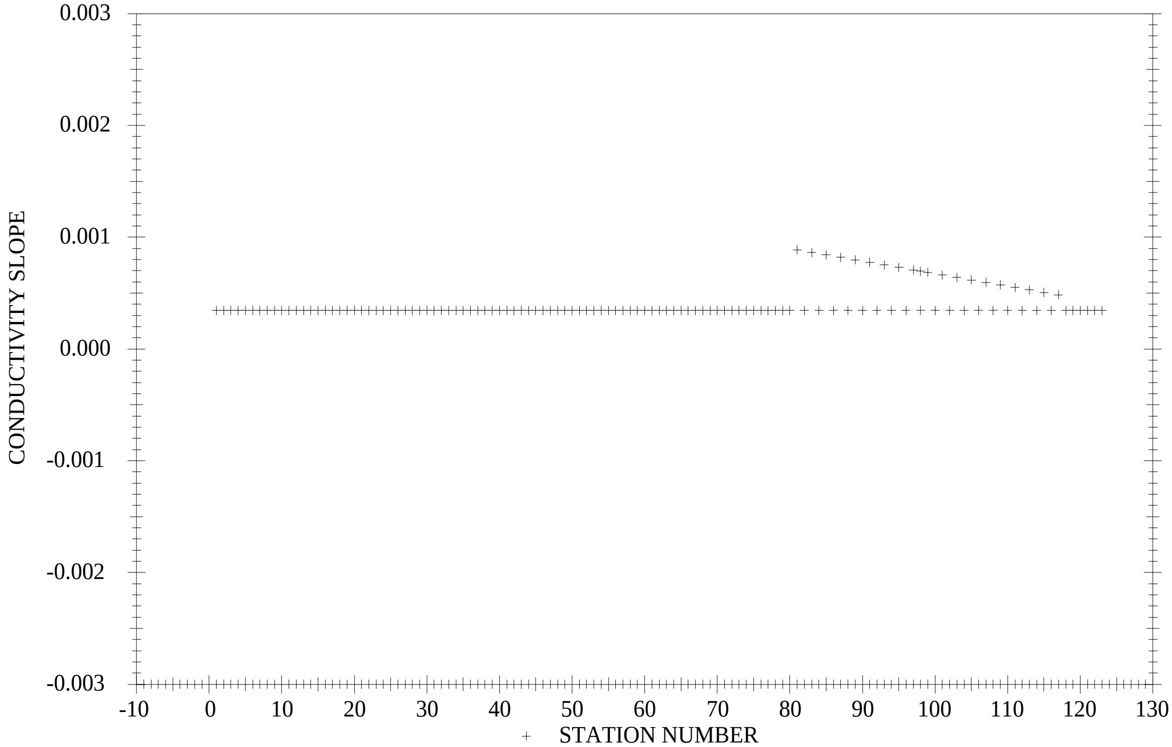

Figure 7a: TUNES-1 Conductivity Slopes, All CTDs

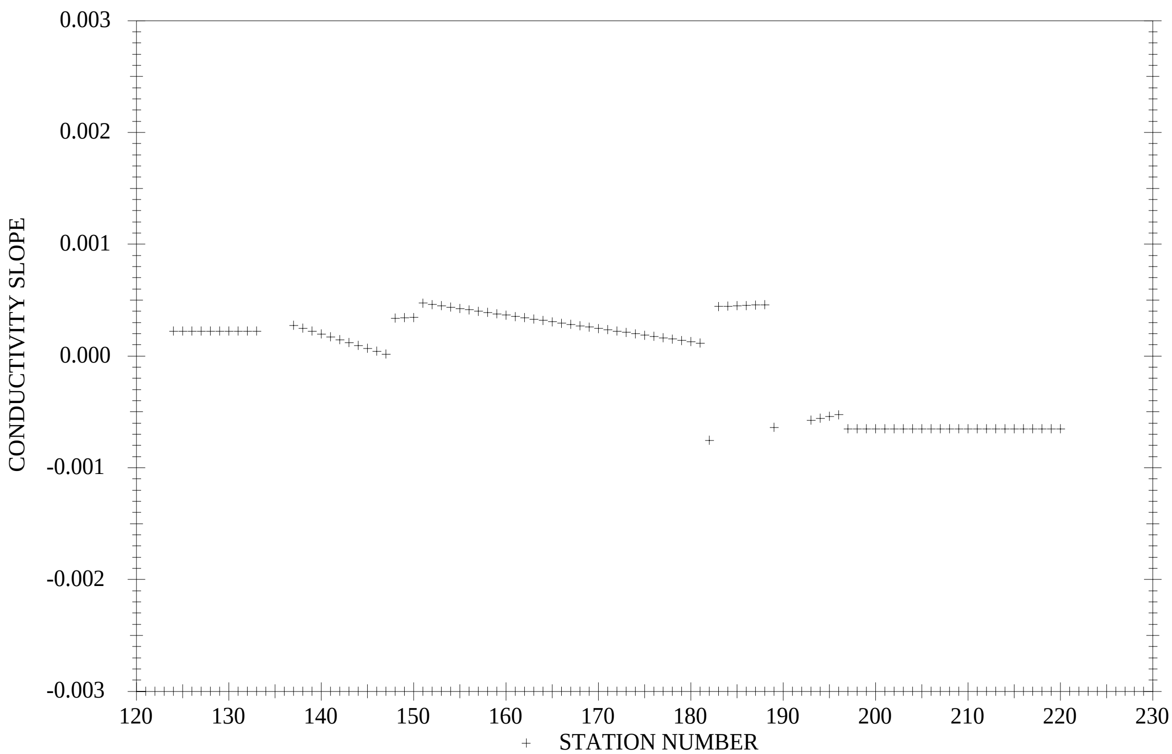

Figure 7b: TUNES-2 Conductivity Slopes, All CTDs

NOTE: Stas 133-136 and 190-192 Cond. Slopes are Off-Scale

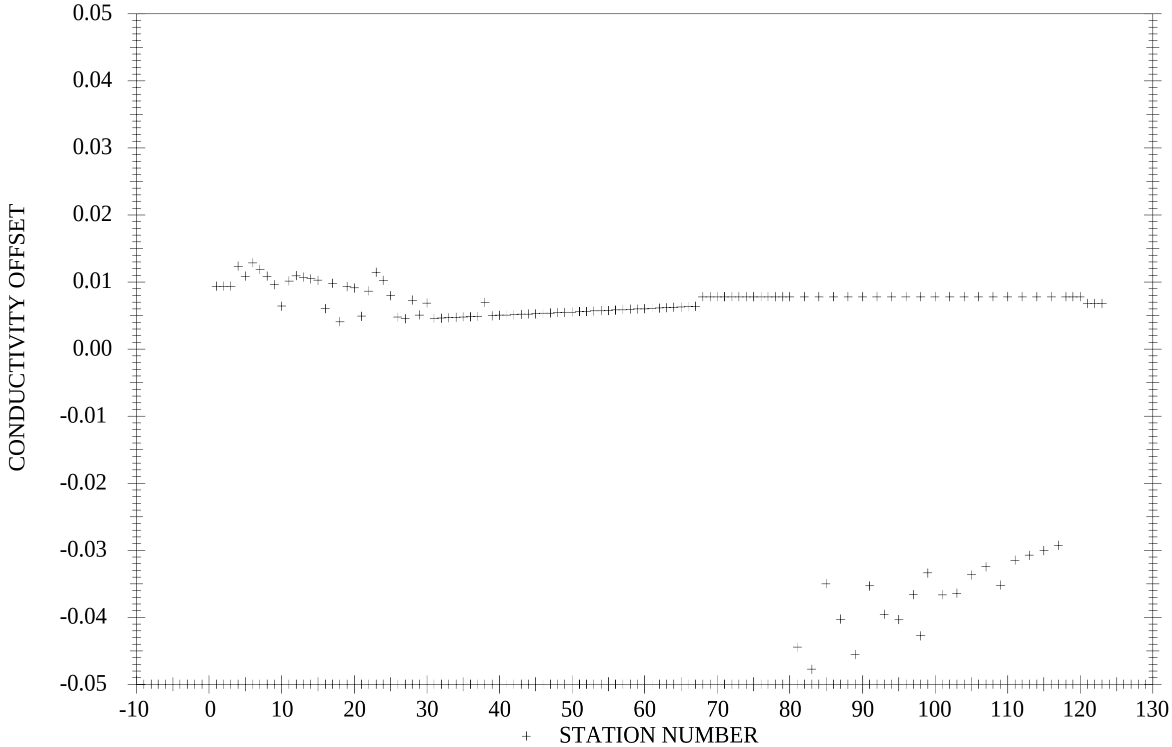

Figure 8a: TUNES-1 Conductivity Offsets, All CTDs

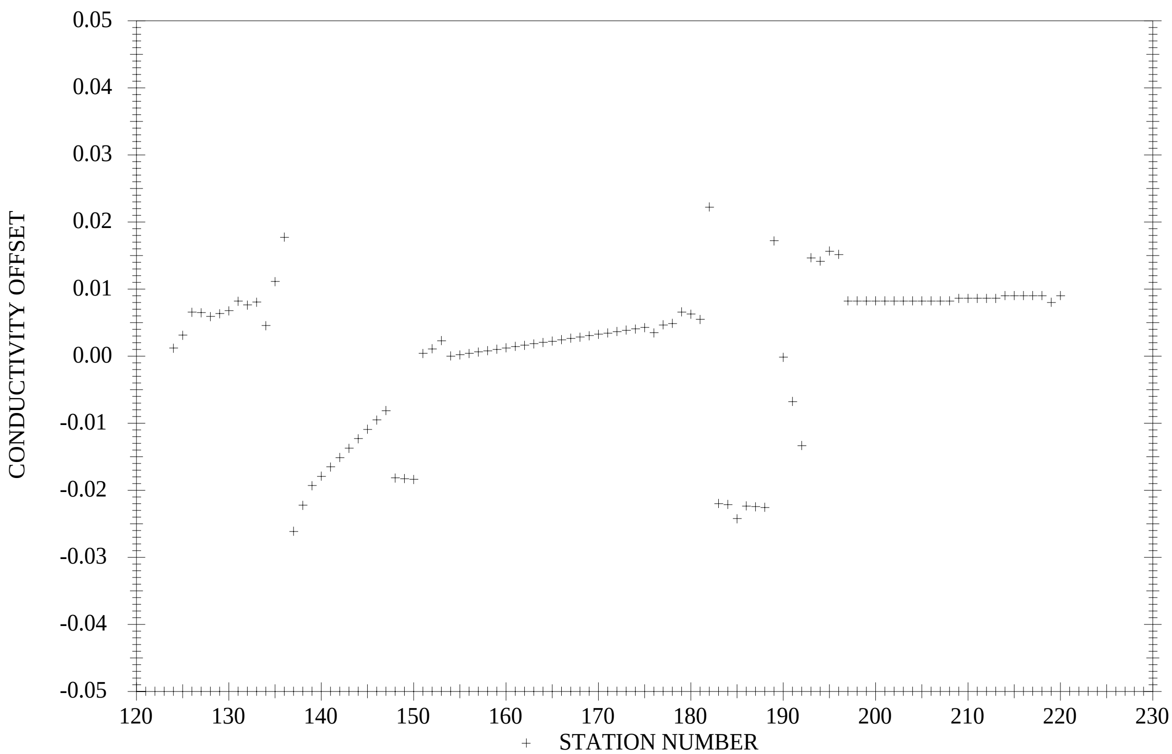

Figure 8b: TUNES-2 Conductivity Offsets, All CTDs

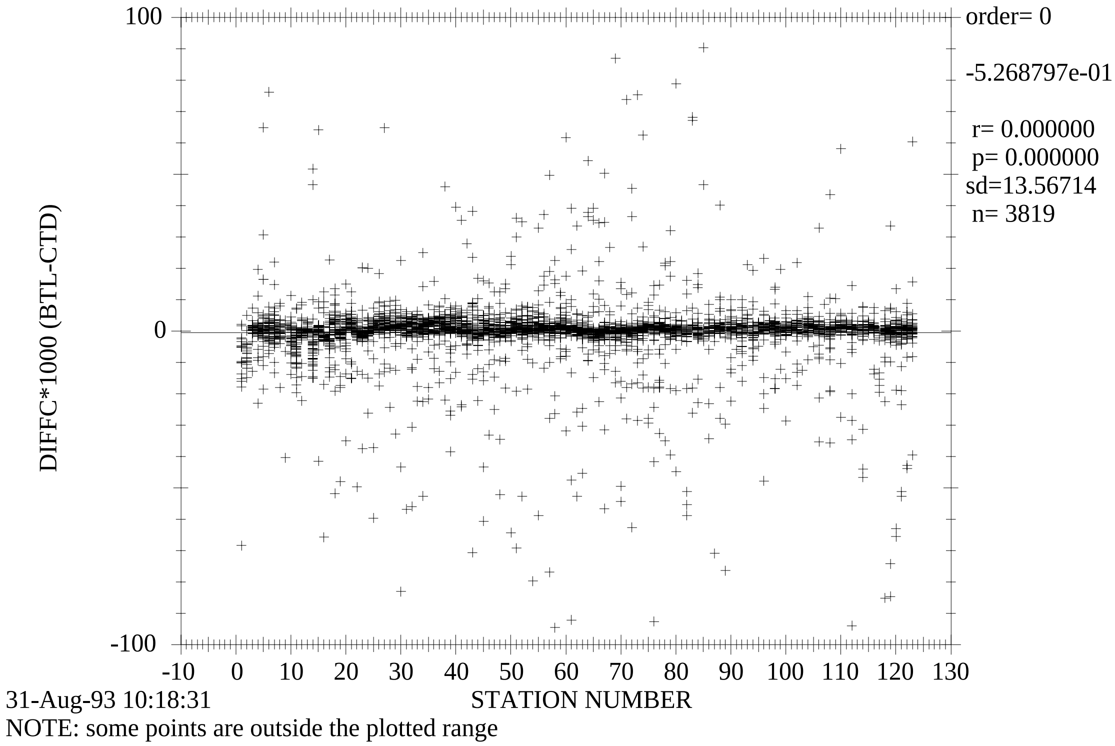

Figure 9a: TUNES-1 Residual Conductivity Bottle-CTD Differences - All Pressures

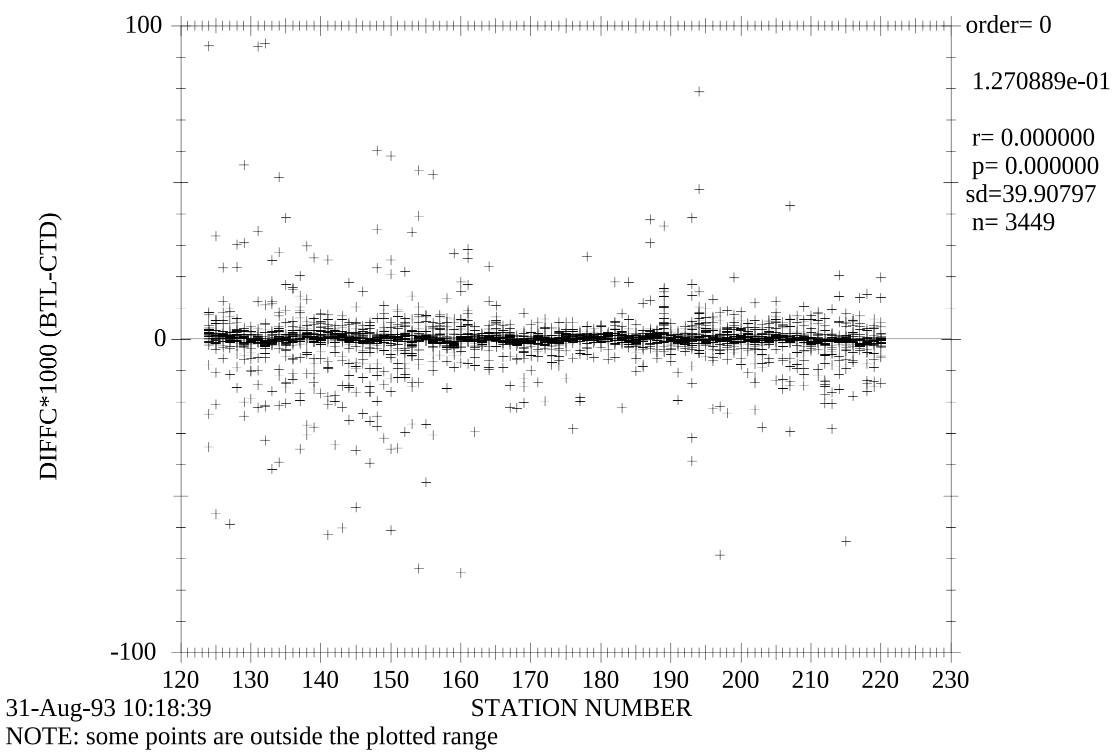

Figure 9b: TUNES-2 Residual Conductivity Bottle-CTD Differences - All Pressures

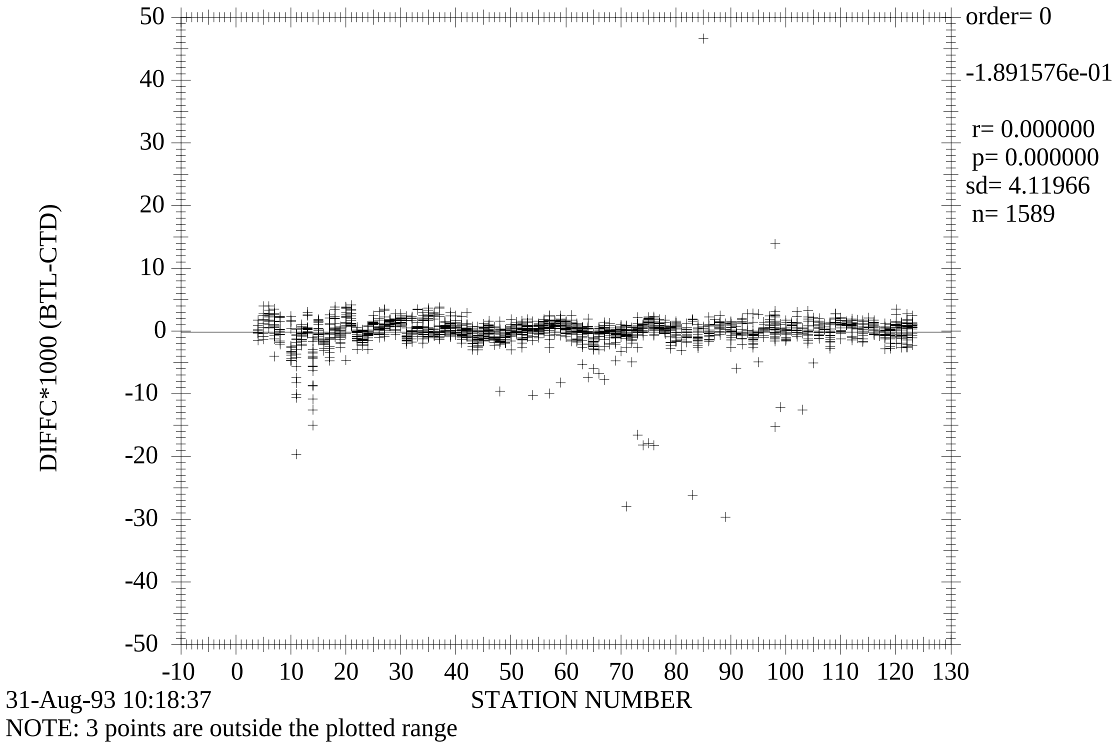

Figure 10a: TUNES-1 Residual Conductivity Bottle-CTD Differences - Prs>1500dbar

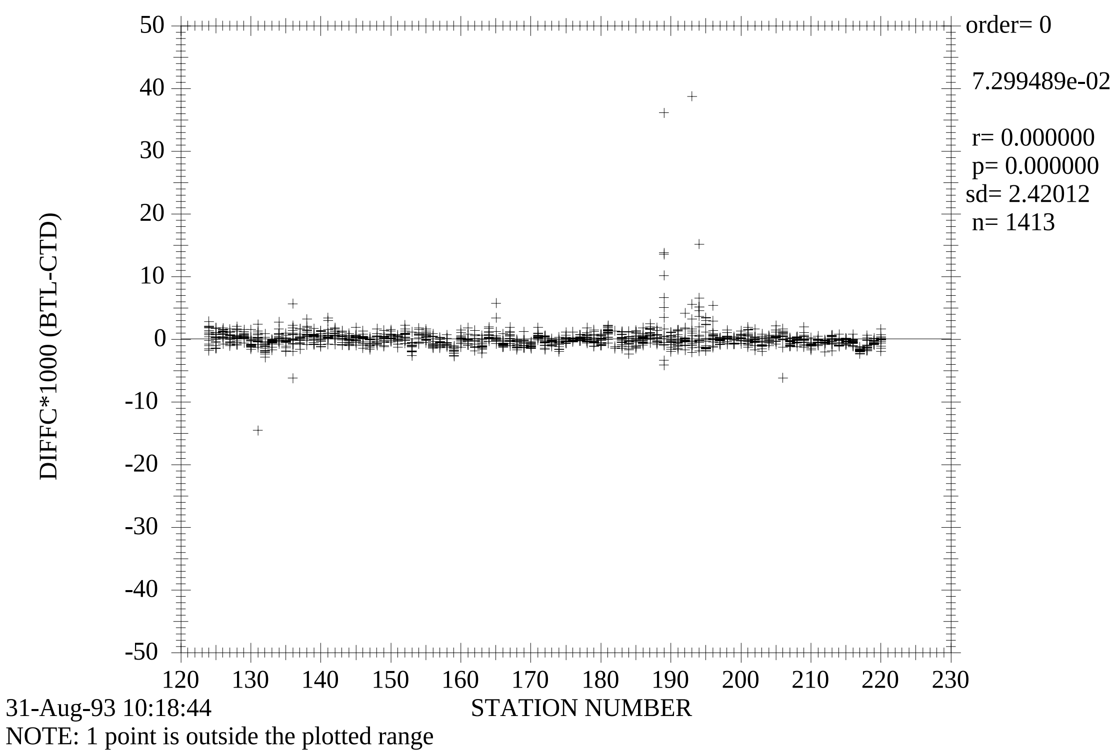

Figure 10b: TUNES-2 Residual Conductivity Bottle-CTD Differences - Prs>1500dbar

C.4. LARGE VOLUME SAMPLING: P17C 31WTTUNES_1 (TUNES 1)

(Robert M. Key, PI)
17 July 1995

Data Submitted by Scripps Institution of Oceanography
Oceanographic Data Facility

DESCRIPTION OF MEASUREMENT TECHNIQUES AND CALIBRATIONS

Large Volume Sampling (LVS) was performed on this expedition. These commonly referred to as Gerard casts were carried out with ~270 liter stainless steel Gerard barrels on which were mounted 2-liter Niskin bottles (Piggyback bottles) with reversing thermometers.

There were 17 large volume stations, with at least one deep cast (2500db to the bottom), and either or both an intermediate (1000db to 2500db) and/or a shallow cast (surface to 1000db). There were 21 casts total, 4 of which were redeployments to complete the complement of 9 levels. The cast was relowered if the complement of 9 levels was not achieved due to pretrips or failure of one Gerard barrel releasing it's messenger thereby tripping the rest of the string of barrels. The Gerard barrel platform, as set up in port prior to the cruise, did not allow enough clearance for barrel during deployment & recovery. The Chief Engineer cut the platform loose and rewelded it to the deck about one foot forward. The spring-loaded trapping-pin was no longer usable so a chain was shackled to one forward corner of the platform, passed aft of the wire then hooked to the other forward corner to hold the trawl wire in the platform "V" while the barrels were being attached and detached. Limited fantail space and the low trawl wire lead required that the crane work over the wire to move barrels from racks to near the centerline just forward of the platform, then the barrel was unhooked and the crane moved to the other side of the wire and rehooked to move the barrel to the attachment position. This procedure was reversed for recovery. Working Gerards off the stern went well in good weather but, as expected, pitching in moderate seas (15-20 knots wind) caused tripping problems. Slowing down the lowering rate to less than 50 meters/minute seemed to help.

Samples for salinity, silicate and 14C were obtained from the Gerard barrels; samples for salinity were drawn from the piggyback bottles. The salinity samples from the piggyback bottle were used for comparison with the Gerard barrel salinities to verify the integrity of the Gerard sample. The identifiers of the sample containers and the numbers of the ODF or Piggyback samplers from which the samples were drawn were recorded on the Sample Log sheet. Normal ODF sampling practice is to open the drain valve before opening the air vent to see if water escapes, indicating the presence of a small air leak in the sampler. This observation ("air leak"), and other comments ("lanyard caught in lid", "valve left open", etc.) which may indicate some doubt about the integrity of the water samples were also noted on the Sample Log sheets. These comments are included in this documentation with investigative comments and results.

The discrete hydrographic data were entered into the shipboard data system and processed as the analyses were completed. The bottle data were brought to a usable, though not final, state at sea. ODF data checking procedures included verification that the sample was assigned to the correct depth. This was accomplished by checking the raw data sheets, which included the raw data value and the water sample bottle, versus the sample log sheets. The salinity and nutrient data were compared by ODF with those from adjacent stations. Any comments regarding the water samples were investigated. The raw data computer files were also checked for entry errors that could have been made on the station number, bottle number and/or sample container number. The salinity and nutrient values were transmitted from PC's attached to either the salinometer or Autoanalyzer system.

Investigation of data included comparison of piggyback salinities versus Gerard salinities, and review of data plots of the station rosette data profile. If any problem was indicated, the data value was flagged. The Quality Comments includes comments regarding missing samples and investigative remarks for comments made on the Sample Log sheets, as well as all flagged (WOCE coded) data values other than 2, an acceptable measurement.

The WOCE codes were assigned to the water data using the criteria:

code 1 = Sample for this measurement was drawn from water bottle, but results of analysis not yet received.

code 2 = Acceptable measurement.

code 3 = Questionable measurement. Does not fit station profile or adjoining station comparisons. No notes from analyst indicating a problem. Datum could be real, but the decision as to whether it is acceptable will be made by a scientist rather than ODF's technicians.

code 4 = Bad measurement. Does not fit station profile and/or adjoining station comparisons. There are analytical notes indicating a problem, but data values are reported. ODF recommends deletion of these data values. Analytical notes for salinity may include large differences between the piggyback and Gerard sample. Sampling errors are also coded 4.

code 9 = Sample for this measurement not drawn.

Quality flags assigned to parameter BTLNBR (bottle number) as defined in the WOCE Operations manual are further clarified as follows:

code 4 = If the bottle tripped at a different level than planned, ODF assigned it a code 4. If there is a 4 code on the bottle, and 2 codes on the salinity, oxygen and nutrients then the pressure assignment was probably correct.

code 3 = An air leak large enough to produce an observable effect on a sample is identified by a 3 code on the bottle and 4 code on the oxygen. (Small air leaks may have no observable effect, or may only affect gas samples).

The following table shows the number of ODF samples drawn and the number of times each WOCE sample code was assigned.

Large Volume Samples
Stations 17-121

	Reported levels	WHP Quality Codes								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
BTLNBR	306	0	287	2	12	0	0	0	0	5
SALNTY	300	0	288	2	10	1	0	0	0	5
SILCAT	152	0	150	0	2	0	0	0	0	154
NITRAT	0	0	0	0	0	0	0	0	0	306
NITRIT	0	0	0	0	0	0	0	0	0	306
PHSPHT	9	0	0	0	9	0	0	0	0	297
REVPRS	306	0	306	0	0	0	0	0	0	0
REVTMP	296	0	292	0	4	10	0	0	0	0

1. Pressure and Temperature

LVS pressures and temperatures were calculated from deep-sea reversing thermometer (DSRT) readings. Each DSRT rack normally held 2 protected (temperature) thermometers and 1 unprotected (pressure) thermometer. Thermometers were read by two people, each attempting to read a precision equal to one tenth of the thermometer etching interval. Thus, a thermometer etched at 0.05 degree intervals would be read to the nearest 0.005 degrees.

Each temperature value reported on the LVS casts is calculated from the average of four readings provided both protected thermometers function normally. The pressure is verified by comparison with the calculation of pressure determined by wireout. The pressure from the thermometer is fitted by a polynomial equation which incorporates the wireout and wire angle.

Calibration of the thermometers are performed in ODF's calibration facility depending on the age of the thermometer and not more than two years of the expedition.

The temperatures are based on the International Temperature Scale of 1990.

2. 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 ensure a continued airtight seal. Salinity was determined after a box of samples had equilibrated to laboratory temperature, usually within 8-12 hours of collection. The draw time and equilibration time, as well as per-sample analysis time and temperature were logged.

A single Guildline Autosal Model 8400A salinometer (Serial Number 57-396) located in a temperature-controlled laboratory was used to measure salinities. The salinometer was 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-120, 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 (UNESCO 1981) was then calculated for each sample from the measured conductivity ratios, and the results merged with the cruise database.

300 salinity measurements were made and 18 vials of standard water were used. The temperature stability of the laboratory used to make the measurements was good. There were some problems with lab temperature control throughout cruise; the Autosal bath temperature was adjusted accordingly. Salinities were generally considered good for the expedition despite the lab temperature problem. Salinity samples were analyzed for the Large Volume casts from both the piggyback bottle and the Gerard barrel.

3. 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 station, usually 18 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. However, on LVS cast, samples for the Gerard barrels were analyzed for silicate only as an added check (with salinity) on barrel sample integrity. Occasionally some samples were refrigerated at 2 to 6 degree C for a maximum of 4 hours. The methods used are described by Gordon et al. (1992), Atlas et al. (1971), and Hager et al. (1972).

All peaks were logged manually, and all the runs were re-read to check for possible reading errors.

Silicate is analyzed using the technique of Armstrong et al. (Armstrong 1967). 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 uM); a correction for this non-linearity is applied in ODF's software.

Modifications of the Armstrong et al. (1967) 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 (1967) 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 55 degree C 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 zero pressure, in-situ salinity, and an assumed laboratory temperature of 25 degree C.

Na2SiF6, the silicate primary standard, is obtained from Fluka Chemical Company and Fischer Scientific and is reported by the suppliers to be >98% pure. Primary standards for nitrate KNO3, nitrite NaNO2, and phosphate KH2PO4, are obtained from Johnson Matthey Chemical Co. and the supplier reports purities of 99.999%, 97%, and 99.999%, respectively.

152 nutrient (Silicate) analyses were performed. No major problems were encountered with the measurements.

REFERENCES AND UNCITED SUPPORTING DOCUMENTATION

Armstrong, F. A. J., C. R. Stearns, and J. D. H. Strickland, 1967. The measurement of upwelling and subsequent biological processes by means of the Technicon Autoanalyzer and associated equipment, Deep-Sea Research, 1144, 381-389.

Atlas, E. L., S. W. Hager, L. I. Gordon and P. K. Park, 1971. A Practical Manual for Use of the Technicon(R) AutoAnalyzer(R) in Seawater Nutrient Analyses; Revised. Technical Report 215, Reference 71-22. Oregon State University, Department of Oceanography. 49 pp.

Bernhardt, H. and A. Wilhelms, 1967. The continuous determination of low level iron, soluble phosphate and total phosphate with the AutoAnalyzer, Technicon Symposia, Volume I, 385-389.

Brewer, P. G. and G. T. F. Wong, 1974. The determination and distribution of iodate in South Atlantic waters. Journal of Marine Research, 3322,1:25-36.

Bryden, H. L., 1973. New Polynomials for Thermal Expansion, Adiabatic Temperature Gradient, Deep-Sea Research, 2200, 401-408.

Carpenter, J. H., 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method, Limnology and Oceanography, 1100, 141-143.

Carter, D. J. T., 1980 (Third Edition). Echo-Sounding Correction Tables, Hydrographic Department, Ministry of Defence, Taunton Somerset.

Chen, C.-T. and F. J. Millero, 1977. Speed of sound in seawater at high pressures. Journal Acoustical Society of America, 6622, No. 5, 1129-1135.

Culberson, C. H., Williams, R. T., et al, August, 1991. A comparison of methods for the determination of dissolved oxygen in seawater, WHP Office Report WHPO 91-2.

Fofonoff, N. P., 1977. Computation of Potential Temperature of Seawater for an Arbitrary Reference Pressure. Deep-Sea Research, 2244, 489-491.

Fofonoff, N. P. and R. C. Millard, 1983. Algorithms for Computation of Fundamental Properties of Seawater. UNESCO Report No. 44, 15-24.

Gordon, L. I., Jennings, Joe C. Jr, Ross, Andrew A., Krest, James M., 1992. A suggested Protocol for Continuous Flow Automated Analysis of Seawater Nutrients in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study. OSU College of Oceanography Descr. Chem Oc. Grp. Tech Rpt 92-1.

Hager, S. W., E. L. Atlas, L. D. Gordon, A. W. Mantyla, and P. K. Park, 1972. A comparison at sea of manual and autoanalyzer analyses of phosphate, nitrate, and silicate. Limnology and Oceanography, 1177, 931-937.

Lewis, E. L., 1980. The Practical Salinity Scale 1978 and Its Antecedents. IEEE Journal of Oceanographic Engineering, OE-5, 3-8.

Mantyla, A. W., 1982-1983. Private correspondence.

Millero, F. J., C.-T. Chen, A. Bradshaw and K. Schleicher, 1980. A New High Pressure Equation of State for Seawater. Deep-Sea Research, 2277AA, 255-264.

Saunders, P. M., 1981. Practical Conversion of Pressure to Depth. Journal of Physical Oceanography, 1111, 573-574.

Sverdrup, H. U., M. W. Johnson, and R. H. Fleming, 1942. The Oceans, Their Physics, Chemistry and General Biology, Prentice-Hall, Inc., Englewood Cliff, N.J.

UNESCO, 1981. Background papers and supporting data on the Practical Salinity Scale, 1978. UNESCO Technical Papers in Marine Science, No. 37, 144 p.

Quality Comments

Remarks for missing samples, and WOCE codes other than 2 from TUNES Leg 1 WOCE P17C Large Volume Samples. Investigation of data may include comparison of bottle salinity and silicate data from piggyback and Gerard with CTD cast 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 micromoles per liter for Silicate unless otherwise noted. The first number before the comment is the cast number (CASTNO) times 100 plus the bottle number (BTLNBR). PB refers to the bottle that is attached to the Gerard.

Station 017

548 @ 497db — Sample log: "Didn't close" Lanyard stuck. No water sample or therm readings. GB93 at this level (497db) has good salinity and SIL compared to other samples this station.

593 @ 497db — Gerard is acceptable, no temperature. See PB (48) comment.

388 @1992db — Sample log: "tripped but messenger hung" Relowered bottom 4 barrels as cast 4. PB (45).

446 @2249db — Sample log: "Air leak" N-G -.001 at 2248db. Gerard (89) is okay.

489 @2249db — Sample log: "Air vent not tight. messenger hung - tripping wire loose" N-G -.001 at 2249db. Gerard SIL also ok. Gerard is okay, PB (46). Bottom 3 barrels tripped as cast 5 with Terminal Reading 762m (wire out when GB89 taken off wire).

141 @3155db — Delta-S(PB-G) at 3155db is 0.007, salinity is 34.665. Footnote salinity bad. Gerard (83) is okay.

183 @3156db — Gerard is okay, PB (41).

142 @3660db — N-G .021 at 3660db. See 185. PB salinity calc ok. No other samples from Niskin. Footnote salinity bad. Gerard (85) is acceptable.

185 @3660db — Sample log: "drain valve loose" N-G -.021 at 3660db. Gerard salinity, silicate & phosphate match profile from other samples this station. PB (142) appears low. Gerard is acceptable, PB (42) may have leaked.

146 @4419db — Delta-S(PB-G) at 4419db is 0.002, salinity is 34.677. Gerard (89) is acceptable.

189 @4419db Sample log: "air vent loose" N-G .002 at 4419db. PO4 & SIL from Gerard also look good. Gerard is acceptable, PB (46).

148 @4931db Sample log: "bottom end cap hung up" No water samples.

193 @4931db No check sample from PB. See 148. Gerard salinity, phosphate & silicate match profile from other samples this station.

Station 026

345 @ 175db Sample log: "Didn't close." No temperature. Gerard (88) is acceptable.

