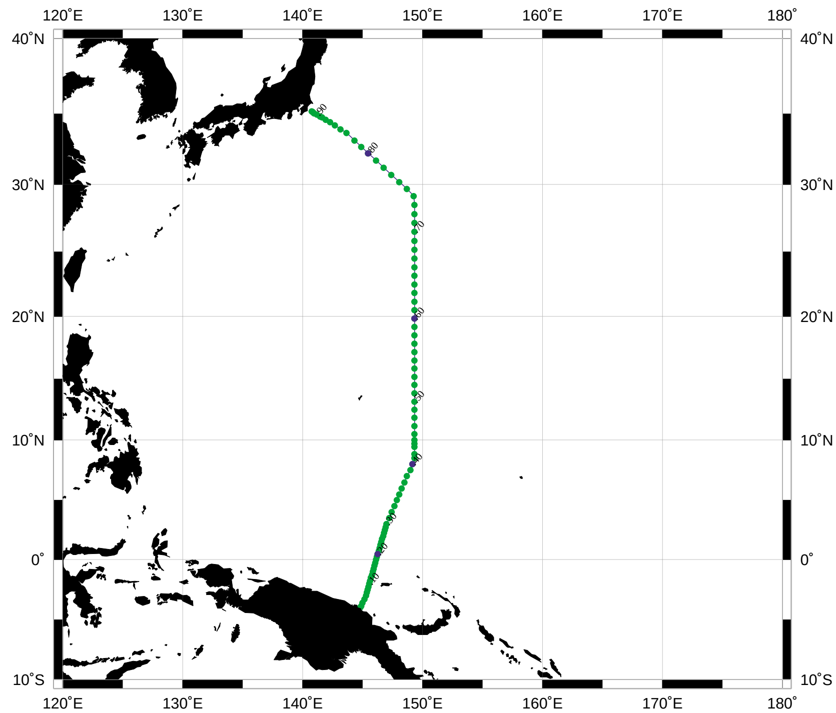
A. Cruise Narrative for WOCE P10



A.1. Highlights

WHP Cruise Summary Information

WOCE section designation	**P10**
Expedition designation (EXPOCODE)	**3250TN026_1**
Chief Scientist(s) and their affiliation	**Melinda Hall*, Terrence Joyce**/WHOI**
Dates	1993.10.05 - 1993.11.10
Ship	R/V Thomas G. Thompson
Ports of call	Fiji, Papua New Guinea to Yokohama, Japan
Number of stations	94 svs, 7 lvs
Geographic boundaries of the stations	35° 10' N 140° 45.17 E 149° 20.83 E 4° 0.92' S
Floats and drifters deployed	Twelve ALACE floats
Moorings deployed or recovered	none

Contributing Authors: Daniel Torres, T. Joyce, P. Hacker, E. Firing, Marshall Swartz, Laura Goepfert, Joe Jennings, Bob Key, Steven Covey, Karl Newyear, Scott Birdwhistell, Chris Sabine, Rich Rotter, Art Dorety, Michio AOYAMA, George Anderson

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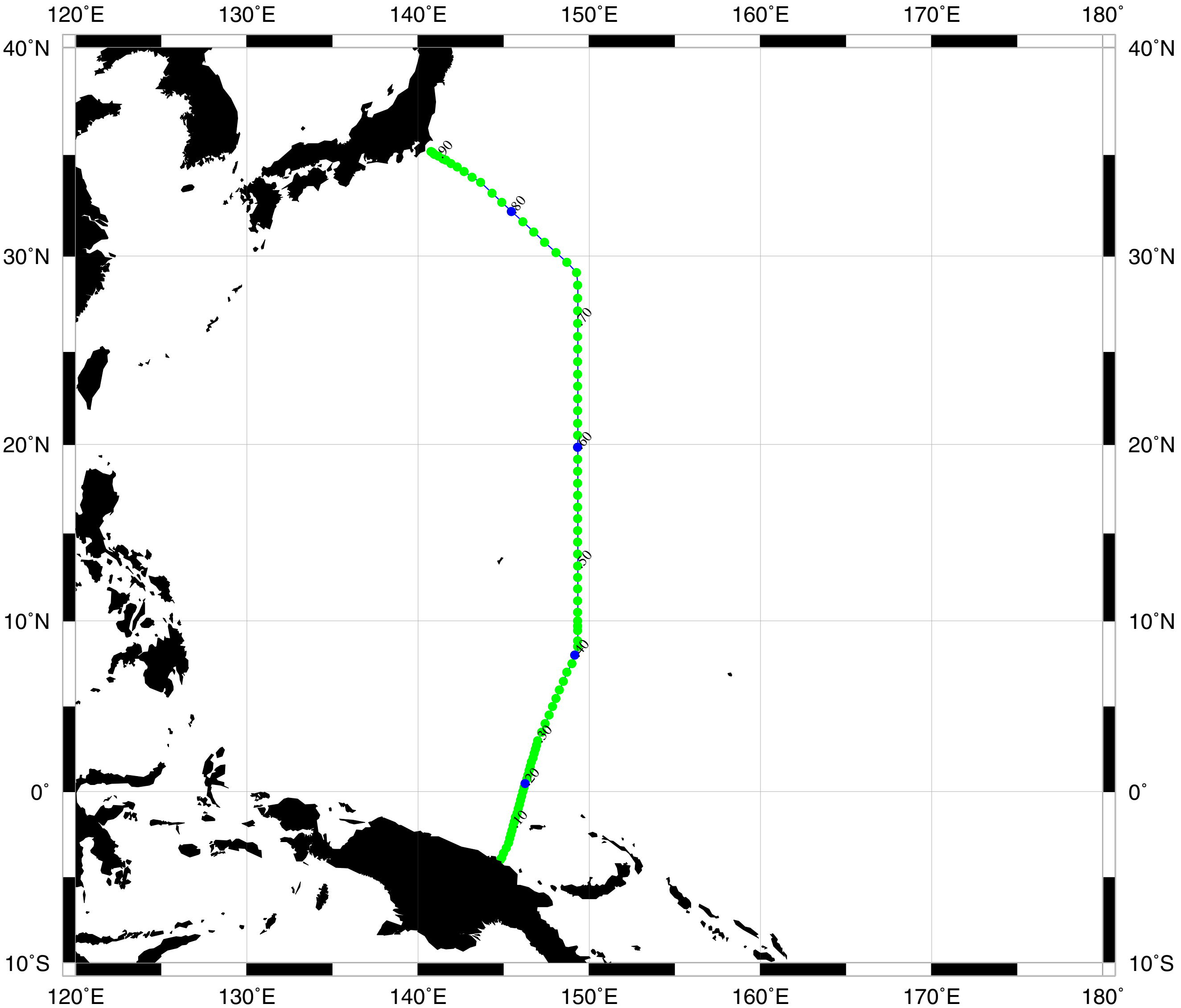
WHP Cruise and Data Information

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

Cruise Summary Information	Hydrographic Measurements
Description of scientific program	CTD - general
	CTD - pressure
Geographic boundaries of the survey	CTD - temperature
Cruise track (figure)	CTD - conductivity/salinity
Description of stations	CTD - dissolved oxygen
Description of parameters sampled	
Bottle depth distributions (figure)	Salinity
Floats and drifters deployed	Oxygen
	Nutrients
	CFCs
Principal Investigators for all measurements	Helium
Cruise Participants	Tritium
	Radiocarbon
Problems and goals not achieved	CO2 system parameters
	Other parameters
	Large Volume Samples
Underway Data Information	**Acknowledgments**
Navigation	**References**
Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	**DQE Reports**
Thermosalinograph	CTD
Meteorological observations	S/O2/nutrients
	CFCs
	14C
	Data Processing History

Station locations for P10 : HALL



Produced from .sum file by WHPO-SIO

A.2. Cruise Summary

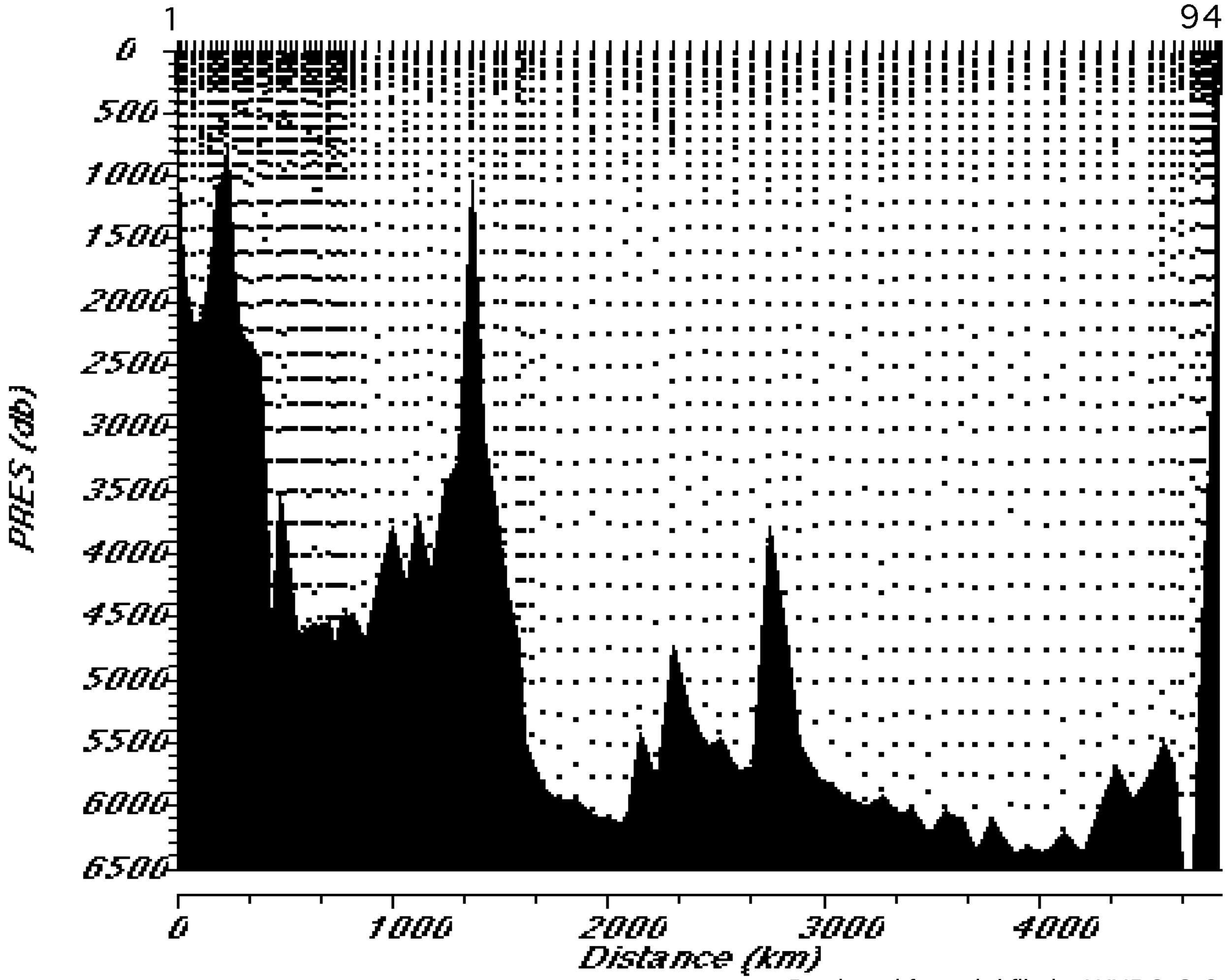
The objective of this cruise was to occupy a hydrographic section nominally along 149 E from Papua, New Guinea to shelf of Japan near Yokohama as part of the onetime WHP survey of the Pacific Ocean. A CTD with a 36 place, 10 liter rosette was used on a total of 94 small volume stations with water sampling for salinity, oxygen, nutrients, CFCs, tritium/helium-3, alkalinity, TCO2, and radiocarbon. The station spacing ranged from 5 to 40 nautical miles and most lowerings were made to within 10 meters of the bottom. A lowered ADCP (LADCP) was attached to the rosette on 53 of the stations. At 7 stations, additional casts were made for large volume sampling of radiocarbon in the deep and mid-depth waters. These large volume casts were usually made with nine, 250 liter Gerard Barrels. Underway measurements along the cruise included pCO2, ADCP, digital echo-sounding, thermosalinograph, and meteorology. Twelve ALACE floats were deployed along the cruise track to the south of 20 N.