388 @ 176db No temperature, PB (45) did not trip. Gerard probably okay, salinity agrees with rosette data. Silicate is ~2.0 high vs. rosette data.

343 @ 542db Delta-S(PB-G) at 542db is 0.004, salinity is 34.030. Gerard (85) is probably okay. PB salinity is high compared with rosette data.

385 @ 543db Gerard is probably okay, PB (43). Silicate agrees with rosette data.

344 @ 794db Delta-S(PB-G) at 794db is 0.005, salinity is 34.282. Gerard (87) is probably okay. PB salinity is high compared with rosette data.

387 @ 795db Gerard is okay, PB (44). Silicate agrees with rosette data.

342 @1091db Sample log: "Broken bottom block." Gerard (84) is acceptable. Delta-S(PB-G) at 1091db is 0.002, salinity is 34.449.

142 @2997db Delta-S(PB-G) at 2997db is -0.007, salinity is 34.657. Footnote salinity bad, could be drawing error. Gerard (84) is acceptable.

146 @3999db Delta-S(PB-G) at 3999db is -0.003, salinity is 34.679. Gerard (89) is okay. PB salinity is low compared with rosette data.

148 @4506db Sample log: "Spigot was pushed in, little water in niskin" N-G -.003 at 4509db. Gerard (93) is acceptable. Delta- S(PB-G) at 4506db is -0.003, salinity is 34.681.

193 @4506db Gerard is acceptable, PB (48).

149 @4761db Delta-S(PB-G) at 4761db is 0.006, salinity is 34.683. PI to decide integrity of Gerard (94).

194 @4761db Salinity is low compared to rosette cast, too. Silicate is low compared with adjoining rosette stations, but is acceptable. PB (49). Footnote salinity bad. PI to decide integrity of Gerard.

Station 034

Cast 1 All samples accounted for. C-14 extraction only.

183 @2582db Sample log: "Needs pillow block." PB (42).

150 @3793db Sample log: "Replaced Niskin 46 with 50 - broken upper block." Delta-S(PB-G) at 3793db is 0.009, salinity is 34.680. Gerard (89).

148 @4405db Delta-S(PB-G) at 4405db is 0.004, salinity is 34.683. Gerard (93).

193 @4406db Sample log: "Tightened niskin trip." PB (48).

Station 046

183 @3453db Sample log: "Didn't latch - O-ring off center." Salinity agrees with rosette and PB salinity, silicate agrees with rosette data. Let PI decide on integrity of Gerard. PB (42).

143 @3703db Temperature is ~0.09 high, salinity agrees with Gerard and rosette data. Footnote temperature bad. Gerard (84) is acceptable.

184 @3703db Gerard is acceptable. See PB (43) temperature comment. Footnote temperature bad.

145 @4209db No sample or temperature, Gerard (87) also had no sample.

187 @4209db Sample log: "Didn't trip - no tripping pin." No sample or temperature, PB (45) also had no sample.

189 @4465db Sample log: "Closed but didn't latch." Salinity agrees with rosette and PB salinity, silicate agrees with rosette data. Let PI decide on integrity of Gerard. PB (50).

Station 057

342 @1240db Sample log: "Spigot pushed in." Gerard (83) is acceptable.

383 @1241db Sample log: "Replaced lid o-ring but still a very tight fit. Did not latch - swap with 88 next time." Gerard is acceptable, PB (42).

350 @1511db Gerard (89) is acceptable within 20db of reassigned pressure.

389 @1511db Sample log: "Lid closed @ ~1570 by salt, Si, and T." Thermometric pressure, both Niskin (50) & Gerard salinities (89), and Gerard silicate

indicate barrel closed at about 1510db instead of the intended depth of 2242db. The double ping came on time and all samples below were ok so the messenger released properly but the Gerard lid closed early or late. Footnote bottle did not trip correctly. PB (50). Samples are good within 20 db of reassigned pressure.

344 @1741db Sample log: "Came up no therm rack?" Gerard (85) is acceptable.

385 @1742db Gerard is acceptable, no temperature, see PB (44) comment.

142 @3301db Delta-S(PB-G) at 3301db is 0.014, salinity is 34.672. Gerard (83) leaked.

183 @3301db Sample log: "Didn't latch - o-ring again same as before." Delta-S(PB-G) at 3301db is 0.014, salinity is 34.672. Data show leak on Gerard 83. Footnote bottle leaking, samples bad. PB (42).

145 @3981db Gerard (87) is acceptable. Temperature is ~0.04 high. Footnote temperature bad.

187 @3982db Gerard is acceptable. Footnote temperature bad. PB (45).

Station 066

343 @1420db Delta-S(PB-G) at 1420db is 0.02, salinity is 34.585. Gerard salinity is low. Could be a drawing error. Let PI decide integrity of Gerard (85).

385 @1420db Delta-S(PB-G) at 1420db is 0.02, salinity is 34.585. Gerard salinity is low. Silicate agrees with rosette cast. Could be a drawing error. Footnote salinity bad. Let PI decide integrity of Gerard (85). PB (43).

387 @1658db Sample log: "Messenger not released." Gerard is acceptable, PB (44). The remainder of the profile was done as Cast 4.

149 @4935db Delta-S(PB-G) at 4935db is 0.004, salinity is 34.693. Gerard (94) may have leaked. Gerard salinity is low, silicate looks reasonable. Suspect there was a leak, let PI decide.

194 @4936db Sample log: "Air vent open on return. Was definitely closed when deployed." Gerard salinity is low, silicate looks reasonable. Suspect there was a leak, let PI decide. Footnote bottle leaking, salinity bad. PB (49).

Station 076

Cast 1	Sample log: "Cast nominal. Thermometer malfunction."
389 @1588db	Sample log: "Therm rack 6 reversed on deck." Temperature is lost. Gerard salinity and silicate agree with rosette data. Gerard is acceptable, PB (50).
350 @1588db	Temperature is lost. Gerard salinity and silicate agree with rosette data. Gerard (89) is acceptable.

Station 098

150 @ 617db	Delta-S(PB-G) at 617db is -0.014, salinity is 34.577. Thermometric Pressure 617 vs intended depth 3370db. Water samples also from about 617db. Footnote bottle pretripped and samples bad. Gerard (88) appears to have leaked.
188 @ 617db	Sample Log: "Bad o-ring? Would not pressurize; opened and reclosed, o-ring damaged." Thermometric Pressure 617 vs intended depth 3370db. Water samples also from about 617db. Lid o-ring cut, difficult to open lid. Used 617 db as accepted pressure with water samples as is. Footnote bottle did not trip correctly, samples bad. PB (50).
393 @1894db	Delta-S(PB-G) at 1893db is -0.0592, salinity is 34.639. Salinity too high, but sil reasonable. Footnote salinity bad.
145 @3117db	Delta-S(PB-G) at 3117db is -0.011, salinity is 34.677. PI to decide integrity of Gerard (87).
187 @3118db	Delta-S(PB-G) at 3117db is -0.011, salinity is 34.677. Gerard salinity is high, SiO3 agrees with rosette data. Footnote salinity bad. Have PI decide the integrity of Gerard samples. PB (45).

Station 121

289 (No Pressure) Sample Log: "Did not trip. Redone as cast 3."

290 (No Pressure) Sample Log: "Did not trip. Redone as cast 3."

293 (No Pressure) Sample Log: "Did not trip. Redone as cast 3."

294 (No Pressure) Sample Log: "Did not trip. Redone as cast 3."

350 @1921db Gerard (89)is acceptable at reassigned pressure.

389 @1921db Sample Log: "Pretripped." Samples are acceptable at reassigned pressure. PB (50).

347 @2220db Gerard (90) is acceptable at reassigned pressure.

390 @2220db Sample Log: "Pretripped." Samples are acceptable at reassigned pressure. PB (47).

348 @2534db Delta-S(PB-G) at 2534db is -0.002, salinity is 34.664. Gerard (93) is acceptable at reassigned pressure.

393 @2535db Sample Log: "Pretripped." Samples are acceptable at reassigned pressure. PB (48).

281 @2673db Salinity bottle was broken before analysis could be performed. Salinity lost. Silicate is high compared to rosette data, but agrees with silicate from other Gerard casts (which are also higher than rosette data). Suspect Gerard is acceptable. PB (41).

349 @2864db Delta-S(PB-G) at 2864db is 0.002, salinity is 34.675. Gerard (94) is acceptable at reassigned pressure.

394 @2864db Sample Log: "Pretripped." Samples are acceptable at reassigned pressure. PB (49).

242 @2938db Gerard (84) is acceptable, PB salinity is low. Footnote salinity questionable. Delta-S(PB-G) at 2938db is -0.004, salinity is 34.670.

445 @3282db Sample Log: "Valve open." Gerard (87) is acceptable. Delta-S(PB-G) at 3282db is -0.002, salinity is 34.680.

D. WHPO Summary

Several data files are associated with this report. They are the p17c.sum, p17c.hyd, p17c.csl and *.wct files. The p17c.sum file contains a summary of the location, time, type of parameters sampled, and other pertient information regarding each hydrographic station. The p17c.hyd file contains the bottle data. The *.wct files are the ctd data for each station. The *.wct files are zipped into one file called p17cwct.zip. The p17c.csl file is a listing of ctd and calculated values at standard levels.

The following is a description of how the standard levels and calculated values were derived for the p17c.csl file:

Salinity, Temperature and Pressure: These three values were smoothed from the individual CTD files over the N uniformly increasing pressure levels using the following binomial filter-

$$t(j) = 0.25ti(j-1) + 0.5ti(j) + 0.25ti(j+1) \quad j=2....N-1$$

When a pressure level is represented in the *.csl file that is not contained within the ctd values, the value was linearly interpolated to the desired level after applying the binomial filtering.

Sigma-theta(SIG-TH:KG/M3), Sigma-2 (SIG-2: KG/M3), and Sigma-4(SIG-4: KG/M3): These values are calculated using the practical salinity scale (PSS-78) and the international equation of state for seawater (EOS-80) as described in the Unesco publication 44 at reference pressures of the surface for SIG-TH; 2000 dbars for Sigma-2; and 4000 dbars for Sigma-4.
Gradient Potential Temperature (GRD-PT: C/DB 10-3) is calculated as the least squares slope between two levels, where the standard level is the center of the interval. The interval being the smallest of the two differences between the standard level and the two closest values. The slope is first determined using CTD temperature and then the adiabatic lapse rate is subtracted to obtain the gradient potential temperature. Equations and Fortran routines are described in Unesco publication 44.

Gradient Salinity (GRD-S: 1/DB 10-3) is calculated as the least squares slope between two levels, where the standard level is the center of the standard level and the two closes values. Equations and Fortran routines are described in Unesco publication 44.

Potential Vorticity (POT-V: 1/ms 10-11) is calculated as the vertical component ignoring contributions due to relative vorticity, i.e. pv=fN2/g, where f is the coriolius parameter, N is the bouyancy frequency (data expressed as radius/sec), and g is the local acceleration of gravity.

Bouyancy Frequency (B-V: cph) is calculated using the adiabatic leveling method, Fofonoff (1985) and Millard, Owens and Fofonoff (1990). Equations and Fortran routines are described in Unesco publication 44.

Potential Energy (PE: J/M2: 10-5) and Dynamic Height (DYN-HT: M) are calculated by integrating from 0 to the level of interest. Equations and Fortran routines are described in Unesco publication, Processing of Oceanographic station data, 1991.

Neutral Density (GAMMA-N: KG/M3) is calculated with the program GAMMA-N (Jackett and McDougall) version 1.3 Nov. 94.

E. Data Quality Evaluations

E.1 DQE of CTD data for Tunes Leg 1 WOCE P17C

(Robert Millard)
January 26, 1995

General:

The data quality of the CTD data of the individual 2-decibar CTD profiles and the CTD salinity and oxygen found in the water sample file are examined. The individual 2 decibar profiles were checked for glitches in temperature, salinity and oxygen by comparing individual profiles against one of two average profiles; the first average is of the East-West section and involving stations 6 through 17 and the second station grouping is the North-South section involving stations 18 through 123. The average profiles include standard deviation of temperature, salinity and oxygen which when scaled (default edit factor is 5.0 times the standard deviation) become the edit criteria for flagging questionable data. The stability parameter is also computed for observations within a profile and values less than a stability value (E = -5.0e-4 per meter) are also flagged. The stability edit criteria flags density inversions greater than .015 Kg/M3 per decibar. The screening of the entire 2 decibar data set against these edit criteria indicated the data to be free of spurious bad values in temperature, salinity and oxygen.

The CTD salinity (conductivity) and oxygen calibrations are checked using the water sample data file P17C.DQE. In comparing the CTD and water sample salinity and oxygen in the water sample file, only those data having a quality flag indicating a good measurement (ie values of 2) were used. The salinity and oxygen differences (CTD-Water Sample) are plotted in histogram form with salinity in figure 1 and oxygen figure 2. Salinity and oxygen differences are plotted versus station number in figures 3 and 4 and versus pressure in figures 5a, 5b and 6. The plots versus pressure use expanded scales which don't show the extreme differences that occur in the upper few hundred decibars. The maximum salinity difference is .16 psu while the maximum difference of oxygen is 53.6 micromoles/kg.

The deep water sample salinity and oxygen differences are also examined separately by further screening the good data (ie. quality value ="2") to exclude potential temperature values greater than 2.5 C. These comparisons are displayed in histograms of salinity and oxygen differences (figures 7 & 8) plus plots of the salinity and oxygen differences versus station number in figures 9 and 10 respectively. The CTD salinity and oxygen of the water sample file are found to be well matched to the water samples over the cruise.

Details:

Evaluation of CTD Calibrations to water samples:

Salinity:
The histogram of salinity differences for all depths (figure 1) shows a symetric distribution. The standard deviation is fairly large at 0.010 psu but 149 of a total of 3723 good salinity values that have a difference exceeding ±.02 psu. All of these large differences are shallower than 320 decibars and if excluded decrease the standard deviation to .0041 psu. The histogram of salinity differences for potential temperatures below 2.5 C (figure 7) has a mean difference of -0.00015 psu and a much smaller standard deviation of .0016 psu. The histogram of deep salinity differences is fairly normally distributed with a scatter that probably represents the uncertainty of the water sample salinity data. All good values of the salinity differences are plotted versus station in figure 3 and show no station dependent variations over the cruise. The distribution of salinity differences versus pressure (figure 5a) hints that the CTD salinity has a trend towards slightly saltier values as depth increases. The salinity differences below 2.5 C are displayed on an expanded scale in figure 5b to make this slight pressure dependence more obvious. A least squares regression line found on figure 5b indicates the pressure dependence is about .001 psu per 1500 decibars. The plot of deep salinity differences versus station shown in figure 9 suggests a small station dependent variations of about ±0.001 psu in several 10 to 20 station groups. For example, the section of data between stations 43 and 57 appears to show the CTD salinity slightly salty at 43 and drifts to a slightly fresh value by station 57. An expanded scale plot is made for stations 43 to 57 (figure 11) that better shows the station drift as does the line indicating the least squares fit. This drift is reinforced by plots of potential temperature versus salinity for the two four station groups plots including stations 43 and 57. Figure 12 has salinities of stations 42, 43, 44, and 45 for both the 2 decibar CTD and water sample files. The water sample salinities (squares) are fresher [below 1.3 C) than CTD salinities of either the 2 decibar (down) or water sample file CTD salinity (up). Figure 13 showns stations 54, 55, 56, and 57 nown the water sample salinities (squares) on the salty side of the CTD salts (both down and up). The magnitude of these salinity drifts are small (±0.001 psu) but they are systematic. Figure 9 shows a hint of this behavior in two other stations groups (stations 60 through 78) and perhaps stations 20 through 30 but no close examination was made.

Oxygen:
The distribution of oxygen differences at all depths shown in the histogram of figure 2 indicates a well behaved fairly random distribution. The standard deviation of oxygen differences for all levels is 4.47 micromole/kg. The histogram of oxygen differences for potential temperatures below 2.5 C is tighter with a standard deviation of 1.12 Um/kg. The plot of oxygen differences for all good oxygens versus station in figure 4 has no suggestion of a station dependence. The largest oxygen difference is 53.6 micromoles/kg and 63 oxygen differences of a total of 3220 good oxygen comparisons exceed 15 microMoles/kg. All are shallower than 455 decibars. The plot of oxygen differences versus pressure (figure 6) shows that the CTD oxygen differences are well

behaved in the vertical. Figure 6 uses expanded scales that excludes oxygen differences greater than ±15 micromoles/kg. The distribution of deep oxygen differences versus station in figure 10 are devoid of any station dependence trends. The CTD oxygen calibrations for this data set are excellent.

Comparison 2-dbar stations to Mean profile: Stations 1 to 17- East-West

The data quality of the 2 decibar CTD data for the East-West section compares well to the mean profile. A few of the shallow oxygen levels of the coastal stations (1 and 2) are flagged as questionable even with a large (10 standard deviation) edit criteria. A check of the water sample data indicates that these oxygens are fine and the problem resides with using the East-West mean profile in the coastal region.

Comparison 2-dbar stations to Mean profile Sta 18 to 123: North-South section

Comparing the individual salinity, temperature and oxygen values against an edit criteria of 5 standard deviations from the mean profile of stations 18 through 123, no data errors were incountered for any of the station files listed below. The individual profiles were also tested for density instabilities using a minimum stability parameter value of -1.0 E-5. This amounts to a density inversion of .015 kg/M3 per decibar.

Summary:

On the whole, WOCE section P17C represents a model CTD data set. The Tunes leg 1 CTD data set is well calibrated in salinity at the ±0.001 psu level and the CTD oxygen calibration is excellent. There is a suggestion of a pressure dependence to the CTD salinity (conductivity) with the CTD becoming increasingly salty with increasing pressure by roughly .001 psu per 1500 decibars which should be examined. This is about the magnitude of the conductivity cell pressure deformation correction. There is a hint of a drift in the salinity differences below 2.5 C that should be checked out. The 2 decibar profiles are free of spurious data gliches. The Chief Scientists cruise report has a very useful discussion of the CTD instrument calibration results. There is mention of a follow up report that ODF is writing on the CTD calibrations but I have not seen it.

Listing of results from a check for spurious data in 2 decibar station files

File name	Pmax	E_Tot	T_err	S_err	O2_err	E_err	Sd_fact	E_Min	
001D1.WCT	552.0	19	0	0	19	0	7.00	-0.50E-03	0
002D1.WCT	912.0	14	0	0	14	0	7.00	-0.50E-03	0
003D1.WCT	1476.0	0	0	0	0	0	7.00	-0.50E-03	0
004D1.WCT	2464.0	0	0	0	0	0	7.00	-0.50E-03	0
005D1.WCT	3448.0	0	0	0	0	0	7.00	-0.50E-03	0
006D1.WCT	4074.0	0	0	0	0	0	7.00	-0.50E-03	0
007D1.WCT	4228.0	0	0	0	0	0	7.00	-0.50E-03	0
008D1.WCT	4414.0	0	0	0	0	0	7.00	-0.50E-03	0
009D1.WCT	4596.0	0	0	0	0	0	7.00	-0.50E-03	0
010D1.WCT	4768.0	0	0	0	0	0	7.00	-0.50E-03	0
011D1.WCT	4878.0	0	0	0	0	0	7.00	-0.50E-03	0
012D1.WCT	4972.0	0	0	0	0	0	7.00	-0.50E-03	0
013D1.WCT	4480.0	0	0	0	0	0	7.00	-0.50E-03	0
014D1.WCT	5228.0	0	0	0	0	0	7.00	-0.50E-03	0

File name	Pmax	E_Tot	T_err	S_err	O2_err	E_err		Sd_fact	E_Min
015D1.WCT	5192.0	0	0	0	0	0	7.00	-0.50E-03	0
016D1.WCT	4410.0	0	0	0	0	0	7.00	-0.50E-03	0
017D2.WCT	5222.0	0	0	0	0	0	7.00	-0.50E-03	0
018D1.WCT	5190.0	0	0	0	0	0	5.00	-0.50E-03	
019D1.WCT	5136.0	0	0	0	0	0	5.00	-0.50E-03	
020D1.WCT	4850.0	0	0	0	0	0	5.00	-0.50E-03	
021D1.WCT	4254.0	0	0	0	0	0	5.00	-0.50E-03	
022D1.WCT	5030.0	0	0	0	0	0	5.00	-0.50E-03	
023D1.WCT	4636.0	0	0	0	0	0	5.00	-0.50E-03	
024D1.WCT	4686.0	0	0	0	0	0	5.00	-0.50E-03	
025D1.WCT	4658.0	0	0	0	0	0	5.00	-0.50E-03	
026D2.WCT	5272.0	0	0	0	0	0	5.00	-0.50E-03	
027D1.WCT	4560.0	0	0	0	0	0	5.00	-0.50E-03	
028D1.WCT	4566.0	0	0	0	0	0	5.00	-0.50E-03	
029D1.WCT	3894.0	0	0	0	0	0	5.00	-0.50E-03	
030D1.WCT	4394.0	0	0	0	0	0	5.00	-0.50E-03	
031D1.WCT	4546.0	0	0	0	0	0	5.00	-0.50E-03	
032D1.WCT	4190.0	0	0	0	0	0	5.00	-0.50E-03	
033D1.WCT	4366.0	0	0	0	0	0	5.00	-0.50E-03	
034D2.WCT	4650.0	0	0	0	0	0	5.00	-0.50E-03	
035D1.WCT	4746.0	0	0	0	0	0	5.00	-0.50E-03	
036D1.WCT	4690.0	0	0	0	0	0	5.00	-0.50E-03	
037D1.WCT	4606.0	0	0	0	0	0	5.00	-0.50E-03	
038D1.WCT	4928.0	0	0	0	0	0	5.00	-0.50E-03	
039D1.WCT	4524.0	0	0	0	0	0	5.00	-0.50E-03	
040D1.WCT	5280.0	0	0	0	0	0	5.00	-0.50E-03	
041D1.WCT	5242.0	0	0	0	0	0	5.00	-0.50E-03	
042D1.WCT	5312.0	0	0	0	0	0	5.00	-0.50E-03	
043D1.WCT	5306.0	0	0	0	0	0	5.00	-0.50E-03	
044D1.WCT	5350.0	0	0	0	0	0	5.00	-0.50E-03	
045D1.WCT	5386.0	0	0	0	0	0	5.00	-0.50E-03	
046D2.WCT	5346.0	0	0	0	0	0	5.00	-0.50E-03	
047D1.WCT	5384.0	0	0	0	0	0	5.00	-0.50E-03	
048D1.WCT	5280.0	0	0	0	0	0	5.00	-0.50E-03	
049D1.WCT	5284.0	0	0	0	0	0	5.00	-0.50E-03	
050D1.WCT	5270.0	0	0	0	0	0	5.00	-0.50E-03	
051D1.WCT	5108.0	0	0	0	0	0	5.00	-0.50E-03	
052D1.WCT	5394.0	0	0	0	0	0	5.00	-0.50E-03	
053D1.WCT	4926.0	0	0	0	0	0	5.00	-0.50E-03	
054D1.WCT	4872.0	0	0	0	0	0	5.00	-0.50E-03	
055D1.WCT	4930.0	0	0	0	0	0	5.00	-0.50E-03	
056D1.WCT	4912.0	0	0	0	0	0	5.00	-0.50E-03	
057D2.WCT	5042.0	0	0	0	0	0	5.00	-0.50E-03	
058D1.WCT	4980.0	0	0	0	0	0	5.00	-0.50E-03	
059D1.WCT	4978.0	0	0	0	0	0	5.00	-0.50E-03	
060D1.WCT	4990.0	0	0	0	0	0	5.00	-0.50E-03	
061D1.WCT	4930.0	0	0	0	0	0	5.00	-0.50E-03	
062D1.WCT	4932.0	0	0	0	0	0	5.00	-0.50E-03	
063D1.WCT	4970.0	0	0	0	0	0	5.00	-0.50E-03	
064D1.WCT	5008.0	0	0	0	0	0	5.00	-0.50E-03	
065D1.WCT	5012.0	0	0	0	0	0	5.00	-0.50E-03	
066D2.WCT	4884.0	0	0	0	0	0	5.00	-0.50E-03	
067D1.WCT	4868.0	0	0	0	0	0	5.00	-0.50E-03	
068D1.WCT	4806.0	0	0	0	0	0	5.00	-0.50E-03	
069D1.WCT	4808.0	0	0	0	0	0	5.00	-0.50E-03	
070D1.WCT	4814.0	0	0	0	0	0	5.00	-0.50E-03	
071D1.WCT	4850.0	0	0	0	0	0	5.00	-0.50E-03	

File name	Pmax	E_Tot	T_err	S_err	O2_err	E_err	Sd_fact	E_Min
072D1.WCT	4728.0	0	0	0	0	0	5.00	-0.50E-03
073D1.WCT	4706.0	0	0	0	0	0	5.00	-0.50E-03
074D1.WCT	4704.0	0	0	0	0	0	5.00	-0.50E-03
075D1.WCT	4640.0	0	0	0	0	0	5.00	-0.50E-03
076D2.WCT	4652.0	0	0	0	0	0	5.00	-0.50E-03
077D1.WCT	4600.0	0	0	0	0	0	5.00	-0.50E-03
078D1.WCT	4512.0	0	0	0	0	0	5.00	-0.50E-03
079D1.WCT	4374.0	0	0	0	0	0	5.00	-0.50E-03
080D1.WCT	4392.0	0	0	0	0	0	5.00	-0.50E-03
081D1.WCT	4394.0	0	0	0	0	0	5.00	-0.50E-03
082D1.WCT	4408.0	0	0	0	0	0	5.00	-0.50E-03
083D1.WCT	4436.0	0	0	0	0	0	5.00	-0.50E-03
084D1.WCT	4486.0	0	0	0	0	0	5.00	-0.50E-03
085D1.WCT	4508.0	0	0	0	0	0	5.00	-0.50E-03
086D1.WCT	4582.0	0	0	0	0	0	5.00	-0.50E-03
087D1.WCT	4628.0	0	0	0	0	0	5.00	-0.50E-03
088D1.WCT	4618.0	0	0	0	0	0	5.00	-0.50E-03
089D1.WCT	4540.0	0	0	0	0	0	5.00	-0.50E-03
090D1.WCT	4534.0	0	0	0	0	0	5.00	-0.50E-03
091D1.WCT	4446.0	0	0	0	0	0	5.00	-0.50E-03
092D1.WCT	4318.0	0	0	0	0	0	5.00	-0.50E-03
093D1.WCT	4382.0	0	0	0	0	0	5.00	-0.50E-03
094D1.WCT	4352.0	0	0	0	0	0	5.00	-0.50E-03
095D1.WCT	4272.0	0	0	0	0	0	5.00	-0.50E-03
096D1.WCT	3954.0	0	0	0	0	0	5.00	-0.50E-03
097D1.WCT	3446.0	0	0	0	0	0	5.00	-0.50E-03
098D2.WCT	4380.0	0	0	0	0	0	5.00	-0.50E-03
098D4.WCT	4382.0	0	0	0	0	0	5.00	-0.50E-03
099D1.WCT	4286.0	0	0	0	0	0	5.00	-0.50E-03
100D1.WCT	4286.0	0	0	0	0	0	5.00	-0.50E-03
101D1.WCT	4368.0	0	0	0	0	0	5.00	-0.50E-03
102D1.WCT	4404.0	0	0	0	0	0	5.00	-0.50E-03
103D1.WCT	4360.0	0	0	0	0	0	5.00	-0.50E-03
104D1.WCT	4542.0	0	0	0	0	0	5.00	-0.50E-03
105D1.WCT	4556.0	0	0	0	0	0	5.00	-0.50E-03
106D1.WCT	4446.0	0	0	0	0	0	5.00	-0.50E-03
107D1.WCT	4460.0	0	0	0	0	0	5.00	-0.50E-03
108D1.WCT	4424.0	0	0	0	0	0	5.00	-0.50E-03
109D1.WCT	4350.0	0	0	0	0	0	5.00	-0.50E-03
110D1.WCT	4506.0	0	0	0	0	0	5.00	-0.50E-03
111D1.WCT	4418.0	0	0	0	0	0	5.00	-0.50E-03
112D1.WCT	4498.0	0	0	0	0	0	5.00	-0.50E-03
113D1.WCT	4466.0	0	0	0	0	0	5.00	-0.50E-03
114D1.WCT	4498.0	0	0	0	0	0	5.00	-0.50E-03
115D1.WCT	4564.0	0	0	0	0	0	5.00	-0.50E-03
116D1.WCT	4624.0	0	0	0	0	0	5.00	-0.50E-03
117D1.WCT	4676.0	0	0	0	0	0	5.00	-0.50E-03
118D1.WCT	4740.0	0	0	0	0	0	5.00	-0.50E-03
119D1.WCT	4702.0	0	0	0	0	0	5.00	-0.50E-03
120D1.WCT	4712.0	0	0	0	0	0	5.00	-0.50E-03
121D1.WCT	4720.0	0	0	0	0	0	5.00	-0.50E-03
122D1.WCT	4636.0	0	0	0	0	0	5.00	-0.50E-03
123D1.WCT	4586.0	0	0	0	0	0	5.00	-0.50E-03

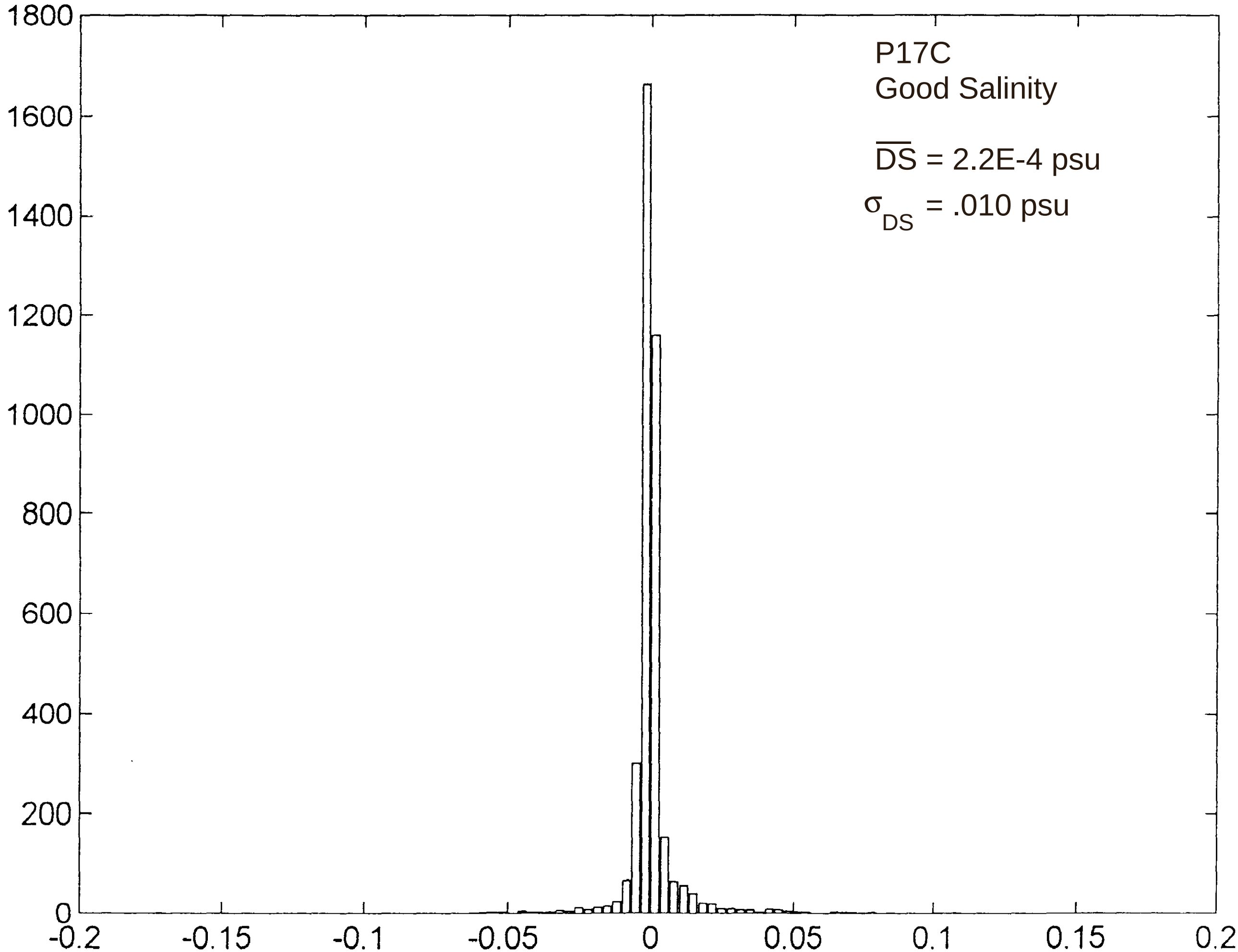

Figure 1 (CTD DQE)

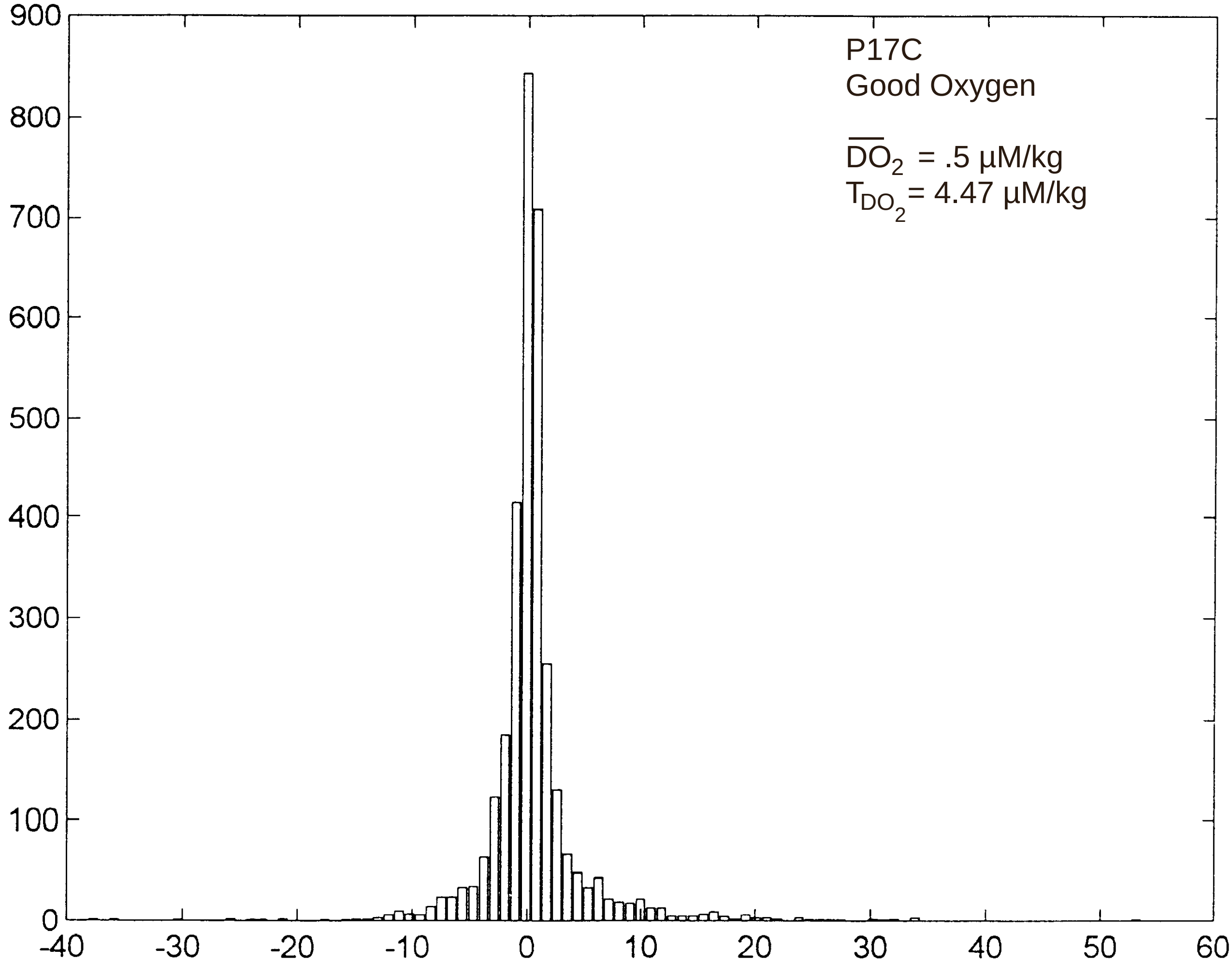

Figure 2 (CTD DQE)

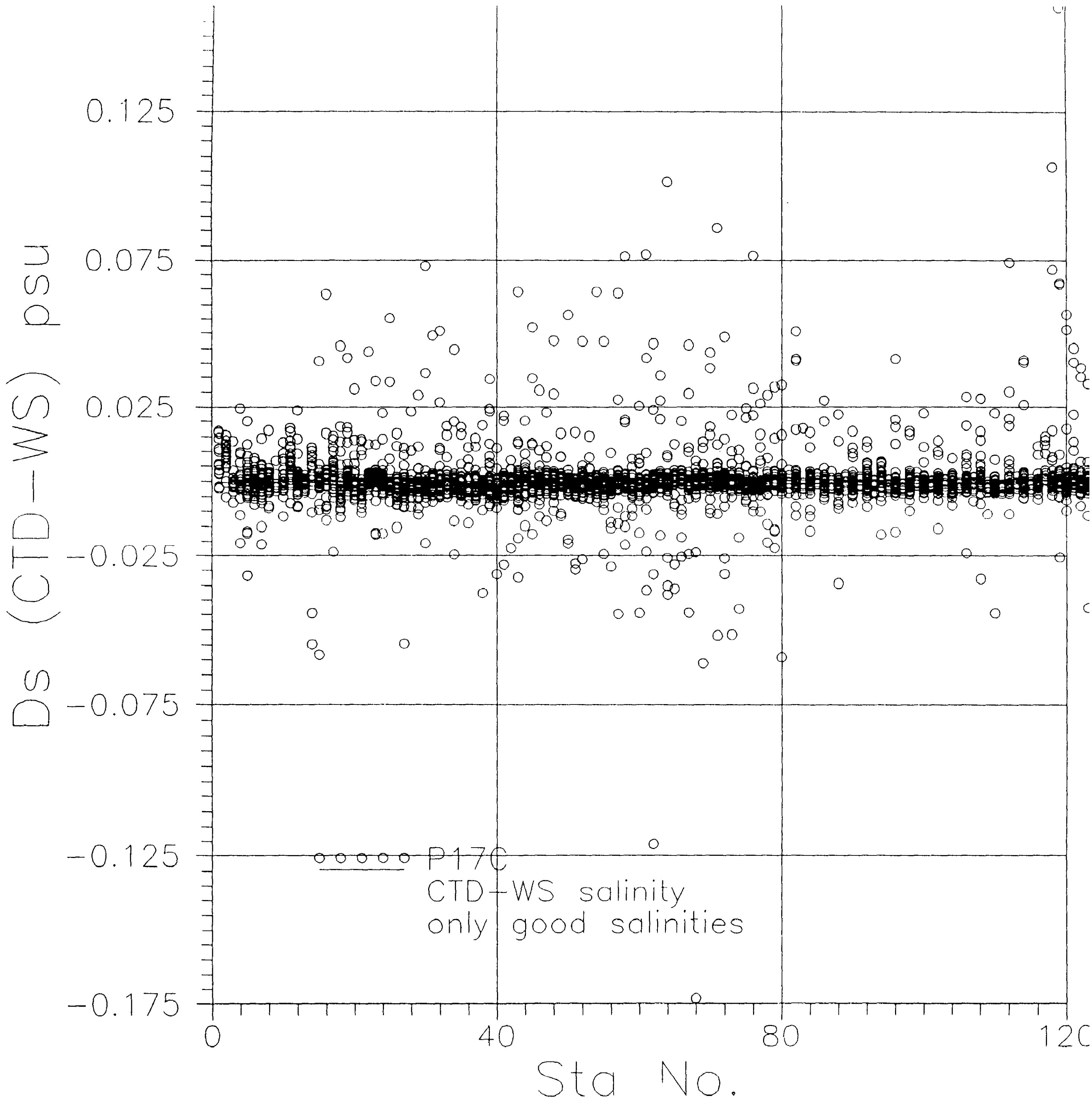

Figure 3 (CTD DQE)

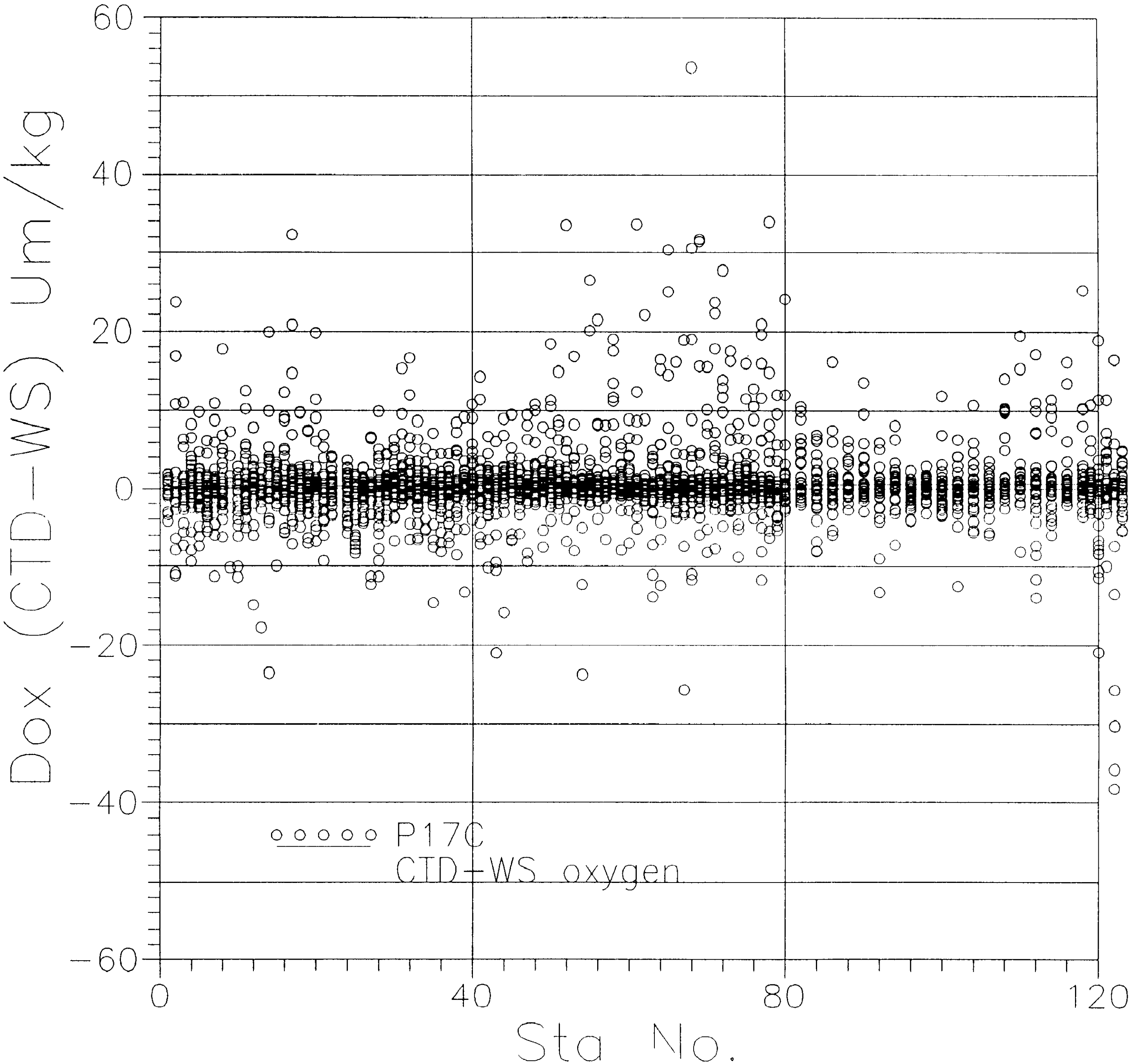

Figure 4 (CTD DQE)

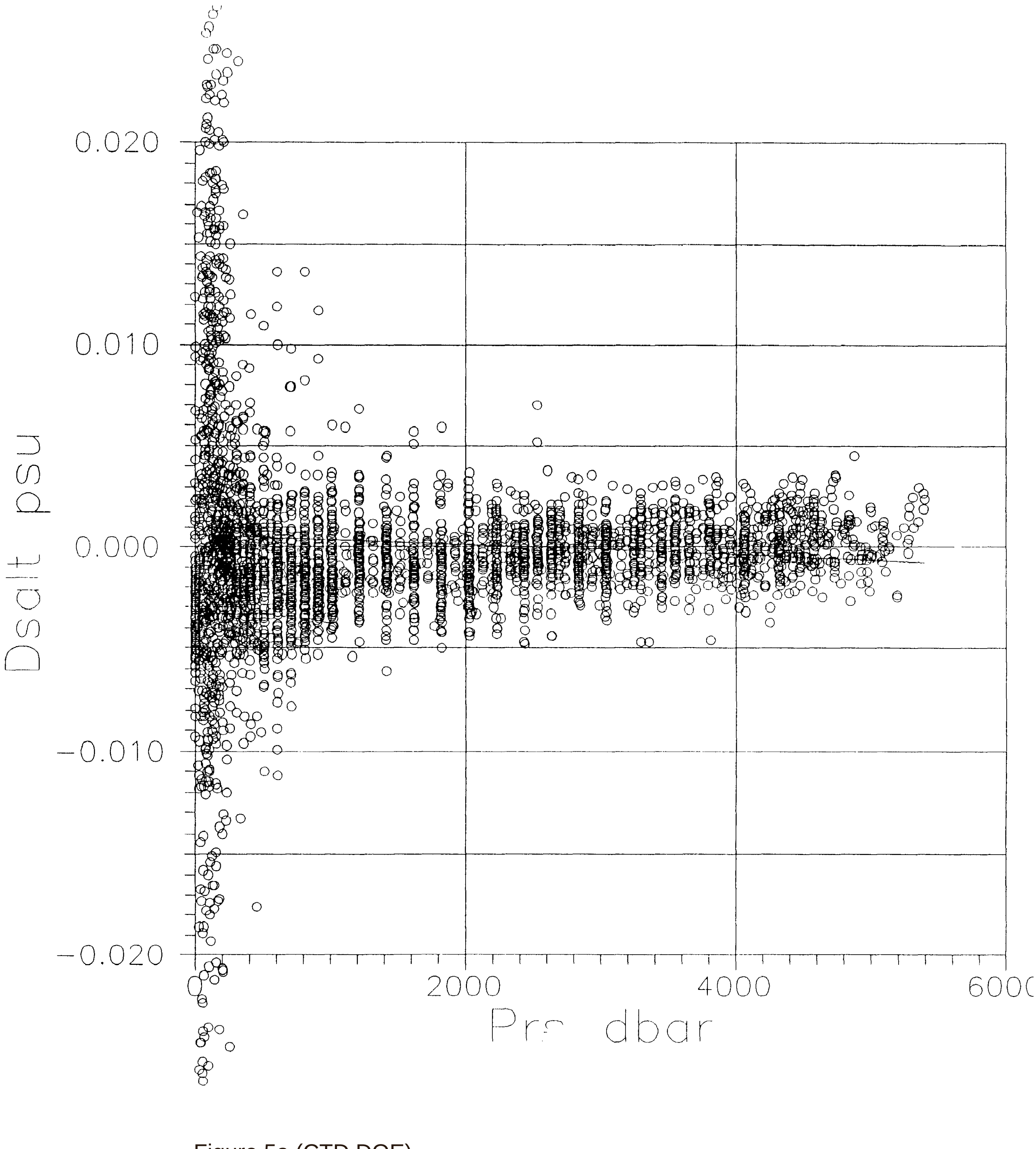

Figure 5a (CTD DQE)

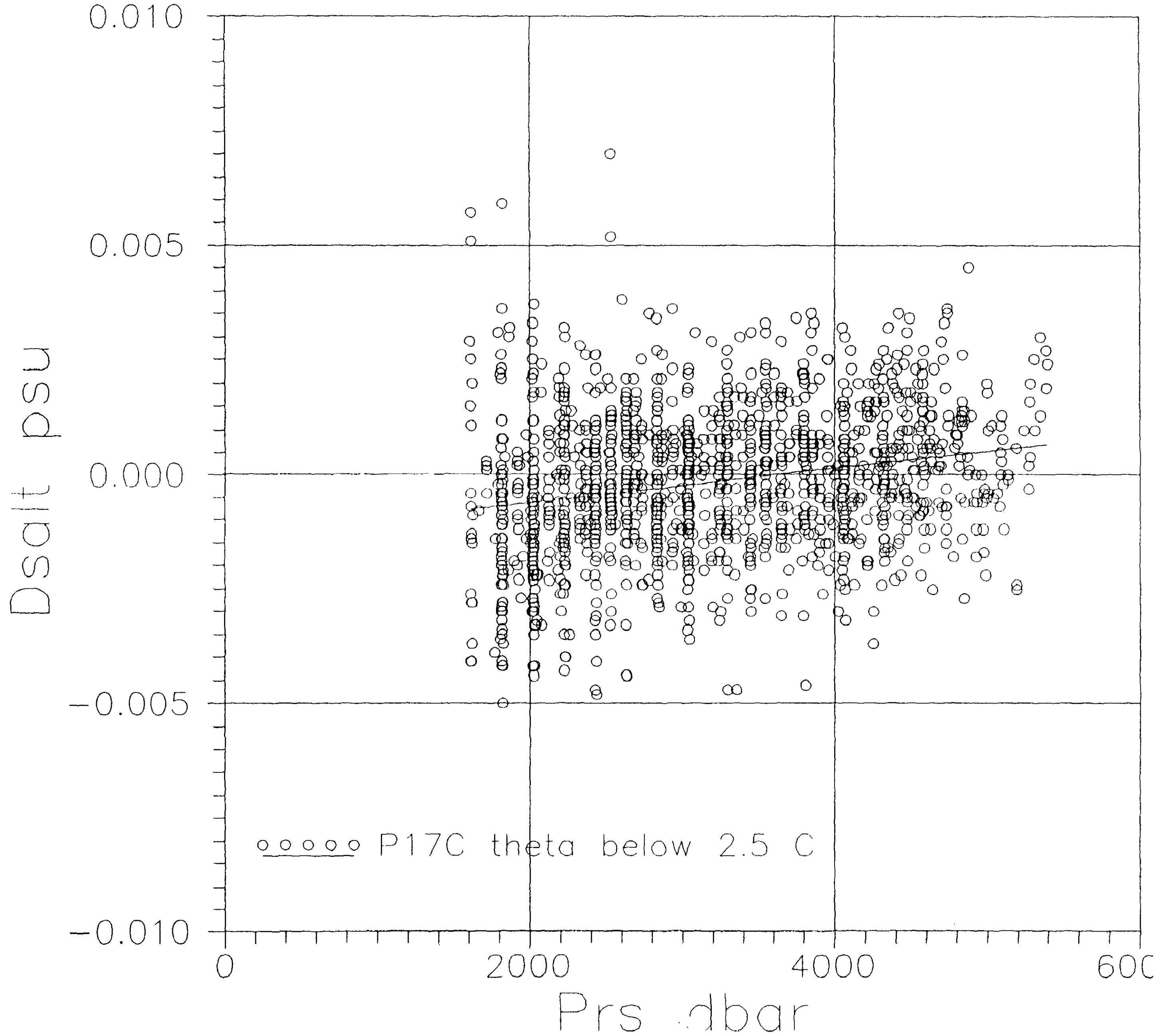

Figure 5b (CTD DQE)

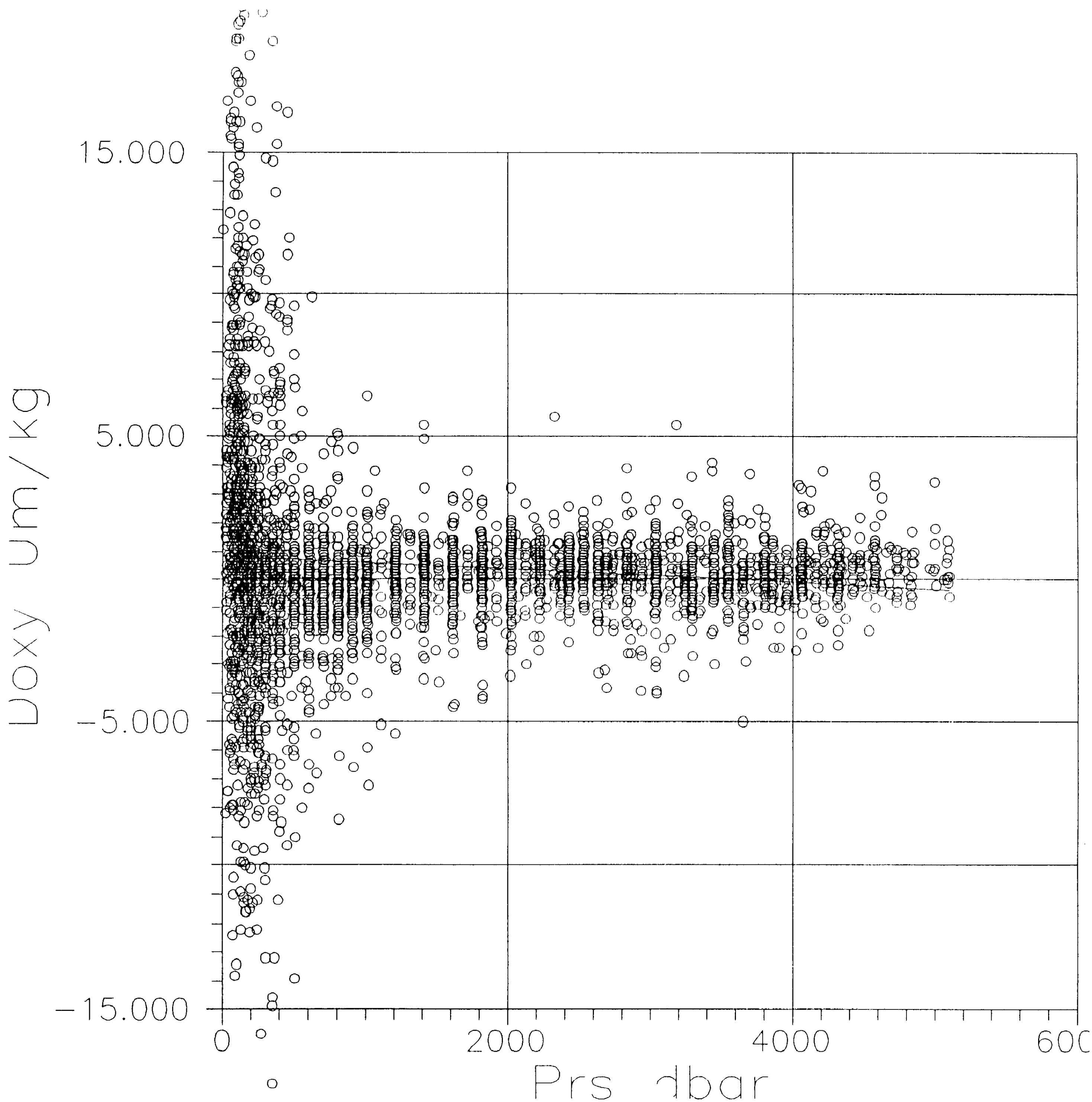

Figure 6 (CTD DQE)

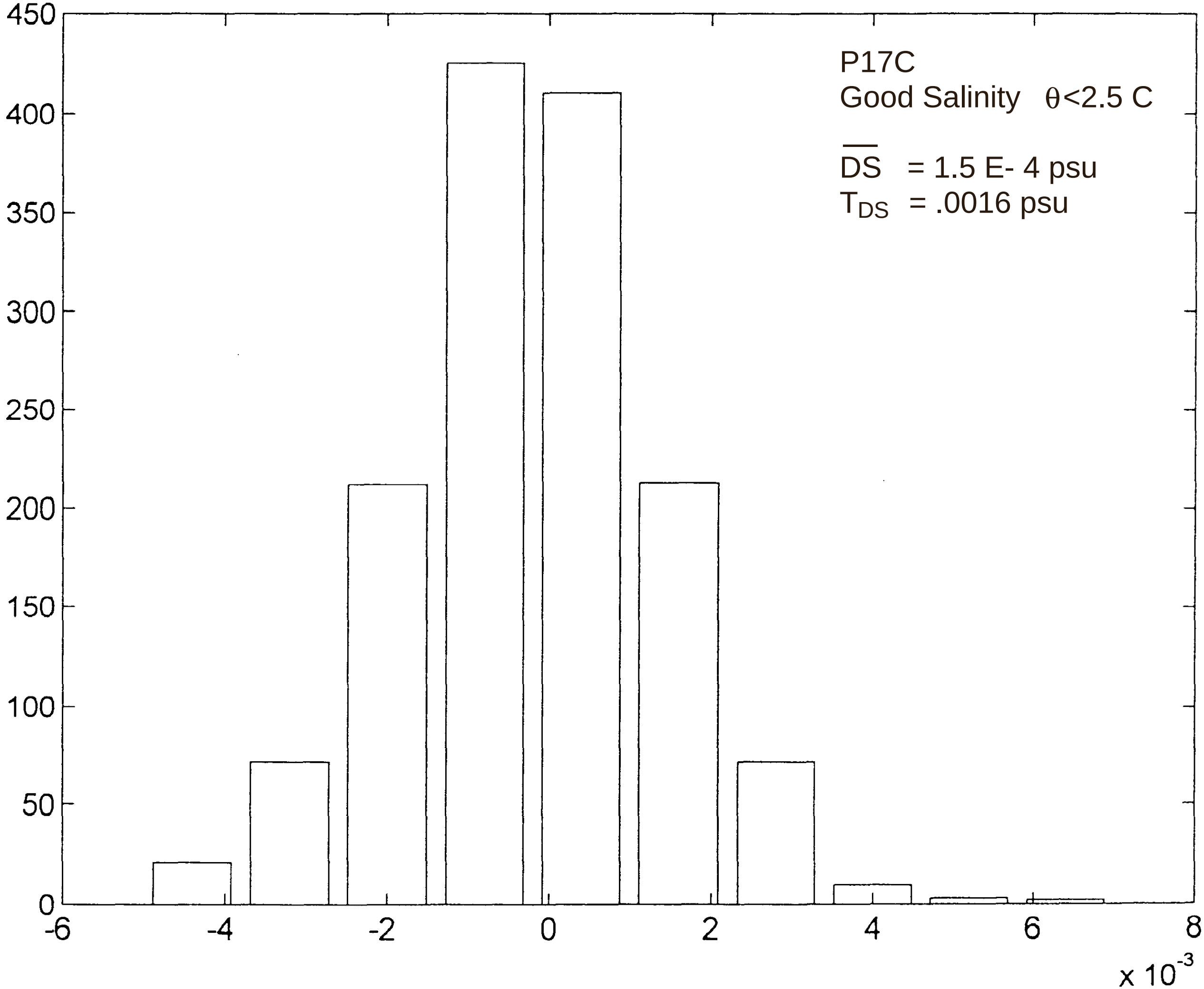

Figure 7 (CTD DQE)

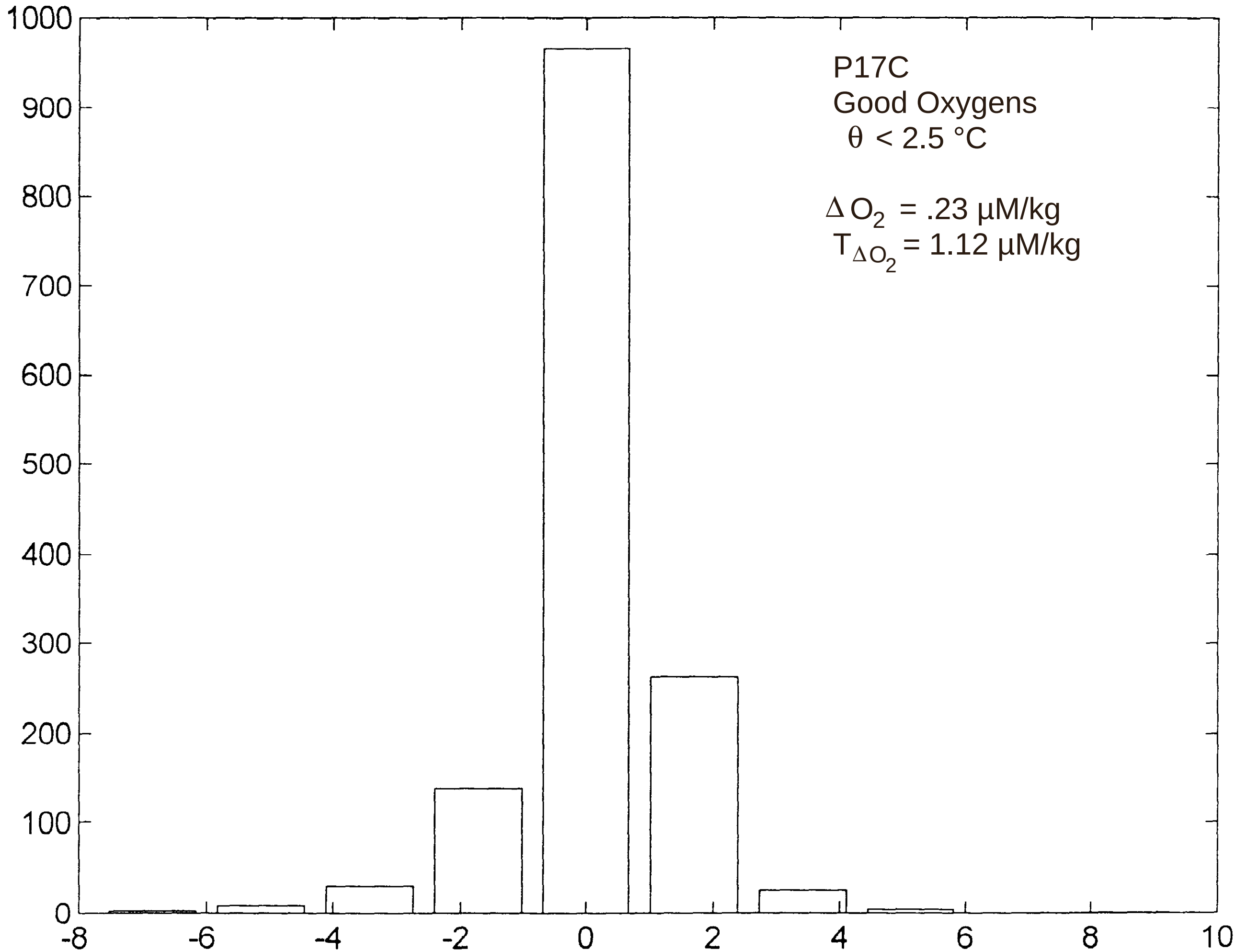

Figure 8 (CTD DQE)

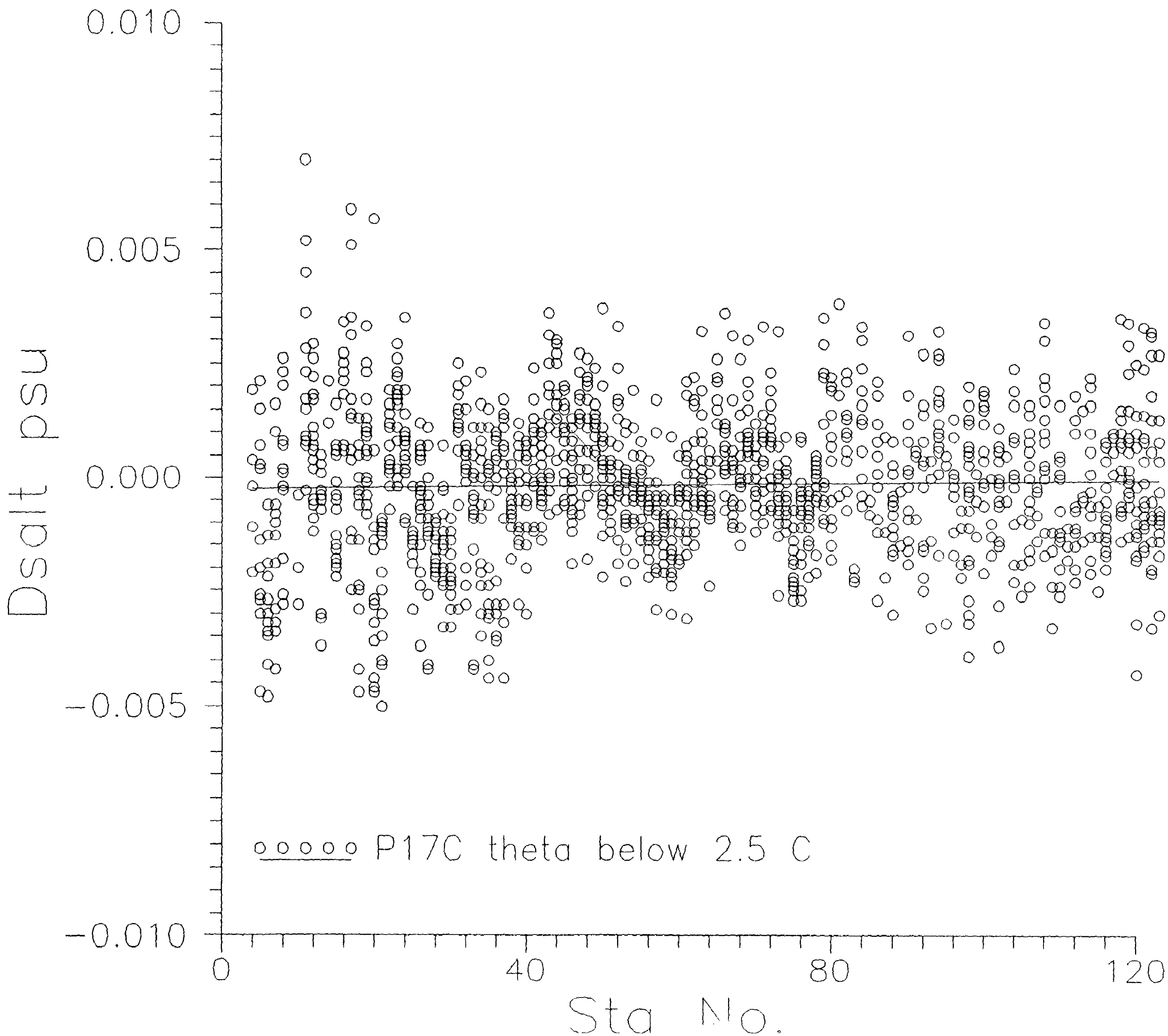

Figure 9 (CTD DQE)

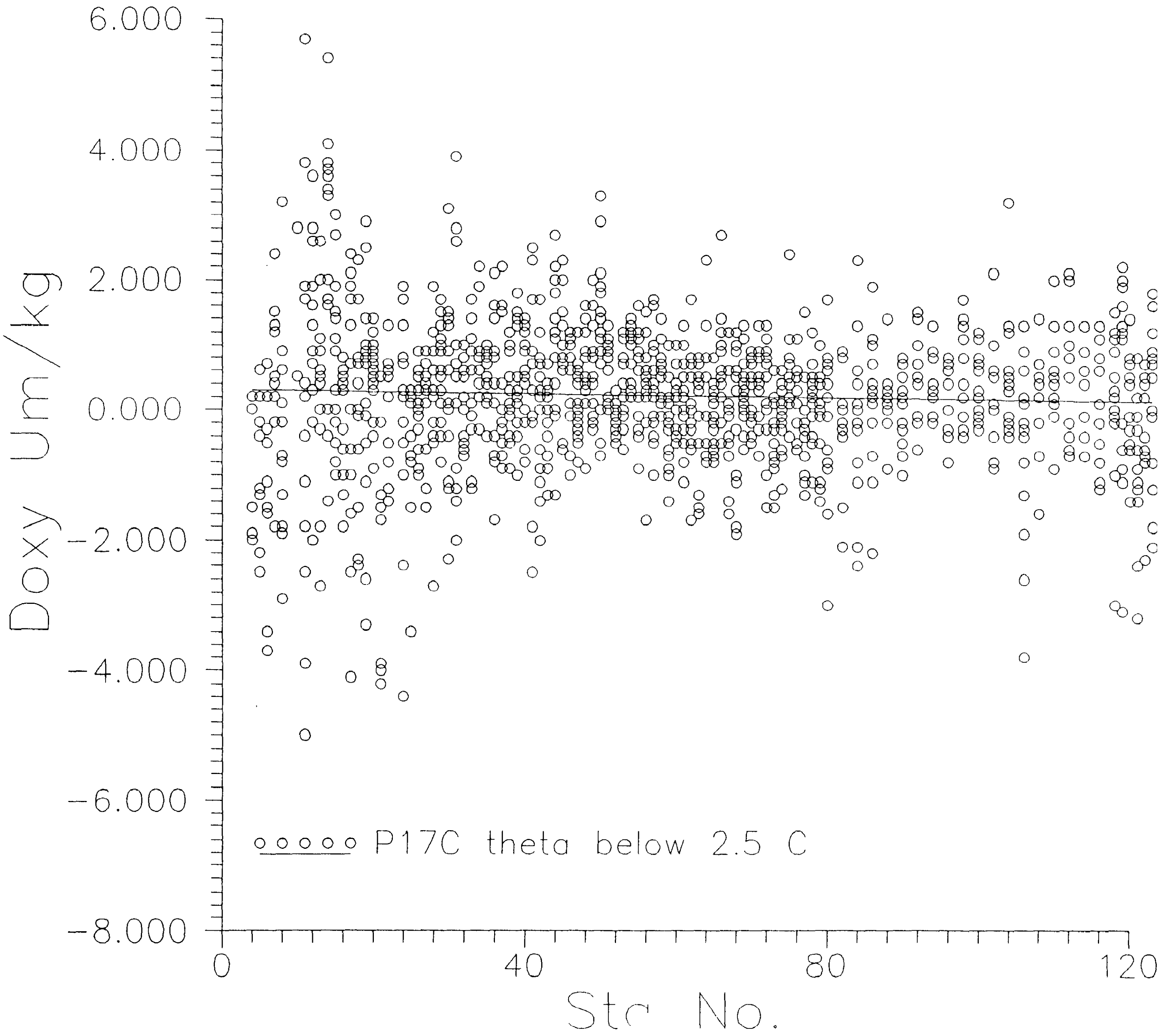

Figure 10 (CTD DQE)