A.3. List of Principal Investigators

Name	Responsibility	Affiliation
M. Hall	CTD,S,O2	WHOI
L. Gordon	Nutrients	Oregon State Univ.
M. Warner	CFCs	Univ. Washington
C. Sabine	TCO2, pCO2, alkalinity	Princeton Univ.
R. Key	Radiocarbon (SVS, LVS)	Princeton Univ.
W. Jenkins	Tritium/Helium-3	WHOI
T. Joyce	Underway ADCP	WHOI
P. Hacker & E. Firing	Lowered ADCP	Univ. Hawaii

A.4. Scientific Program

The P10 cruise was the third in a series of three WHP onetime cruises aboard the Thompson in 1993 following P17N and P14N. The ship departed Suva, Fiji, on 29 September and steamed westwards towards the northern coastline of Papua, New Guinea, where the section began at the 200m isobath. During the 7 day deadhead, we carried out three test stations (not included in the station numbering scheme) to shake down equipment and water sampling methodology. The station track, designed in early planning documents for 145 E, was shifted eastward in an effort to depart the New Guinea coastline perpendicular to the bathymetry, then skirt the Mariana Ridge and Trough to the east, thus making the whole section in the East Mariana Basin, rather than in both that basin and the Philippine Basin further west. Where bottom depths changed rapidly (near the coast and passing the Caroline Seamounts around 6-8 N) station spacing was dictated by topographic changes; within 3 degrees of the equator, spacing was every 15 minutes of latitude along the ship track (nominally 15 nm, but slightly more due to the track angle), stretching to 30 nm up to 10.5 N, then 40 nm from there to station 73 at 28.5 N. At that point we began our dogleg towards the Japan coast in order to cross the Kuroshio at an approximately right angle. ADCP results indicated that this crossing was indeed close to right angles. Over the northern dogleg, station spacing gradually decreased to resolve the strong front of the Kuroshio and ultimately, to accommodate rapid topographic changes near the coast. Stations generally went to within 10 m of the bottom except over the Japan Trench and a few other stations where bottom depths exceed 6000 dbar. No stations were lost due to weather and the ship arrived on schedule in Yokohama on 10 November.



A.5. Major Problems or goals not achieved

On station 65, on 31 October, we were retrieving the intermediate Large Volume cast and had taken 2 Gerard bottles off of the wire when the winch failed to stop and the third bottle was 2-blocked, breaking the wire and causing the remaining 7 bottles to be lost. Fortunately, no one was injured, but the loss reduced the ability to carry out LVS sampling and the final LVS stations was designed to use small volume radiocarbon measurements for the intermediate cast. Another problem was encountered with the salinity measurements causing unacceptably large sample to sample 'noise'. Various causes were examined including changing Autosals, changing Autosal location until the problem was finally isolated: the 120 ml flint glass WHOI sample bottles were replaced with 200 ml Scripps Kimax bottles commencing with station 59 and a dramatic improvement was seen. The WHOI bottles, over 5 years old, were found to have flakes of an insoluble substance that appeared to come from the inside surface.

A.6. Other Incidents of Note

A.7. Cruise Participants

Name	Responsibility	Affiliation
Melinda Hall	Ch. Sci., CTD watch	WHOI
Terrence Joyce	Co-Ch. Sci, CTD watch, ADCP	WHOI
Marshall Swartz	CTD & Rosette Hardware	WHOI
George Tupper	Salts, Oxygen, CTD watch, ALACE floats	WHOI
George Knapp	Salts, Oxygen	WHOI
Susan Wijffels	CTD watch	WHOI
Dan Torres	CTD watch, bathymetry	WHOI
Sarah Zimmerman	CTD data processor	WHOI
Brian Guest	CTD watch	WHOI
Joe LaCasce	CTD watch	MIT/WHOI joint prgm.
Teresa Turner	Salts, CTD watch	WHOI
Scott Birdwhistell	Tritium/Helium-3	WHOI
Robert Key	Carbon-14	Princeton
Chris Sabine	CO2	Princeton
Rich Rotter	CO2	Princeton
Art Dorety	CO2	Princeton
Peter Hacker	LADCP, CTD watch	U. Hawaii
Joe Jennings	Nutrients	OSU
Consuelo Carbonell-Moore	Nutrients	OSU
Steve Covey	CFCs	U. Wash.
Karl Newyear	CFCs	U. Wash.
Jim Wells	LVS, C-14	Scripps

B. Underway Measurements

B.1 Navigation, Bathymetry and Meteorology
(Daniel Torres)

A digital bathymetric system (Bathy 2000,Ocean Data Equipment Corporation) with a 3.5 kHz pinger was operated for the entire cruise and successfully logged bathymetric data while underway at one minute intervals onto an underway Data Acquisition System (DAS) along with meteorological data (wind speed, direction) from masthead sensors and temperature, conductivity and salinity from a SeaBird thermosalinograph. While these and other navigation measurements (from a Magnavox 1107 and Trimble 10X GPS sets) were updated at approximately 2 second intervals, only one minute sub-samples (unaveraged) were stored on the DAS.

The meteorological data which was merged into the DAS data stream came from a suite of instruments assembled by Alden Electronics. Below is a list of those instruments along with the manufacturer:

Wind speed and direction:	R. M. Young Anemometer
Air temperature:	R. M. Young Temperature Sensor
Humidity:	Rotronic Humidity Sensor
Barometric Pressure:	Air Intellisensor Digital Barometer
Precipitation:	R. M. Young Precipitation Gauge
Short wave radiation:	Eppley PIR Geometer
Long wave radiation:	Eppley Pyranometer PSP

The following table lists the underway measurements available on the DAS:

Value 1 = GMT Date	(nav_date)	
Value 2 = GMT Time	(nav_time)	
Value 3 = DR time	(magnavox_dr_time)	
Value 4 = Latitude	(nav_latitude)	
Value 5 = Longitude	(nav_longitude)	
Value 6 = Status	(magnavox_status)	
Value 7 = Speed Log	(knots)	(nav_speed_log)
Value 8 = SOG	(knots)	(nav_sog)
Value 9 = HDOP	(magnavox_hdop)	
Value 10 = Gyro Heading	(deg. T)	(nav_gyro_heading)
Value 11 = COG	(deg. T)	(nav_cog)
Value 12 = Satellites	(magnavox_satellites)	
Value 13 = Sea Temp.	(deg. C)	(seabird_temperature_int)
Value 14 = Conductivity	(S/m)	(seabird_conductivity)
Value 15 = Salinity	(PSU)	(seabird_salinity)

Value 16 = Water Depth	(meters)	(water_depth)
Value 17 = Wire Out	(meters)	(wire_out)
Value 18 = Wind	(m/s)(deg. R)	(imet_wind_spd_dir)
Value 19 = Air Temp.	(deg. C)	(imet_air_temperature)
Value 20 = Humidity	(percent)	(imet_humidity)
Value 21 = Barometer	(millibars)	(imet_barometric_pressure)
Value 22 = Precip.	(mm/m/h)(tot)	(imet_precipitation)
Value 23 = SW Rad.	(watts/m^2)	(imet_sw_radiation)
Value 24 = LW Rad.	(watts/m^2)	(imet_lw_radiation)

B.2 ADCP and LADCP

(T. Joyce, P. Hacker & E. Firing)

Direct velocity measurements were made along the cruise track with a hull-mounted and a lowered ADCP, both from RDI. The former was a 150 kHz system which profiled at 8 meter vertical resolution and vector-averaged the 1 second ping data onto a 5 minute time series with a vertical range of sampling from 20 to 350 m depth, approximately. The measurement system included a single GPS receiver and an Ashtech 3DF receiver, which measured position as well as ship’s heading, pitch and roll once per second. The Ashtech heading was used to correct for systematic and other errors in the Sperry MK-37 gyros. Data from the ADCP/Ashtech system were logged on a separate data stream from the shipboard DAS.

The lowered ADCP (LADCP) was a 300 kHz, RDI system which was mounted on the rosette frame an used for full-depth velocity profiling. It was used primarily in the equatorial band (45 stations from 4 S to 10.5 N) and for 13 stations across the Kuroshio, where strong, deep currents were expected.

B.3 Thermosalinograph

As noted above, a SeaBird thermosalinograph was employed using an uncontaminated seawater system on the vessel. Data are available at one minute intervals on the DAS.

C. Hydrographic measurements

C.1 Summary of cruise

C.1.1 Major difficulties

The only major difficulty affecting CTD operations was the loss of 46 endcaps on the 10-liter bottles, due to stress-induced fractures of the PVC endcap material, and to lanyard failures. This led to a major diversion of technician time to reinstall endcaps and identify failures, and to numerous lost samples, with lost endcaps and springs. The design of the endcap was changed immediately by Scripps, and implemented on the following cruise with excellent results.

C.1.2 Equipment Configuration

(Marshall Swartz and Laura Goepfert)

Two WHOI-modified EG&G Mk-III CTDs were provided for the cruise, although only one was used throughout the entire cruise (CTD #10). It is provided with an optional oxygen current and temperature channel, and has been modified at WHOI to install a thermally-isolated titanium pressure transducer, with a separately digitized pressure temperature channel (Toole et. al., 1993).

The CTDs both had a digital input for an external serial device. The cruise used two Falmouth Scientific (FSI) Ocean Temperature Modules (OTM) to provide separate and redundant platinum temperature data for assuring calibration stability. They were interchanged several times during the cruise to build up historical information. One FSI Ocean Conductivity Module (OCM), providing a redundant conductivity reading from an inductive conductivity cell, was also used on this channel. Temperature and pressure calibrations were made at WHOI prior to and following the cruise.

The CTD was provided with one platinum temperature probe, with an estimated lag of 250 msec, and a 3 cm conductivity cell. The temperature lag was checked by comparing density reversals in theta salinity (TS) plots (Giles and McDonald, 1986). It was found that 250 ms showed the least amount of looping or density reversals.

The oxygen sensor was installed at the beginning of the cruise, and changed out as called for. The OTM provided a 400 msec platinum temperature reading at 25 Hz to the CTD. The OCM provided the redundant conductivity reading at 4 Hz, and the CTD sampled the sensor suite at 25 Hz.

Two identical rosette frames were provided by Scripps. Each consisted of 36 10-liter custom-designed bottles released by a General Oceanics (GO) model 1016 36-position pylon. The bottles had been produced at SIO based on a design from PMEL. Inside the frame were mounted the CTD, a Lowered Acoustic Doppler Current Profiler (LADCP) provided by University of Hawaii and a 10-kHz pinger.

The 1016 pylon was controlled by a GO 1016-SCI Surface Control Interface (SCI), providing power and commands down the cable, and received status data back. The SCI was controlled through a dedicated personal computer.

The CTD was left powered on at all times, except when disconnected due to cable changeout or retermination. In no event was the CTD warmed up less than 30 minutes. The CTD was kept out of the sun to avoid overheating of the case.

The CTD data was acquired by an EG&G Mk-III deck unit providing demodulated data to two personal computers running EG&G version 3.0 CTD acquisition software (EG&G, Oceansoft acquisition manual, 1990), one providing graphical data to screen and plotter, and the other a running listing output. Bottom approach was controlled by following the pinger direct and bottom return signals on the ship-provided PDR trace.

After each station, the CTD data was forwarded to another set of personal computers running both EG&G CTD post-processing software and custom-built software from WHOI (Millard and Yang, 1993). The data were first-differenced, lag corrected, pressure sorted and centered into 2 decibar bins for final data quality control and analysis, including fitting to water sample salinity and oxygen results. This data was then forwarded to the PI for analysis daily, to compare to historical and water sample data.

C.2 Water sample salinity and oxygen measurements (George Knapp)

A complete description of the water sample dissolved oxygen and salinity measurement techniques used during this cruise is presented by Knapp et al. (1990). As described in this report, samples were collected for the analysis of dissolved oxygen and salinity from each of the 36 ten-liter bottles tripped on the upcast of each CTD station, in accordance with the recommendations of the WOCE Hydrographic Office. The vertical distribution of these samples was a compromise between the need to obtain deep samples for the calibration of the CTD conductivity and oxygen sensors and the requirement to define the characteristics of the water masses by the distributions of the various measured parameters.