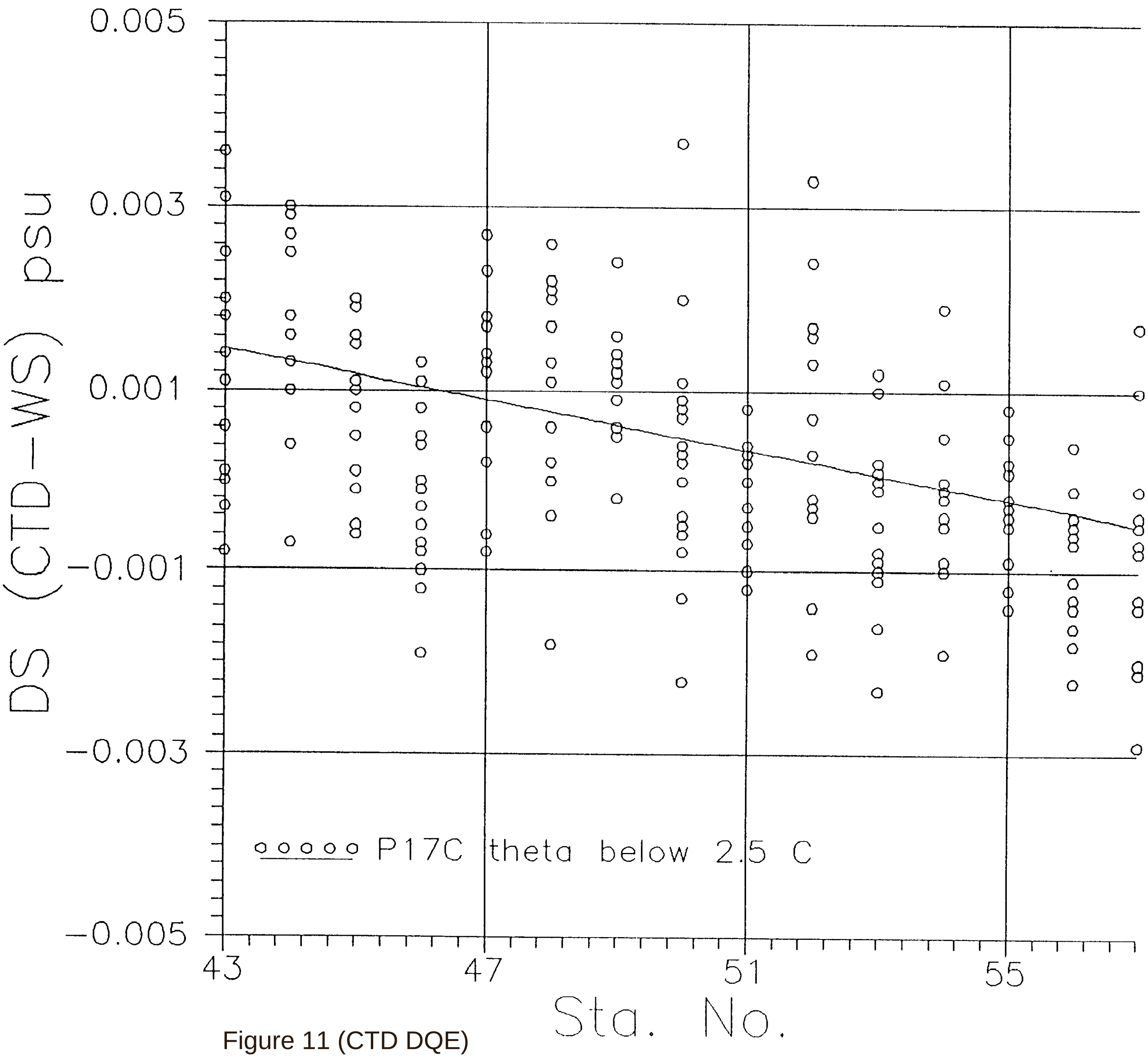

Figure 11 (CTD DQE)

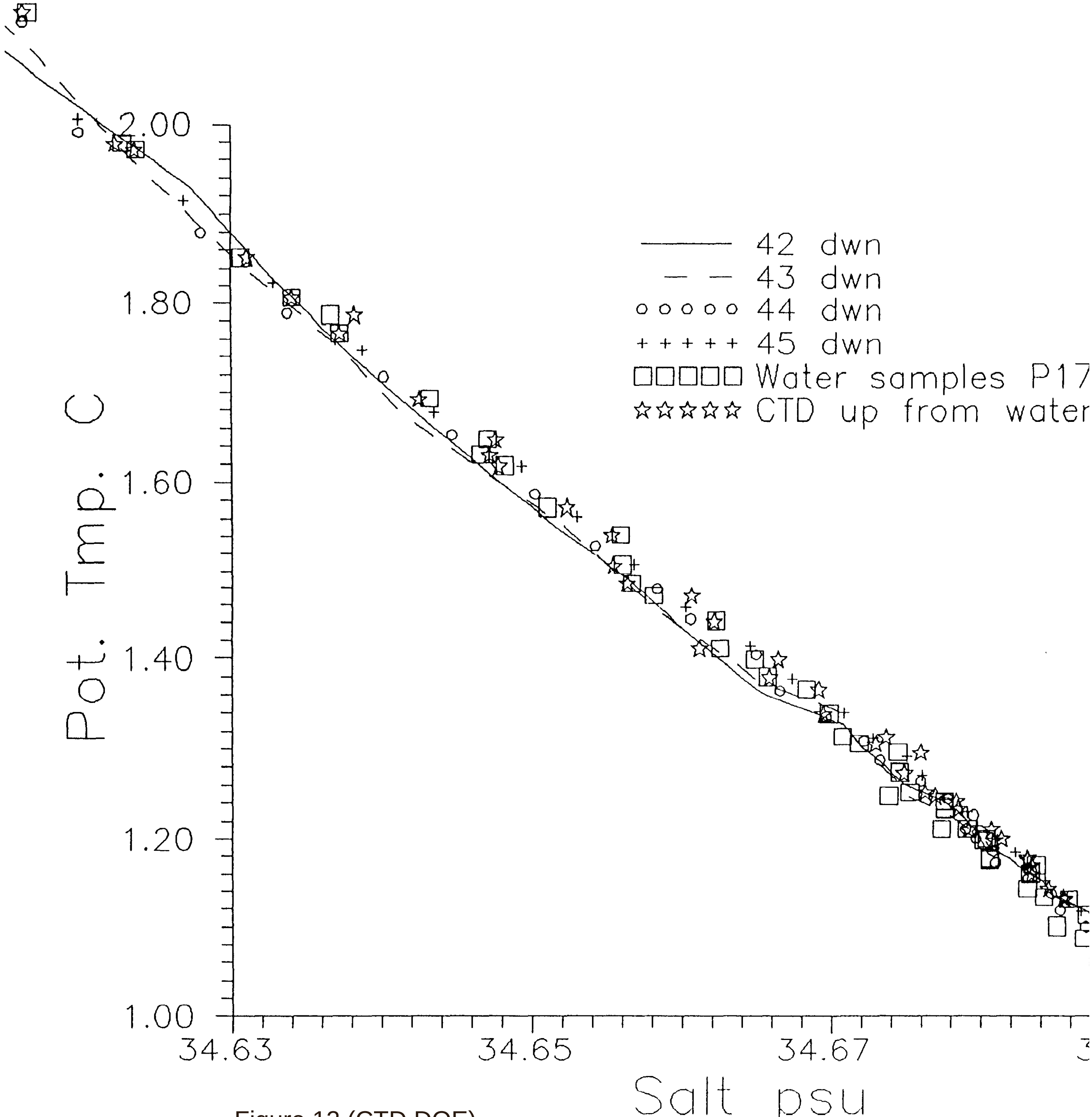

Figure 12 (CTD DQE)

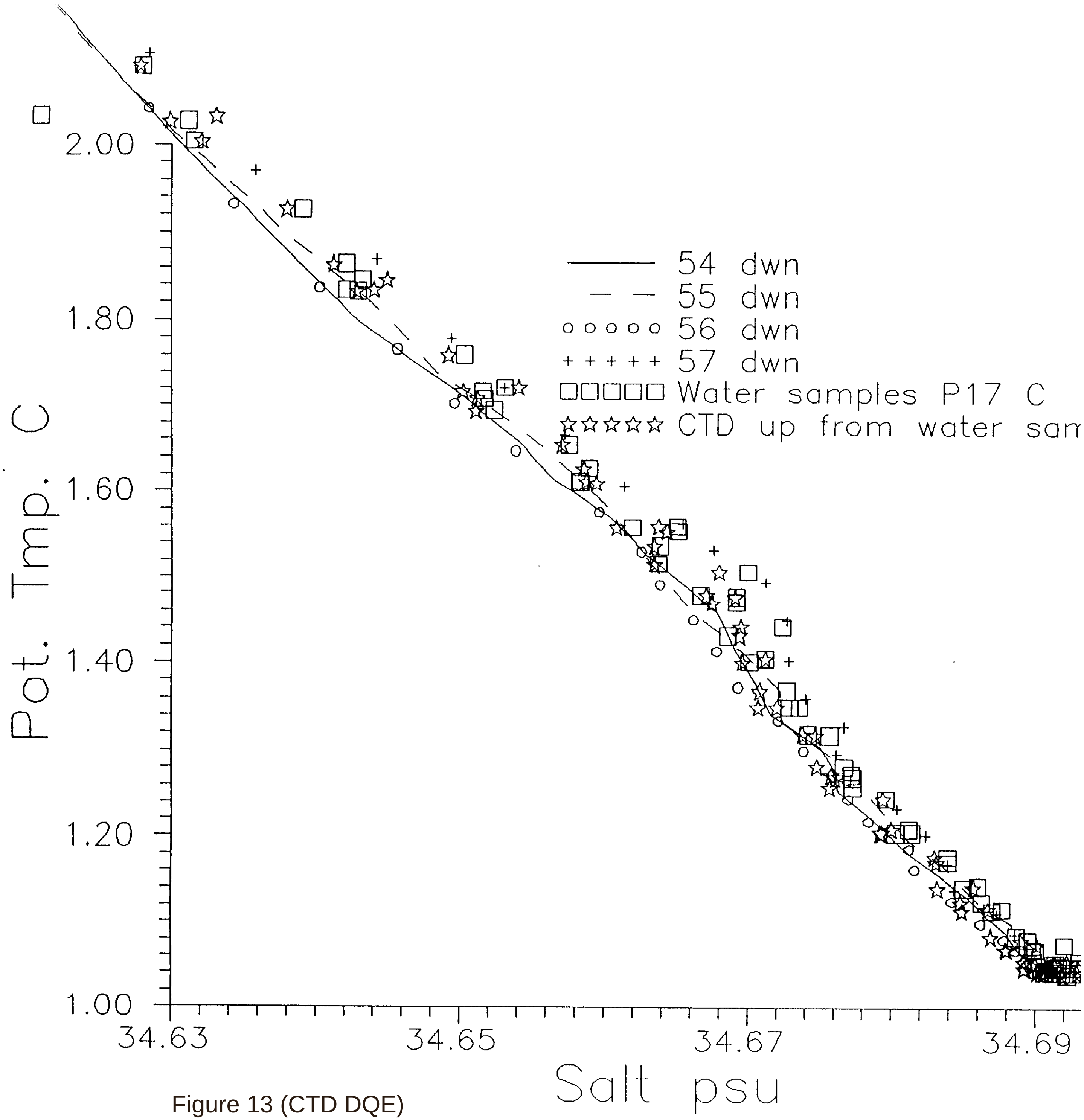

Figure 13 (CTD DQE)

E.2 Comments on DQ Evaluation of TUNES Leg I (P17C) Hydrographic Data

(A. Mantyla)
2 November 1993

Aside from suffering some lost data due to trip malfunctions common to CTD-Rosette casts, the sampling density and data quality of this cruise are quite good. The TUNES Leg I data are comparable to the TPS-24 cruise, and are better than most of the limited nearby historical data. The TUNES silicate, phosphate, and perhaps salinity tend to be lower than other cruises while the oxygen and nitrate data agree well. I expect the most recent data set to be the most reliable. The TUNES Leg I cruise track at 135°W helps to fill in a data sparse series of Marsden Squares in the Pacific and will certainly improve the Pacific deep data array.

The data originators have done a very meticulous job in evaluating the data and in solving trip problems, but they may have been overly zealous in flagging data that merely looked "funny" as "bad" data. Nutrients in particular, that were within the hoped for 1% of full scale accuracy range, were often flagged. In those cases, it is entirely possible that the flagged data could be closer to correct, and the accepted data slightly in error. However, I understand the desire to have an internally consistent data set and have not changed many of the flags.

Double trips, delayed trips and other mis-trips were frequent in the first 1/4 of the cruise and most trip problems have been resolved. I've noted a few other possible trip depth assignment errors below that if corrected, would change the data quality flags from "bad" or "questionable" to "good data". On some stations, a large number of bottles were flagged "4" (did not trip correctly) due to mis-trips or double-trips causing subsequent planned trips to be off by one or more target depths. Comparisons of the water sample salinity and oxygen measurements with the CTDO info is usually sufficient to match the correct CTD trip data to the water sample data with a reasonable degree of certainty, and the data originators have done that quite well for this cruise. I have not changed any of the "4" flags, although I believe that most should NOT be flagged "did not trip correctly" for the following reason: the initial mis-trip or double-trip represents a missed planned sampling depth and could even be a trip between planned depths and should be flagged as a problem. However, the subsequent trips are usually routine or normal, except that the initial CTD information assigned to the trip is incorrect. Once the correct trip info has been aligned with the water sample data, there really is little question as to the correctness of the data, and those levels should be accepted as OK rather than to leave doubt about the data by using the "4" bottle code.

The deep water salinity data early in the cruise bounced around a little more than one would expect from good salinometer operation, but settled down as the cruise progressed. Between stations 48 and 77, bottle 22 was strangely low in salinity 19 out of 29 stations, initially by about .012 and finally by about .022 for stations 73 to 77. Yet, the oxygen and nutrient data appeared to be fine. I don't know of anything that could affect the salinity in the low direction and not affect the other measurements. At any rate the problem went away once the bottle was finally replaced.

Many bottle oxygens were flagged as bad or questionable based on comparisons with the CTD O2, as if the CTD O2 data were perfect. I doubt that it is, and apparently ODF does not consider it good enough to report with the bottle data. They should make an effort to do so, as most other organizations are satisfying the WOCE reporting expectations of including the CTD oxygen data. If the UP water sample O2's are being evaluated against the down CTD O2 data, that may not be appropriate because of occasional real water mass changes between down and up casts and particularly in active interfingering of shallower layers that was common on this cruise. Some O2 data had been flagged bad even when it agreed with the CTD O2(!), usually when the comment "air leak" appeared on the sample log sheet. An air leak may well affect gas samples, but if it is at the level beyond the last reported significant figure, that should not be reason to flag the O_2 data as "bad".

Some of the nutrient problems probably could be resolved by careful evaluation of standards and blanks or possible shifts in machine response (PO_4), but the effort probably would not be worth the return in a few improved nutrient stations at this stage.

The following are some specific problems that should be looked at:

Stations 1 and 2:
Bottle salts average .008 less than CTD, yet the data comments form ODF indicate no difference at 303db and 353db. Station 2: The dot sea file shows a difference of .0070 and .0058. Is there a problem with the final CTD data here? Or was it a poor salinometer run? Discrepancy needs to be resolved.

Station 6:
Initial hang-up at bottle 34 caused bottles 14 and 34 to trip one depth shallower than intended. All flagged "4", "Did not trip correctly". Actually, CTD verifies trip levels, all except possibly 34 and 30 tripped OK. Suggest using "4" code at 34 and 30, accept others as good.

Station 7:
#31 at 3034db: Salinity and $0 sub 2$, flagged questionable, appear to belong 1 depth shallower. Nutrients would fit there also. Suggest moving the data to 2849db and flag the data OK.

Station 8:
249db and 354db: water samples deleted because of mis-trips. ODF data comments lists original analyses for the two depths identical to the last decimal place. Is that true? Not likely for 2 non-adjacent mis-trips. Recheck deleted data.

Station 11:

3401db: Looks like data belongs 1 level up at missed unlisted depth of 3145db. If done, remove uncertain flag from O_2.

Station 12:

As on station 6, bottles 13-34 tripped 1 planned level off, but CTD verifies correct depths. Suggest flag bottles OK, except for #20 and #29, use "4" code.

Stations 15:

Bottle 31 at 3963db flagged "u", but would be OK at next planned level up at 3706db (not listed), as would salinity and nutrients. Suggest change and flag bottle "4", data OK. #33 and #34, 4477db and 4730db: nearly identical nutrients and salinity, O_2 close. Most likely both tripped at same depth. #34 has hung-up on previous stations, so suggest move to 4477db. If not, flag silica "u".

Station 23:

Bottle 34 at 4268db data flagged "u", but is same as data at 4067db. Suggest move bottle 34 one depth up and accept data as OK, bottle "4 flag".

Station 34:

Deepest 3, 4276-4650db, clearly bad, must be titration or pickling error. Suggest omit. Curiously, these were flagged only "questionable", while O_2 at 3297db, only slightly off, was flagged "bad".

Station 44:

#18 and #36, 1011db and 5348db: O2's are identical, 173.3mm, both bad. Could there be some data recording error? If no error found, recommend deleting O_2 at 1011db.

Station 84:

Bottles 12, 2-11 (0-352db) flagged "4 did not trip correctly". Ramp shift probably offset, but CTD verifies correct trip depths, there is no uncertainty. Suggest change flags to OK (2).

Station 86:

First 12 bottles, as on 84. Accept as OK.

Station 98:

Cast 2, 36 fully sampled depths; and cast 4, 11 salinity and O_2 checks only, are merged together. They should not be merged as they are entirely separate profiles. List the casts separately.

E.2.1 Response to DQ Evaluation of TUNES Leg 1 (P17) Hydrographic Data

(Lynne D. Talley and Mizuki Tsuchiya)

June 15, 1994

Bottle flags: The operations manual states that a flag of "4" means that the bottle did not trip correctly. Using perphas the incorrect impression that if there had been any problem with tripping that the bottle should be flagged "4" even if it was felt that the correct tripping depth had been identified. Since this assumption seems to be incorrect many of the bottle flags "4" should be changed to "3".

Salinity at bottle 22: In the orginal report to the WHPO a note was included concering the salinities from station 48, bottle 22 to station 77 are slightly suspicious. This does indeed seem odd, and Arnold Mantyla confirmed that the values are "strangely low" and that this is odd. Not all bottle 22 salts are flagged, but the majority are between stations 48 and 77:

St	/C	Bot	Pres	Salt	Qual1
8	1	22	1615.5	-9.0000	32555555
11	1	22	1717.8	34.5642	22424444
14	1	22	1806.6	34.5747	22422222
48	1	22	2199.2	34.6299	32422222
54	1	22	1818.8	34.6067	32422222
57	2	22	2019.9	34.6209	32422222
59	1	22	1881.2	34.6095	32422322
61	1	22	353.1	34.4822	32422222
62	1	22	1818.2	-9.0000	92999999
63	1	22	2025.5	34.6293	32422222
64	1	22	1719.2	34.6025	32422222
65	1	22	2020.5	34.6295	32422222
66	2	22	1614.6	34.5945	32422222
67	1	22	1717.5	34.6014	32422222
68	1	22	1619.4	34.6060	32422222
69	1	22	1816.6	34.6185	32422222
70	1	22	1617.6	34.6089	32422222
71	1	22	1820.4	34.5942	32422222
72	1	22	1613.1	34.6040	32422222
73	1	22	1619.5	34.5928	32422222
74	1	22	1614.7	34.5892	32422222
75	1	22	1623.2	34.5902	32422222
76	2	22	1620.0	34.5917	32422222
77	1	22	1410.4	34.5750	32422222
102	1	22	1624.6	-9.0000	92999999

***Station 1* salinity**:
Although the station is listed in the DQE comments, there is actually no question listed there for station 1, so no response.

***Station 2* salinity**:
yes, the DQE is correct; the offsets at 303 and 353 db are really -0.007 and -0.006. No change to flags in sea file. The documentation should be changed to reflect this. Here is the corrected text for station 2, in section D (Bottle data comments):

Station 002

113	Bottle was closed but not intended as a sample. NBs 14 thru 17 were open as intended and ramp shaft in correct position. Water samples same as NB36 so assume NB 13 closed at first trip. This level is not reported.
129 @ 303db	Sample Log: "Air vent open" Delta-S -0.007 at 303db, in line with all other offsets on this station. O2 agrees with CTDO.
130 @ 353db	Sample Log: "Air vent open" Delta-S -0.006 at 353db, in line with all other offsets on this station. O2 agrees with CTDO.

Station 6:
mostly agree with DQE except for bottle 12. i.e. 6/1/30: bottle flag 4; 6/1/34: bottle flag 4; 6/1/12: bottle flag should be kept at 3 since "bottom cap knocked open"; 6/1/13-33 except 30 and 34: bottle flag 2

Station 7:
agree with DQE - change as requested i.e. 7/1/30 and 7/1/31: move salt, oxygen, nutrients from level 31 (3033) up to level 30 (2849 db) and flag as OK.

Station 8:
the 249 dbar values in the doc file are in error. They should read "Delete salinity (34.209), oxygen (2.3700), no3 (36.4), po4 (2.70), sio3 (97.5), no2 (0.00)." They have been changed in the new documentation.

Station 008

110 @ 249db	Sample log: Leaker. Delta-S .17 high at 249db. Nutrients also appear to be from deeper water. O2 looks ok. Delete salinity, o2, sil, no3, no2, po4, 34.209 2.37 97.5 36.4 0.00 2.70, respectively.

Station 11:
The measured salinity at bottle 31 is 34.667. The CTD salinity at 3401 is 34.669. The CTD salinity at 3145 is 34.663. The difference between measured and CTD salts for other bottles near this is on the order of -0.001 and -0.003. Thus increasing this difference to -0.006 by shifting the values to 3145 does not seem justified.

Station 12:
agree with DQE - change as requested i.e.
6/1/13-34: change bottle flag to 2 except for
6/1/20, 6/1/29: keep bottle flag of 4

Station 15
It is true that shifting bottle 31 from 3962 db to 3706 db would not be a problem with respect to salinity (it would actually slightly improve the difference between CTD and bottle salinity). The change in potential temperature is slight but enough that the oxygen seems to fit a bit better at 3706

than at 3962. The nutrients fit pretty well at either pressure and theta. There is a slight improvement to oxygen; the nutrients fit alright at both 3962 and 3706. We could therefore go either way - in our own version of the file, we will not change anything about bottle 31 unless the WHPO makes a decision to change the values.

ctdprs	theta	ctdsal	bottlesal
3706	1.4824	34.6761	34.6768
3962	1.4810	34.6786	34.6768

Thus we could have the following entry in the sea file:

15 1 31 31 3706.0 1.4824 34.6761 1.1954 34.6768 136.9 165.48 37.34 0.00 2.58 42222222

This is based on the 2dbar CTD data, since I don't have the raw CTD data here. If you would like this to be more refined, I can go back to ODF>

For station 15, bottle 34: change all CTD to same as bottle 33 at 4477, as suggested by DQE.

Station 23:
agree with DQE - change as requested, i.e. change all bottle 34 CTD data to be the same as bottle 33, no flags.

Station 34:
We assume that the DQE means only the oxygen values in the statement as the other parameters seem OK to us. Change as requested because values are truly terrible (all about 0 oxygen near the bottom).

Station 44:
The oxygen values at 1011 db and 5348 db had already been flagged as "4" (44/1/18 and 44/1/36)

Station 84:
agree with DQE - change bottle flags 84/1/12, 2-11 to 2 as requested

Station 86:
agree with DQE - change bottle flags as requested 86/1/12, 1-11 as requested.

Station 98:
agree with DQE - change as suggested. I believe that the latest version of this file which you received had these two casts separated (but I could be wrong).

Additional list of QUALT2 suggestions (DQE said that he has not listed many changes to "4" here - they are in the discussion above, so complete list should include above comments):

6/1/29	agree	
7/1/34	agree	
8/1/26	disagree	(we would retain 3 for silicate)
8/1/27	agree	
11/1/30	agree	
13/1/30	agree	
14/1/13	agree	
16/1/33	agree	
19/1/35	agree	
20/1/10	agree	
20/1/34	agree	
21/1/1	agree	
21/1/3	agree	
26/2/36	agree	
27/1/28	agree	
31/1/4	agree	
32/1/15	agree	
34/2/27	agree	
34/2/6	agree	
34/2/9	agree	
34/2/10	agree	
34/2/11	agree	
34/2/12	agree	
37/1/24	agree	
39/1/32	agree	
40/1/36	agree	
45/1/9	agree	
52/1/29	agree	
53/1/35	agree	
54/1/5	agree	

54/1/6	agree	
54/1/30	agree	
55/1/8	agree	
55/1/16	disagree	see DQE comment on 59/1/4: this is the beginning of some O_2 structure. It is quite apparent in $CTDO_2$ overlays (plot enclosed).
59/1/14	agree	
63/1/12	agree	
64/1/28	agree	
64/1/30	agree	
65/1/27	agree	
65/1/28	agree	
68/1/22	agree	
74/1/30	agree	
75/1/29	agree	
76/2/25	agree	
77/1/20	agree	
80/1/12	agree	
86/1/2	agree	
87/1/70	agree	
108/1/8	agree	
108/1/31	agree	
116/1/3	agree	
118/1/17	agree	
119/1/25	agree	
120/1/8	agree	
123/1/10	agree	

E.3. CFC Data Quality Evaluation (DQE) on P17C
(F. A. Van Woy)
January 13, 1995

We recently ftp'd the quality word changes that I made for Tunes leg 1, Pl7C. I believe that a reasonable assessment has been done. If the data originator wishes that I reconsider my choices, I will need to be provided with the following:

1) CFC air concentrations for each station
2) Calibration curves used for calculations
3) Chromatograms
4) Sample blanks applied and how determined
5) Stripper efficiency results
6) Contour plots

It is recommended on future cruises that the observer draw and run more replicate samples along with running more deep "blank" samples to assess the sample blank more thuroughly.

I believe that a reasonable quality assessment of the data has been done without the above items and any additional effort would take a fairly intensive involvement from this laboratory.

4 JAN 95

NBR	CASTNO	SAMPNO	CTDPRS	CFC-11	CFC-12	QUALT1	QUALT2
4	1	22	800.2	0.037		2~	3~
6	1	20	808.3		0.013	~2	~3
6	1	21	909.1	0.019	0.009	22	33
6	1	22	1009.3	0.021	0.013	22	33
6	1	34	3451.0		0.011	~2	~3
6	1	35	3867.1		0.020	~2	~3
6	1	36	4073.0	0.008	0.033	66	23
7	1	19	1006.3	0.018	0.003	28	32
10	1	13	407.4	0.649		2~	3~
11	1	20	1108.9	0.014	0.009	28	33
12	1	13	607.9	0.179		2~	3~
12	1	32	4322.5	0.013	0.006	27	32
13	1	20	908.6	0.025		2~	3~
14	1	1	3.0	2.805		2~	3~
14	1	3	48.7	2.922		2~	3~
14	1	5	101.5	3.105		2~	3~
14	1	33	4578.0	0.014	0.000	47	32
20	1	24	2023.7	0.019		2~	3~
22	1	14	602.7	0.161		8~	3~
22	1	16	809.9	0.019		2~	3~
22	1	18	1007.7	0.017		8~	3~
22	1	36	5028.9	0.010		2~	3~
27	1	33	3803.4		0.012	~2	~3
29	1	1	1.6	2.573	1.315	28	33

NBR	CASTNO	SAMPNO	CTDPRS	CFC-11	CFC-12	QUALT1	QUALT2
29	1	2	81.4	2.453	1.344	28	33
29	1	3	127.2	2.590	1.320	22	33
29	1	4	151.9	2.515	1.320	28	33
29	1	5	176.7	2.617	1.377	22	33
29	1	6	203.2	2.521	1.289	28	33
29	1	35	3658.5		0.010	~2	~3
29	1	36	3894.2		0.009	~2	~3
31	1	1	1.2	2.292		2~	3~
31	1	2	79.5	2.323		2~	3~
31	1	3	110.5	2.283		2~	3~
31	1	36	4545.9		0.011	~2	~3
33	1	35	4128.0		0.012	~2	~3
33	1	36	4366.3		0.013	~2	~3
34	2	9	4065.5		0.011	~2	~3
34	2	10	4275.6		0.013	~2	~3
34	2	11	4483.0		0.013	~2	~3
36	1	34	4268.1		0.011	~2	~3
36	1	35	4487.7		0.010	~2	~3
36	1	36	4689.1		0.009	~2	~3
39	1	8	227.5		1.336	~8	~3
43	1	28	3195.6	0.015		2~	3~
44	1	13	503.6		0.020	~2	~3
44	1	17	913.6	0.012	0.007	22	33
57	2	11	401.8	0.009	0.015	22	33
59	1	1	0.2	1.707	1.003	28	33
61	1	35	2225.1	0.013		2~	3~
63	1	10	263.4		0.058	~2	~3
63	1	11	355.0		0.028	~6	~3
66	2	7	127.8		0.139	~2	~3
66	2	8	152.7		0.104	~2	~3
66	2	9	202.5		0.082	~2	~3
66	2	10	253.7		0.051	~2	~3
66	2	11	304.3		0.050	~2	~3
67	1	10	182.1		0.073	~2	~3
67	1	11	243.3		0.067	~2	~3
67	1	12	306.0		0.054	~2	~3
71	1	11	313.6		0.054	~2	~3
76	2	11	307.9		0.088	~2	~3
77	1	3	90.2	1.618	.937	22	33
84	1	3	91.9	1.457	0.863	22	33
86	1	11	384.8	0.088	0.060	22	33
90	1	17	605.1		0.014	~2	~3
94	1	11	304.6		0.148	~2	~3
94	1	19	1008.8	-0.001	0.014	72	23
96	1	14	306.1		0.256	~2	~3
96	1	15	350.5		0.134	~2	~3
96	1	16	396.1		0.114	~2	~3
96	1	17	509.5		0.059	~2	~3
96	1	18	599.6		0.088	~2	~3
98	2	21	1617.9		0.010	~2	~3
100	1	16	606.1		0.012	~2	~3
100	1	17	708.8		0.007	~2	~3
100	1	18	806.4		0.010	~2	~3
100	1	20	1011.6		0.011	~2	~3
100	1	21	1215.7		0.013	~2	~3
108	1	16	711.5		0.011	~2	~3

NBR	CASTNO	SAMPNO	CTDPRS	CFC-11	CFC-12	QUALT1	QUALT2
112	1	18	809.3		0.016	~2	~3
122	1	1	0.2		0.950	~2	~3
122	1	18	960.0		0.008	~2	~3
123	1	36	4581.5	-0.001	0.009	72	23

E.4. Final CFC Data Quality Evaluation (DQE) Comments on P17C

(David Wisegarver)
Dec 2000

During the initial DQE review of the CFC data, a small number of samples were given QUALT2 flags which differed from the initial QUALT1 flags assigned by the PI. After discussion, the PI concurred with the DQE assigned flags and updated the QUAL1 flags for these samples.

The CFC concentrations have been adjusted to the SIO98 calibration Scale (Prinn et al. 2000) so that all of the Pacific WOCE CFC data will be on a common calibration scale.

For further information, comments or questions, please, contact the CFC PI for this section

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or
David Wisegarver (wise@pmel.noaa.gov)

Additional information on WOCE CFC synthesis may be available at:

http://www.pmel.noaa.gov/cfc.

Prinn, R. G., R. F. Weiss, P. J. Fraser, P. G. Simmonds, D. M. Cunnold, F. N. Alyea, S. O'Doherty, P. Salameh, B. R. Miller, J. Huang, R. H. J. Wang, D. E. Hartley, C. Harth, L. P. Steele, G. Sturrock, P. M. Midgley, and A. McCulloch, A history of chemically and radiatively important gases in air deduced from ALE/GAGE/AGAGE. Journal of Geophysical Research, 105, 17,751-17,792, 2000.

E.5 P17C TUNES-1 Final Report for Large Volume Samples

(Robert M. Key)

July 1, 1996

1.0 General Information

WOCE section P17C was the first in a series of three cruise legs collectively referred to as "TUNES". Mizuki Tsuchiya of SIO was chief scientist for this leg. This report covers details of data collection and analysis for the large volume Gerard samples. The reader is referred to "Documentation for WOCE Hydrographic Program section P17C" by L.D. Talley and M. Tsuchiya as the primary source for cruise information. Significant portions of this report (hydrography) were taken directly from a data report prepared by the *Oceanographic Data Facility* at Scripps Institution of Oceanography (dated July 17, 1995). Detailed text describing specific sample/bottle problems which were in the ODF report are reproduced here as an appendix.

Nine large volume (LV) stations were occupied on this leg. The cruise plan called for 2 Gerard casts of 9 barrels each at each LV station. The planned sampling density was 1 station every 5° of latitude (~300nmi). Each station, except for station 34, included at least one deep cast (2500db to the bottom), and an intermediate (1000db to 2500db) cast. In the event of mistripped Gerard sampler(s), casts were repeated as time allowed in an attempt to collect the full suite of samples. The purpose of these casts was to collect samples for ^{14}C analysis. ^{14}C coverage for the upper water column was done *via* small volume AMS sampling from the Rosette. This report covers only the large volume Gerard sampling.

All LV casts for the TUNES cruises were done using the stern A-frame on the R/V Thomas Washington. As is generally the case, the combination of a small vessel with working off the stern led to an elevated failure rate for the LV work relative to working off the side of a larger vessel. This problem is a result of accelerations on the trawl wire caused by ship motion and sea state. Slowing the lowering rate to 50 meters per minute or less reduced the failure rate. The Gerard barrel platform, as set up in port prior to the cruise, did not allow enough clearance for barrel deployment and recovery. The Chief Engineer cut the platform loose and rewelded it to the deck about one foot forward. The spring-loaded trapping-pin was no longer usable so a chain was shackled to one forward corner of the platform, passed aft of the wire then hooked to the other forward corner to hold the trawl wire in the platform "V" while the barrels were being attached and detached. Limited fantail space and the low trawl wire lead required that the crane work over the wire to move barrels from racks to near the center-line just forward of the platform, then the barrel was unhooked and the crane moved to the other side of the wire and re-hooked to move the barrel to the attachment position. This procedure was reversed for recovery. Problems were minimized by the exceptional effort and capability of the Washington's crew. Table 1 summarizes the LV sampling.

TABLE 1. LV Sampling Summary

Station	Cast	Latitude	Longitude	No. Ger. Samples
17	1	34°35.7'N	134°59.1'W	9
	3	34°36.4'N	134°56.6'W	5
	4	34°37.0'N	134°55.7'W	1
	5	34°37.1'N	134°55.2'W	3
26	1	30° 0.8'N	134°58.1'W	9
	3	30° 2.2'N	134°53.6'W	9
34	1	26° 1.2'N	134°59.5'W	9
46	1	19°58.5'N	135° 0.3'W	8
	3	19°58.8'N	135° 1.9'W	9
57	1	14°28.6'N	134°59.3'W	9
	3	14°26.5'N	134°58.4'W	9
66	1	9°58.8'N	135° 2.1'W	9
	3	9°56.5'N	135° 5.5'W	4
	4	9°55.8'W	135° 5.9'W	5
76	1	5° 0.2'N	134°58.9'W	9
	3	4°57.7'N	134°56.0'W	9
98	1	0° 0.3'S	135° 9.5'W	9
	3	0° 0.3'S	135° 8.2'W	9
121	2	5° 4.6'S	135° 0.8'W	5
	3	5° 6.1'S	135° 1.5'W	4
	4	5° 7.9'S	135° 2.9'W	9
Total	21			152

Each Gerard barrel was equipped with a piggyback 5 liter Niskin bottle which had a full set of high precision reversing thermometers to determine sampling pressure and temperature. Both Gerard and Niskin were sampled for salinity. Additionally, each Gerard was sampled for silicate and radiocarbon. The salinity samples from the piggyback bottle were used for comparison with the Gerard barrel salinities to verify the integrity of the Gerard sample. Discrete sample information was recorded on a log sheet. Normal sampling practice is to open the Gerard drain valve before opening the air vent to see if water escapes, indicating the presence of a small air leak in the sampler. This observation ("air leak"), and other comments ("lanyard caught in lid", "valve left open", etc.) which may indicate some doubt about the integrity of the water samples were also noted on the log sheets. These comments are included in the appendix. The hydrographic data were entered into the shipboard data system and processed as analyses were completed. The bottle data were brought to a usable, though not final, state at sea. ODF data checking procedures included verification that the sample was assigned to the correct depth. ODF compared salinity and nutrient data with data from adjacent stations and with the rosette cast data from the same station. Any comments regarding the water samples were investigated. The raw data computer files were also checked for entry errors.

2.0 Personnel

LV sampling for this cruise was under the direction of the principal investigator, Robert M. Key (Princeton). All LV ^{14}C extractions at sea were done by Leonard Lopez (SIO-ODF). In addition to Key and Lopez, deck work was done by the SIO CTD group with assistance from many of the scientific party. Lopez was primarily responsible for reading thermometers. Salinities and nutrients were analyzed by the SIO CTD group and the Oregon State Univ. group respectively. ^{14}C analyses were performed at Göte Östlund's laboratory (U. Miami, R.S.M.A.S.). Key collected the data from the originators, merged the files, assigned quality control flags to the ^{14}C, rechecked the flags assigned by ODF and submitted the data files to the WOCE office (8/95).

3.0 Results

This data set and any changes or additions supersedes any prior release.

In this data set Gerard samples can be differentiated from Niskin samples by the bottle number. Niskin bottle numbers are in the range 41-50 while Gerards are in the range 81-94.