C.2.1 Salinity Analysis

Considerable problems with the water sample salinities were encountered during the first half of this cruise. Because the first 16 stations were in shallow water where there was a lot of variability in the salinity, these problems were not readily apparent. As we progressed into deeper water they became more visible. There was an abnormally large scatter in the deep salinities, resulting in many samples being flagged as questionable or bad. Problems with the salinometers included radio interference, an unclean source of ship's power, and several instances of operator error. These problems were gradually sorted out and rectified. By far, however, the largest source of this large scatter in the salinities came from the bottles that were used to collect the salinity samples. The bottles were 120 ml Boston Round, flint glass bottles with screw caps equipped with Poly-Seal cones to prevent leakage and evaporation. Most of the bottles were at least 5 years old, and had been stored continuously with small amounts of salt water in them. Close examination of them revealed flakes of an insoluble substance that appeared to be coming from the inside surface. It is now believed these particles were the main cause of the majority of the bad salinities from approximately the first 58 stations. Commencing with station 59, salinities were collected in 200 ml square Kimax bottles owned by SIO, with polyethylene caps and inserts, and a dramatic improvement was seen.

IAPSO Standard Water Batch P-114 was used through station 12. Commencing with station 13, batch P-120 was used for the remainder of the cruise. At the time it was noted that the standby number of the Autosal shifted by +.0015 equivalent salinity units. Post-cruise comparisons of the salinities measured during this cruise with historical measurements suggest that the measured salinities from the later stations were erroneously high. Comparisons of batch P-120 with batches P-118, P-123 and P-124, made during the summer of 1995 confirm that P- 120 is approximately .0015 fresher than stated on its label. Thus, it was decided to subtract .0015 from all salinity measurements commencing with station 13, effectively referencing all salinities to Batch P-114.

Because of the multiple problems with salinity during the first 55 stations, estimated accuracy is 0.005 psu. Subsequent salinity data has an estimated accuracy of 0.002 psu.

C.2.2 Dissolved Oxygen Analysis

No problems were encountered with the analysis of dissolved oxygen. Estimated accuracy is 0.02 ml/l. The majority of the data flagged as questionable or bad was due to sampling error on deck.

C.3 Water sample Nutrient measurements
(Joe Jennings)

C.3.1 Analysts, Equipment and Techniques

Nutrient analysts on P10 were Maria Consuelo Carbonell-Moore and Joe C. Jennings, Jr. from L. I. Gordon's analytical group at Oregon State University. The continuous flow analyzer used was an Alpkem Rapid Flow Analyzer (RFA), model 300. A Keithley data acquisition system was used in parallel with analog stripchart recorders to acquire the absorbence data. The software used to process the nutrient data was developed at OSU. All of the reagent and standard materials were provided by OSU. The methods are described in Anonymous (1985) and in Gordon et. al. (a & b).

C.3.2 Sampling Procedures

Nutrient samples were drawn from all CTD/rosette casts at stations 1 through 94 and at several test stations which preceded station 1. High density polyethylene (HDPE) bottles of approximately 30 ml volume were used as sample containers, and these same bottles were positioned directly in the autosampler tray. These bottles were routinely rinsed at least 3 times with one third to one half of their volume of sample before filling, and were thoroughly cleaned with 10% HCl every two or three days.

The nutrient samples were drawn following those for gases: helium, tritium, dissolved oxygen and carbon dioxide. In some instances, the nutrient sampling procedure was not completed for almost 2 hours after the CTD arrived on deck. At most stations, the RFA was started before sampling was completed to reduce the delay and minimize possible changes in nutrient concentration due to biological processes. Analyses were typically completed within three to four hours of the end of the CTD/rosette casts except at Stns 21 and 24 where analytical problems resulted in a delay of about 5 hours.

C.3.3 Calibration and Standardization

The volumetric flasks and pipettes used to prepare standards were gravimetrically calibrated both prior to and after the cruise. The Eppendorf Maxipettor adjustable pipettes used to prepare mixed standards typically have a standard deviation of less than 0.002 ml on repeated deliveries of 10 ml volumes. High concentration mixed standards containing nitrate, phosphate, and silicic acid were prepared at intervals of 4 to 7 days and kept refrigerated in HDPE bottles. During the "deadhead" steam at the beginning of the cruise, duplicate high concentration standards were prepared for each nutrient and compared to ensure that both gave the same response. For almost every station, a fresh "working standard" was prepared by precise dilution of 20 ml of the high concentration mixed standard with low nutrient seawater. This working standard has nutrient concentrations which are 75 - 85% of those found in Deep and Bottom waters. A separate nitrite standard solution was also added to these working standards. Corrections for the actual volumes of the flasks and pipettes were included in the preliminary data.

The WOCE Operations Manual calls for nutrient concentrations to be reported in units of micromoles per kilogram (M/kg). Because the salinity information required to compute density is not usually available at the time of initial computation of the nutrient concentrations, our concentrations are always originally computed and reported as micromoles per liter. This unit conversion will be made using the corrected salinity data when it is available.

C.3.4 Equipment and analytical problems

There were no major problems with equipment. One failure of a power supply module was resolved quickly by replacement with a spare module.

C.3.5 Measurement of Precision and Bias

C.3.5.1 Short Term Precision and Bias

Throughout the cruise, replicate samples drawn in different sample bottles from the same Niskin bottle were analyzed to assess the precision of the RFA analyses. These replicate samples were analyzed as adjacent samples (one after the other) at the beginning and again at the end of each sample runs to help monitor deterioration in the samples or uncompensated instrumental drift. Our estimates of short term precision based on these replicate analyses are given below. The values given are the absolute mean differences between replicate pairs from the beginning to the end of each sample run. (Units are reported in micromoles per liter and as percentages of typical deep water concentrations.)

Phosphate:	0.022	(<1.0%)
Nitrate + Nitrite:	0.09	(<0.3%)
Silicic acid:	0.3	(<0.3%)
Nitrite:	0.02	(<2.0%)

C.3.5.2 Longer Term Precision:

On most of the sample runs during P10, an "old" working standard from the previous station was run with the "new" working standard which had been freshly prepared. The "old" standards were kept refrigerated in plastic bottles. The average age of the "old" standards when reanalyzed was eight hours.

We calculated the difference in absorbance (peak height) between the new standards and the old standard which were run immediately after them. These differences, with regard to sign, were tabulated and analyzed statistically. The results were converted to concentration units by multiplying the difference by the mean sensitivity factor for each nutrient and are shown on the table below. Based on these statistics, it does not appear that significant degradation of the working standards occurred in the 3 to 8 hour time frame between stations.

Table 1. Differences between working standards at adjacent stations. Differences are expressed as "new" standard minus "old", and are given in concentration units (M/l). The number of comparisons used for these statistics was 87.

	Phosphate	**Nitrate**	**Silicic acid**	**Nitrite**
Mean, (M/l) wrt sign:	-0.008	-0.013	-0.09	-0.013
RMS dev:	0.009	0.095	0.30	0.032

C.3.6 Comparison with other data.

We made comparisons of the P10 nutrient data with data from several other cruises. Where possible, groups of several stations were selected where cruise tracks crossed or were parallel and the nutrients were then plotted against potential temperature (theta). The data we used came from the 1973-1974 GEOSECS cruise, the 1985 WEPOCS I cruise, and the 1989 WOCE section along 10 N. The nutrient data from these cruises was collected either with the Technicon AutoAnalyzer II (GEOSECS and WEPOCS) or the Alpkem RFA 300 (10 N and P10).

C.3.6.1 Nitrate

The deep and bottom water P10 nitrate concentrations tend to be somewhat lower than the historical data we used for this comparison. The difference is about 0.3 M between the deepest P10 and WEPOCS I samples, 0.5 M between the P10 and both the 10N and 24N data, and as much as 1.0 - 1.5 M at the nutrient maximum (ca. 2300 db) between the P10 nitrates and GEOSECS stn 224. Below about 3500 db, the GEOSECS nitrates are only 0.5 to 0.75 M higher than the P10 data. There is more overlap of the P10 nitrate/theta envelopes with all of the historic data in the upper water column. Relative to the deep water concentrations, the agreement between cruises is within 1 - 2% except at the nutrient maximum in the GEOSECS stn, where the difference is as much as 3.5%.

C.3.6.2 Phosphate

The deep phosphate/theta envelopes of the P10 data overlap with those of the WEPOCS I, 10N and 24N cruises. GEOSECS stn 224 plots mostly within the P10 envelope with the deepest GEOSECS samples about 0.03 M lower than the P10 data. The 24N data envelope tends to be on the lower side of the P10 envelope, but they do overlap. Above about 1.5 C, the 10N phosphate data are somewhat higher (0.02 - 0.07 M) than the P10 data. As a percentage of deep water concentrations, these cruises agree within 1 - 2%.

C.3.6.3 Silicic acid (silicate)

The pattern here is similar to that with nitrate; good agreement with the WEPOCS data and overlapping, but slightly lower silicic acid/theta envelopes than the other reference cruises. In the deep and bottom waters, the P10 data is within 1.0 M of the all of the other cruises. At the silicic acid maximum (2300 db), the GEOSECS data is higher by ca. 4 M while the 10N and 24N cruise data is 1 - 2 M higher than the maximum concentrations determined on P10. The agreement is within < 1% in the bottom water and 1 - 3% at the silicic acid maxima.

C.3.7 Nutrient QC Notes: P10 Cruise

A first pass QC check on the nutrient data was carried out during the P10 cruise, primarily by comparing vertical profiles and nutrient/theta relationships. During the post-cruise quality control phase, all nutrient data were rechecked using log notes and the analog stripchart recordings made at sea and by examining parameter/parameter plots for outliers. Any correctable errors have been identified and corrected as appropriate, and the data quality flags have been edited to conform to the definitions in the WOCE Operations Manual (WOCE Report No. 67/91). A detailed list of flagged data is given in Appendix A for all Rosette (ROS) casts on the cruise.

C.3.8 Nutrients Data Processing Notes:

Converted the file from Bob Key to the WHP .lvs format.

Parameters that were in the original file but were not retained in the .lvs file because they are not in the .lvs record format description:

latitude
longitude
depth (m)
nitrate
nitrite
phosphate
silicate
AOU
sigma 0
sigma 1
sigma 2
sigma 3
sigma 4

QUALT1 flags for:

temperature
nitrate
nitrite
phosphate
silicate
aou

The Key file had station numbers 1-13, but the .sum file indicated that the LVS stations were 16, 25, 34, 47, 56, 65, and 74. In addition the cast numbers in the Key file were always 1 and 3, which did not agree with the .sum file. After comparing the maximum pressure in the .sum file with the maximum pressure in the Key file for each cast, I was able to determine which station and cast numbers to use.

There is a 0 flag for some of the parameters, in fact all of the oxygens except where there was no sample which is flagged 9. This is not a valid number for the quality flags. I left them as 0 since I have no way of knowing what they should be.

Sarilee Anderson
17 Dec. 1999

References

Anonymous. 1985. RFA-300 Rapid Flow Analyzer Operation Manual. Preliminary. Alpkem Corporation, Clackamas, Oregon. Looseleaf binder, unnumbered pages.

Gordon, L.I., J.C. Jennings, Jr., A.A. Ross and J.M. Krest., A suggested protocol for continuous flow automated analysis of seawater nutrients (phosphate, nitrate, nitrite and silicic acid) in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study. Available from the US WHP Office or the authors.

Gordon, L. I., J. Krest, and A. Ross, b. (in preparation), Reducing sensitivity in continuous flow analysis of silicic acid in seawater.

C.4 CTD Data
(Laura Goepfert)

C.4.1 SUMMARY OF LABORATORY CALIBRATIONS FOR CTDs

The pressure, temperature, and conductivity sensors were calibrated by Marshall Swartz at the Woods Hole Oceanographic Institute's Calibration Laboratory.

C.4.1.1 PRESSURE CALIBRATIONS

Method/Calibration Standards
The pressure transducer of CTD10 was calibrated in a temperature controlled bath to the WHOI Ruska dead weight tester (DWT) as described by Millard and Yang (1993). The pre-cruise calibration was completed on September 21, 1993 and consisted of pressure calibrations at two temperatures, the ice point, and room temperature. The post-cruise pressure calibration was completed on February 13, 1994 and consisted of three temperatures; 1.36 C, 14.96 C, and 29.7 C.

	BIAS		SLOPE	QUADRATIC
pre-cruise	ice	-.555377E+01	0.100175E+00	-.142270E-08
	room	-.441239E+01	0.100146E+00	-.150717E-08
post-cruise	1.36 C	-.447623E+01	0.100137E+00	-.110389E-08
	14.96 C	-.453082E+01	0.100139E+00	-.128877E-08
	29.70 C	-.402724E+01	0.100112E+00	-.112505E-08

Using the post-cruise pressure calibrations, new pressure temperature terms were computed. These terms were used to correct both the static and the dynamic response of the pressure transducer to temperature changes (Toole, 1994).

PRESSURE TEMPERATURE

CTD10	S1	S2	T0	BIAS	SLOPE
	-1.533E-6	.5112E-1	1.36	36.19	-9.0792E-3

C.4.1.2 TEMPERATURE CALIBRATIONS

Method/Calibration Standards
The pre-cruise temperature calibration was completed on September 21, 1993, and the post-cruise was finished February 23, 1994.

The pre-cruise calibration was done using the ITS-68 temperature scale whereas the post-cruise calibration used the ITS-90 temperature scale. To convert the temperatures to ITS68 scale for use in the determination of salinity the following formula was used (NIST,1990):

$$ITS68 = x +(2.21667E-04 * x) + (5.95238E-07 * x^2).$$

	BIAS	SLOPE	QUADRATIC
pre-cruise	.858035E-02	.499729E-03	.389166E-11
post-cruise	.684949e-02	.499742e-03	.434164E-11

A shift between the pre and post-cruise temperature calibration for CTD10 was noted. The shift showed an offset of .002 deg. C at 0 deg. C, .001 C at 15 C, and 0 at 25 C. CTD10 temperature measurements during the cruise was compared with an Ocean Temperature Module's (OTM) temperature and the difference between the two remained constant. A shift, therefore, did not occur during the cruise.

The OTM used on the cruise was compared with the pre and post-temperature calibrations for a couple of deep stations. It was found that the pre-cruise temperature calibration for CTD 10 most closely matched the temperature readings of the OTM. Therefore, the pre-cruise temperature calibration was used to scale the data.

C.4.1.3 CONDUCTIVITY CALIBRATIONS

Method/Calibration Standards
Only a pre-cruise conductivity calibration was performed. Bottled salinities were drawn during the temperature calibration, five samples at each temperature. These values were then converted to conductivity and compared to the values read by the CTD at the different temperatures (Millard and Yang, 1993).

	BIAS	SLOPE
pre-cruise	.624569E-02	.100627E-02

In the final processing of the data gathered, the pre-cruise ice point pressure and the pre-cruise temperature scaling factors were employed with the post-cruise pressure temperature scaling factors.

C.4.2 SUMMARY OF AT SEA CALIBRATIONS

The pressure bias of CTD10 at the sea surface, was recorded at the beginning of each station. The pressure bias was found by averaging fifteen scans before the package entered the water and subtracting this from the pressure bias term in each station's calibration file.

C.4.2.1 CONDUCTIVITY CALIBRATION

Basic fitting procedure
The CTD conductivity sensor data was fit to the water sample conductivity as described in Millard and Yang 1993. The cruise was fit as one large group, and divided into sections where there was a noticeable shift in the sensor. These groups were fit for both slope and bias. Due to problems in water sample conductivity measurements as described earlier in this report, any questionable water sample conductivities were excluded from the fit. Furthermore, the edit factor for the determination of good bottles was changed from 2.8 to 2.5.

Closer inspection of the CTD-Water Sample (ws) conductivity data revealed a shape in the deep water residuals. The deep water residuals showed an offset of .001. This appeared to be a pressure dependent shape. Alteration of Beta, the coefficient of thermal expansion of the conductivity cell, from 1.5E-08 to .75E-08 brought the at depth residuals to zero.

However, an offset in the surface of the CTD- WS residual plot at approximately 500 db of .002 remained. A correction was applied to the raw CTD conductivity. The correction applied was:

C=Cold+.002 *exp [-(C-37.5 ^2/b],

where b= 6 when C>37.5 and b=3 when C<37.5 (Toole, 1994).

After these corrections had been applied, the stations were re-fit to the raw water sample conductivity. Conductivity fits applied to the final CTD data are tabulated in Appendix B.

As stated earlier, it was found that salinities starting with station 13 were .0015 higher than those observed in the historical data. It was determined that a correction of -.0015 be added to both the CTD and the water sample salts. This was done to both the *.CTD files and the *.SEA files.

C.4.2.2 Oxygen Calibrations

Basic Fitting procedure

The CTD oxygen sensor variables were fit to water sample oxygen data to determine the six parameters of the oxygen algorithm (Millard and Yang, 1993). As with conductivity, the entire cruise was fit as one group and then divided into sections where shifts in the behavior of the sensor were noted. The edit factor was changed from 2.8 to 2.5 for valid data. The oxygen data appeared to fit better and easier when the edit factor was lowered.

C.4.3 QUALITY CONTROL OF 2DB CTD DATA AND SEA FILES

Qualifications for marking conductivity data Surface spikes in Salinity that appeared in the first and second decibars of the stations were not uncommon. These spikes, which were probably caused by pressure averaging conductivity data prior to the package entering the water, were marked as questionable.

Several spikes were found in the CTD files, and were removed by interpolating between the pressure bins. The quality word was changed to six to reflect the interpolation. The stations where this occurred and the bins which were interpolated are shown in the table below

station	start bin	end bin
13	2275 db	2289 db
35	2167 db	2191 db
90	1171 db	1175 db

In the SEA files the CTD salinity values were subtracted from the water sample salinity and the differences were compared to an edit factor. The edit criteria used from 0 db to 1000 db was .01 psu, and 1000 db to 7000 db, was .005 psu. If surface bottles exceeded the edit criteria they were accepted as good. Variability in surface salinity is expected since the vessel tends to drift during the CTD cast. However, if the CTD salinity was in the salinity spike of the 2db averaged file than it was marked as questionable.

C.4.3.2 Qualifications for marking oxygen data

As the package approaches the sea floor the descent rate slows, thus affecting the flow rate of sea water passed the oxygen sensor. This slowing of the package results in a 'tail' in the 2 db averaged oxygen values. Therefore, in stations where the 'tail' is present the oxygen values in the pressure bins at the bottom of the cast have been marked as questionable.

In the SEA file, the CTD oxygens were subtracted from the water sample oxygen, and the difference was compared to an edit factor. The edit criteria for 0 db to 1000 db was .50 ml/l and from 1000 db to 7000 db was .05 ml/l. If the difference exceeded the criteria the sample was looked at more closely to see which was less questionable. If the surface bottles were off by more than .5 ml/l they were usually accepted as good.

Due to the merging of the down-trace CTD oxygens with the up-trace water bottle sample, the edit criteria was often exceeded. This can most often be found in high transition zones where owing to both horizontal variability and large time intervals the difference between the two oxygen values can be large (Owens and Millard, 1985). Therefore, in areas of high transition both values were accepted as good. In the deeper water if both the CTD and water sample exceeded the edit criteria and there exists a high transition zone in either temperature or oxygen content then both were considered good if they fell on the 2 db averaged down CTD trace.

C.5 CFC-11 and CFC-12 Measurements

Analysts: Mr. Steven Covey, University of Washington
Mr. Karl Newyear, University of Washington

Our goal was to measure the distribution of theta chlorofluorocarbons, CFC-11 and CFC-12, as part of the P10 onetime section. Full water column profiles and surface marine air samples were analyzed with an electron capture gas chromatography system similar to one described by Bullister and Weiss (1988). In total, 1272 water and 73 air samples were taken. based on 70 pairs of replicate water samples, we estimate our precision to be approximately 2% and 3% of the CFC-12 and CFC-11 concentration, respectively.

Our sampling strategy was guided by expected freon presence time constraints. Due to their relatively recent introduction to the natural environment, CFC-11 and CFC-12 are not expected to be found (nor were they) at depths greater than about 1800 m on the section. However, the deepest Niskin bottle was always sampled in order to detect any topographically-trapped circulation features. Additionally, we were limited in time because each sample took 11 minutes to be fully analyzed. In order to sample each station and run the required standards and blanks limited the number of water samples per cast to about 18-21. Sample Collection and Analysis

Samples for CFC analysis were drawn from the 10-liter Niskins into100-cc ground glass syringes fitted with plastic stopcocks. These samples were the first aliquots drawn from the particular Niskins. There were very high contamination levels of the CFC samples during the early part of the expedition resulting from the Niskin bottles.

Between WHP sections P14N and P10, the gray Niskin bottles were stored in large foam-filled plastic containers (used for shipments of frozen fish). The insulating foam in these containers was made by using CFC-11 as a blowing agent. The CFC-11 in the air in these boxes builds up to at least 500 times the CFC-11 values in clean air. During the month over which the Niskin bottles were stored in the box, the CFC-11 was absorbed into the PVC material of the Niskins. When these Niskins were then used to collect seawater samples, the CFC-11 desorbs into the water. At the first test station (Station 998), the CFC-11 concentrations varied from 0.2 to 1.8 pmol/kg in waters that should be CFC-free. During section P14N, the CFC-11 blank of these same bottles was 0.0045 pmol/kg. A second test cast was carried out using white PVC bottles made by ODF which had not been stored in the "fish boxes". At this station (999), the CFC blanks were much lower (0.0 to 0.06 pmol/kg) but still higher than normal. These white sampling bottles did not fit the rosette as well as the gray bottles and were replaced for a third test cast. At Station 997, the CFC-11 blanks in the gray bottles had decreased to between 0.06 and 0.75 pmol/kg. The mean and standard deviation of these blanks makes the derivation of any useful CFC-11 concentrations from the gray bottles impossible.

The gray bottles unfortunately remained as the only sampling bottles until Station 21. During this time, the CFC-11 sampling blanks decreased to between 0.03 and 0.8 pmol/kg, depending upon the individual bottle. In theory, the desorption of CFC-11 from the Niskins should be a first order process with time. The e-folding time appears to be on the order of 5 days, i.e. by the end of the cruise the contamination levels should be about 2% of those at the beginning of the cruise. At Station 21, bottle 2, 4, 6, 8, and 10 were replaced with the white 10-liter bottles for a test which confirmed the gray bottles were still a large problem (The mean CFC-11 sampling blanks were 0.099 +/- 0.044 pmol/kg for the gray bottles and 0.007 +/- 0.010 pmol/kg for the white bottles.) Between Stations 22-55, only white 10-liter bottles were used on the rosette. At Station 56, gray Niskins went into positions 11 and 21 where they remained until the end of the cruise. Positions 2 and 4 were filled with gray Niskins from Station 61 to the end. These bottles remained too contaminated for reliable CFC-11 measurements.

The samples were analyzed using a CFC extraction and analysis system of Dr. Richard Gammon of the University of Washington. The analytical procedure and data analysis are described by Bullister and Weiss (1988). Dr. Warner and his technician, Steven Covey, had used the system during WOCE section P14N and left the system set up in the main laboratory of the R.V. Thompson with a small gas flow (to prevent contamination problems) between the two WOCE expeditions. The CFC concentrations in air were measured approximately twice per day during this expedition. Air was pumped to the main laboratory from the bow through Dekabon tubing.

Calibration

A working standard, calibrated on the SIO1986 scale, was used to calibrate the response of the electron capture detector of the Shimadzu Mini-2 GC to the CFCs. This standard, Airco cylinder CC88098, contained gas with CFC-11 and CFC-12 concentrations of 274.0 parts per trillion (ppt) and 496.8 ppt, respectively. To convert these results to the SIO1993 scale, CFC-11 concentrations need to be multiplied by 0.9755 and CFC-12 concentrations need to be multiplied by 1.0128.