3.1 Pressure and Temperature

Pressure and temperature for LV casts are determined by reversing thermometers mounted on the piggyback Niskin bottle. Each bottle was equipped with the standard set of 2 protected and 1 unprotected thermometer. Each temperature value reported on the LV casts was calculated from the average of four readings, provided both protected thermometers functioned normally. Reported temperatures are relative to the International Temperature Scale of 1990. All thermometers, calibrations and calculations were provided by SIO-ODF. Reported temperatures for samples in the thermocline are believed to be accurate to 0.01°C and for deep samples 0.005°C. Pressures were calculated using standard techniques combining wire out with unprotected thermometer data. In cases where the thermometers failed, pressures were estimated by thermometer data from adjacent bottles combined with wire out data. Because of the inherent error in pressure calculations and the finite flushing time required for the Gerard barrels, the assigned pressures have an uncertainty of approximately 10 dB. The pressures recorded in the data set for each Gerard-Niskin pair generally differ by approximately 0.5 dB with the Gerard pressure being the greater. This is because the Niskin is hung near the upper end of the Gerard.

3.2 Salinity

A salinity samples was collected from each Gerard barrel and each piggyback Niskin bottle. Analyses were performed by the same personnel who ran the salt samples collected from the Rosette bottles so the analytical precision should be the same for LV salts and Rosette salt samples. When both Gerard and Niskin trip properly, the difference between the two salt measurements should be within the range 0.000 - 0.003 on the PSU scale. Somewhat larger differences can occur if the sea state is very calm and the cast is not "yoyo'ed" once the terminal wire out is reached. This difference is due to the flushing time required for the Gerard barrels and the degree of difference is a function of the salinity gradient where the sample was collected. In addition to providing primary hydrographic data for the LV casts, measured salinity values help confirm that the barrels closed at the desired depth. For the area covered by this leg, deep nutrient values (especially silicate) are as useful for trip confirmation as salt measurements due to the very low vertical gradient in salinity.

Salinity samples were drawn into 200 ml Kimax high alumina borosilicate bottles after 3 rinses, and were sealed with 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 ensure a continued airtight seal. Salinity was determined after a box of samples had equilibrated to laboratory temperature, usually within 8-12 hours of collection. The draw time and equilibration time, as well as per-sample analysis time and temperature were logged.

A single Guildline Autosal Model 8400A salinometer located in a temperature controlled laboratory was used to measure salinities. The salinometer was standardized for each cast with IAPSO Standard Seawater (SSW) Batch P-114, 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 (UNESCO 1981) was then calculated for each sample from the measured conductivity ratios, and the results merged with the cruise database. There were some problems with lab temperature control throughout cruise; the Autosal bath temperature was adjusted accordingly. Salinities were generally considered good for the expedition despite the lab temperature problem.

3.3 Nutrients

Nutrient samples were collected from Gerard samples. On this leg silicate values were measured on all samples and phosphate on a few selected samples. LV nutrients were measured along with Rosette nutrients so the analytical precision for Gerard samples should be the same as Rosette samples. For some unknown reason, nutrients collected from LV casts are frequently subject to systematic offsets from samples taken from Rosette bottles. For this reason it is recommended that these data be viewed primarily as a means of checking sample integrity (*i.e.* trip confirmation). The Rosette-Gerard discrepancy is frequently less for silicate than for other nutrients.

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 with solutions prepared aboard ship from preweighed chemicals; these solutions were used as working standards before and after each cast to correct for instrumental drift during analysis. Sets of 4-6 different concentrations of shipboard standards were analyzed periodically to determine the linearity of colorimeter response and the resulting correction factors.

Nutrient analyses were performed on a modified 4 channel Technicon AutoAnalyzer II, generally within one hour of the cast. Occasionally samples were refrigerated at 2 to 6 °C for a maximum of 4 hours. The methods used are described by Gordon *et al*. (1992), Atlas *et al*. (1971), and Hager *et al*. (1972). All peaks were logged manually, and all the runs were re-read to check for possible reading errors.

Silicate was analyzed using the technique of Armstrong *et al*. (1967). ODF''s methodology is known to be non-linear at high silicate concentrations (>120 μM); a correction for this non-linearity was applied. Phosphate was analyzed using a modification of the Bernhardt and Wilhelms (1967) technique.

Na_2SiF_6, the silicate primary standard, was obtained from Fluka Chemical Company and Fischer Scientific and is reported by the suppliers to be >98% pure. Primary standards for phosphate, KH_2PO_4, were obtained from Johnson Matthey Chemical Co. and the supplier reports purity of 99.999%.

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

152 nutrient (silicate) analyses were performed. No major problems were encountered with the measurements.

3.4 ^{14}C

Most of the $\Delta^{14}C$ values reported here have been distributed in a data report produced by Östlund (1992). That report included preliminary hydrographic data and is superceded by this submission.

All Gerard samples deemed to be "OK" on initial inspection at sea were extracted for ^{14}C analysis using the technique described by Key (1991). The extracted $^{14}CO_2$/NaOH samples were returned to the Ocean Tracer Lab at Princeton and subsequently shipped to Östlund's lab in Miami. Both ^{13}C and ^{14}C measurements are performed on the same CO_2 gas extracted from the large volume samples (^{13}C analyses at M. Stuiver's lab, U. Washington). The standard for the ^{14}C measurements is the NBS oxalic acid standard for radiocarbon dating. R-value is the ratio between the measured specific activity of the sample CO_2 to that of CO_2 prepared from the standard, the latter number corrected to a $\delta^{13}C$ value of -19‰ and age corrected from today to AD1950 all according to the international agreement. $\Delta^{14}C$ is the deviation in ‰ from unity, of the activity ratio, isotope corrected to a sample $\delta^{13}C$ value of -25‰. For further information of these calculations and procedures see Broecker and Olson (1981), Stuiver and Robinson (1974) and Stuiver (1980). Östlund's lab reports a precision of 4‰ for each measurement based on a long term average of counting statistics.

Of the 152 Gerard samples collected, ^{14}C has been measured on 148 (97%). This exceeds the rate funded for this work (80%).

Existing ^{14}C data for the area sampled on this cruise is limited to a few GEOSECS measurements. Comparison of these two data sets indicates that they are in agreement to the precision of the measurements.

4.0 Data Summary

Figures 1, 2, 3 summarize the large volume ^{14}C data collected on this leg. All $\Delta^{14}C$ measurements with a quality flag value of 2 are included in each figure. Figure 1 shows the $\Delta^{14}C$ values plotted as a function of pressure for the thermocline region (1a) and for the deep and bottom waters (1b). One sigma error bars (±4‰) are shown in both 1a. and 1b. The most noticeable characteristic is the strong minimum in the 2000-2600dB range for all stations. Figure 2 show the $\Delta^{14}C$ values plotted against measured Gerard barrel silicate values. The rather strong ^{14}C-silicate correlation noted for the TUNES-3 (P16C) data is not so evident in Figure 2. Figure 3 is a coarse resolution machine contoured section of the ^{14}C distribution in the deep and bottom waters for this leg. The minimum decreases in intensity and scope to the south and has an extreme value of -251‰. The "bi-lobed" nature of the -240‰ contour is an artifact of the gridding routine.

5.0 References and Supporting Documentation

Armstrong, F. A. J., C. R. Stearns, and J. D. H. Strickland, 1967. The measurement of upwelling and subsequent biological processes by means of the Technicon Autoanalyzer and associated equipment, *Deep-Sea Research, 14,* 381-389.

Atlas, E. L., S. W. Hager, L. I. Gordon and P. K. Park, 1971. A Practical Manual for Use of the Technicon AutoAnalyzer in Seawater Nutrient Analyses; Revised. Technical Report 215, Reference 71-22. Oregon State University, Department of Oceanography. 49 pp.

Bernhardt, H. and A. Wilhelms, 1967. The continuous determination of low level iron, soluble phosphate and total phosphate with the AutoAnalyzer, Technicon Symposia, Volume I, 385-389.

Brewer, P. G. and G. T. F. Wong, 1974, The determination and distribution of iodate in South Atlantic waters, *Journal of Marine Research, 32*, 1:25-36.

Broecker, W.S., and E.A. Olson, 1961, Lamont radiocarbon measurements VIII, *Radiocarbon, 3,* 176-274.

Bryden, H. L., 1973, New polynomials for thermal expansion, adiabatic temperature gradient, *Deep-Sea Research, 20,* 401-408.

Carpenter, J. H., 1965, The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method, *Limnology and Oceanography, 10,* 141-143.

Carter, D. J. T., 1980, (Third Edition), Echo-Sounding Correction Tables, Hydrographic Department, Ministry of Defence, Taunton Somerset.

Chen, C.-T. and F. J. Millero, 1977, Speed of sound in seawater at high pressures, *Journal Acoustical Society of America, 62(5),* 1129-1135.

Culberson, C. H., Williams, R. T., et al, August, 1991, A comparison of methods for the determination of dissolved oxygen in seawater, WHP Office Report WHPO 91-2.

Fofonoff, N. P., 1977, Computation of potential temperature of seawater for an arbitrary reference pressure, *Deep-Sea Research, 24*, 489-491.

Fofonoff, N. P. and R. C. Millard, 1983, Algorithms for computation of fundamental properties of seawater, UNESCO Report No. 44, 15-24.

Gordon, L. I., Jennings, Joe C. Jr., Ross, Andrew A., Krest, James M., 1992, A suggested protocol for continuous flow automated analysis of seawater nutrients in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study, OSU College of Oceanography Descr. Chem. Oc. Grp. Tech. Rpt. 92-1.

Hager, S. W., E. L. Atlas, L. D. Gordon, A. W. Mantyla, and P. K. Park, 1972, A comparison at sea of manual and autoanalyzer analyses of phosphate, nitrate, and silicate, *Limnology and Oceanography, 17*, 931-937.

Key, R.M., 1991, Radiocarbon, in: WOCE Hydrographic Operations and Methods Manual, WOCE Hydrographic Program Office Technical Report.

Key, R.M., D. Muus and J. Wells, 1991, Zen and the art of Gerard barrel maintenance, WOCE Hydrographic Program Office Technical Report.

Lewis, E. L., 1980, The practical salinity scale 1978 and its antecedents, *IEEE Journal of Oceanographic Engineering, OE-5*, 3-8.

Mantyla, A. W., 1982-1983. Private correspondence.

Millero, F. J., C.-T. Chen, A. Bradshaw and K. Schleicher, 1980, A new high pressure equation of state for seawater, *Deep-Sea Research, 27A*, 255-264.

Saunders, P. M., 1981, Practical conversion of pressure to depth, *Journal of Physical Oceanography, 11*, 573-574.

Stuiver, M., and S.W. Robinson, 1974, University of Washington GEOSECS North Atlantic carbon-14 results, *Earth Planet. Sci. Lett., 23,* 87-90.

Stuiver, M., 1980, Workshop on ^{14}C data reporting, *Radiocarbon, 3,* 964-966.

Sverdrup, H. U., M. W. Johnson, and R. H. Fleming, 1942, The Oceans, Their Physics, Chemistry and General Biology, Prentice-Hall, Inc., Englewood Cliffs, N.J.

UNESCO, 1981, Background papers and supporting data on the Practical Salinity Scale, 1978, UNESCO Technical Papers in Marine Science, No. 37, 144 p.

6.0 Quality Control Flag Assignment

Quality flag values were assigned to all bottles and all measurements using the code defined in Tables 0.1 and 0.2 of WHP Office Report WHPO 91-1 Rev. 2 sections 4.5.1 and 4.5.2 respectively. In this report the only bottle flag values used were 2, 3, 4 and 9. For the measurement flags values of 2, 3, 4 or 9 were assigned. The interpretation of measurement flag 9 is unambiguous, however the choice between values 2, 3 or 4 is involves some interpretation. For this data set, the salt and nutrient values were checked by plotting them over the same parameters taken from the rosette at the same station. Points which were clearly outliers were flagged “4”. Points which were somewhat outside the envelop of the other points were flagged “3”. In cases where the entire cast seemed to be shifted to higher or lower concentrations (in nutrient values), but the values formed a smooth profile, the data was flagged as “2”. The few phosphate measurements which were made on these samples are all flagged “4”. Comments are given in the next section for flag values of 3 or 4 in almost all cases. Once the nutrient and salt data had been flagged, these results were considered in flagging the ^{14}C data. There is very little overlap between this data set and any existing ^{14}C data, so that type of comparison was impractical. In general the lack of other data for comparison led to a more lenient grading on the ^{14}C data.

When using this data set for scientific application, any ^{14}C datum which is flagged with a “3” should be carefully considered. My subjective opinion is that any datum flagged “4” should be disregarded. When flagging ^{14}C data, the measurement error was taken into consideration. That is, approximately one-third of the ^{14}C measurements are expected to deviate from the true value by more than the measurement precision of ~4‰.

No measured values have been removed from this data set. When using this data set, it is advised that the nutrient data only be considered as a tool for judging the quality of the ^{14}C data regardless of the quality code value. A summary of all flags is provided in Table 2.

TABLE 2. TUNES-1 Quality Code Summary

	Reported	**WHP Quality Codes**								
	Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
BTLNBR	306	0	286	3	12	0	0	0	0	5
SALNTY	301	0	287	3	10	0	0	0	0	5
SILCAT	152	0	149	1	2	0	0	0	0	154
NITRAT	0	0	0	0	0	0	0	0	0	306
NITRIT	0	0	0	0	0	0	0	0	0	306
PHSPHT	9	0	0	0	9	0	0	0	0	297
REVPRS	306	0	306	0	0	0	0	0	0	0
REVTMP	296	0	292	0	4	0	0	0	0	10
DELC14	148	0	139	8	1	0	0	0	0	158[a]

a. ^{14}C large volume samples can not be collected from piggyback Niskin bottles

7.0 APPENDIX: Detailed Sample Notes

The following table lists comments recorded on the sample collection and thermometer sheets, and includes notes on sample flags provided by ODF. Any text in this listing shown in *italics* was added by the author in the final QC check which included the ^{14}C data. The first column is the cast number (CASTNO) times 100 plus the bottle number (BTLNBR). In the comment field, “GB” or “G” stands for Gerard, “PB” refers to the piggyback 5 liter Niskin bottle and “N-G” is the arithmetic difference between the measured salinity values for a Niskin - Gerard pair.

TABLE 3.

Sample ID	Comment
Station 17	
548 @ 497db	Sample log: “Didn’t close” Lanyard stuck. No water sample or therm. readings. GB93 at this level (497db) has good salinity and SIL compared to other samples this station.
593 @ 497db	Gerard is acceptable, no temperature. See PB (48) comment.
388 @ 1992db	Sample log: “tripped but messenger hung” Re-lowered bottom 4 barrels as cast 4. PB (45).
446 @ 2249db	Sample log: “Air leak” N-G -.001 at 2248db. Gerard (89) is okay.
489 @ 2249db	Sample log: “Air vent not tight. messenger hung - tripping wire loose” N-G -.001 at 2249db. Gerard SIL also ok. Gerard is okay, PB (46). Bottom 3 barrels tripped as cast 5 with Terminal Reading 762m (wire out when GB89 taken off wire).
141 @ 3155db	Delta-S(PB-G) at 3155db is 0.007, salinity is 34.665. Footnote salinity bad. Gerard (83) is okay.
183 @ 3156db	Gerard is okay, PB (41).
142 @ 3660db	N-G=.021 at 3660db. See 185. PB salinity calc ok. No other samples from Niskin. Footnote salinity bad. Gerard (85) is acceptable.
185 @ 3660db	Sample log: “drain valve loose” N-G -.021 at 3660db. Gerard salinity, silicate & phosphate match profile from other samples this station. PB (142) appears low. Gerard is acceptable, PB (42) may have leaked.
146 @ 4419db	Delta-S(PB-G) at 4419db is 0.002, salinity is 34.677. Gerard (89) is acceptable.
189 @ 4419db	Sample log: “air vent loose” N-G=.002 at 4419db. PO4 & SIL from Gerard also look good. Gerard is acceptable, PB (46).
148 @ 4931db	Sample log: “bottom end cap hung up” No water samples.

TABLE 3.

Sample ID	Comment
193 @ 4931db	No check sample from PB. See 148. Gerard salinity, phosphate & silicate match profile from other samples this station.
Station 26	
345 @ 175db	Sample log: “Didn't close.” No temperature. Gerard (88) is acceptable.
388 @ 176db	No temperature, PB (45) did not trip. Gerard probably okay, salinity agrees with rosette data. Silicate is ~2.0 high vs. rosette data.
343 @ 542db	Delta-S(PB-G) at 542db is 0.004, salinity is 34.030. Gerard (85) is probably okay. PB salinity is high compared with rosette data.
385 @ 543db	Gerard is probably okay, PB (43). Silicate agrees with rosette data.
344 @ 794db	Delta-S(PB-G) at 794db is 0.005, salinity is 34.282. Gerard (87) is probably okay. PB salinity is high compared with rosette data.
387 @ 795db	Gerard is okay, PB (44). Silicate agrees with rosette data.
342 @ 1091db	Sample log: “Broken bottom block.” Gerard (84) is acceptable. Delta-S(PB-G) at 1091db is 0.002, salinity is 34.449.
142 @ 2997db	Delta-S(PB-G) at 2997db is -0.007, salinity is 34.657. Footnote salinity bad, could be drawing error. Gerard (84) is acceptable.
146 @ 3999db	Delta-S(PB-G) at 3999db is -0.003, salinity is 34.679. Gerard (89) is okay. PB salinity is low compared with rosette data.
148 @ 4506db	Sample log: “Spigot was pushed in, little water in niskin” N-G -.003 at 4509db. Gerard (93) is acceptable. Delta- S(PB-G) at 4506db is -0.003, salinity is 34.681.
193 @ 4506db	Gerard is acceptable, PB (48).
149 @ 4761db	Delta-S(PB-G) at 4761db is 0.006, salinity is 34.683. PI to decide integrity of Gerard (94). ^{14}C *looks ok*, *code as 2.*
194 @ 4761db	Salinity is low compared to rosette cast, too. Silicate is low compared with adjoining rosette stations, but is acceptable. PB (49). Footnote salinity bad. PI to decide integrity of Gerard. ^{14}C *is ok*, *code as 2.*
Station 34	
Cast 1	All samples accounted for. C-14 extraction only.

TABLE 3.

Sample ID	Comment
181 @ 2281	^{14}*C low based on profile and on section plot, coded 3*
183 @ 2582db	Sample log: “Needs pillow block.” PB (42).
150 @ 3793db	Sample log: “Replaced Niskin 46 with 50 - broken upper block.” Delta-S(PB-G) at 3793db is 0.009, salinity is 34.680. Gerard (89).
189 @ 3793db	*Salinity and* ^{14}C *consistent with pressure of about 3200db, but not silicate. Salinity and* ^{14}C *coded as 3.*
148 @ 4405db	Delta-S(PB-G) at 4405db is 0.004, salinity is 34.683. Gerard (93).
193 @ 4406db	Sample log: “Tightened niskin trip.” PB (48). ^{14}C *low relative to profile and in section plot. Coded 3.*
194 @ 4714db	^{14}C *low relative to profile and in section plot. Coded 3.*
Station 46	
183 @ 3453db	Sample log: “Didn't latch - O-ring off center.” Salinity agrees with rosette and PB salinity, silicate agrees with rosette data. Let PI decide on integrity of Gerard. PB (42). ^{14}C *looks ok. All flags remain 2.*
143 @ 3703db	Temperature is ~0.09 high, salinity agrees with Gerard and rosette data. Footnote temperature bad. Gerard (84) is acceptable.
184 @ 3703db	Gerard is acceptable. See PB (43) temperature comment. Footnote temperature bad. ^{14}C *high by about 2 sigma on both profile and section plots, coded 3.*
145 @ 4209db	No sample or temperature, Gerard (87) also had no sample.
187 @ 4209db	Sample log: “Didn't trip - no tripping pin.” No sample or temperature, PB (45) also had no sample.
189 @ 4465db	Sample log: “Closed but didn't latch.” Salinity agrees with rosette and PB salinity, silicate agrees with rosette data. Let PI decide on integrity of Gerard. PB (50). ^{14}C *looks ok. All flags remain 2.*
393 @ 2649	^{14}C *high by about 2 sigma on both profile and section plots, coded 3.*
Station 57	
342 @ 1240db	Sample log: “Spigot pushed in.” Gerard (83) is acceptable.

TABLE 3.

Sample ID	Comment
383 @ 1241db	Sample log: “Replaced lid o-ring but still a very tight fit. Did not latch - swap with 88 next time.” Gerard is acceptable, PB (42).
350 @ 1511db	Gerard (89) is acceptable within 20db of reassigned pressure.
389 @ 1511db	Sample log: “Lid closed @ ~1570 by salt, Si, and T.” Thermometric pressure, both Niskin (50) & Gerard salinities (89), and Gerard silicate indicate barrel closed at about 1510db instead of the intended depth of 2242db. The double ping came on time and all samples below were ok so the messenger released properly but the Gerard lid closed early or late. Footnote bottle did not trip correctly. PB (50). Samples are good within 20 db of reassigned pressure.
344 @ 1741db	Sample log: “Came up no therm rack?” Gerard (85) is acceptable.
385 @ 1742db	Gerard is acceptable, no temperature, see PB (44) comment.
142 @ 3301db	Delta-S(PB-G) at 3301db is 0.014, salinity is 34.672. Gerard (83) leaked.
183 @ 3301db	Sample log: “Didn't latch - o-ring again same as before.” Delta-S(PB-G) at 3301db is 0.014, salinity is 34.672. Data show leak on Gerard 83. Footnote bottle leaking, samples bad. PB (42). ^{14}C *value somewhat high, but within 2 sigma of expected. Coded as 3 by association with other measurements.*
145 @ 3981db	Gerard (87) is acceptable. Temperature is ~0.04 high. Footnote temperature bad.
187 @ 3982db	Gerard is acceptable. Footnote temperature bad. PB (45).
Station 66	
343 @ 1420db	Delta-S(PB-G) at 1420db is 0.02, salinity is 34.585. Gerard salinity is low. Could be a drawing error. Let PI decide integrity of Gerard (85).
385 @ 1420db	Delta-S(PB-G) at 1420db is 0.02, salinity is 34.585. Gerard salinity is low. Silicate agrees with rosette cast. Could be a drawing error. Footnote salinity bad. Let PI decide integrity of Gerard (85). PB (43). ^{14}C *looks ok, code as 2.*
387 @ 1658db	Sample log: “Messenger not released.” Gerard is acceptable, PB (44). The remainder of the profile was done as Cast 4.

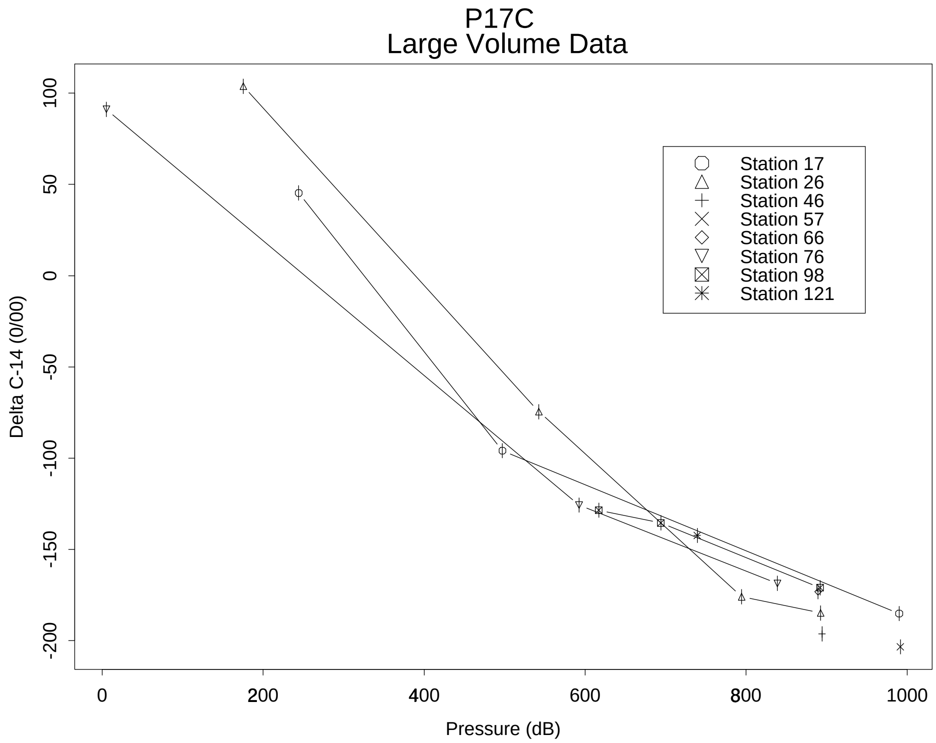
TABLE 3.

Sample ID	Comment
149 @ 4935db	Delta-S(PB-G) at 4935db is 0.004, salinity is 34.693. Gerard (94) may have leaked. Gerard salinity is low, silicate looks reasonable. Suspect there was a leak, let PI decide.
194 @ 4936db	Sample log: “Air vent open on return. Was definitely closed when deployed.” Gerard salinity is low, silicate looks reasonable. Suspect there was a leak, let PI decide. Footnote bottle leaking, salinity bad. PB (49). ^{14}C *looks ok, code as 2.*
Station 76	
Cast 1	Sample log: “Cast nominal. Thermometer malfunction.”
389 @ 1588db	Sample log: “Therm rack 6 reversed on deck.” Temperature is lost. Gerard salinity and silicate agree with rosette data. Gerard is acceptable, PB (50).
350 @ 1588db	Temperature is lost. Gerard salinity and silicate agree with rosette data. Gerard (89) is acceptable.
Station 98	
150 @ 617db	Delta-S(PB-G) at 617db is -0.014, salinity is 34.577. Thermometric Pressure 617 vs intended depth 3370db. Water samples also from about 617db. Footnote bottle pretripped and samples bad. Gerard (88) appears to have leaked.
188 @ 617db	Sample Log: “Bad o-ring? Would not pressurize; opened and recused, o-ring damaged.” Thermometric Pressure 617 vs intended depth 3370db. Water samples also from about 617db. Lid o-ring cut, difficult to open lid. Used 617 db as accepted pressure with water samples as is. Footnote bottle did not trip correctly, samples bad. PB (50).
393 @ 1894db	Delta-S(PB-G) at 1893db is -0.0592, salinity is 34.639. Salinity too high, but soil reasonable. Footnote salinity bad.
145 @ 3117db	Delta-S(PB-G) at 3117db is -0.011, salinity is 34.677. PI to decide integrity of Gerard (87).
187 @ 3118db	Delta-S(PB-G) at 3117db is -0.011, salinity is 34.677. Gerard salinity is high, SiO3 agrees with rosette data. Footnote salinity bad. Have PI decide the integrity of Gerard samples. PB (45). ^{14}C *is also off, appears to have been from about 2400db, coded as 4.*

TABLE 3.

Sample ID	Comment
Station 121	
289 @ ?db	Sample Log: “Did not trip. Redone as cast 3.”
290 @ ?db	Sample Log: “Did not trip. Redone as cast 3.”
293 @ ?db	Sample Log: “Did not trip. Redone as cast 3.”
294 @ ?db	Sample Log: “Did not trip. Redone as cast 3.”
350 @ 1921db	Sample Log: “Pretripped.” Samples are acceptable at reassigned pressure. PB (50).
347 @ 2220db	Gerard (90) is acceptable at reassigned pressure.
390 @ 2220db	Sample Log: “Pretripped.” Samples are acceptable at reassigned pressure. PB (47).
348 @ 2534db	Delta-S(PB-G) at 2534db is -0.002, salinity is 34.664. Gerard (93) is acceptable at reassigned pressure.
393 @ 2535db	Sample Log: “Pretripped.” Samples are acceptable at reassigned pressure. PB (48).
281 @ 2673db	Salinity bottle was broken before analysis could be performed. Salinity lost. Silicate is high compared to rosette data, but agrees with silicate from other Gerard casts (which are also higher than rosette data). Suspect Gerard is acceptable. PB (41).
349 @ 2864db	Delta-S(PB-G) at 2864db is 0.002, salinity is 34.675. Gerard (94) is acceptable at reassigned pressure.
394 @ 2864db	Sample Log: “Pretripped.” Samples are acceptable at reassigned pressure. PB (49).
242 @ 2938db	Gerard (84) is acceptable, PB salinity is low. Footnote salinity questionable. Delta-S(PB-G) at 2938db is -0.004, salinity is 34.670.
445 @ 3282db	Sample Log: “Valve open.” Gerard (87) is acceptable. Delta-S(PB-G) at 3282db is -0.002, salinity is 34.680.

8.0 Figures



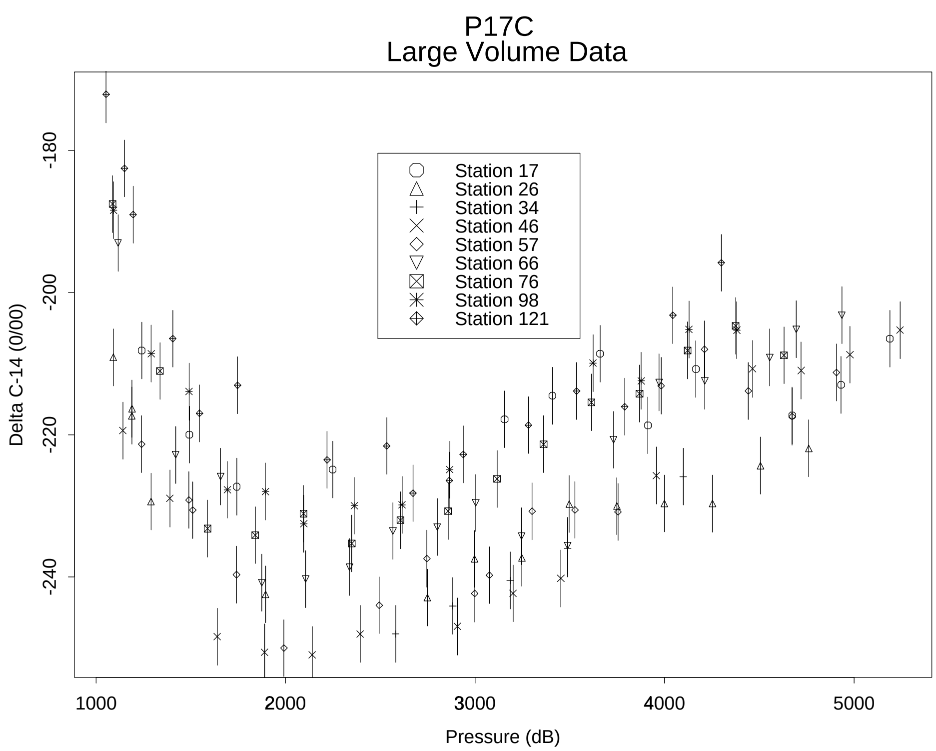


Figure 1: ^{14}C as a function of pressure for the thermocline (upper) and deep/bottom waters. In both, error bars are 4‰ or one standard deviation for the measurement.

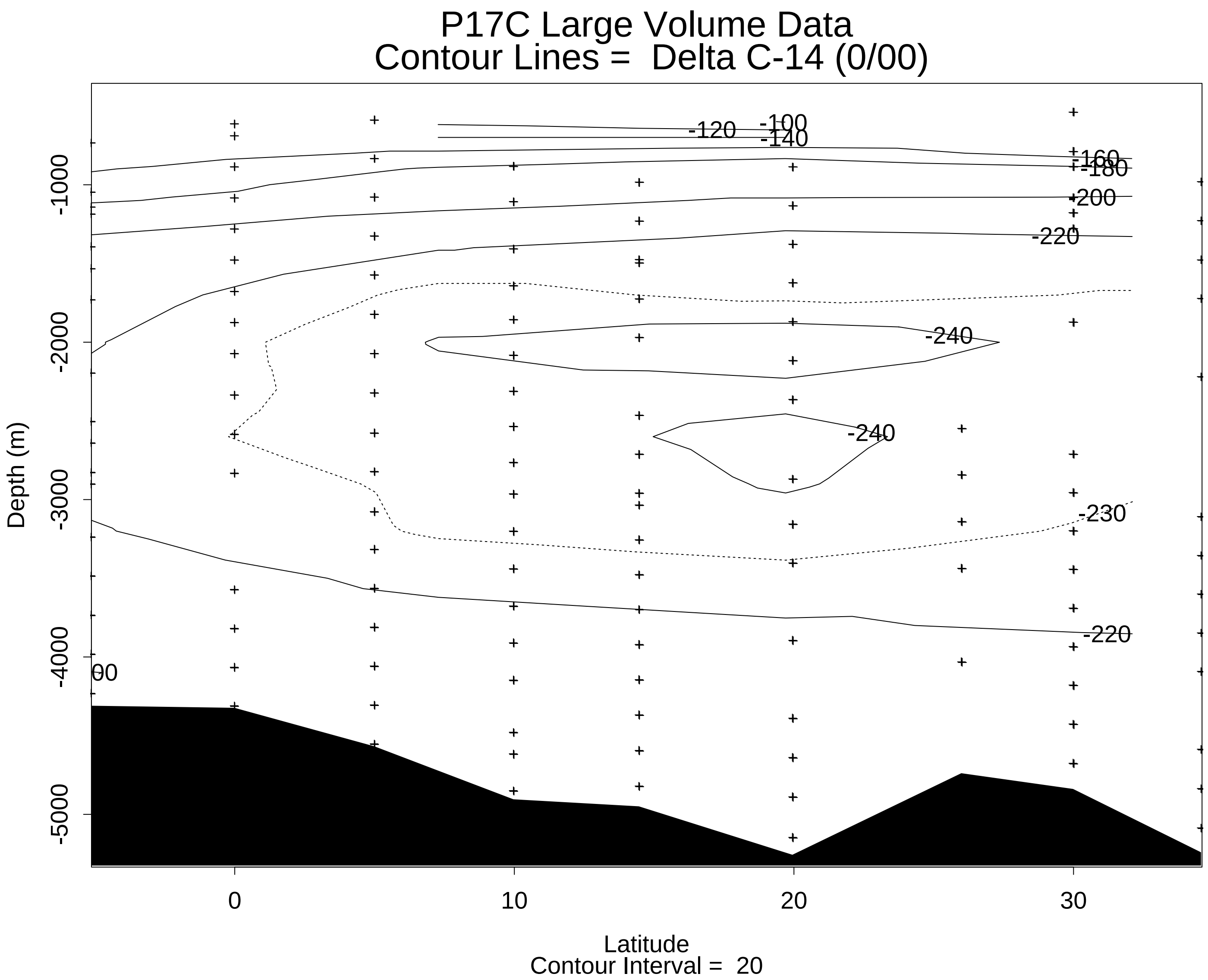


Figure 2: Machine contoured14C section for P17C large volume measurements having a quality flag value of 2. The division of the minimum located around 2500m is an artifact of the gridding/contouring package.