Sampling Blanks

The contamination problems with CFC-11 are discussed in detail above. CFC-12 was not affected by this problem. We have attempted to estimate this level of contamination by taking the mode of measured CFC concentration in samples which should be CFC-free. In this region, measurements of other transient tracers such as carbon-14 indicate that the deep waters are much older than the CFC transient. We have used all samples deeper than 2000 meters to determine the blanks of 0.001 picomoles per kilogram (pmol/kg) for

CFC-12 and 0.006 pmol/kg for CFC-11 in the white bottles. These concentrations have been subtracted from all the reported dissolved CFC concentrations.

Data

In addition to the CFC concentrations which have merged with the .hyd file, the following three tables have been included to complete the data set. The first two are tables of the duplicate samples. The third is a table of the atmospheric CFC concentrations interpolated to each station.

Table 1: CFC-11 Concentrations in Replicate Samples

STATION NUMBER	SAMP NO.	CFC-11 (pM/kg)
24	126	0.955
24	126	0.958
26	130	0.429
26	130	0.482
30	128	1.715
30	128	1.694
31	127	1.067
31	127	1.070
32	125	1.818
32	125	1.823
34	326	0.674
34	326	0.684
36	127	1.053
36	127	1.042
38	124	1.803
38	124	1.809
40	111	0.002
40	111	0.005
43	130	0.212
43	130	0.220
45	132	2.251
45	132	2.261
46	131	0.188
46	131	0.192
47	332	1.727
47	332	1.722
48	132	1.895
48	132	1.972
50	130	1.634
50	130	1.647
51	134	1.953
51	134	1.961
53	132	2.298
53	132	2.314
55	134	1.980
55	134	1.932
56	333	2.181
56	333	2.203
57	130	2.572
57	130	2.564
58	132	2.398
58	132	2.352
59	135	1.683
59	135	1.699
60	130	1.781
60	130	1.763
61	128	2.517
61	128	2.431
63	131	2.452
63	131	2.459
64	129	2.498
64	129	2.442
65	331	2.492
65	331	2.504
66	133	2.595
66	133	2.564
67	130	2.419
67	130	2.372
68	134	2.473
68	134	2.401
69	132	2.617
69	132	2.686
70	132	2.495
70	132	2.531
71	126	1.380
71	126	1.299
72	134	2.484
72	134	2.446
73	134	2.378
73	134	2.437
74	332	2.674
74	332	2.673
76	130	2.535
76	130	2.468
77	132	2.731
77	132	2.647
79	130	2.189
79	130	2.195
80	132	2.640
80	132	2.635
81	134	2.225
81	134	2.320
82	130	2.499
82	130	2.514
83	132	2.633
83	132	2.675
86	130	2.157
86	130	2.211
88	128	1.599
88	128	1.639
90	120	1.499
90	120	1.519
92	114	2.120
92	114	2.120
93	108	2.176
93	108	2.185

Table 2: CFC-12 Concentrations in Replicate Samples

Sta	Samp	CFC-12
1	101	0.710
1	101	0.710
1	105	0.984
1	105	0.994
1	109	0.981
1	109	0.980
2	110	0.054
2	110	0.031
3	101	0.012
3	101	0.002
3	109	0.339
3	109	0.333
3	116	0.987
3	116	0.991
4	101	-0.003
4	101	0.014
4	119	0.998
4	119	0.951
5	101	-0.004
5	101	0.012
5	118	0.740
5	118	0.731
6	118	0.793
6	118	0.804
10	104	0.107
10	104	0.112
12	114	0.381
12	114	0.397
14	117	0.709
14	117	0.740
16	322	0.334
16	322	0.327
17	114	-0.001
17	114	-0.001
20	127	0.827
20	127	0.857
24	125	0.258
24	125	0.276
24	126	0.464
24	126	0.459
26	130	0.235
26	130	0.240
30	128	0.852
30	128	0.840
31	127	0.510
31	127	0.528

Sta	Samp	CFC-12
32	101	-0.001
32	101	0.005
32	125	0.932
32	125	0.949
34	326	0.310
34	326	0.337
36	127	0.497
36	127	0.506
38	124	0.923
38	124	0.940
40	111	0.000
40	111	0.002
43	130	0.089
43	130	0.102
45	132	1.104
45	132	1.154
46	131	0.094
46	131	0.093
47	332	0.831
47	332	0.848
48	132	0.949
48	132	0.979
50	130	0.797
50	130	0.801
51	134	1.060
51	134	1.052
53	132	1.221
53	132	1.231
55	134	1.102
55	134	1.071
56	333	1.162
56	333	1.177
57	130	1.339
57	130	1.333
58	132	1.258
58	132	1.250
59	135	0.946
59	135	0.932
60	130	0.982
60	130	0.978
61	128	1.317
61	128	1.293
63	131	1.263
63	131	1.297
64	129	1.294
64	129	1.251

Sta	Samp	CFC-12
65	331	1.286
65	331	1.299
66	133	1.383
66	133	1.368
67	130	1.248
67	130	1.215
68	134	1.334
68	134	1.285
69	132	1.408
69	132	1.441
70	132	1.323
70	132	1.338
71	126	0.651
71	126	0.628
72	134	1.329
72	134	1.316
73	134	1.262
73	134	1.312
74	332	1.425
74	332	1.403
76	130	1.309
76	130	1.269
77	132	1.453
77	132	1.421
79	130	1.114
79	130	1.122
80	132	1.400
80	132	1.416
81	134	1.180
81	134	1.221
82	130	1.308
82	130	1.341
83	132	1.400
83	132	1.421
86	130	1.084
86	130	1.137
88	128	0.805
88	128	0.823
90	120	0.729
90	120	0.720
92	114	1.071
92	114	1.076
93	108	1.134
93	108	1.144

Table 3: Atmospheric CFC Concentrations

STATION NUMBER	F11 PPT	F12 PPT
1	262.5	515.6
2	262.5	515.6
3	262.5	515.6
4	262.5	515.6
5	262.5	515.6
6	262.5	515.6
7	262.5	515.6
8	262.5	515.6
9	262.5	515.6
10	262.2	515.4
11	262.2	515.4
12	262.2	515.4
13	262.2	515.6
14	262.2	515.6
15	262.2	515.6
16	262.2	515.6
17	262.3	516.2
18	262.1	516.2
19	262.7	515.2
20	262.7	515.2
21	262.7	515.2
22	262.7	515.2
23	263.3	515.3
24	263.3	515.3
25	263.3	515.3
26	263.3	515.3
27	263.6	515.2
28	264.2	514.1
29	264.2	514.1
30	263.6	515.2
31	263.5	514.7
32	263.3	515.5

STATION NUMBER	F11 PPT	F12 PPT
33	263.3	515.5
34	263.3	515.5
35	263.3	515.5
36	264.4	518.7
37	265.2	520.5
38	264.4	520.5
39	265.6	522.2
40	267.2	525.6
41	267.2	525.6
42	267.2	525.6
43	267.2	525.6
44	267.2	525.6
45	267.2	525.6
46	266.9	524.4
47	266.9	524.4
48	267.1	524.0
49	268.4	528.8
50	268.5	530.2
51	268.5	530.2
52	268.5	530.2
53	269.0	531.9
54	269.0	531.9
55	269.0	531.9
56	269.0	531.9
57	269.0	531.9
58	268.4	530.5
59	267.1	526.6
60	267.1	526.6
61	267.3	527.3
62	267.5	528.1
63	267.5	528.1
64	267.5	528.1

STATION NUMBER	F11 PPT	F12 PPT
65	267.5	528.1
66	267.8	526.5
67	268.1	525.8
68	268.1	525.8
69	268.1	525.8
70	268.2	525.0
71	268.2	525.0
72	268.2	525.0
73	268.1	525.2
74	267.8	526.2
75	267.8	526.2
76	267.8	526.2
77	268.2	527.2
78	268.4	527.3
79	268.4	527.3
80	268.4	527.3
81	268.7	527.3
82	269.1	528.2
83	269.1	528.4
84	269.1	528.4
85	269.1	528.4
86	269.1	528.4
87	269.1	528.4
88	274.5	543.1
89	274.5	543.1
90	274.5	543.1
91	274.5	543.1
92	272.8	537.8
93	272.8	537.8
94	272.8	537.8

C.6 Tritium/Helium-3

(Scott Birdwhistell)

A total of 32 stations were sampled for Tritium and helium on the cruise. Stations were selected to elucidate the boundary current on the north side of New Guinea, the equatorial zone, the Kuroshio and the large scale general circulation of the western Pacific. Normally 16 helium and tritium samples were taken on each of the stations resulting in approximately 480 water samples for each variable, mainly in the upper and mid-depth parts of the water column. In addition, two stations were sampled for deep heliums. These 32 samples will be used in conjunction wit other WOCE deep helium stations, to describe aspects of the abyssal circulation.

C.7 CO2

(Chris Sabine, Rich Rotter and Art Dorety)

The Princeton Ocean Tracer Laboratory (OTL) group participated in P10 as part of the department of Energy (DOE) global survey of carbon dioxide in the oceans. On the cruise approximately 1100 samples from 35 stations were collected and analyzed for total carbon dioxide (TCO2) using standard coulometric techniques. An equivalent number of samples were collected for alkalinity titration, of which 80% were analyzed on board he ship using an automated, closed cell, potentiometric system. The remaining 220 sample will be returned for analysis ashore. The data will be used by our group to further understand the marine carbon system of the far western Pacific and the potential role of this area as a sink for anthropogenic CO2.

In addition to the discreet sampling for CO2, an underway pCO2 system was run throughout the cruise to collect boundary layer atmospheric and ocean mixed layer concentrations. This system together with the ship’s navigational and meteorological data will be used to calculate air-sea pCO2 differences for flux calculations.

Appendix A: Nutrient Quality Control Notes

(Joe Jennings)

STN #	NUTRIENTS AFFECTED	HYDRO SAMPLE #	PROBLEM NOTED	FLAG ASSIGNED
003	ALL	14	empty hydro bottle	9
007	ALL	18	empty hydro bottle	9
015	ALL	11	empty hydro bottle	9
015	ALL	21	empty hydro bottle	9
016	N+N, PO4	4	Low; oxygen and Salt flagged; bad bottle?	3
016	N+N, PO4	14	Low; oxygen and Salt flagged; bad bottle?	3
017	ALL	1	empty hydro bottle	9
017	ALL	20	empty hydro bottle; row missing in file. It	
		9	should be flagged with 9's and not deleted	
019	ALL	24	empty hydro bottle	9
020	ALL	5	empty hydro bottle	9
021	ALL	35	Noted as leaker	4
022	N+N	2,4,6-8,	Out of profile	3
		12,13,15		
023	N+N	1,2,6,8-16	Cd coil dying, crummy peaks	3
025	ALL	17	empty hydro bottle	9
025	ALL	5	Bad bottle	4
025	ALL	11	Noted as leaker	4
025	ALL	3	empty hydro bottle	9
025	ALL	29	Noted as leaker	4
026	ALL	3	empty hydro bottle	9
026	ALL	11	empty hydro bottle	9
026	ALL	29	Leaker	4
026	ALL	1	empty hydro bottle	9
026	ALL	20	Leaker?	3
027	ALL	3	empty hydro bottle	9
027	ALL	13	empty hydro bottle	9
028	ALL	1	didn't sample, leaking badly	9
028	ALL	21	didn't sample, leaking badly	9
028	PO4	3	Too high	3
029	ALL	29	didn't sample, leaking badly	9
029	ALL	13	didn't sample, leaking badly	9
029	ALL	11	didn't sample, leaking badly	9
030	ALL	11	too low, Salt flagged, O2 suspicious	9
030	ALL	26	out of water, did not sample	9
030	ALL	31	didn't sample, leaking badly	9
031	ALL	13	Noted as leaker	4
031	ALL	11	empty hydro bottle	9
032	N+N	11,14	Low on theta plot, no obvious problems	3
033	N+N	13	Low in theta plot, no obvious problems	3
033	PO4	8-17	Possible shift; can't be corrected	3
034	ALL	7	didn't sample, leaking badly	9
035	ALL	11	didn't sample, leaking badly	9

STN #	NUTRIENTS AFFECTED	HYDRO SAMPLE #	PROBLEM NOTED	FLAG ASSIGNED
036	ALL	14	empty hydro bottle	9
036	ALL	5	Noted as leaker	4
041	ALL	21	Noted as leaker	4
042	ALL	22	High? Salt bad	3
043	ALL	21	didn't sample, leaking badly	9
043	ALL	33	didn't sample, leaking badly	9
043	N+N	22	High? Salt bad	3
044	ALL	13	Noted as leaker; no notes in logsheet	4
045	N+N	19	High	3
047	ALL	25	didn't sample, leaking badly	9
048	ALL	33	didn't sample, leaking badly	9
050	ALL	11	Noted as leaker	4
050	ALL	5	Noted as leaker	4
051	ALL	3	Bad bottle, petcock open	4
051	ALL	5	Bad bottle, petcock open	4
052	ALL	8	Leaker?	3
058	ALL	17	Noted as leaker	4
058	ALL	5	Noted as leaker	4
059	ALL	5	Noted as leaker	4
061	ALL	4	didn't sample, leaking badly	9
062	ALL	27	Leaker, low	4
065	ALL	1	Noted as leaker	4
069	ALL	27	Noted as leaker, high	4
070	ALL	9	Noted as leaker	4
071	ALL	9	Noted as leaker	4
071	Si(OH)4	16-18	Low	3
071	ALL	15	Noted as leaker	4
072	ALL	21	Noted as leaker	4
074	ALL	29	Noted as leaker	4
077	N+N	6-21	High; apparent baseline shift	3
079	PO4	18-23	Very high, no obvious reason	3
079	ALL	24	Leaker	4
080	Si(OH)4	16,17	Low	3
081	ALL	4	Noted as leaker	4
082	ALL	33	High, no reason, oxygen flagged	3
082	ALL	15	Noted as leaker	4
086	ALL	11	Noted as leaker	4
088	ALL	21	Noted as leaker	4

Note: "Noted as leaker" generally refers to samples which were drawn and analyzed, but were noted in the Small Volume Sample Log as suspected of leaking. This data is reported, but is considered to be "bad". By contrast, "didn't sample" generally refers to hydro bottles which were clearly identified as leaking early in the process of drawing samples and which were therefore not sampled.

Appendix B: Comments on CTD data acquisition

(Marshall Swartz)

From the beginning of the cruise, the 10-liter bottles had problems with endcap failures. Typically, the endcap would fracture when closed due to a lanyard failure, or a piece of the body of the endcap would fracture, causing the uncontrolled ejection of the remaining parts out of the bottle into the hanger. This was found to be due to design deficiencies in the thickness of the body of the encap, and due to machining problems, causing stress fractures along a machined groove root.

The deficiencies were communicated to Scripps, and the problem was corrected on subsequent designs. The spring tension was maintained as low as would retain water in the bottles (approximately 35-35 lbs.).

Two Scripps frames with 10-liter bottles were maintained in a ready state. They are noted as the "old" and the "new" frame/bottle set. They were used interchangeably, with the only difference being that the LADCP, which had to be removed from the frame to be recharged, was more easily mounted and dismounted from the "new" frame, and thus was kept there.

Station by Station problems, changes including:

STATION	COMMENTS
1	OTM 1316 installed within 15 cm horizontally of CTD temperature sensor.
2	
3	Bottle 14 not sampled due to leakage.
4	
5	Double bottle trip at 900db (nominal pressure)-operator error.
6	
7	OTM 1316 stopped shutdown during cast. Suspected firmware lockup in OTM. Bottle 18 not sampled due to leakage.
8	Package powered down than back up at approximately 100db to try and revive OTM 1316.
9	Changed cable for OTM 1316, used cable from #2 frame.
10	
11	
12	
13	Salinity spike in down trace, interpolated down 2 db averaged file btw 2275 db and 2289 db.
14	
15	Suspected pylon 1460 performance, and removed it. Installed pylon 1419 and new cable prior to station 15. New station configuration. CTD 10, P1419, aft SCI 1419, OTM 1316 AND GREY BOTTLES No sample from bottle 11 or 20, both returned to surface empty.

16 First of the GERARD Stations. Cast one Deep Gerard, cast two CTD, cast 3 shallow Gerard. Conductivity sensor left dry.
17 Started waiting 30 sec after arriving at each bottle depth before triggering bottle release, to assure flushing and dissipation of entrained water. A couple of synch errors interpolated in down *.edt file. Bottle 20 not cocked, but vented to sea.
18 Conductivity jump interpolated in down *.edt file.
19 Swapped OTM 1316 to OTM 1317.Resurfaced package to remove rag. Winch problems on up cast between 3400- 3200 db. Bottle 24 not sampled due o'ring not being properly seated.
20 Bottle 5 not sampled bottom o'ring not seated. Bottle 31 was tripped mechanically but not electrically salts, and oxygens drawn to see where it tripped.
21 Swapped OTM 1317 to OTM 1316.Several deep bottles fired in pairs to assists CFC people evaluate bottles. SCI had com errors going to position. Two synch errors taken out of up *.edt trace.
22
23
24 Bottles 1-30 tripped, skipped 31-35, tripped 36.Salt bottles SG 'grey' on odd number positions. Salt bottles SW 'white' on even number positions. Conductivity jump at 29.3 db interpolated.
25 Swapped OTM 1316 to OTM 1317.Gerard station before CTD cast New frame, with CTD 10 and Pylon 1419.Lanyard hangups on bottles 11, 17, and 29, no sample taken.
26 Conductivity sensor not covered, dried out. OTM 1317 intermittent response. Lanyard hangups on bottles 3, 11, and 28, no samples taken. Synch error interpolated at 403 db in down *.edt file.
27 Lanyard hangups on bottles 3,13, and 21, no samples taken.
28 No samples taken from bottle 21, no water.
29 Fired bottles 1- 31, skipped 32- 35, fired 36Lanyard hangups on bottles 1, 11, 13, and 21, no samples taken. Conductivity interpolation at 21.3 db in down *.edt.
30 Fired bottles 1-32, skipped 33- 35, fired 36.Conductivity interpolation at 16.5 db in down *.edt file
31 Lanyard hangups on bottles 11 and 17, no samples.
32
33
34 Gerard Station
35 OCM replace OTM 1317. Autosal #10 developed electrical problem in range select circuit and was repaired. Fired bottle 1-28, skipped 29- 35, fired 36.Skipped bottle 21, could not get a seal. Salinity spike- interpolated 2 db averaged file btw 2167 db and 2191 db.
36 Fired bottles 1-30, skipped 31- 35, fired 36.Again bottle 21 was skipped.
37 Fired bottles 1- 25, skipped 26-35, fired bottle 36.Petcock open on bottle 21, did not sample. Synch error in upcast at 2205 db, interpolated.
38 Fired bottles 1-26, skipped 27- 35, fired bottle 36.Pinger battery changed. Autosal cell interface circuit board was fixed prior to running salts on station 38.
39 Fired bottles 1- 18, skipped 19- 35, fired 36.
40 Fired bottles 1- 24, skipped 25- 35, fired 36.

41 Fired bottles 1-27, skipped 28- 35, fired 36.
42 Fired bottles 1- 36, skipping 11, 21, 34, and 35.
43 Fired bottles 1- 36, skipping positions 11 and 21.Synch errors at 253 db interpolated *.edt file.
44 Fired bottles 1- 36, skipping positions 11 and 21.Acquisition started on PC after package entered the water.
45 Fired bottles 1- 36, skipped positions 3, and 21.
46 Gerard station NOISEY SALTS Skipped positions 11 and 21 again.
47 Skipped positions 11 and 21 again.
48 Lanyard hangup on bottle 33, no sample.
49 Winch problem at 5000db, paid out wire and then started bringing the package back up.
50 Synch error at 1284 db, interpolated down cast *.edt file.
51 Swapped OCM to OTM 1317Winch problems at 2952 m, lost main propulsion for 6 min. Paid out winch due to gaps in lays, started reeling back in at 3353 m (wire out).Winch stopped at 926.8 db (upcast), more winch problems at 460 db. Bottles 1-15 may have been compromised by winch payout. In an effort to identify source of errors in sample salts, triple salt samples were taken. One set was drawn into WHOI 125ml bottles and sampled on WHOI autosal #10, one set taken with SIO 250ml bottles and run on WHOI Autosal #10, and one set taken with SIO 250ml bottles and run on an SIO Autosal operating in the wet lab. All samples drawn by same individual.
52 A couple of winch problems on upcast. Winch paused at 4715 m, occasional slow downs and pauses due to winch. Conductivity spike in down trace interpolated around 3393 db in *.edt file.
53 Changed OTM 1317 out for OCM Winch was slowed down and stopped on several occasion on the upcast due to winch leveling problems.
54
55 Bottle position 11 and 21 were not used.
56 Winch problems on upcast around 4000 db. Salt replicates for bottles in firing positions 1-9.
57 Winch slow down on up cast at 4720 db. Bottle 13, lanyard caught in end cap- no sample. EXTRA SAMPLES OF SALTS DRAWN FOR COMPARISON SCRIPPS BOTTLES ON WHOI AND SCRIPPS AUTOSALS
58
59 Winch slow down at approximately 5265 db.
60 EXTRA SAMPLE OF SALTS DRAWN TO COMPARE SAMPLE BOTTLES
61 Swapped OCM to OTM 1317.No sample bottle 4, water would not come out. Sampled 1-31, skipped 32-35, sampled 36.Noticed large (approximately 0.5 cm squared area) flakes of iridescent material inside WHOI 125ml sample bottles which appear to trap water and come off. These bottles are several years old, and no problems have been noted previously. Tried removing flakes with hydrochloric acid with only partial success.
62 Synch error interpolated at 1986 db in down cast.
63 Swapped OTM 1317 to OCM. Rough weather, took Package down immediately from surface. No sample bottle 35.Synch error interpolated at 2861 db.
64

65 Gerard station, Cast 2. Lost 7 gerard barrels- cable snapped. Winch problems on upcast, slow between bottles.
66 Winch slow down on uptrace btw 4715 db and 3590 db.
67 New winch speed: was 30m/min 0- 300m 60m/min 300- 5500m 40m/min 5500- bottom NOW 30m/min 0-300m 60m/min 300- near bottom.
68 Wire connectors on termination replaced prior to station. Slow down of package speed on down trace btw 4200 m and 4650m.
69 Bottle position 13 not sampled- end cap not closed.
70
71 Numerous communications errors encountered with pylon/SCI. Result is that pylon resets itself to home position during cast, and must be repositioned to the next bottle- not always successfully. Suspect that the pylon/SCI communication channel FSK signal is being interfered by the CTD FSK signal, a condition which shows up on anoscilloscope.
72 Swapped OCM for OTM 1317. Pylon/SCI communications problems again like station 71. Reset pylon by powering off the SCI, waiting 30 seconds, then powering on and repositioning to desired bottle.
73 Winch wrap problem at 1412 m out, brought down to 1820 m. Bottles 19 and 20 may have been compromised due to this.
74 Swapped OTM 1317 for OCM. Bottle in position 13 came up empty- no sample.
75
76 Wire problems, package slow down during up cast
77 Winch slow down at 2393 m on upcast. Synch error in down cast interpolated 2120 db.
78
79 No water in bottle 29, no samples.
80
81 Swapped OCM for OTM 1317. POWERED DOWN BEFORE STATION FOR TWO HOURS WHILE LADCP REPLACED AND OTM 1317 REPLACED OCM.
82 Winch slowed several times on uptrace. Operator error- two bottles tripped at 150 m, none at 800 m. Conductivity jumps in down trace. Synch error interpolated at 2288 db.
83
84
85 HEAVY WEATHER, SHIP DRIFTED A WAYS BTW UP AND DOWN CAST.
86 HEAVY WEATHER CONTINUED, LARGE DRIFT FOR VESSELL. Winch stop on down cast at ~2900 db. Lower end cap open on bottle 5, no sample.
87 WEATHER GETTING BETTER. Several winch slow down on upcast. COM ERRORS RESETTING PYLON.
88 Conductivity jump in down cast- interpolated 3213 db. Skipped bottle 33, 34 and 35.
89 Skipped bottles 28- 35.
90 Skipped bottles 25- 35. No sample bottle 19, leaks at end cap. Conductivity jumps in down cast. Salinity spike, interpolated 2db averaged file btw 1171 db and 1175 db.
91 Skipped bottles 23-35.
92 Skipped bottles 16- 35.
93
94 Conductivity jumps in down cast at 89.7 db, interpolated *.edt file.