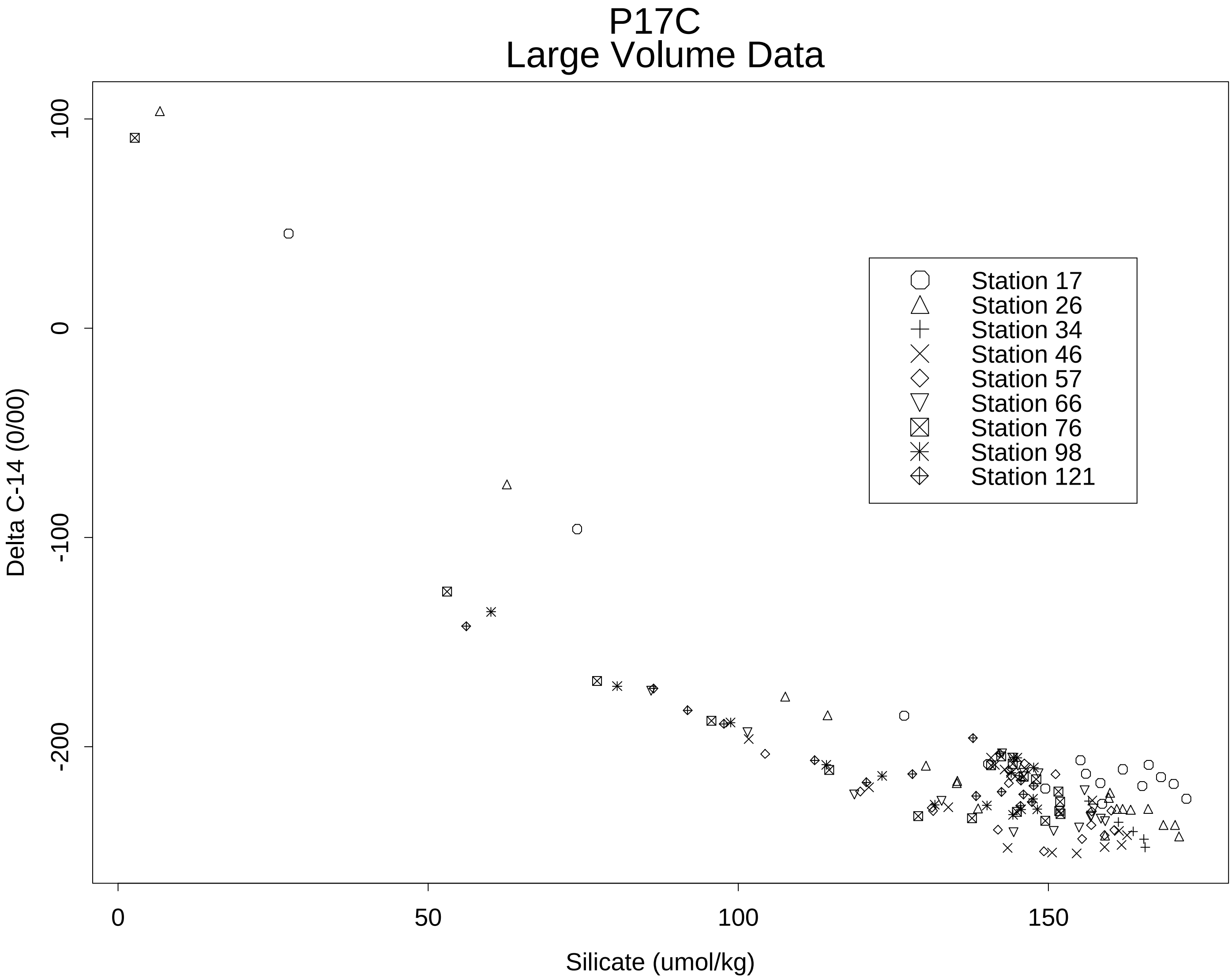


Figure 3: Only data with a quality flag value of 2 for both silicate and14C are included. The strong correlation (for both deep and thermocline measurements) between these measurements for the P16C (TUNES-3) data is not so evident here.

E.6 P17C TUNES-1 Final Report for AMS 14C Samples

(Robert M. Key)

July 2, 1996

1.0 General Information

WOCE section P17C was the first in a series of three cruise legs referred to as "TUNES". Mizuki Tsuchiya of SIO was chief scientist for this leg. This report covers details of data collection and analysis for the small volume radiocarbon samples. The reader is referred to "Documentation for WOCE Hydrographic Program section P17C" by L.D. Talley and M. Tsuchiya as the primary source for cruise information. Of 121 stations, 29 were sampled for radiocarbon. The AMS station locations are shown in Figure 1 and sum-

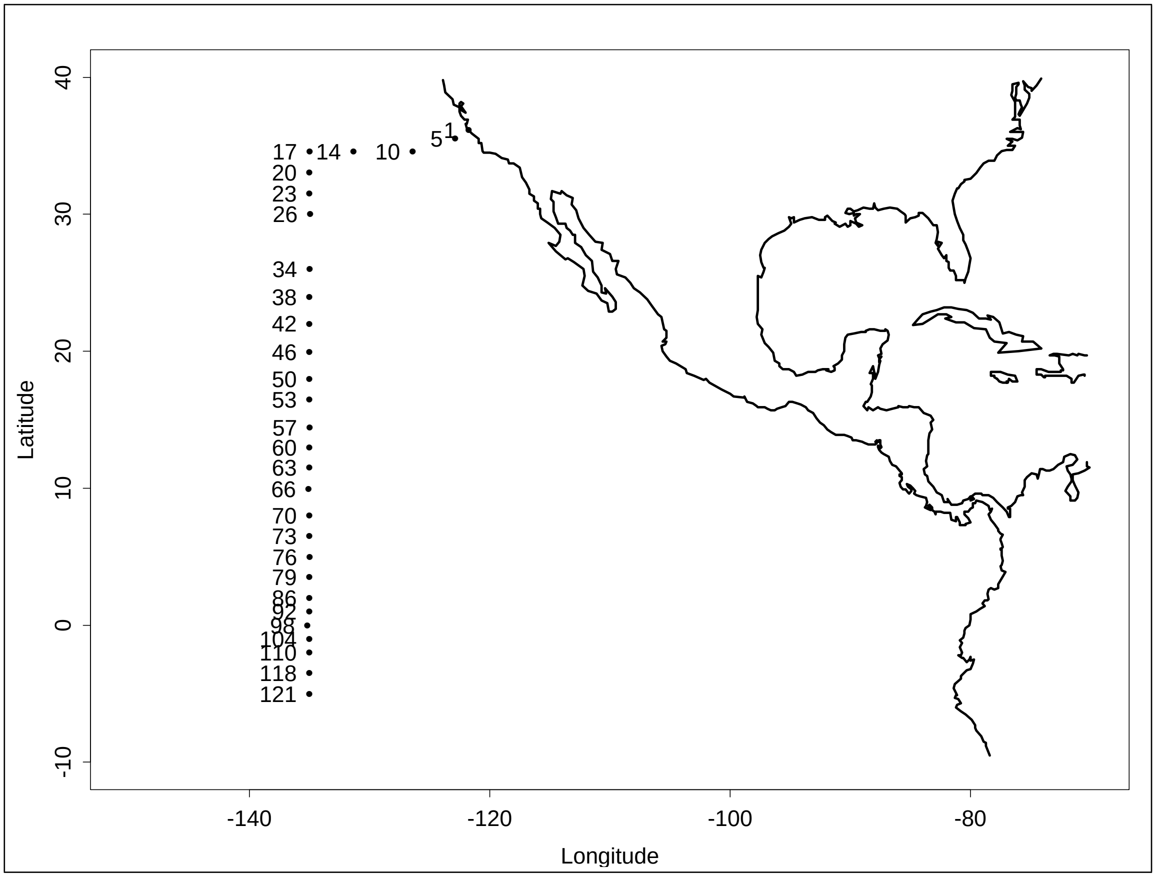


Figure 1: AMS radiocarbon station locations for WOCE cruise P17C (TUNES-1).

marized in Table 1.

Table 1: P17C Station Summary

Station	Date 1991	Latitude	Longitude	Bottom Depth (m)
1	6/2	36.172	-121.737	557
5	6/3	35.548	-122.863	3403
10	6/5	34.582	-126.400	4682
14	6/7	34.585	-131.320	5135
17	6/8	34.598	-134.963	5129
20	6/9	33.065	-134.997	4761
23	6/10	31.532	-135.002	4562
26	6/11	30.033	-134.952	5181
34	6/14	26.040	-134.970	4571
38	6/15	23.998	-135.000	4851
42	6/16	22.037	-134.997	5225
46	6/18	19.982	-135.017	5257
50	6/19	18.000	-135.005	5183
53	6/20	16.500	-135.000	4849
57	6/21	14.462	-134.978	4983
60	6/22	13.002	-135.003	4907
63	6/23	11.503	-135.000	4893
66	6/24	9.965	-135.057	4811
70	6/25	8.000	-134.998	4743
73	6/26	6.523	-135.000	4638
76	6/27	4.992	-134.972	4578
79	6/28	3.517	-135.002	4311
86	6/29	2.000	-134.990	4510
92	6/30	0.990	-135.000	4260
98	7/1	0.003	-135.157	4317
104	7/3	-0.993	-135.002	4479
110	7/4	-1.973	-135.002	4435
118	7/5	-3.488	-135.002	4672
121	7/6	-5.008	-135.008	4658

^{14}C samples were additionally collected for measurement by the large volume technique on 9 stations (17, 26, 34, 46, 57, 66, 76, 98 and 121). AMS sampling was used for the upper thermocline and large volume sampling for the deep and bottom waters. Results for the large volume samples are reported in Key (1996).

2.0 Personnel

^{14}C sampling for this cruise was carried out by Robert M. Key (Princeton). ^{14}C analyses were performed at the National Ocean Sciences AMS Facility (NOSAMS) at Woods Hole Oceanographic Institution. Salinities and nutrients were analyzed by the SIO CTD group and the Oregon State Univ. group respectively. Key collected the data from the originators, merged the files, assigned quality control flags to the ^{14}C and submitted the data files to the WOCE office (7/96).

3.0 Results

This ^{14}C data set and any changes or additions supersedes any prior release.

3.1 Hydrography

Hydrography from this leg have been submitted to the WOCE office by the chief scientist and described in the previously mentioned report.

3.2 ^{14}C

Most of the $\Delta^{14}C$ values reported here have been distributed in a data report (NOSAMS, 1994). That report included preliminary hydrographic data and ^{14}C results which had not been through the WOCE quality control procedures. This report supersedes any previous ^{14}C data distributions.

At this time 449 of 507 samples collected have been measured and reported. Replicate measurements were made on 8 of the samples. These replicate analyses are tabulated and summarized in Table 2. The table shows the mean and standard deviation for each set

Table 2: Summary of Replicate Analyses

Sta-Cast-Bottle	$\Delta^{14}C$	Err	Mean[a]	Standard Deviation[b]
14-1-3	77.0	3.7	76.7	0.4
	76.4	5.2		
17-2-1	79.1	8.4	82.0	4.1
	84.9	5.2		
23-1-11[c]	-21.6	5.5	-10.1	16.3
	1.4	18.3		
23-1-16	-182.1	3.9	-172.9	13.0
	-163.7	4.2		
26-2-12	-32.6	4.2	-30.8	2.6
	-28.9	4.9		

Table 2: Summary of Replicate Analyses

Sta-Cast-Bottle	$\Delta^{14}C$	Err	Mean[a]	Standard Deviation[b]
42-1-7	98.2	3.1	97.0	1.8
	95.7	3.2		
46-2-16	-181.6	4.0	-187.8	8.8
	-194.0	7.1		
76-2-13	-92.8	3.3	-100.8	11.3
	-108.8	7.3		

a. Error weighted mean reported with data set

b. Error weighted standard deviation of the mean reported with data set.

c. Only second run retained for data set

of duplicates. For these few samples, the average standard deviation is 7.3‰. This precision estimate is approximately correct for the time frame over which these samples were measured. For a summary of the improvement in precision with time at NOSAMS, see Key, *et al*. (1996). In the final data reported to the WOCE office, the error weighted mean and the larger of the standard deviation and the error weighted standard deviation of the mean are given for replicate analyses.

4.0 Quality Control Flag Assignment

Quality flag values were assigned to all ^{14}C measurements using the code defined in Table 0.2 of WHP Office Report WHPO 91-1 Rev. 2 section 4.5.2. Measurement flags values of 2, 3, 4, 6 and 9 have been assigned to date. Approximately 50 samples remain to be measured. Currently, the unmeasured samples are incorrectly coded with a flag value of 9 (no sample collected) rather than 1 (sample collected) or 5 (no result reported). The choice between values 2 (good), 3 (questionable) or 4 (bad) is involves some interpretation. There is very little overlap between this data set and any existing ^{14}C data, so that type of comparison was difficult. In general the lack of other data for comparison led to a more lenient grading on the ^{14}C data.

When using this data set for scientific application, any ^{14}C datum which is flagged with a “3” should be carefully considered. My subjective opinion is that any datum flagged “4” should be disregarded. When flagging ^{14}C data, the measurement error was taken into consideration. That is, approximately one-third of the ^{14}C measurements are expected to deviate from the true value by more than the measurement precision. No measured values have been removed from this data set.

Table 3 summarizes the quality control flags assigned to this data set. For a detailed description of the flagging procedure see Key, *et al*. (1996c). As more of the Pacific

Table 3: Summary of Assigned Quality Control Flags

Flag	Number
2	431
3	7
4	3
6	8

data set becomes available, it is possible that some of these flag values may be modified. Any additional data received for this leg will be reported to the WOCE office as they become available.

5.0 Data Summary

Figures 2, 3, 4 summarize the AMS ^{14}C data collected on this leg. Only $\Delta^{14}C$ measurements with a quality flag value of 2 are included in each figure. Figure 2 shows the $\Delta^{14}C$ values with 2σ error bars plotted as a function of pressure for the upper two kilometers of the water column. The most noticeable characteristic is the broad spread of the data

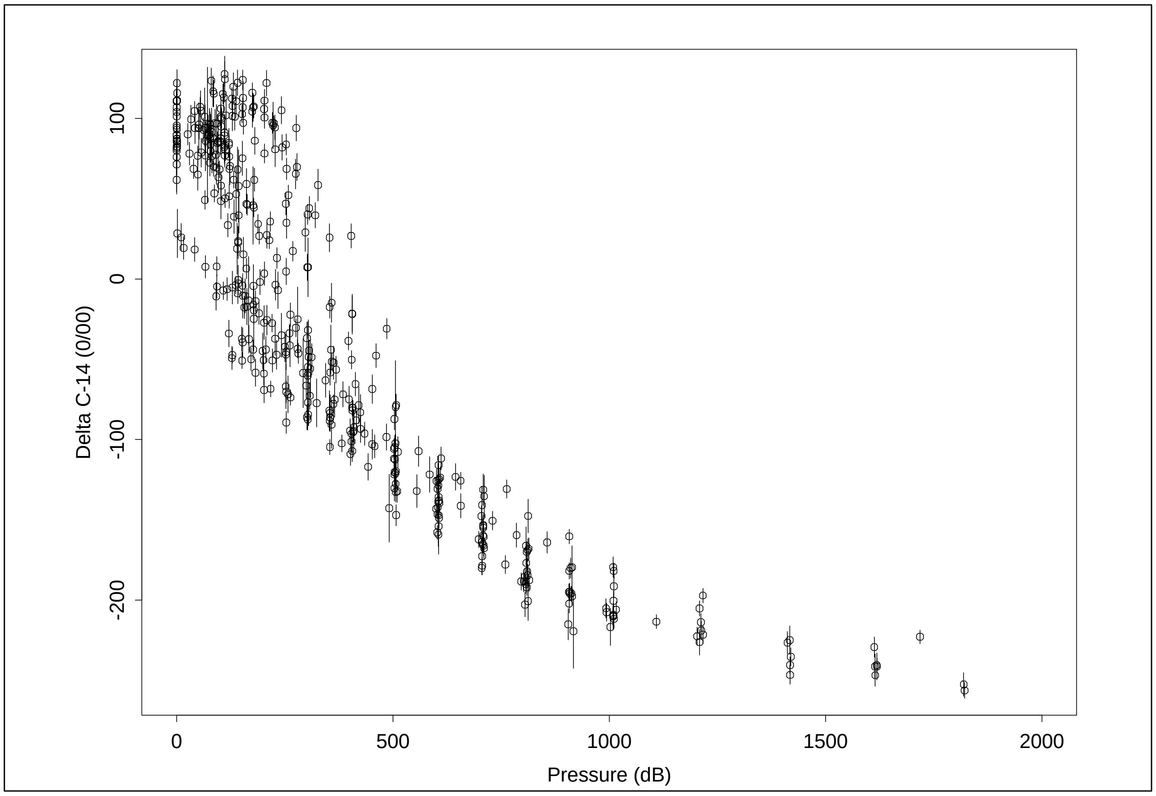


Figure 2: AMS $\Delta^{14}C$ results for P17C stations shown with 2σ error bars.Only those measurements having a quality control flag value of 2 are plotted.

in the upper 500m. This is primarily due to shoaling of isopycnals in the equatorial zone. This figure also clearly demonstrates the sampling strategy used during the TUNES legs. That is, AMS sampling was almost totally limited to the upper 1500 meters of the water column. Large volume Gerard barrel sampling was used to cover the deep and bottom waters. This strategy was chosen primarily because the collection cost for AMS ^{14}C samples is significantly less than for the Gerard technique. At the time of this cruise, it was known that the AMS technique was less precise than the large volume technique, however Figure 2 clearly demonstrates that AMS precision is easily sufficient to resolve the vertical gradients in $\Delta^{14}C$, at least in the upper kilometer.

Figure 3 shows the $\Delta^{14}C$ values plotted against silicate for samples from the upper 2 kilometers of the water column. The straight line shown in the figure is the least squares

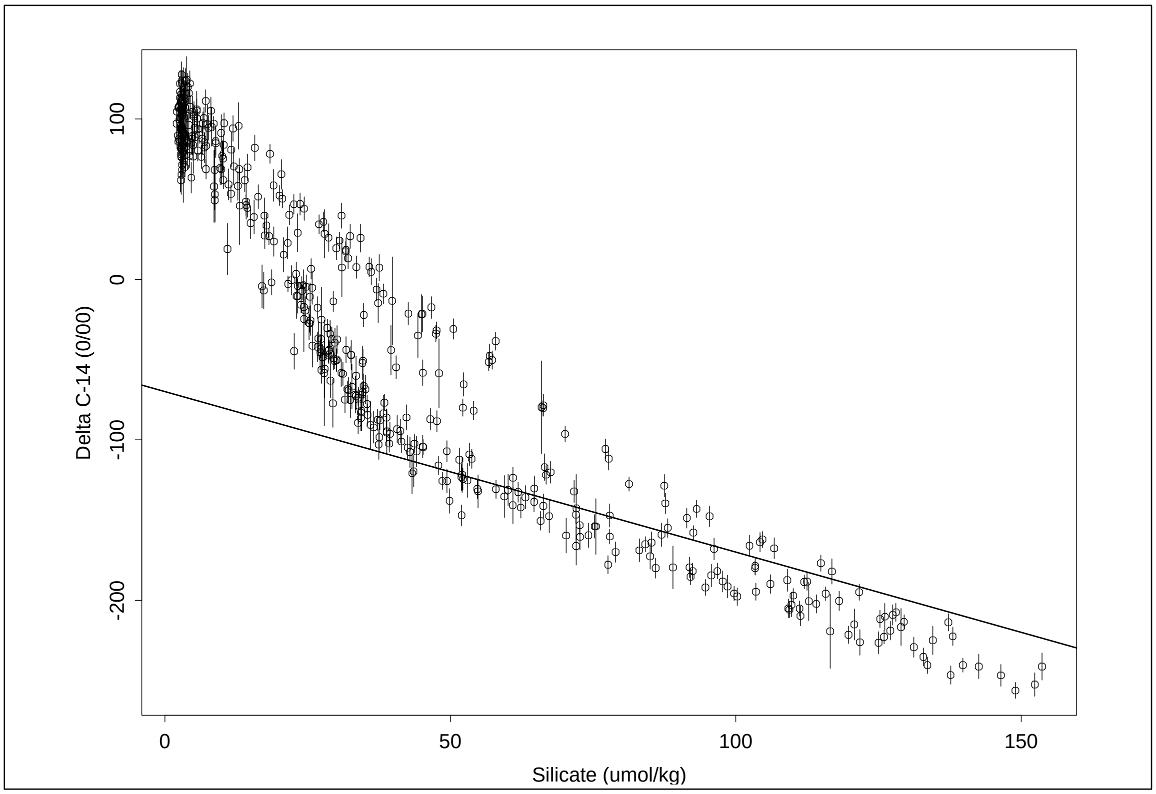
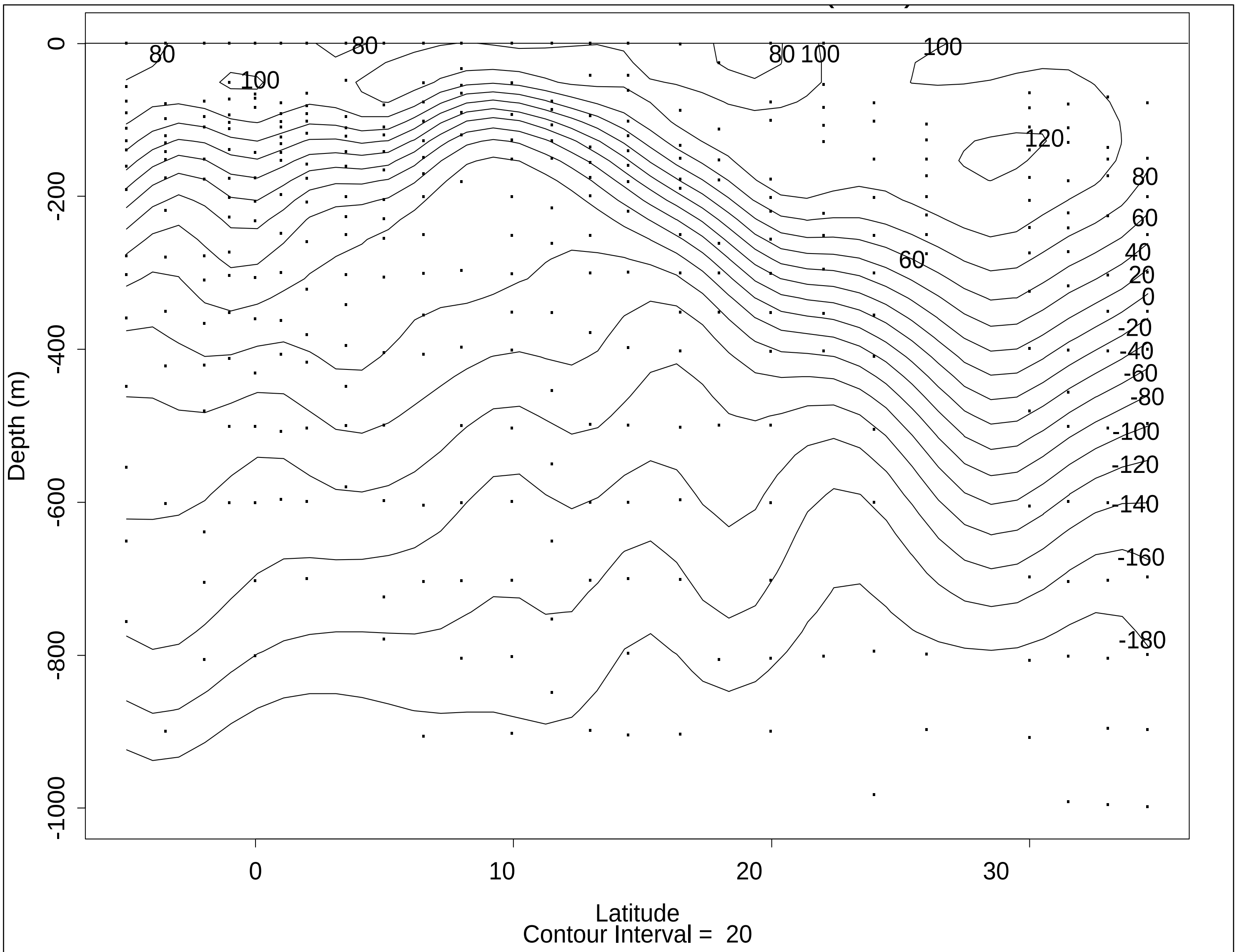


Figure 3: $\Delta^{14}C$ as a function of silicate for P17C AMS samples. The straight line shows the relationship proposed by Broecker, *et al.*, 1995 ($\Delta^{14}C$ = -70 - Si with radiocarbon in ‰ and silicate in µmol/kg).

regression relationship derived by Broecker *et al.* (1995) based on the GEOSECS global data set. According to their analysis, this line ($\Delta^{14}C$ = -70 - Si) represents the relationship between naturally occurring radiocarbon and silicate for most of the ocean. They interpret deviations in $\Delta^{14}C$ above this line to be due to input of bomb-produced radiocarbon. Clearly, this relationship is not ideal for the P17C data set. The points in Figure 3 fall into two distinct groups. The first group falls below the line for silicate concentrations greater than approximately 50µmol/kg then slopes sharply upward for lower silicate concentrations. The second group has fewer points, but generally has a linear trend across the plotted silicate concentration range and is significantly above and steeper than Broecker's relationship. The first data grouping is from stations which are south of ~20 °N. For these data, the break in the trend ($\Delta^{14}C$~-100‰; Si~40µmol/kg) occurs at approximately the same location as CFC-11 goes to zero. While CFC-11 concentration may not be as good an indicator as tritium, the data is consistent with the break point being the zone to which bomb-produced radiocarbon has penetrated.

Figure 4 is an objective section (LeTraon, 1990) of the $\Delta^{14}C$ distribution for the upper kilometer of the water column (Station 17-121). Obvious in the figure are the doming of the isopleths near the Equator and the subsurface location of the maximum $\Delta^{14}C$ concentration for most of the section.

Figure 4: delta 14C concentration in the upper kilometer of the meridional portion of TUNES leg 1 (Stations 17-121; WOCE line P17C). Gridding done using the method of Letraon (1990); all samples measured using the AMS technique (Key, 1996a,b; Key,et al., 1996). For most of the section the maximum concentration is found below the surface.



6.0 References and Supporting Documentation

Key, R.M., P17C TUNES-1 Final Report for Large Volume Samples, OTL Technical Report 96-2, 18pp., 1996a.

Key, R.M., WOCE radiocarbon program reports progress, *WOCE Notes, 8(1),12-17,* 1996b.

Key, R.M., WOCE Pacific Ocean radiocarbon program, *Radiocarbon, submitted*, 1996c.

Key, R.M., P.D. Quay and NOSAMS, WOCE AMS Radiocarbon I: Pacific Ocean results; P6, P16 & P17, *Radiocarbon, submitted*, 1996.

LeTraon, P.Y., A method for optimal analysis of fields with spatially variable mean, *J. Geophys. Res.*, *95*, 13543-13547, 1990.

NOSAMS, National Ocean Sciences AMS Facility Data Report #94-093, Woods Hole Oceanographic Institution, Woods Hole, MA, 02543, 1994.

Peng, T.-H., R. M. Key and H. G. Östlund, Temporal variations of bomb radiocarbon inventory in the Pacific Ocean, *Marine Chem., submitted,* 1996.

Talley, L.D. and M. Tsuchiya, “Documentation for WOCE Hydrographic Program section P17C”, unpublished WHP manuscript.

Appendix C: TUNES Calibration Figures

NOTE: some differences fall outside of the plotted limits.
Please refer to the bottle data quality codes.

Appendix D:

TUNES Processing Notes

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TUNES-1 / WOCE-P17C CTD Shipboard and Processing Comments

sta/cast	Comments
999/01	TEST cast - not part of final data distribution; all btls tripped same press.; dirty xmiss
001/01	
002/01	
003/01	
004/01	
005/01	
006/01	
007/01	
008/01	
009/01	wire jumped sheave/mangled at 20mwo, discovered/fixed at 60mwo; back to 40mwo and restart cast: 33-min. delay; outer rosette did not trip: no discrete oxygen values below 350db - used stas 8+10 bottles to approximate deep ctdoxy fit
010/01	NEW END TERMINATION prior to cast; incrs. current slightly at 340db down; bad/high raw ctdoxy from 0-12db - ctdoxy no good above 14db
011/01	
012/01	deck unit lvl too high = crazy signal during trip/confirm time
013/01	CTD/Rosette hit bottom/stayed awhile; winch op noted heave compensator stopped functioning near beg. of upcast: fixed; inner rosette did not trip: no discrete oxy values above 350db - used stas 12+14 bottles to approximate surface ctdoxy fit - ctdoxy no good above 40db
014/01	NEW END TERMINATION prior to cast, approx. 100 m wire cut off first; down 200m after 3972db trip/winch op.error: unplanned yoyo; Raw ctdoxy = 0 from 20-30db down - ctdoxy no good above 114db
015/01	yoyo back down at 2349db up to get skipped bottle; raw ctdoxy = 0 from 0-4db down - ctdoxy no good above 10db
016/01	UP cast; no vcr recording 800-1100db down: vcr power off, data lost
017/02	long pause at 15db to check computer problem; 11-min. stop at 20db down; hi raw ctdoxy at surface - ctdoxy no good above 12db
018/01	slight data glitch each time bottle triggered: lowered DU level partway thru upcast; raw ctdoxy = 0 from 0-14db down - ctdoxy no good above 18db
019/01	raw ctdoxy = 0 from 0-12db down - ctdoxy no good above 20db
020/01	raw ctdoxy = 0 from 10-16 plus 24-34db down - ctdoxy no good above 54db
021/01	raw ctdoxy = 0 from 22-30db - ctdoxy no good above 42db; used some of stas 20+22 deep bottles for deeper ctdoxy fitting: discrete values for 21 seem a bit high 022/01
023/01	no oxygen signal this cast
024/01	fixed ctdoxy sensor prior to cast
025/01	switch to pylon #2 on outer rosette
026/02	no vcr recording until 4587db up: pushed wrong button?

027/01	switch to pylon #3 on outer rosette; compensator problem/delay at 15m down; xmiss signal crazy 370-775db down; ethernet hangup at 2680db down: 1-hr delay; delay again at 800db up: finish cast w/o computer; replayed from 815db up and merged raw data later
028/01	15-min. delay at start; xmiss bad to 1000db down
029/01	2020db (dn or up?) ethernet interruption/several minutes: "someone" disconnected during cast
030/01	3500db down through up: xmiss signal all over
031/01	xmiss no good on upcast
032/01	xmiss signal went west at 3500db down
033/01	xmiss repairs attempted before cast
034/02	xmiss no good 3000db down and throughout up
035/01	xmiss no good below 2700db down; occas. ok after 3000db
036/01	xmiss goes wild below 800db down; 45-min. delay at 3553db up for winch malfnct (wouldn't pull wire n): yoyod back down during repair then 9-min. delay at 3279db up to re-check
037/01	no xmiss: removed for repairs prior to cast
038/01	no xmiss
039/01	no xmiss
040/01	no xmiss
041/01	no xmiss; winch dropped ros. on rail, then to deck, during launch (about 4 ft); no apparent damage to MTs/eqpt
042/01	no xmiss; 1-hr delay in start due to ship-power problems
043/01	no xmiss
044/01	no xmiss
045/01	no xmiss
046/02	xmiss back on: data goes haywire 4150db dn thru 3400db up
047/01	xmiss no good 450db dn thru 100db up
048/01	xmiss no good approx. 460db dn thru 100db up
049/01	xmiss signal PERFECT: Carl got it this time
050/01	-.004 salin offset at 2640db down, continues until gradual return by about 2700db
051/01	
052/01	
053/01	
054/01	
055/01	
056/01	
057/02	winch counter problem: back to surface from 45 mwo, rezero, start back down (never came out of water)
058/01	
059/01	
060/01	winch did not stop at btm when requested; 2m off btm at one point, back up to 8m off for trip
061/01	yoyo? near 3915db trip/gave winch wrong depth
062/01	

063/01	cast stopped approx. 10 minutes at 15 meters for compensator problem
064/01	
065/01	
066/02	
067/01	
068/01	delay cast start 15 minutes due to no PRT-2 signal: replaced cable
069/01	increased voltage from 16/17 to 25 approx 4265 rawdb (down?)
070/01	
071/01	
072/01	
073/01	
074/01	winch stopped 1640 mwo down: wire almost touching hull
075/01	winch stopped at 475mwo down due to engine problem
077/01	
078/01	
079/01	voltage check pre-cast/3000+db up = 25v
080/01	C-sensors kept wet w/saltwater regularly beg. this cast
081/01	LADCP cast, no xmiss/oxy/altimeter on CTD-2
082/01	
083/01	LADCP cast, no xmiss/oxy/altimeter on CTD-2
084/01	20m overshoot at 364db trip, yo back
085/01	10-min. delay at start to add weights to rosette pkg
086/01	
087/01	
088/01	acquis. started before C-sensor cover removed: saltwater = thought it was in water
089/01	
090/01	
091/01	
092/01	overshot 422db btl by 40db, yo back
093/01	
094/01	
095/01	acquisition not started until after CTD in water -another pilot error top 0-8db extrapolated
096/01	
097/01	steamed west nearly 10 miles to avoid seamount/get deeper water
098/02	15-minute delay at start: computer problems.
098/04	
099/01	all power to engines/CTD/computers/winch counter off while cast at 216db down; pkg dragged up to 147db due to huge wire angle; during comp.boots, vcr on/winch back to surface to rezero; restart cast in-water, chopped off pre-outage data/re-avgd from near-surface restart
100/01	
101/01	
102/01	
103/01	

104/01	
105/01	
106/01	
107/01	density invers. at base of mixed layer, 56-66db/-.035 total drop; long/ continuous/ smooth: probably real
108/01	
109/01	
110/01	
111/01	
112/01	145db up: yo back to 312db: forgot to switch to inner pylon
113/01	
114/01	
115/01	
116/01	
117/01	vcr not turned on until 100db down
118/01	
119/01	
120/01	xmiss dropout area approx. 750-1300db down, ok after that: presume "it" fell off
121/01	
122/01	salt spike 2100db down (dropout/large): probable goop on sensor; big spike 2084-2098 despiked; longer-lasting/smaller-size inversion 2174-2284 too big to despike
123/01	

TUNES-2 / WOCE-P17S/P16S CTD Shipboard and Processing Comments

sta/cast	Comments
998/01	using CTD-1 from beginning of cruise. TEST cast: btls 20-36 all tripped at 1000m; 3 additional btls tripped at 400m
124/01	repeat station 123 from leg 1
125/01	
126/01	
127/01	
128/01	-.1 mmho/cm cond. spike at 148-152 db down; despiked/ok now
129/01	ABORT at 150m: sensor caps on/pinger off; data not saved
129/02	1-hr deploymt delay when rosette hit ship hard at initial launch: weights knocked loose, CTD end clamp broken, other misc.breakage. No cast# assigned to 2-minute first launch/data not used.
130/01	brief yoyo on down (15 to 12m) at base of T mixed-layer
131/01	
132/02	
133/01	frequent/high cond. noise (not drop-outs) on down from 810-1300 db, again 1985-bottom; yoyo 50m back down after 2544 db trip to check sensor

	response: problem occurs when P increases - cracked cell? yoyo from 2546-2598 db up; 436,448,478 db levels interpolated: cutouts in raw data signal.
134/01	replaced cond. cell with new spare prior to cast.
135/01	cond. problem may still be here, but smaller amplitude
136/01	cond. problem still here: maybe FSI temp board?
137/01	switch to CTD-2 beginning this cast
138/01	
139/01	
140/01	
141/01	
142/01	dipped into water before sensor covers removed/pinger on; trip inner rosette first for freons
143/03	
144/01	
145/01	
146/01	xmiss cleaned at start of cast
147/01	
148/01	used PRT-1 for primary temperature during cast; used PRT-2 for final data - see station 150 PRT comments
149/01	used PRT-1 for primary temperature during cast; used PRT-2 for final data - see station 150 PRT comments
150/01	PRT-1 T offsets: +.7 deg at 528 db down and two smaller offsets. PRT-1 definitely sick; used PRT-2 for final data
151/01	CTD-10 starting here; trip detect only sees outer pylon: CTD data for top 12 trips extracted manually
152/01	
153/02	
154/01	
155/01	
156/01	
157/01	
158/01	
159/01	pauses at 2549/2742 db trips for winch operator work
160/01	
161/01	
162/01	
163/01	
164/01	
165/02	inner pylon tripped first for freons
166/02	
167/01	
168/01	no well-defined mixed layer
169/01	
170/01	stop at 1812 db down: winch trouble
171/01	

172/02

173/01

174/01

175/01

176/01

177/01

178/01

179/02 cast start delayed 10 mins. after rosette hit side of ship: one lanyard broken/repaired, no other damage noted.

180/02 xmiss check (before or after cast?)

181/01

182/01 ABORT at 100m down: complete signal loss; CTD-10 flooded

182/02 back to CTD-1 w/orig. C-sensor, changed shielding around PRT-2 temperature interface. Cond. problem worse: shorten cast to 2000m/24 btls. Cond. noise has pressure-direction (down) dependence, up much cleaner. -.2 mmho/cm cond. spike 252-254 db up: despiked/ok now. Multiple spikes on up cast, most despiked/ok now. Some smaller cond. noise still remains. Yoyo from 294-330 db up.