Data Quality Evaluation

DQ evaluation of WOCE P10 CTD data (EXPOCODE: 3250TN026_1).
Michio AOYAMA
21 March 1996

General:
The data quality of WOCE P10 CTD data (EXPOCODE: 3250TN026_1) and the CTD salinity and oxygen found in dot sea file are examined. The individual 2 dbar profiles were observed in temperature, salinity and oxygen by comparing the profiles obtained in the same basin. The 94 profiles of P10 CTD data were divided into four groups as follows;

Station number	corresponding basin name
from 1 to 20	
from 20 to 39	East Caroline Basin
from 39 to 60	East Mariana Basin
from 60 to 94	North Pacific Basin

The CTD salinity and oxygen calibrations are examined using the water sample data file p10.mka. DQE used the water sample data flagged "2" only for the DQE work.

Details

1. CTD profiles

The temperature and salinity profiles generally look good. DQE observed decrease of oxygen concentration near the bottom of the sea in the most of the dot wct files. These decreases observed at the deepest 10 - 30 dbar and ranged from 1 mol/kg to 4 mol/kg. Since DQE thinks that these decreases is originated the decrease of lowering rate of CTD and an a lowring rate artifact, they should be flagged "3".

2 Evaluation of CTD calibrations to water samples

2.1 Salinity calibration

The onboard calibration for salinity looks good in general. Standard deviation of Ds, Ds = CTD salinity in dot sea file - bottle salinity, is 0.00553 pss for all data and 0.00123 pss for deeper than 2000 dbar, respectively. The histogram of Ds for all depths shows a symmetric distribution (fig. 1). Since the larger difference are shallower layers, larger Ds disappeared in the histogram of Ds for deeper than 2000 dbar (fig. 2). DQE, however, observed the non-symmetric distribution of Ds in deep salinity fit. DQE thinks that this non-symmetric distribution depends on a small bias on the bottle salinity measurements among the first 58 stations (see the DQE comments on Hydrographic data).

2.2 Oxygen calibration;

The histogram of Dox, Dox = CTD oxygen in dot sea file - bottle oxygen, for all depths shows a symmetric distribution. Standard deviation of Dox is 4.38 mol/kg for all depths. The histogram of Dox for deeper than 2000 dbar becomes beautiful and standard deviation of Dox is 0.96 mol/kg (fig. 4). These confirms the good oxygen calibration work. DQE observed no significant station dependency of Dox. Though, pressure dependency of Dox is observed (see the DQE comments on Hydrographic data).

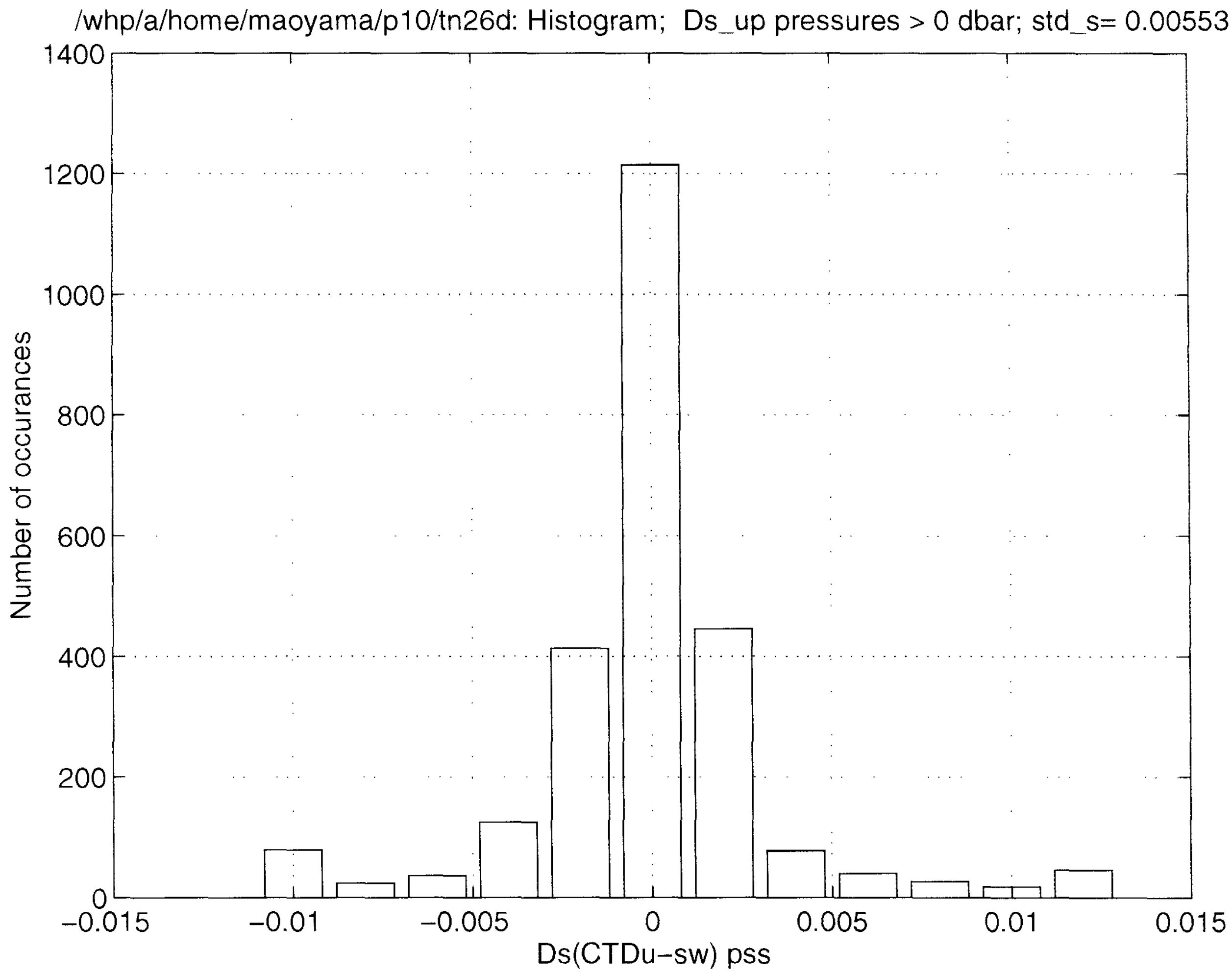
3. The following are some specific problems that should be looked at:

stn. 34	from 3800 dbar to 4300 dbar;	temperature looks like shifting toward 0.02 deg C higher than those of nearby stations.
stn. 42	from 3500 dbar to 4000 dbar;	temperature looks like shifting toward 0.02 deg C higher than those of nearby stations.
stn. 68	from 4700dbar to 4900 dbar;	periodical noisy oxygen profile were observed. Suggest flg "3".
stn. 89	from 3000 dbar to 4000 dbar;	temperature looks like shifting toward 0.03 deg C lower than those of nearby stations.

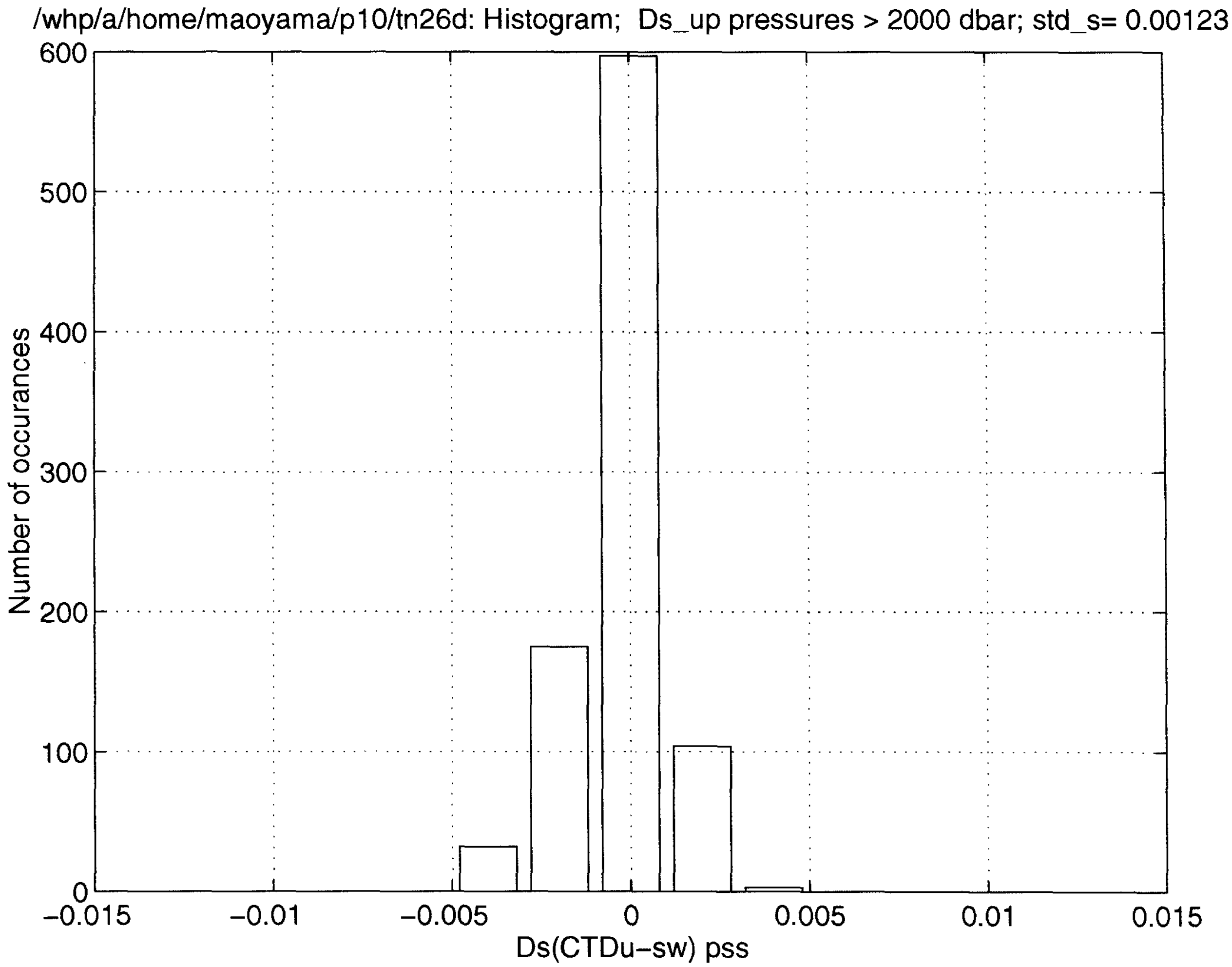
In the 4 dot wct files, wrong STNNBRs are found. DQE changed the STNNBRs as follows;