183/01 back to CTD-2 using PRT-2 for primary temperature. No inner-pylon detect circuit in: CTD data for top 12 trips extracted manually. Ctdoxy signal cutouts top 120 db. Two DSRTs added to each cast from here to end of cruise to monitor PRT drifting problems.

184/01 still no inner-pylon detect, CTD data for top 12 trips extracted manually; ctdoxy signal cutouts top 70 db

185/01 pylon detect for inner pylon installed; ctdoxy problem fixed: sensor interconnect cable problem.

186/01

187/02 ctdoxy probe acting up till 1900 db down

188/01 new oxygen sensor; PRT-2 jumped; cond. seems ok

189/01 ABORT at 300m: CTD-2/PRT-2 + cond. jumping; PRT-1 locked up at 32767 (raw data)

189/02 ABORT at 300m - similar problems to cast 1

189/03 rebuilt CTD-2: CTD-2 card cage in CTD-1 Pressure case w/turret, PRT, endcaps, A/D, digitizer, mmux, P/T/orig.C sensors from CTD-1: still cond. noise: low-side S noise from CTD-1 moved to CTD-2? Ctdoxy sensor malfunctioning, reads 20% of normal values; ctdoxy data not usable. Delay 27 minutes at 15m down: computer problems.

190/01 CTD-2 cond. sensor interface board swapped in, ctdoxy sensor wires swapped; using CTD-1 tty/fsk card; ctdoxy still not working - see cast 189/03. Cast delayed 15 minutes for cable/connector repairs. Yoyo from 2968-2978 db up.

191/01 CTD oxygen useless again: see cast 189/03

192/01 CTD oxygen useless again: see cast 189/03; pinger died near bottom

193/01 delay cast start 40 mins.: replaced CTD-1 cond sensor interface. Replaced ctdoxy sensor w/old one: ok. Yoyo from 2632-2642 db up.

194/01 TEST cast to <600m using CTD-2 P-sensor interface: no effect.

194/02	TEST cast to <600m using CTD-10 T-sensor interface: no effect.
194/03	CTD-1 P/T sensor interfaces. Same cond. noise as before.
195/01	experiments w/winch speed vs. cond. noise on downcast
196/01	found loose FSI-T bulkhead connector, tightened it: changed, but did not eliminate, cond. noise: some stable cond. areas.
197/01	replaced FSI bulkhead/cleaned cond. sensor guard: coating on PRT/cond. guard peeling off: large sheet still attached to top of guard: apparently flapped over cond. cell going down, flapped out of the way going up. Removed coating from guard: no more cond. problem!
198/02	
199/01	
200/01	
201/01	
202/01	
203/01	rosette lowered into bottom (+8m after btm trip): winch went the wrong way; no damage, but bottom cond. spike cut off in p-series. 1418 db level interpolated: cutout in raw data signal.
204/01	NEW END TERMINATION prior to cast; steep btm/side of seamount
205/01	problem w/winch or heave compensator from 15m to 2233m
206/01	
207/01	steep bottom
208/01	yoyo from 17-4 db down
209/01	-.5 mmho/cm cond. spike (seasnot?) 1056-1070 db down: despiked/ok now
210/02	
211/01	1-hr delay at cast start: dead signal in-water, immed. back out: slip ring plug slipped/plugged back in and insulation repaired. Second false- start when cast resumed before computer ready. Data from false starts not saved.
212/01	heave-compensator disabled 15-260m down as a test
213/01	bad/high ctdoxy rdgs up: water leaked into sensor
214/01	
215/01	
216/01	
217/01	rosette briefly out of water before srfc btl closed; lowered back in
218/01	
219/01	
220/01	descent delayed 5 mins. due to heave compensator

TUNES-1: CAST STOPS LONGER THAN 1-MINUTE

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
001/01	DOWN	4.8	20	(18 - 22)
		1.2	412	(410 - 414)
		7.3	516	(514 - 518)
002/01	DOWN	3.9	19	(16 - 22)
		1.1	912	(910 - 914)
003/01	DOWN	5.9	18	(16 - 20)
		1.6	1225	(1222 - 1228)
		1.5	1430	(1428 - 1432)
004/01	DOWN	5.5	20	(18 - 22)
005/01	DOWN	2.1	2	(0 - 4)
		5.8	18	(16 - 20)
		1.4	3446	(3444 - 3448)
006/01	DOWN	3.8	20	(18 - 22)
007/01	DOWN	4.1	20	(18 - 22)
		1.3	4228	(4226 - 4230)
008/01	DOWN	3.5	22	(20 - 24)
		1.0	4375	(4374 - 4376)
009/01	DOWN	4.1	20	(18 - 22)
		36.0	73	(68 - 78)
		1.8	4596	(4594 - 4598)
010/01	DOWN	3.5	22	(20 - 24)
		1.2	4767	(4766 - 4768)
011/01	DOWN	4.8	20	(18 - 22)
		1.1	4862	(4860 - 4864)
		1.3	4873	(4870 - 4876)
012/01	DOWN	2.7	22	(20 - 24)
013/01	DOWN	2.8	18	(16 - 20)
014/01	DOWN	1.8	2	(0 - 4)
		3.0	18	(16 - 20)
015/01	DOWN	3.3	20	(18 - 22)
016/01	UP	1.9	32	(30 - 34)
		1.0	208	(206 - 210)
		1.3	2022	(2020 - 2024)
		1.1	4082	(4080 - 4084)
017/02	DOWN	11.1	18	(16 - 20)
018/01	DOWN	1.2	3	(2 - 4)
		3.9	18	(16 - 20)
019/01	DOWN	3.3	18	(16 - 20)
		1.0	5114	(5112 - 5116)
020/01	DOWN	6.2	19	(16 - 22)
021/01	DOWN	1.2	2	(0 - 4)
		2.3	20	(18 - 22)
022/01	DOWN	5.3	18	(16 - 20)
023/01	DOWN	4.9	20	(18 - 22)
024/01	DOWN	3.4	18	(16 - 20)

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
025/01	DOWN	2.2	18	(16 - 20)
026/02	DOWN	4.8	18	(16 - 20)
027/01	DOWN	7.6	18	(16 - 20)
		59.3	2763	(2760 - 2766)
028/01	DOWN	2.3	18	(16 - 20)
029/01	DOWN	3.6	20	(18 - 22)
030/01	DOWN	1.9	18	(16 - 20)
031/01	DOWN	2.8	18	(16 - 20)
032/01	DOWN	2.4	17	(14 - 20)
033/01	DOWN	4.0	18	(16 - 20)
034/02	DOWN	2.8	18	(16 - 20)
035/01	DOWN	2.6	18	(16 - 20)
		1.3	4610	(4608 - 4612)
036/01	DOWN	2.9	18	(16 - 20)
037/01	DOWN	2.7	17	(16 - 18)
038/01	DOWN	2.6	16	(14 - 18)
039/01	DOWN	3.4	18	(16 - 20)
040/01	DOWN	2.2	16	(14 - 18)
041/01	DOWN	3.2	18	(16 - 20)
042/01	DOWN	2.3	18	(16 - 20)
043/01	DOWN	3.0	18	(16 - 20)
		1.2	5174	(5172 - 5176)
044/01	DOWN	2.2	16	(14 - 18)
045/01	DOWN	2.6	16	(14 - 18)
046/02	DOWN	3.0	18	(16 - 20)
047/01	DOWN	2.3	18	(16 - 20)
048/01	DOWN	2.3	18	(16 - 20)
049/01	DOWN	1.8	18	(16 - 20)
050/01	DOWN	2.3	16	(14 - 18)
051/01	DOWN	1.9	17	(16 - 18)
052/01	DOWN	1.0	5	(2 - 8)
		3.1	18	(16 - 20)
053/01	DOWN	1.3	16	(14 - 18)
054/01	DOWN	3.3	18	(16 - 20)
055/01	DOWN	2.5	16	(14 - 18)
		1.2	4900	(4898 - 4902)
056/01	DOWN	2.1	18	(16 - 20)
057/02	DOWN	1.1	40	(38 - 42)
		6.4	48	(46 - 50)
058/01	DOWN	2.2	18	(16 - 20)
059/01	DOWN	1.6	16	(14 - 18)
060/01	DOWN	3.3	18	(16 - 20)
061/01	DOWN	2.3	16	(14 - 18)
062/01	DOWN	2.6	18	(16 - 20)
063/01	DOWN	7.6	18	(16 - 20)
064/01	DOWN	2.9	18	(16 - 20)
065/01	DOWN	1.8	18	(16 - 20)

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
066/02	DOWN	2.3	18	(16 - 20)
067/01	DOWN	2.3	18	(16 - 20)
068/01	DOWN	2.4	18	(16 - 20)
069/01	DOWN	2.1	16	(14 - 18)
070/01	DOWN	2.5	18	(16 - 20)
071/01	DOWN	2.6	16	(14 - 18)
072/01	DOWN	2.0	18	(16 - 20)
073/01	DOWN	2.5	26	(24 - 28)
074/01	DOWN	2.8	18	(16 - 20)
		3.8	1619	(1614 - 1624)
075/01	DOWN	1.9	16	(14 - 18)
		5.9	479	(476 - 482)
076/02	DOWN	1.7	16	(14 - 18)
		1.0	4648	(4646 - 4650)
077/01	DOWN	2.2	16	(14 - 18)
078/01	DOWN	1.8	18	(16 - 20)
079/01	DOWN	2.0	16	(14 - 18)
080/01	DOWN	2.1	17	(14 - 20)
081/01	DOWN	2.3	18	(16 - 20)
		1.1	4386	(4384 - 4388)
082/01	DOWN	1.8	18	(16 - 20)
083/01	DOWN	1.8	18	(16 - 20)
084/01	DOWN	1.6	16	(14 - 18)
		1.1	4484	(4482 - 4486)
085/01	DOWN	2.0	18	(16 - 20)
086/01	DOWN	1.6	17	(16 - 18)
087/01	DOWN	2.0	18	(16 - 20)
088/01	DOWN	1.8	18	(16 - 20)
089/01	DOWN	1.9	18	(16 - 20)
090/01	DOWN	2.5	18	(16 - 20)
		1.7	4530	(4526 - 4534)
091/01	DOWN	2.4	18	(16 - 20)
092/01	DOWN	2.1	18	(16 - 20)
093/01	DOWN	2.0	18	(16 - 20)
094/01	DOWN	2.0	16	(14 - 18)
095/01	DOWN	2.9	18	(16 - 20)
096/01	DOWN	2.1	16	(14 - 18)
097/01	DOWN	2.1	18	(16 - 20)
098/02	DOWN	12.0	18	(16 - 20)
098/04	DOWN	2.0	20	(18 - 22)
099/01	DOWN†			
100/01	DOWN	1.7	18	(16 - 20)
		1.0	4285	(4282 - 4288)
101/01	DOWN	2.0	18	(16 - 20)
102/01	DOWN	1.9	16	(14 - 18)
103/01	DOWN	1.7	18	(16 - 20)
104/01	DOWN	1.6	17	(16 - 18)

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
105/01	DOWN	1.8	18	(16 - 20)
106/01	DOWN	1.8	17	(16 - 18)
		1.5	4406	(4404 - 4408)
107/01	DOWN	2.2	18	(16 - 20)
		1.5	4434	(4432 - 4436)
108/01	DOWN	1.9	18	(16 - 20)
109/01	DOWN	1.6	18	(16 - 20)
110/01	DOWN	2.1	18	(16 - 20)
111/01	DOWN	1.5	18	(16 - 20)
112/01	DOWN	1.8	16	(14 - 18)
113/01	DOWN	2.2	18	(16 - 20)
114/01	DOWN	1.8	18	(16 - 20)
115/01	DOWN	1.9	18	(16 - 20)
116/01	DOWN	1.6	16	(14 - 18)
117/01	DOWN	1.9	18	(16 - 20)
118/01	DOWN	2.0	18	(16 - 20)
		1.3	50	(48 - 52)
119/01	DOWN	1.8	18	(16 - 20)
120/01	DOWN	1.6	18	(16 - 20)
		1.8	4709	(4706 - 4712)
121/01	DOWN	1.8	18	(16 - 20)
122/01	DOWN	1.7	18	(16 - 20)
123/01	DOWN	1.8	16	(14 - 18)

†NOTE: No stops during 099/01: power outage during down cast. Package brought back to surface without shutting down heave compensator; pressure-series data taken from this second full down cast, no stops.

TUNES-2: CAST STOPS LONGER THAN 1-MINUTE

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
124/01	DOWN	2.3	18	(16 - 20)
125/01	DOWN	1.9	18	(16 - 20)
126/01	DOWN	7.7	2	(0 - 4)
		2.1	18	(16 - 20)
127/01	DOWN	3.5	18	(16 - 20)
128/01	DOWN	5.0	18	(16 - 20)
129/02	DOWN	1.9	18	(16 - 20)
130/01	DOWN	1.1	8	(6 - 10)
		2.8	18	(16 - 20)
131/01	DOWN	5.1	18	(16 - 20)
132/02	DOWN	4.0	16	(14 - 18)
133/01	UP	1.6	16	(14 - 18)
		2.7	2545	(2544 - 2546)
134/01	UP	2.0	16	(14 - 18)
135/01	UP	1.6	1	(0 - 2)
		4.7	14	(12 - 16)
		1.5	368	(366 - 370)
136/01	UP	1.8	18	(16 - 20)
		1.7	2308	(2306 - 2310)
137/01	DOWN	2.3	17	(16 - 18)
138/01	DOWN	6.0	18	(16 - 20)
139/01	DOWN	1.9	20	(18 - 22)
140/01	DOWN	2.8	20	(18 - 22)
141/01	DOWN	2.0	18	(16 - 20)
142/01	DOWN	4.6	2	(0 - 4)
		1.9	16	(14 - 18)
143/03	DOWN	1.4	4	(0 - 8)
		2.4	21	(20 - 22)
144/01	DOWN	2.5	18	(16 - 20)
145/01	DOWN	1.8	20	(18 - 22)
146/01	DOWN	2.1	18	(16 - 20)
147/01	DOWN	1.9	20	(18 - 22)
148/01	DOWN	2.9	18	(16 - 20)
149/01	DOWN	1.6	20	(18 - 22)
150/01	DOWN	2.6	18	(16 - 20)
151/01	DOWN	1.8	19	(18 - 20)
152/01	DOWN	2.0	20	(18 - 22)
153/02	DOWN	2.9	18	(16 - 20)
154/01	DOWN	1.9	20	(18 - 22)
155/01	DOWN	2.0	22	(20 - 24)
156/01	DOWN	3.0	20	(18 - 22)
157/01	DOWN	2.1	20	(18 - 22)
158/01	DOWN	1.8	19	(18 - 20)
159/01	DOWN	2.2	22	(20 - 24)
160/01	DOWN	4.2	12	(10 - 14)

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
161/01	DOWN	2.3	22	(20 - 24)
		2.2	503	(500 - 506)
162/01	DOWN	3.1	22	(20 - 24)
		2.0	406	(404 - 408)
163/01	DOWN	1.8	22	(20 - 24)
		1.3	498	(496 - 500)
164/01	DOWN	1.9	20	(18 - 22)
		2.2	415	(412 - 418)
165/02	DOWN	2.3	20	(18 - 22)
166/02	DOWN	2.1	22	(20 - 24)
		1.6	410	(408 - 412)
167/01	DOWN	1.7	21	(20 - 22)
		1.2	410	(408 - 412)
168/01	DOWN	1.9	26	(24 - 28)
		1.6	410	(408 - 412)
169/01	DOWN	2.2	20	(18 - 22)
		1.2	547	(544 - 550)
170/01	DOWN	2.1	20	(18 - 22)
		9.6	1822	(1820 - 1824)
171/01	DOWN	2.5	20	(18 - 22)
172/02	DOWN	2.0	20	(18 - 22)
		1.2	426	(424 - 428)
173/01	DOWN	2.0	18	(16 - 20)
174/01	DOWN	2.5	22	(20 - 24)
175/01	DOWN	2.2	20	(18 - 22)
		1.0	409	(408 - 410)
176/01	DOWN	1.9	20	(18 - 22)
177/01	DOWN	2.5	22	(20 - 24)
178/01	DOWN	1.7	22	(20 - 24)
		1.3	412	(410 - 414)
179/02	DOWN	1.4	8	(6 - 10)
		2.0	24	(22 - 26)
180/02	DOWN	1.3	19	(18 - 20)
		1.1	442	(440 - 444)
181/01	DOWN	1.8	22	(20 - 24)
		1.8	405	(402 - 408)
		1.1	5801	(5798 - 5804)
182/02	UP	1.4	2	(0 - 4)
		2.0	16	(14 - 18)
		2.6	293	(292 - 294)
		1.8	510	(508 - 512)
		1.5	2042	(2040 - 2044)
183/01	DOWN	2.1	20	(18 - 22)
184/01	DOWN	2.6	18	(16 - 20)
185/01	DOWN	2.0	22	(20 - 24)
		1.4	515	(512 - 518)
186/01	DOWN	2.7	20	(18 - 22)
		1.4	612	(610 - 614)

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
187/02	DOWN	2.1	18	(16 - 20)
		1.1	394	(392 - 396)
188/01	DOWN	3.0	20	(18 - 22)
		1.5	512	(510 - 514)
189/03	UP†	1.2	2	(0 - 4)
		1.3	20	(18 - 22)
		1.1	516	(514 - 518)
		5.6	3094	(3092 - 3096)
		5.4	4442	(4440 - 4444)
190/01	UP†	2.1	22	(20 - 24)
		1.5	428	(426 - 430)
		5.6	2968	(2966 - 2970)
		5.5	4224	(4220 - 4228)
191/01	UP†	2.2	2	(0 - 4)
		2.4	18	(16 - 20)
		1.7	362	(360 - 364)
		5.2	2924	(2920 - 2928)
		5.4	4226	(4224 - 4228)
192/01	UP†	2.2	18	(16 - 20)
		1.4	44	(42 - 46)
		2.2	410	(408 - 412)
		5.1	2717	(2714 - 2720)
		5.4	4022	(4020 - 4024)
193/01	UP†	1.1	2	(0 - 4)
		2.0	18	(16 - 20)
		1.4	410	(408 - 412)
		5.7	2632	(2630 - 2634)
		1.7	3294	(3292 - 3296)
		5.2	3818	(3816 - 3820)
194/03	UP†	2.2	20	(18 - 22)
		1.3	526	(524 - 528)
		1.1	1432	(1430 - 1434)
		5.4	2862	(2860 - 2864)
		5.4	4164	(4162 - 4166)
195/01	UP†	1.2	1	(0 - 2)
		1.9	18	(16 - 20)
		1.9	404	(402 - 406)
		3.4	2184	(2182 - 2186)
		5.5	2800	(2796 - 2804)
		7.0	3385	(3382 - 3388)
		3.3	3439	(3438 - 3440)
		5.8	3861	(3858 - 3864)
196/01	UP†	2.3	18	(16 - 20)
		1.2	450	(448 - 452)
		5.3	2674	(2672 - 2676)
		5.3	3766	(3764 - 3768)
197/01	DOWN	4.3	18	(16 - 20)
		1.1	410	(408 - 412)

station /cast	down /up	#minutes stopped	avg.pressure (decibars)	pressure range
198/02	DOWN	2.3	18	(16 - 20)
		1.3	1657	(1654 - 1660)
199/01	DOWN	2.5	18	(16 - 20)
200/01	DOWN	1.8	18	(16 - 20)
		1.0	512	(510 - 514)
201/01	DOWN	2.4	18	(16 - 20)
		1.4	416	(414 - 418)
202/01	DOWN	1.7	18	(16 - 20)
203/01	DOWN	2.1	18	(16 - 20)
204/01	DOWN	4.8	24	(22 - 26)
205/01	DOWN	12.2	19	(16 - 22)
		1.3	396	(394 - 398)
206/01	DOWN	1.6	18	(16 - 20)
207/01	DOWN	2.0	18	(16 - 20)
208/01	DOWN	2.1	18	(16 - 20)
209/01	DOWN	2.9	18	(16 - 20)
210/02	DOWN	1.8	16	(14 - 18)
		1.2	408	(406 - 410)
211/01	DOWN	3.0	22	(20 - 24)
212/01	DOWN	6.5	17	(14 - 20)
213/01	DOWN	2.0	18	(16 - 20)
		1.1	400	(398 - 402)
214/01	DOWN	1.8	18	(16 - 20)
215/01	DOWN	1.0	19	(18 - 20)
		1.1	415	(414 - 416)
216/01	DOWN	2.2	18	(16 - 20)
		1.1	444	(442 - 446)
217/01	DOWN	2.2	17	(16 - 18)
218/01	DOWN	2.8	16	(14 - 18)
219/01	DOWN	2.1	20	(18 - 22)
220/01	DOWN	6.2	18	(16 - 20)
		1.2	420	(418 - 422)

†NOTE: two 5-minute therm soaks on each UP CAST, stas. 183-220

TUNES-1: CTD Temperature and Conductivity Corrections Summary

Sta/ Cast	PRT Response Time (secs)	Temperature Coefficients			Conductivity Coefficients	
		corT = t2*T2 + t1*T + t0			corC = c1*C + c0	
		t2	t1	t0	c1	c0
001/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0093
002/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0093
003/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0093
004/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0123
005/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0108
006/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0128
007/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0118
008/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0108
009/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0096
010/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0064
011/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0101
012/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0109
013/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0107
014/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0105
015/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0102
016/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0060
017/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0098
018/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0041
019/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0093
020/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0091
021/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0049
022/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0086
023/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0114
024/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0102
025/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0080
026/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0047
027/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0045
028/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0073
029/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0051
030/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0068
031/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0046
032/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0046
033/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0047
034/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0047
035/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0048
036/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0048
037/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0049
038/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0069
039/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0050
040/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0050
041/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0051
042/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0051
043/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0052

Sta/ Cast	PRT Response Time (secs)	Temperature Coefficients corT = t2*T2 + t1*T + t0			Conductivity Coefficients corC = c1*C + c0	
		t2	t1	t0	c1	c0
044/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0052
045/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0053
046/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0053
047/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0054
048/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0054
049/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0055
050/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0055
051/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0056
052/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0056
053/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0057
054/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0057
055/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0058
056/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0058
057/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0059
058/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0059
059/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0060
060/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0060
061/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0061
062/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0061
063/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0062
064/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0062
065/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0063
066/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0063
067/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0064
068/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
069/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
070/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
071/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
072/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
073/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
074/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
075/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
076/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
077/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
078/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
079/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
080/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
081/01	.360	1.28600e-05	-7.32720e-04	-1.4935	8.86400e-04	-0.0445
082/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
083/01	.360	1.28600e-05	-7.32720e-04	-1.4935	8.64000e-04	-0.0478
084/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
085/01	.360	1.28600e-05	-7.32720e-04	-1.4935	8.41600e-04	-0.0350
086/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
087/01	.360	1.28600e-05	-7.32720e-04	-1.4935	8.19200e-04	-0.0403
088/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078

Sta/ Cast	PRT Response Time (secs)	Temperature Coefficients corT = t2*T2 + t1*T + t0			Conductivity Coefficients corC = c1*C + c0	
		t2	t1	t0	c1	c0
089/01	.360	1.28600e-05	-7.32720e-04	-1.4935	7.96800e-04	-0.0456
090/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
091/01	.360	1.28600e-05	-7.32720e-04	-1.4935	7.74400e-04	-0.0353
092/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
093/01	.360	1.28600e-05	-7.32720e-04	-1.4935	7.52000e-04	-0.0396
094/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
095/01	.360	1.28600e-05	-7.32720e-04	-1.4935	7.29600e-04	-0.0404
096/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
097/01	.360	1.28600e-05	-7.32720e-04	-1.4935	7.07200e-04	-0.0366
098/02	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
098/04	.360	1.28600e-05	-7.32720e-04	-1.4935	6.96000e-04	-0.0428
099/01	.360	1.28600e-05	-7.32720e-04	-1.4935	6.84800e-04	-0.0334
100/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
101/01	.360	1.28600e-05	-7.32720e-04	-1.4935	6.62400e-04	-0.0367
102/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
103/01	.360	1.28600e-05	-7.32720e-04	-1.4935	6.40000e-04	-0.0364
104/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
105/01	.360	1.28600e-05	-7.32720e-04	-1.4935	6.17600e-04	-0.0337
106/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
107/01	.360	1.28600e-05	-7.32720e-04	-1.4935	5.95200e-04	-0.0325
108/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
109/01	.360	1.28600e-05	-7.32720e-04	-1.4935	5.72800e-04	-0.0352
110/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
111/01	.360	1.28600e-05	-7.32720e-04	-1.4935	5.50400e-04	-0.0315
112/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
113/01	.360	1.28600e-05	-7.32720e-04	-1.4935	5.28000e-04	-0.0308
114/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
115/01	.360	1.28600e-05	-7.32720e-04	-1.4935	5.05600e-04	-0.0300
116/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
117/01	.360	1.28600e-05	-7.32720e-04	-1.4935	4.83200e-04	-0.0293
118/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
119/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
120/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0078
121/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0068
122/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0068
123/01	.325	1.93330e-05	-5.72760e-04	-1.4841	3.44500e-04	0.0068

TUNES-2: CTD Temperature and Conductivity Corrections Summary

Sta/ Cast	PRT Response Time (secs)	Temperature Coefficients			Conductivity Coefficients	
		corT = t2*T2 + t1*T + t0			corC = c1*C + c0	
		t2	t1	t0	c1	c0
124/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0012
125/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0031
126/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0065
127/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0065
128/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0059
129/02	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0063
130/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0067
131/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0082
132/02	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0076
133/01	.325	1.93330e-05	-5.72760e-04	-1.4841	2.23244e-04	0.0080
134/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-3.80005e-02	0.0045
135/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-3.81843e-02	0.0111
136/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-3.83681e-02	0.0177
137/01	.360	1.28600e-05	-7.32720e-04	-1.5035	2.73821e-04	-0.0261
138/01	.360	1.28600e-05	-7.32720e-04	-1.5035	2.48147e-04	-0.0222
139/01	.360	1.28600e-05	-7.32720e-04	-1.5035	2.22472e-04	-0.0193
140/01	.360	1.28600e-05	-7.32720e-04	-1.5035	1.96798e-04	-0.0179
141/01	.360	1.28600e-05	-7.32720e-04	-1.5035	1.71124e-04	-0.0165
142/01	.360	1.28600e-05	-8.92720e-04	-1.5030	1.45449e-04	-0.0151
143/03	.360	1.28600e-05	-1.01272e-03	-1.5027	1.19775e-04	-0.0137
144/01	.360	1.28600e-05	-1.01272e-03	-1.5027	9.41008e-05	-0.0123
145/01	.360	1.28600e-05	-1.01272e-03	-1.5027	6.84265e-05	-0.0109
146/01	.360	1.28600e-05	-1.01272e-03	-1.5027	4.27522e-05	-0.0095
147/01	.360	1.28600e-05	-1.07272e-03	-1.5025	1.70779e-05	-0.0081
148/01	.500	1.37930e-05	-4.90710e-04	-1.4844	3.38337e-04	-0.0182
149/01	.500	1.37930e-05	-4.90710e-04	-1.4844	3.41332e-04	-0.0183
150/01	.500	1.37930e-05	-4.90710e-04	-1.4844	3.44328e-04	-0.0184
151/01	.240	1.61680e-05	-1.21370e-04	-1.5021	4.72316e-04	0.0004
152/01	.240	1.61680e-05	-1.21370e-04	-1.5021	4.60423e-04	0.0011
153/02	.240	1.61680e-05	-1.21370e-04	-1.5021	4.48529e-04	0.0023
154/01	.240	1.61680e-05	-1.21370e-04	-1.5021	4.36636e-04	-0.0000
155/01	.240	1.61680e-05	-1.21370e-04	-1.5021	4.24742e-04	0.0002
156/01	.240	1.61680e-05	-1.21370e-04	-1.5021	4.12848e-04	0.0004
157/01	.240	1.61680e-05	-1.21370e-04	-1.5021	4.00955e-04	0.0006
158/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.89061e-04	0.0008
159/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.77168e-04	0.0010
160/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.65274e-04	0.0012
161/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.53380e-04	0.0014
162/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.41487e-04	0.0016
163/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.29593e-04	0.0018
164/01	.240	1.61680e-05	-1.21370e-04	-1.5021	3.17700e-04	0.0020
165/02	.240	1.61680e-05	-1.21370e-04	-1.5021	3.05806e-04	0.0022
166/02	.240	1.61680e-05	-1.21370e-04	-1.5021	2.93912e-04	0.0024

Sta/ Cast	PRT Response Time (secs)	Temperature Coefficients			Conductivity Coefficients	
		corT = t2*T2 + t1*T + t0			corC = c1*C + c0	
		t2	t1	t0	c1	c0
167/01	.240	1.61680e-05	-1.21370e-04	-1.5021	2.82019e-04	0.0026
168/01	.240	1.61680e-05	-1.21370e-04	-1.5021	2.70125e-04	0.0028
169/01	.240	1.61680e-05	-1.21370e-04	-1.5021	2.58232e-04	0.0030
170/01	.240	1.61680e-05	-1.21370e-04	-1.5021	2.46338e-04	0.0032
171/01	.240	1.61680e-05	-1.21370e-04	-1.5021	2.34444e-04	0.0034
172/02	.240	1.61680e-05	-1.21370e-04	-1.5021	2.22551e-04	0.0036
173/01	.240	1.61680e-05	-1.21370e-04	-1.5021	2.10657e-04	0.0038
174/01	.240	1.61680e-05	-1.21370e-04	-1.5021	1.98764e-04	0.0040
175/01	.240	1.61680e-05	-1.21370e-04	-1.5021	1.86870e-04	0.0042
176/01	.240	1.61680e-05	-1.21370e-04	-1.5021	1.74976e-04	0.0034
177/01	.240	1.61680e-05	-1.21370e-04	-1.5021	1.63083e-04	0.0046
178/01	.240	1.61680e-05	-1.21370e-04	-1.5021	1.51189e-04	0.0049
179/02	.240	1.61680e-05	-1.21370e-04	-1.5021	1.39296e-04	0.0066
180/02	.240	1.61680e-05	-1.21370e-04	-1.5021	1.27402e-04	0.0063
181/01	.240	1.61680e-05	-1.21370e-04	-1.5021	1.15508e-04	0.0055
182/02	.325	1.93330e-05	-5.72760e-04	-1.4841	-7.54052e-04	0.0222
183/01	.500	1.37930e-05	-4.90710e-04	-1.4844	4.43169e-04	-0.0220
184/01	.500	1.37930e-05	-4.90710e-04	-1.4844	4.46165e-04	-0.0221
185/01	.500	1.37930e-05	-4.90710e-04	-1.4844	4.49160e-04	-0.0242
186/01	.500	1.37930e-05	-4.90710e-04	-1.4844	4.52155e-04	-0.0224
187/02	.500	1.37930e-05	-4.90710e-04	-1.4844	4.55150e-04	-0.0225
188/01	.500	1.37930e-05	-4.90710e-04	-1.4844	4.58145e-04	-0.0226
189/03	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.39488e-04	0.0172
190/01	.325	1.93330e-05	-5.72760e-04	-1.4841	4.87559e-02	-0.0002
191/01	.325	1.93330e-05	-5.72760e-04	-1.4841	4.89572e-02	-0.0068
192/01	.325	1.93330e-05	-5.72760e-04	-1.4841	4.91585e-02	-0.0134
193/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-5.74023e-04	0.0146
194/03	.325	1.93330e-05	-5.72760e-04	-1.4841	-5.57657e-04	0.0141
195/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-5.41291e-04	0.0156
196/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-5.24925e-04	0.0151
197/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
198/02	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
199/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
200/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
201/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
202/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
203/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
204/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
205/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
206/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
207/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
208/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0082
209/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0086
210/02	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0086
211/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0086

Sta/ Cast	PRT Response Time (secs)	Temperature Coefficients corT = t2*T2 + t1*T + t0			Conductivity Coefficients corC = c1*C + c0	
		t2	t1	t0	c1	c0
212/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0086
213/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0086
214/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0090
215/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0090
216/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0090
217/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0090
218/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0090
219/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0080
220/01	.325	1.93330e-05	-5.72760e-04	-1.4841	-6.52178e-04	0.0090

SUMMARY OF TUNES CTD OXYGEN TIME CONSTANTS

Oxygen Sensor	Casts Used	Temperature		Press. (tauP)	O2 Grad. (tauOG)
		Fast(tauTF)	Slow(tauTS)		
A	Leg1	32.0	363.0	19.4	60.0
A/B	Leg2/Downs	32.0	363.0	19.4	60.0
A	Leg2/Ups†	16.0	450.0	13.5	150.0

†NOTE: pressure-series upcasts had an inverted elapsed time: 0 dbar times were re-defined as 0, and other times were generated by subtracting averaged time from averaged surface time. This required calculating entirely new taus in order to fit the data.

TUNES-1 CTD Oxygen: Levenberg-Marquardt Non-linear Least-Squares-Fit Coefficients

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4/fast)	TScoeff (c5/slow)	OGcoeff (c6)
001/01	7.24802e-03	-1.64874e-01	-5.88046e-04	7.50834e-04	-2.29928e-01	2.91662e-04
002/01	1.59970e-03	2.30376e-02	-1.03207e-04	8.18827e-02	-1.59326e-01	-1.66324e-03
003/01	3.15026e-04	5.19964e-03	7.51034e-04	1.78011e-02	5.06902e-02	-1.74772e-05
004/01	7.28075e-04	1.79259e-02	2.31249e-04	-1.12050e-02	2.99172e-03	-5.14948e-04
005/01	8.66148e-04	1.55705e-02	1.78445e-04	-3.37323e-03	-1.65596e-02	9.05355e-04
006/01	8.99873e-04	1.04697e-02	1.65530e-04	-1.72045e-02	-4.14432e-03	6.32709e-03
007/01	9.95399e-04	1.31497e-02	1.47997e-04	1.84243e-03	-3.36391e-02	5.64380e-04
008/01	9.76694e-04	1.77033e-02	1.41771e-04	-4.73605e-03	-2.48935e-02	-2.11440e-04
009/01	9.56440e-04	2.65778e-02	1.37522e-04	4.83369e-02	-7.45201e-02	-7.79174e-04
010/01	9.88382e-04	2.24958e-02	1.40405e-04	1.60402e-02	-4.78611e-02	1.03090e-04
011/01	1.13390e-03	1.13424e-02	1.23589e-04	2.04578e-02	-5.86905e-02	-2.96790e-04
012/01	1.06528e-03	1.00242e-02	1.36141e-04	4.39809e-03	-3.99916e-02	-2.03792e-03
013/01	1.09533e-03	6.75918e-03	1.26515e-04	4.51826e-02	-7.65037e-02	-4.16009e-03
014/01	1.07251e-03	8.60413e-03	1.24851e-04	1.38971e-01	-1.35022e-01	6.97923e-03
015/01	1.03634e-03	1.26313e-02	1.36051e-04	1.10361e-02	-4.22628e-02	3.94571e-04

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4/fast)	TScoeff (c5/slow)	OGcoeff (c6)
016/01	1.10259e-03	1.19435e-02	1.27983e-04	-1.31185e-02	-1.47817e-02	-1.77437e-02
017/02	1.07216e-03	5.80046e-03	1.35903e-04	8.59448e-03	-4.07108e-02	5.04564e-05
018/01	1.06536e-03	8.52198e-03	1.36759e-04	-7.69007e-04	-3.22740e-02	2.19749e-04
019/01	1.02844e-03	6.34713e-03	1.46257e-04	1.34253e-02	-3.92523e-02	-1.39068e-03
020/01	1.08031e-03	1.06394e-02	1.31171e-04	1.74680e-02	-4.72440e-02	8.04953e-05
021/01	1.00108e-03	2.35202e-02	1.33305e-04	-5.11347e-04	-2.92555e-02	-1.31592e-05
022/01	1.00705e-03	8.12132e-03	1.48304e-04	-5.21132e-03	-2.44990e-02	1.43356e-03
024/01	9.90458e-04	9.22801e-03	1.50433e-04	-6.93736e-03	-2.65718e-02	2.21753e-04
025/01	9.97056e-04	1.16453e-02	1.44410e-04	7.84342e-03	-3.74745e-02	2.94954e-05
026/02	1.03810e-03	5.56055e-03	1.40735e-04	4.04221e-03	-3.62965e-02	-4.02753e-04
027/01	1.01856e-03	8.29145e-03	1.45002e-04	2.24841e-04	-3.20108e-02	-1.72571e-04
028/01	9.70011e-04	1.04460e-02	1.50544e-04	5.67253e-04	-2.79504e-02	2.16493e-03
029/01	1.05468e-03	7.92969e-03	1.37816e-04	3.81980e-03	-3.67238e-02	-1.81125e-03
030/01	9.49553e-04	1.24023e-02	1.59852e-04	-4.20201e-03	-2.23668e-02	2.71781e-03
031/01	9.85060e-04	2.58952e-02	1.37944e-04	3.77824e-03	-3.17873e-02	-5.48317e-04
032/01	1.03245e-03	8.75749e-03	1.39766e-04	6.84639e-03	-3.64584e-02	1.99483e-04
033/01	1.03076e-03	1.36677e-02	1.36592e-04	6.32074e-03	-3.75352e-02	-4.11677e-04
034/02	9.82250e-04	8.61063e-03	1.52167e-04	4.74635e-05	-2.86427e-02	6.01967e-04
035/01	1.01850e-03	8.53818e-03	1.42389e-04	3.56802e-03	-3.21076e-02	5.37797e-03
036/01	1.04144e-03	1.06440e-02	1.36975e-04	1.60627e-03	-3.38525e-02	-5.11363e-04
037/01	1.04224e-03	8.09104e-03	1.39074e-04	6.00267e-03	-3.65478e-02	1.93133e-04
038/01	1.03076e-03	6.28557e-03	1.41788e-04	3.63026e-03	-3.27407e-02	8.86588e-04
039/01	9.93443e-04	1.32195e-02	1.44250e-04	6.18536e-03	-3.44103e-02	2.59714e-04
040/01	9.58210e-04	1.41796e-02	1.51090e-04	5.23193e-03	-2.99385e-02	-1.58064e-05
041/01	1.16584e-03	-2.82046e-03	1.27278e-04	8.75520e-03	-4.25786e-02	-1.12129e-04
042/01	1.03155e-03	2.24784e-02	1.30674e-04	1.60939e-02	-4.49273e-02	-3.10167e-04
043/01	1.05447e-03	1.81437e-02	1.33218e-04	1.78523e-02	-4.79855e-02	-9.99104e-04
044/01	1.08574e-03	1.13440e-02	1.32482e-04	2.35363e-02	-5.30591e-02	-1.12824e-03
045/01	1.06818e-03	1.03064e-02	1.36599e-04	1.16715e-02	-3.99727e-02	-5.14995e-04
046/02	1.00316e-03	7.55728e-03	1.48355e-04	1.04310e-03	-3.08853e-02	1.16109e-03
047/01	1.02483e-03	1.06734e-02	1.39914e-04	1.21200e-02	-4.06460e-02	3.79392e-04
048/01	1.00316e-03	1.48015e-02	1.42201e-04	6.85070e-03	-3.47429e-02	-1.30695e-03
049/01	1.02951e-03	1.30529e-02	1.38424e-04	5.41685e-03	-3.46088e-02	6.31640e-04
050/01	1.00293e-03	9.48351e-03	1.47140e-04	7.73951e-03	-3.55515e-02	-3.65630e-04
051/01	9.72054e-04	1.86726e-02	1.43866e-04	1.83395e-02	-4.35549e-02	-1.26155e-03
052/01	9.70327e-04	1.82255e-02	1.45232e-04	5.00731e-03	-3.22816e-02	-3.54447e-04
053/01	1.01009e-03	1.08612e-02	1.44849e-04	-5.18183e-03	-2.40106e-02	1.70157e-03
054/01	9.75391e-04	1.62491e-02	1.45787e-04	2.50062e-02	-5.10526e-02	-8.92685e-04
055/01	1.01451e-03	7.39458e-03	1.47500e-04	2.40399e-03	-3.04572e-02	-2.53883e-03
056/01	9.84372e-04	1.38237e-02	1.47096e-04	6.91325e-03	-3.32705e-02	-1.55152e-03
057/02	1.03037e-03	8.38242e-03	1.42387e-04	7.76727e-03	-3.49248e-02	-2.81035e-04
058/01	9.69592e-04	1.62891e-02	1.49699e-04	1.50016e-03	-2.96223e-02	-1.73616e-03
059/01	9.63017e-04	1.05540e-02	1.54861e-04	-1.25922e-02	-1.51927e-02	2.31573e-03
060/01	1.02484e-03	7.95632e-03	1.42830e-04	1.63860e-02	-4.35597e-02	-3.36013e-04
061/01	9.91187e-04	1.30870e-02	1.46085e-04	1.80930e-02	-4.36226e-02	-2.54740e-03
062/01	1.01511e-03	1.42072e-02	1.40783e-04	5.06870e-03	-3.47600e-02	2.79641e-03
063/01	9.60282e-04	2.20035e-02	1.44553e-04	3.13200e-02	-5.54393e-02	1.43921e-03
064/01	9.67337e-04	2.70884e-02	1.38605e-04	3.06649e-02	-5.54674e-02	6.84215e-04

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4/fast)	TScoeff (c5/slow)	OGcoeff (c6)
065/01	9.64649e-04	1.98868e-02	1.44409e-04	9.92911e-03	-3.49676e-02	-3.89444e-04
066/02	1.03870e-03	1.07897e-02	1.36764e-04	2.80503e-02	-5.28224e-02	-2.05641e-04
067/01	9.85742e-04	1.20290e-02	1.46600e-04	6.16394e-03	-3.22376e-02	2.66969e-04
068/01	1.00534e-03	1.81370e-02	1.37677e-04	1.30288e-02	-4.07731e-02	-1.14477e-03
069/01	9.94832e-04	9.67186e-03	1.48290e-04	2.06267e-03	-2.82917e-02	-1.22294e-03
070/01	1.00110e-03	1.07634e-02	1.45605e-04	5.16307e-03	-3.07097e-02	-1.01830e-03
071/01	1.00034e-03	1.32691e-02	1.44228e-04	-6.82664e-04	-2.66101e-02	-2.20217e-03
072/01	9.76264e-04	1.47092e-02	1.48223e-04	-7.18445e-03	-1.98852e-02	1.39682e-03
073/01	9.42906e-04	1.76837e-02	1.50809e-04	1.36076e-02	-3.51466e-02	-5.41324e-04
074/01	9.48056e-04	1.58121e-02	1.52092e-04	3.09958e-03	-2.61022e-02	1.77388e-03
075/01	1.02317e-03	5.76000e-03	1.45881e-04	-1.93653e-03	-2.40303e-02	1.94567e-03
076/02	1.02695e-03	1.97063e-03	1.48249e-04	5.29817e-03	-3.13972e-02	-1.33717e-03
077/01	9.66208e-04	1.59690e-02	1.48381e-04	8.66840e-03	-3.27822e-02	-7.50186e-05
078/01	9.53351e-04	2.03614e-02	1.49489e-04	-2.20506e-03	-2.36307e-02	1.60376e-03
079/01	8.44279e-04	3.63518e-02	1.60255e-04	8.20097e-03	-2.79678e-02	3.43004e-03
080/01	8.54124e-04	4.18296e-02	1.51174e-04	4.77798e-03	-2.58247e-02	1.65132e-03
082/01	1.00127e-03	1.43549e-02	1.44893e-04	1.41171e-03	-2.76183e-02	1.75646e-04
084/01	8.12746e-04	5.58512e-02	1.47347e-04	2.72998e-02	-4.56791e-02	6.91253e-04
086/01	9.87364e-04	1.83455e-02	1.43221e-04	1.10180e-03	-2.65874e-02	9.00150e-04
088/01	9.86015e-04	1.66219e-02	1.45459e-04	1.07200e-03	-2.74424e-02	7.95173e-04
090/01	1.00997e-03	1.18297e-02	1.43149e-04	-1.18376e-03	-2.70019e-02	-6.38732e-04
092/01	9.81762e-04	2.08147e-02	1.43329e-04	5.52989e-03	-3.16522e-02	8.92567e-04
094/01	1.01862e-03	9.87764e-03	1.44475e-04	-6.81784e-04	-2.68728e-02	1.00537e-03
096/01	9.81805e-04	1.40748e-02	1.47398e-04	4.11519e-03	-3.04472e-02	-4.03410e-04
098/02	1.00086e-03	1.49427e-02	1.42494e-04	2.08308e-03	-2.88540e-02	1.22995e-04
100/01	1.02141e-03	3.96023e-03	1.49361e-04	-5.75500e-03	-2.31526e-02	-2.76749e-04
102/01	9.85521e-04	2.25166e-02	1.40578e-04	-4.42452e-04	-2.66883e-02	1.78573e-03
104/01	1.03763e-03	8.35658e-03	1.41275e-04	6.19153e-03	-3.32475e-02	-2.98631e-04
106/01	8.99253e-04	3.47073e-02	1.49996e-04	-8.87613e-04	-2.34300e-02	9.71442e-04
108/01	1.02563e-03	1.53350e-02	1.38094e-04	1.33474e-03	-2.93419e-02	1.23564e-03
110/01	9.29449e-04	3.02655e-02	1.46778e-04	7.77714e-03	-3.07882e-02	-1.90474e-04
112/01	1.08311e-03	-4.59158e-03	1.44577e-04	-3.46664e-03	-2.58978e-02	1.25448e-03
114/01	9.31699e-04	2.59204e-02	1.52274e-04	-3.38423e-03	-2.16661e-02	3.74394e-04
116/01	9.97384e-04	7.41649e-03	1.51550e-04	-8.25043e-04	-2.44237e-02	8.58486e-04
118/01	9.44063e-04	2.43379e-02	1.48560e-04	7.56279e-03	-3.20960e-02	-1.03462e-03
119/01	9.63304e-04	2.74987e-02	1.41882e-04	4.87114e-03	-2.91449e-02	1.49102e-03
120/01	8.47012e-04	6.18122e-02	1.37217e-04	2.80281e-02	-4.84563e-02	1.57515e-03
121/01	9.76510e-04	1.14462e-02	1.52606e-04	-6.87172e-03	-1.73796e-02	3.55328e-03
122/01	9.06873e-04	4.25844e-02	1.39208e-04	1.41900e-02	-3.72395e-02	7.62275e-03
123/01	9.72822e-04	2.56395e-02	1.40124e-04	6.35854e-03	-3.23910e-02	-1.80945e-04

TUNES-2 CTD Oxygen: Levenberg-Marquardt Non-linear Least-Squares-Fit Coefficients

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4/fast)	TScoeff (c5/slow)	OGcoeff (c6)
124/01	9.74036e-04	2.74161e-02	1.38260e-04	1.13660e-02	-3.74159e-02	1.35937e-04
125/01	9.88555e-04	1.42946e-02	1.46805e-04	-8.23080e-04	-2.42034e-02	2.32403e-03
126/01	9.64627e-04	2.19085e-02	1.46160e-04	1.56478e-03	-2.69694e-02	1.39288e-03
127/01	7.20499e-04	9.55390e-02	1.36654e-04	2.30895e-02	-3.92416e-02	-8.73076e-04
128/01	7.85126e-04	8.58324e-02	1.29759e-04	1.87087e-02	-3.71071e-02	5.77933e-04
129/02	9.74450e-04	2.45606e-02	1.40970e-04	-2.42716e-03	-2.34322e-02	4.75858e-04
130/01	9.72792e-04	1.21977e-02	1.51431e-04	-3.75316e-03	-1.88455e-02	6.11484e-03
131/01	9.46839e-04	2.20674e-02	1.49447e-04	2.02056e-03	-2.41925e-02	7.48703e-03
132/02	8.69841e-04	5.28195e-02	1.40260e-04	4.57305e-03	-2.52919e-02	8.28663e-04
133/01	1.23075e-03	-3.70209e-02	1.38253e-04	-3.38737e-02	3.77030e-03	-4.45136e-03
134/01	1.16423e-03	-2.22803e-02	1.41353e-04	-3.17152e-02	3.43710e-03	-7.22666e-03
135/01	1.13587e-03	-2.13681e-02	1.45314e-04	-4.15103e-02	1.36212e-02	-1.44598e-03
136/01	1.14442e-03	-5.48818e-03	1.30485e-04	-2.21766e-02	-5.84958e-03	-4.89250e-03
137/01	8.04538e-04	8.80899e-02	1.30294e-04	1.79691e-02	-3.71009e-02	-3.46420e-04
138/01	9.27807e-04	4.47543e-02	1.39047e-04	5.78485e-03	-2.93921e-02	5.83201e-04
139/01	9.26000e-04	5.28698e-02	1.31956e-04	5.99761e-03	-2.90277e-02	-3.67244e-04
140/01	9.72469e-04	3.33778e-02	1.39136e-04	7.93609e-03	-3.19523e-02	4.51678e-04
141/01	1.02034e-03	2.82425e-02	1.32970e-04	8.15073e-03	-3.45033e-02	-6.18173e-04
142/01	8.78143e-04	6.32930e-02	1.34683e-04	1.31040e-02	-3.30647e-02	1.90743e-03
143/03	9.70027e-04	3.39855e-02	1.38869e-04	6.13234e-03	-3.17918e-02	-5.63932e-04
144/01	9.97689e-04	2.77420e-02	1.37296e-04	9.77747e-03	-3.55768e-02	-1.82198e-04
145/01	1.00357e-03	2.01629e-02	1.43201e-04	7.79951e-03	-3.12180e-02	7.34854e-03
146/01	1.00234e-03	2.37381e-02	1.41278e-04	8.35470e-03	-3.40002e-02	-3.19773e-03
147/01	9.25596e-04	4.63474e-02	1.39812e-04	5.32981e-03	-2.65962e-02	6.16987e-03
148/01	9.43262e-04	4.94159e-02	1.32288e-04	1.36087e-02	-3.74967e-02	-9.84955e-04
149/01	9.08413e-04	6.01087e-02	1.31258e-04	7.29372e-03	-2.96914e-02	3.04312e-04
150/01	1.13607e-03	-2.16355e-02	1.49687e-04	9.08542e-03	-3.85515e-02	-9.85967e-04
151/01	9.86250e-04	2.35871e-02	1.45587e-04	5.27522e-03	-3.14749e-02	-2.00609e-03
152/01	9.79475e-04	3.37289e-02	1.35609e-04	4.46854e-03	-2.88005e-02	8.63516e-04
153/02	1.01440e-03	2.98860e-02	1.30338e-04	4.92377e-03	-3.21539e-02	1.42977e-03
154/01	9.56233e-04	3.86116e-02	1.36852e-04	1.91465e-03	-2.75336e-02	1.62430e-03
155/01	8.43446e-04	8.20899e-02	1.25023e-04	7.79834e-04	-2.26916e-02	1.00613e-03
156/01	8.94453e-04	6.14941e-02	1.32899e-04	-9.68918e-04	-2.36078e-02	5.26077e-04
157/01	9.83516e-04	3.12903e-02	1.37690e-04	1.28305e-03	-2.82337e-02	1.61909e-03
158/01	9.50178e-04	2.48023e-02	1.52902e-04	-2.84830e-03	-2.22188e-02	5.00782e-03
159/01	1.10911e-03	-1.57433e-02	1.45069e-04	4.34918e-03	-3.42891e-02	6.99069e-04
160/01	9.15838e-04	5.65461e-02	1.31994e-04	-2.82383e-03	-2.23812e-02	1.50998e-03
161/01	9.76541e-04	3.67686e-02	1.35698e-04	3.52564e-03	-3.03183e-02	2.38863e-04
162/01	1.00913e-03	2.18993e-02	1.39440e-04	-4.99025e-04	-2.78230e-02	5.73047e-04
163/01	9.92499e-04	2.25870e-02	1.44242e-04	-3.10614e-04	-2.63406e-02	1.92347e-03
164/01	1.01372e-03	2.01795e-02	1.43503e-04	-1.18380e-03	-2.71355e-02	-2.37808e-05
165/02	9.47497e-04	4.61054e-02	1.34169e-04	-1.32815e-03	-2.50594e-02	-4.23704e-04
166/02	1.01222e-03	1.16514e-02	1.47535e-04	-3.01877e-03	-2.72148e-02	-1.62388e-04
167/01	9.65490e-04	3.07138e-02	1.43549e-04	-2.94021e-03	-2.46337e-02	1.54298e-03
168/01	1.01952e-03	9.38912e-03	1.47524e-04	-3.31298e-03	-2.56856e-02	9.19736e-05
169/01	9.92975e-04	2.15173e-02	1.45156e-04	-1.27772e-03	-2.66347e-02	-5.56928e-05

Sta/ Cast	Slope (c1)	Offset (c2)	Pcoeff (c3)	Tfcoeff (c4/fast)	TScoeff (c5/slow)	OGcoeff (c6)
170/01	1.09682e-03	-4.67248e-03	1.43783e-04	4.33293e-03	-3.61059e-02	4.13626e-04
171/01	1.03991e-03	1.51834e-02	1.41128e-04	5.82635e-03	-3.48170e-02	-1.11327e-03
172/02	9.65464e-04	2.88758e-02	1.45327e-04	-1.07821e-02	-1.90955e-02	1.17278e-04
173/01	9.92514e-04	2.54707e-02	1.43603e-04	-1.35774e-03	-2.64658e-02	-3.90692e-04
174/01	1.02221e-03	1.61930e-02	1.44875e-04	6.18773e-03	-3.37413e-02	1.07993e-04
175/01	9.70707e-04	3.81207e-02	1.40143e-04	-2.35929e-03	-2.45734e-02	-3.91433e-05
176/01	1.02346e-03	1.71879e-02	1.43864e-04	1.61324e-03	-2.90824e-02	4.25191e-04
177/01	1.00907e-03	2.90049e-02	1.38135e-04	-1.01364e-03	-2.58912e-02	3.42700e-03
178/01	1.04821e-03	1.43697e-02	1.41951e-04	4.73295e-03	-3.23759e-02	2.37301e-04
179/02	1.03618e-03	1.08475e-02	1.47259e-04	-1.65927e-03	-2.70478e-02	1.12468e-03
180/02	1.02725e-03	8.05786e-03	1.45292e-04	-2.51802e-03	-2.88875e-02	-5.86707e-04
181/01	9.83335e-04	2.96404e-02	1.39107e-04	4.05513e-03	-3.04371e-02	-6.92337e-06
182/02	1.16887e-03	7.62552e-03	8.78018e-05	-2.61066e-02	-9.76593e-03	-3.77702e-03
183/01	1.00920e-03	2.06813e-02	1.43375e-04	-2.72462e-02	-8.78713e-03	-4.85355e-04
184/01	1.01351e-03	1.73297e-02	1.45849e-04	-2.66070e-02	-8.54734e-03	-1.03444e-03
185/01	9.39419e-04	4.11220e-02	1.41664e-04	-6.73055e-03	-1.73737e-02	3.85836e-03
186/01	9.85708e-04	2.94156e-02	1.43114e-04	-5.15553e-03	-2.17635e-02	1.91419e-04
187/02	9.93422e-04	3.03151e-02	1.40169e-04	1.81920e-03	-2.85360e-02	2.29725e-03
188/01	9.92379e-04	1.83591e-02	1.47224e-04	3.31433e-03	-3.26159e-02	-4.28132e-06
193/01	8.56067e-04	7.41068e-02	1.31170e-04	-3.48618e-02	1.45682e-02	-2.31530e-03
194/03	1.01673e-03	3.30716e-02	1.31019e-04	-2.48869e-02	-1.50489e-03	-6.41632e-03
195/01	1.03338e-03	2.20898e-02	1.36240e-04	-2.84714e-02	-8.76995e-06	-9.26474e-03
196/01	8.56847e-04	8.00897e-02	1.28120e-04	-3.22148e-02	1.33820e-02	-1.04290e-03
197/01	9.98900e-04	1.96720e-02	1.45111e-04	9.30220e-03	-3.71486e-02	-4.30105e-04
198/02	9.63034e-04	3.00695e-02	1.45933e-04	-1.22247e-03	-2.79709e-02	-1.23479e-03
199/01	8.90092e-04	4.50071e-02	1.53063e-04	6.98631e-04	-2.34627e-02	1.49480e-03
200/01	9.55612e-04	1.96937e-02	1.63588e-04	6.05485e-03	-3.01778e-02	-3.26536e-04
201/01	9.61216e-04	3.64178e-02	1.44177e-04	2.86506e-03	-2.95201e-02	-9.88325e-04
202/01	9.68779e-04	3.78174e-02	1.42125e-04	2.10321e-03	-3.06230e-02	-2.12457e-03
203/01	9.75186e-04	3.20391e-02	1.46398e-04	1.19479e-03	-2.91412e-02	8.22370e-04
204/01	1.02167e-03	2.29675e-02	1.45919e-04	4.17063e-03	-3.38061e-02	-1.29569e-03
205/01	8.53594e-04	8.25995e-02	1.33500e-04	-1.40165e-03	-2.17228e-02	6.54864e-04
206/01	9.03648e-04	5.93182e-02	1.39662e-04	-2.76579e-03	-2.20259e-02	1.93567e-03
207/01	9.40520e-04	5.16192e-02	1.37779e-04	1.53863e-03	-2.76990e-02	-1.30542e-03
208/01	9.43210e-04	4.38431e-02	1.46352e-04	1.69443e-03	-2.78140e-02	-3.41290e-03
209/01	8.57270e-04	8.25120e-02	1.32823e-04	-2.07116e-03	-2.15492e-02	1.16307e-03
210/02	1.14233e-03	-1.64812e-02	1.49065e-04	1.36421e-02	-4.58470e-02	-5.32877e-03
211/01	1.02694e-03	2.00706e-02	1.45605e-04	8.83728e-04	-3.02670e-02	-7.39584e-04
212/01	1.00621e-03	2.79678e-02	1.44059e-04	6.48505e-03	-3.36940e-02	-1.57985e-04
213/01	8.38116e-04	9.23205e-02	1.27497e-04	1.33727e-03	-2.28328e-02	5.04368e-04
214/01	6.87475e-04	1.37463e-01	1.24238e-04	-1.92717e-03	-1.42103e-02	7.51458e-04
215/01	9.26096e-04	4.83288e-02	1.47684e-04	-9.00041e-04	-2.46545e-02	-1.05974e-03
216/01	1.11954e-03	-1.04200e-02	1.54310e-04	9.97415e-03	-3.95453e-02	-1.27928e-03
217/01	1.02024e-03	3.49490e-02	1.42072e-04	5.76715e-03	-3.22223e-02	5.60629e-04
218/01	1.13903e-03	-1.62749e-02	1.55528e-04	3.12347e-03	-3.42289e-02	-7.74700e-04
219/01	7.96293e-04	1.09757e-01	1.29044e-04	-1.49413e-03	-2.03201e-02	4.02498e-05
220/01	1.00456e-03	3.96412e-02	1.38775e-04	4.36451e-03	-3.09871e-02	-7.55432e-04

WHPO Data Processing Notes

Date	Contact	Data Type	Data Status Summary
11/2/93	Mantyla	NUTs/S/O	DQE Report rcvd @ WHPO
12/13/93	Talley	NUTs/S/O	DQE Report sent to PI
04/07/94	Jenkins	He/Tr Shallow	Submitted for DQE

The next message (1000+ lines) contains the tritium-helium data for the TUNES 2 leg. Just to reiterate, this is the Thomas Washington cruise that took place in the summer of 1991, covering Pl7c-Pl6c along 135W and 150W respectively. The data are organized as one line per "sample", which may contain tritium, helium or both. -99 represents no data or sample for a variable. The columns are as follows:

Sta, Cast, Bottle, Pressure (db), tritium (TU), sigma-tritium (TU), delta-3He (permil), sigma-delta (permil), conc-Helium (nM/Kg), sigma-conc (nM/Kg), quall, qual2

The quality numbers for tritium (quall) are
- 1 = valid sample
- 2 = possible under-extraction
- 3 = possible contamination
- 7 = identity suspected
- 9 = no sample

In this data set, there were no quall values of 2,3 or 7

The quality numbers for helium (qual2) are
- 1 = valid sample
- 2 = possible under extraction
- 3 = possible (air) contamination
- 7 = identity suspected
- 9 = no sample In this data set, there were no qual2 values of 7

Also, the obvious applies, if a sample value is null (-99) its error, which may not appear as null (-99) is meaningless.

Also, the tritium data has been corrected for a small (.0045 TU) blank due to cosmogenic production during storage.

Finally, I was hoping to finish up a paper that I am working on for this data: I don't mind you using it for demonstration purposes, but-I would hope that its distribution could be restricted over the next 4-5 months until I have had a chance to get it submitted and hopefully reviewed and accepted. Also, it will give me a chance to make one final pass at the data to ensure that there are no problems with it. I hope this is OK.

Date	Contact	Data Type	Data Status Summary
05/06/94	Joyce	He/Tr	Data Merged into BTL file

BTL file complete except for CFCs and CTDOXY

Date	Contact	Data Type	Data Status Summary
06/13/94	Talley	NUTs/S/O	PI Responded to DQE Report
01/13/95	Van Woy	CFCs	DQE Report rcvd @ WHPO
01/24/95	Van Woy	CFCs	DQE Report sent to PI
01/25/95	Tsuchiya	all	OK to make Data Public
01/26/95	Millard	CTD	DQE Report rcvd @ WHPO

Date	Contact	Data Type	Data Status Summary
01/27/95	Talley	all	OK to make Data Public
07/01/96	Key	DELC14	DQE Report rcvd @ WHPO
03/04/98	Kozyr	CO2	Final Data Rcvd @ WHPO
01/19/99	Willey	CFCs	Data rcvd @ WHPO

received the CFC-11/12 datasets for the following WHP lines:

EXPOCODE 31WTTUNES_2	WHP-ID	P17S,P16S
EXPOCODE 31WTTUNES_1	WHP-ID	P17C
EXPOCODE 316N138/12	WHP-ID	P19C
EXPOCODE 318MWEST_4-5	WHP-ID	P21E/W
EXPOCODE 316N138/3	WHP-ID	P6E

Each file looks fine and has been placed in the proper archived directory on our machine so that they can be merged in with the rest of the values. -Steve Diggs

I just ftp'd our cfc files to the /INCOMING/RFine_cfcs directory. The files named *.sea are hydro files with our final cfc values and quality bytes merged in. The files named *_cfcs.dat are files that include station, cast, bottle, cfcs and quality bytes.

Date	Contact	Data Type	Data Status Summary
02/17/99	Bartolacci	CFCs	Data Merged/OnLine

P16s(31WTTUNES_2), p17c(31WTTUNES_1), and p19c(316N138_12) have all had cfc data from Rana Fine merged and updated into them.
The tables and files have been updated to reflect this change.
Data are public.

Date	Contact	Data Type	Data Status Summary
04/29/99	Quay	DELC13	Data and/or Status info Requested by dmb
10/08/99	Evans	DELHE3	Data Update
10/20/99	Willey	CFCs	Final Data Rcvd @ WHPO

This is a follow-up to last month's message requesting that all of our Pacific and Indian Ocean CFCs be made accessible to the public. Our
cruises are: (Pacific) P17C, P1716S, P06E, P19C, P17N, P21E, and
(Indian) I09N, I05W/I04, I07N, I10.

Date	Contact	Data Type	Data Status Summary
01/18/00	Key	DELC14 LV	Final Data Rcvd @ WHPO

forwarded to Sarilee for reformatting You may have tons of questions regarding the following. Hopefully I can answer most of them. I have tried to pare this listing down to a minimum at this point.

Attached are 5 ascii files and one pdf file for P17C LV (a.k.a.TUNES-1):

P17CLV.data - my version of the final data file with all qc flags (this file has a temperature flag (tf) and a pressure flag (pf). The appendix to this report contains all shipboard notes regarding sample collection, problems, etc.

P17CLV.sta -	my version of the final LV station file
P17CLV.pdf -	my final data report for P17C LV data
31WTTUNES1.ldo -	original LV report produced by SIO (Sanborn)
31WTTUNES1.lsu -	final version of p17c lv sum file
31WTTUNES1.lvs -	initial version of p17c lv hyd file (no C14 prior to my QC, but close to WOCE format and with all times and locations)

AND

Date	Contact	Data Type	Data Status Summary

5 ascii files and 1 pdf file for P17C LV (a.k.a. TUNES-3). This cruise was run by WHOI with 1 SIO Tech aboard to help with LV work. As a result, no "official" hyd file was ever created. I got P,T,S data from SIO, nuts from OSU, C-14 from Stuiver and Ostlund.

31WTP17C.doc	LV general info file from Talley
31WTP17C.ps	Talley postscript cruise report for LV work
31WTP17.lvs	original SIO P,T,S file
P16CLV.sta	my final version of the LV station file
P16CLV.data	my final version of the LV data file with C14, C13, nuts, and interpolated oxygen. I provided all final QC flags.P16CLV.pdf - my final report for this leg. Appendix includes decklog notes, etc. This document failed to get an official OTL report number or data (I use 1/31/97).

02/04/00	Kozyr	ALKALI/TCARBN	Final Data Rcvd @ WHPO; (DQE Complete)
06/21/00	Bartolacci	helium/delhe3	not yet merged into btl file
07/25/00	Johnson	DOC	ODF Report rcvd @ WHPO

transferred files to the ftp-incoming directory:
/usr/export/ftp-incoming on whpo:

p16a_p17a
p17c_p17s_p16s
p17e_p19s

I already gave you p19c (which I see is in P19Cdoc). I thought it was redundant to put long names in every filename, so I made the directory name with the cruise lines, and the files are all the same. The figs files are all figxx.ps (where xx should indicate the figure numbers referenced in the documentation). I also included ps and ascii versions of the original documentation and applicable appendices. (appendix a and b will be missing - they are outdated now and shouldn't be included in anything.)

08/31/00	Anfuso	HELIUM/DELHE3	helium, delhe3 Data merged into BTL file

Merged Updated %deltaHe3 and molal[He] over some existing (outdated) data at request of L. Evans (see notes in 00_README file). Outdated helium data saved in original directory as p17chy_rplcd_2000.08.31.txt.

p17che_edt.dat: edited copy of p17woce.csv.txt.
Replaced column delimiting ',' with spaces;
aligned columns for merging,
replaced unreported data white space with -9.0000 value for molal[He] on sta/cst/btl: 25/1/26;29/1/1,31,32;41/1/27;44/1/36;61/1/ 30;65/1/18,23,33;69/1/19,28.

Runtime format: %delHe: a7,i6,a7,f10.2,i6
-->p17chy_delhe.dat
molal[He]: a7,i6,a7,16x,f11.4,i6
-->p17chy_delhe_he.dat

10/05/00	Anfuso	CO2	Website Updated

Data merged into online file Bottle: (tcarbn, alkali)

Merged TCARBN and ALKALI data into hyd file. Updated file is on line. Merging notes in original subdir 1998.03.04_P17C_CO2_XXX.

Date	Contact	Data Type	Data Status Summary
12/11/00	Uribe	DOC	Submitted, OnLine
	File contained here is a CRUISE SUMMARY and NOT sumfile. Documentation is online.		
020/6/01	Stuart	DELC13	Submitted
02/23/01	Huynh	DOC	pdf version online
	Includes ODF report for legs 1-2, Appendices A-D, DQE reports for CTD and Hyd (with a response to hyd DQE), SVC14 & LVS final reports and data status notes.		
02/26/01	Jenkins	He/Tr shallow	Data are Public
	may require minor revisions It was brought to my attention that the WOCE Pacific/Indian He-Tr data was not as yet made public. After submitting it to you last year, I had intended on going through it one more time to ensure there were no problems with it. Unfortunately, I have not had the time to do this. Is it possible, therefore, to release it as public data, and if there are any subsequent minor revisions, to make changes? I suspect there might be a few samples in the set that might have got through our initial quality control.		
06/22/01	Uribe	CTD/BTL	Website Updated; CSV File Added
	CTD and Bottle files in exchange format have been put online.		
10/24/01	Bartolacci	CFCs	Data ready to be merged
	CFC data from Dave Wisegarver for P17C placed in the original subdirectory in a the directory called 2001.07.09_P17C_CFC_UPDT_WISEGARVER. notes, readme and data files are located in this directory. data are ready for merging.		
12/11/01	Diggs	CTD	Website Updated; CSV File Added
	Due to a flurry of messages, I have updated the CTD-Exchange file using the "Diggs" v1.0e ctd-to-exchange code followed by the rename_exctd.pl code. CTD-Exchange filenames *must* be in the standard form (p17c_XXSTN_XCAST_ct1.csv) for them to be zipped in the proper order. New file placed online and checked with JOA3.0 under Mac OSX1.1.		
12/19/01	Anderson	BTL/CFC/DELC13/SUM	Website Updated
	Data merged into online file, CSV file added. Copied QUALT1 flags to QUALT2 flags. Checked to make sure Q2 were compatible with Arnold Mantyla's Q2 flags. Found Talley and Tsuchiya's response to Mantylas DQ evaluation. Made changes to Q2 flags according to their response. Merged CFC's from Wisegarver (July 9, 2001) file. Merged DELC13 received from Key (May, 2001) Some minor reformatting of the .sum file to make it compatiable with the accepted format. Converted to exchange format using new program. The new .sea, .sum, and exchange files put online.		
03/28/02	Anderson	BTL	LVS data converted to WOCE format
	Bottle: (theta, salnty, silcat, nitrat, nitrit, phspht, revprs, revtmp, delc14, c14err) Converted LVS data sent by Bob Key to WOCE format. This file needs to be linked to the web page.		

Date	Contact	Data Type	Data Status Summary
06/07/02	Jenkins	DELHE3	Data Update

I'm a bit confused and trying to figure things out here. I don't believe we reported a station 29 bottle 1 for P17c. We reported data for bottles 2,4,6,7,9,10,12 and 14 for that station. Same issue for station 41. We didn't analyze a bottle 3 there. We only reported data for bottles 2,4<=>16,18 and 19.

By the way, negative values for del3He are certainly valid, and should not be set to zero. Zero values for del3He may not necessarily mean a problem, but I'll go through the numbers you listed.

We took some copper tube samples from station 123 (bottles 2<=>17) on P17c. Although the samples were analyzed on the mass spectrometer, the results were not processed appropriately (they slipped through the net) yet somehow got included in the submission. The best thing to do here is to eliminate them for the atlas, and we'll see if we can recalculate them and resubmit them later.

Sample 121-1-8	(160.8 dbar) was underextracted (procedural problem) and should be eliminated.
Sample 121-1-5	(110.8 dbar) should be fine: the del3He = -0.004% (thus was rounding to zero for you)
Sample 116-1-4	(80.1 dbar) was not analyzed by us (I don't know how it got in the mix)
Sample 110-1-9	(212.2 dbar) was a failed analysis and should not have been reported
Sample 110-1-11	(310.3 dbar) was not analyzed by us for helium
Samples 80-1-X	(82-150 dbar) were not analyzed by us for helium (I don't know why, but they weren't)
Sample 65-1-4	(73 dbar) wasn't analyzed by us for helium
Sample 65-1-13	(610 dbar) wasn't analyzed by us for helium
Sample 54-1-8	(241 dbar) was underextracted (procedural problem) and should be eliminated
Sample 48-1-7	(232 dbar) wasn't analyzed by us for helium
Sample 44-1-14	(601 dbar) was underextracted (procedural problem) and should be eliminated
Sample 33-1-11	(300 dbar) was underextracted (procedural problem) and should be eliminated
Sample 21-1-10	(253 dbar) wasn't analyzed by us for helium
Sample17-2-15	(699 dbar) wasn't analyzed by us for helium

In short, the only one from the bunch that should be kept is 121- 1-5 (110.8 dbar). I'm sorry that the other rubbish somehow got entrained in the file. I think it was one of my earlier submissions.

06/28/02	Anderson	LVS	Data Update

File converted to WOCE format Converted lvs fileP17CLV.data sent by Bob Key to WOCE format. Found in p17c/original/2000.01.12_P17C_C14_Key

07/01/02	Uribe	LVS	LVS data linked to web site

09/03/02	Kappa	DOC	New PDF and Text files compiled

Added CFC DQE reports from Van Woy and D. Wisegarver; and these Data Processing Notes. Deleted Appendicies A & B as suggested by Mary Johnson/ODF (see 7/25/00 above). Added Large Volume Data Reports