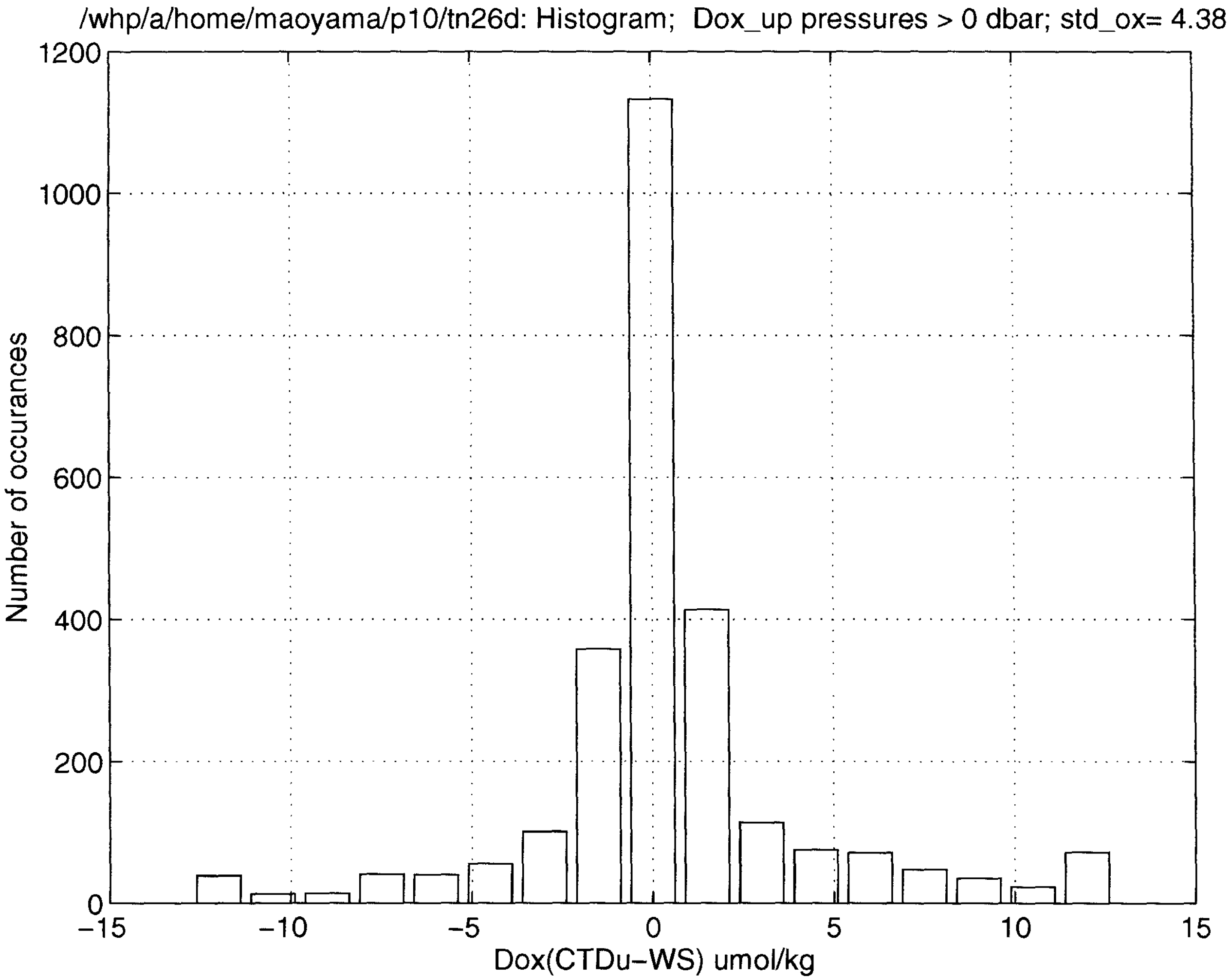
file name	found	DQE put
tn26d022.wct	STNNBR 21	22
tn26d046.wct	STNNBR 45	46
tn26d062.wct	STNNBR 63	62
tn26d066.wct	STNNBR 67	66

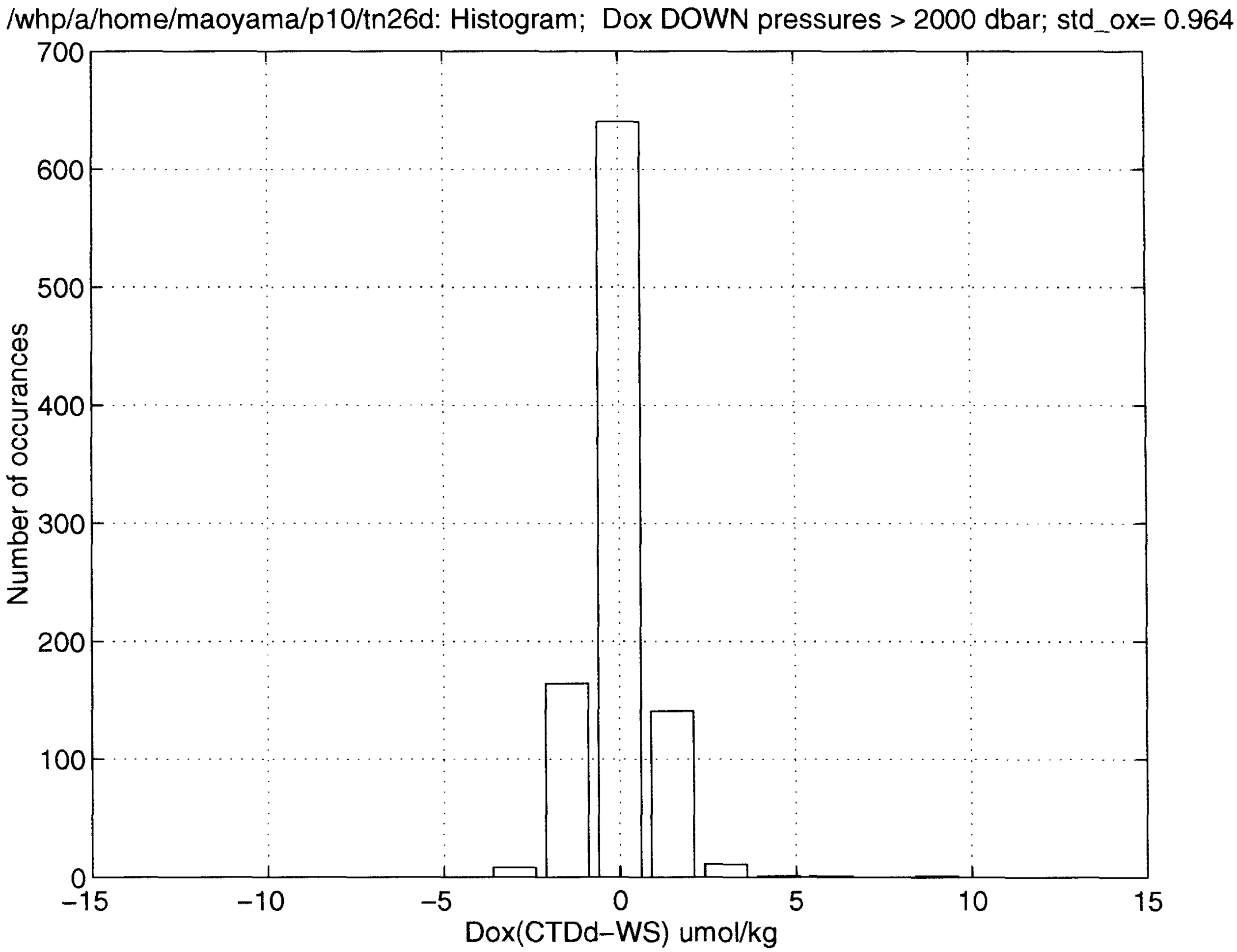
DQE assumed that the filename might be correct. However, DQE compared the maximum pressures in dot wct file with those in dot sum file to confirm it.



/whp/a/home/maoyama/p10/tn26d: Histogram; Ds_up pressures > 0 dbar; std_s= 0.00553
1400
1200
1000
800
600
400
200
0
Number of occurances
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
Ds(CTDu-sw) pss


/whp/a/home/maoyama/p10/tn26d: Histogram; Ds_up pressures > 2000 dbar; std_s= 0.00123
Number of occurances
600
500
400
300
200
100
0
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
Ds(CTDu-sw) pss


/whp/a/home/maoyama/p10/tn26d: Histogram; Dox_up pressures > 0 dbar; std_ox= 4.38
Number of occurances
1200
1000
800
600
400
200
0
−15
−10
−5
0
5
10
15
Dox(CTDu−WS) umol/kg


/whp/a/home/maoyama/p10/tn26d: Histogram; Dox DOWN pressures > 2000 dbar; std_ox= 0.964
Number of occurances
0
100
200
300
400
500
600
700
−15
−10
−5
0
5
10
15
Dox(CTDd−WS) umol/kg

DQ evaluation of WOCE P10 Hydrographic data (EXPOCODE: 3250TN026_1).
Michio AOYAMA
20 March 1996, revised on 21 March

The data quality of the hydrographic data of the WOCE P10 cruise (EXPOCODE: 3250TN026_1) are examined. The data files for this DQE work was P10.sum and P10.mka (this P10.mka file is created for DQE, then it has a new column of quality 2 word) provided by WHPO.

General

The station spacing ranged from 5 to 40 nautical miles and the sampling layer spacing was kept ca. 250 dbar in the deeper layers during this P10 cruise. The ctd lowerings were made to within 10 meters to the sea bottom except several stations. Since the data originators have done a pretty reliable work in evaluating their data, hydrographic data flagged "2-good" has a pretty good quality. Then this DQE work was enjoyable and fun for me. This high density and high quality data will improve our knowledge on the western North Pacific following the update of Pacific Ocean deep water data set. Although, I would like to complain of the flagging to salinity data in hydrographic data file.

DQE used the data flagged "2" by data originator for this DQE work.

DQE examined 6 profiles and 5 property vs. property plots as listed below:

salinity, oxygen, silicate, nitrate, nitrite and phosphate profiles
theta vs. salinity plot
theta vs. oxygen plot
salinity vs. oxygen plot
nitrate vs. phosphate plot
salinity vs. silicate plot

1. Salinity

DS, DS=CTD salinity - bottle salinity in dot sea file, vs. station #. for the deeper layer (theta below 1.5 deg C) show relatively larger variability of salinity difference among the stations up to 58. DS ranged from -0.005 to 0.003 at the first 58 stations. Then DS ranged from -0.003 to 0.002 psu. This distribution is easy to understand with the saying on the problem of salinity measurements in the cruise report. Cruise report stated the accuracy is 0.005 psu for the first 55 stations, this might be first 58 stations, and 0.002 psu for the subsequent stations (C.2.1 salinity Analysis) . DQE, however, think that this statement should be for "precision", not for "accuracy".

Fig. 1 also shows a bias of ca. -0.001 in DS distribution among the first 58 stations. DQE thinks that observed bias may have originated from the bias during the bottle salinity measurement. The overlay plot of theta vs. bottle salinity, theta vs. CTD salinity in upcast and theta vs. CTD salinity in upcast for stations 53 and 54 are shown for example (fig. 2). Unreasonable values for some of the bottle salinity (marked "+" in fig. 2) are observed in fig. 2. DQE thinks that these questionable bottle salinity data could not be flagged out by PI because of the problem on the salinity measurements among the first 58 stations. Then, DQE suggests that some of the bottle salinity data having larger DS should be flagged "3". The overlay plot of theta vs. salinity (bottle, CTD up and CTD down) will help flagging to them.

DQE thinks that the edit criteria might be around 0.003 pss (0.002 x 1.414) because both CTD salinity and bottle salinity would be able to have accepted accuracy of 0.002 psu. The edit criteria stated in the cruise report for deep waters does not meet the WHP one-time survey standards for water samples and it for CTD measurements. The used criteria was 0.005 psu from 1000 dbar to 7000 dbar and it is wider than 0.003 psu induced as mentioned above.

2. Oxygen

Bottle oxygen profile looks good. Salinity vs. oxygen and theta vs. oxygen plots also looks reasonable. DQE thinks that the flags of the bottle oxygen data are reliable.

The used edit criteria for CTD oxygen and bottle oxygen was 0.05 ml/l (ca. 2.2 mol/kg) for 1000 dbar to 7000 dbar (C.3.2). DQE examined Dox, Dox=CTD oxygen - bottle Oxygen, vs. pressure. In the depth from 1000 dbar to 7000 dbar(fig. 3), Dox ranged within the edit criteria except a few data at the oxygen minimum layers. In the deeper and low gradient layers, Dox ranged +/- 1.5 mol/kg and this corresponds 1% of the oxygen concentration there. Then DQE agrees with this edit criteria.

DQE observes "weak pressure dependency" of Dox in fig. 3. Although the range of dependency is ca. 1 mol/kg, if PI of CTDO could correct this tendency, the quality of CTD oxygen data will be improved.

3. Nutrients

Since nutrient PI has done a pretty reliable work in evaluating their data, the profiles of silicate, nitrate, nitrite and phosphate looks pretty well. Nitrate vs. phosphate plot and silicate vs. salinity plot also look pretty reasonable.

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

STNNBR XX/ CASTNO X/ SAMPNO XX at XXXX dbar:

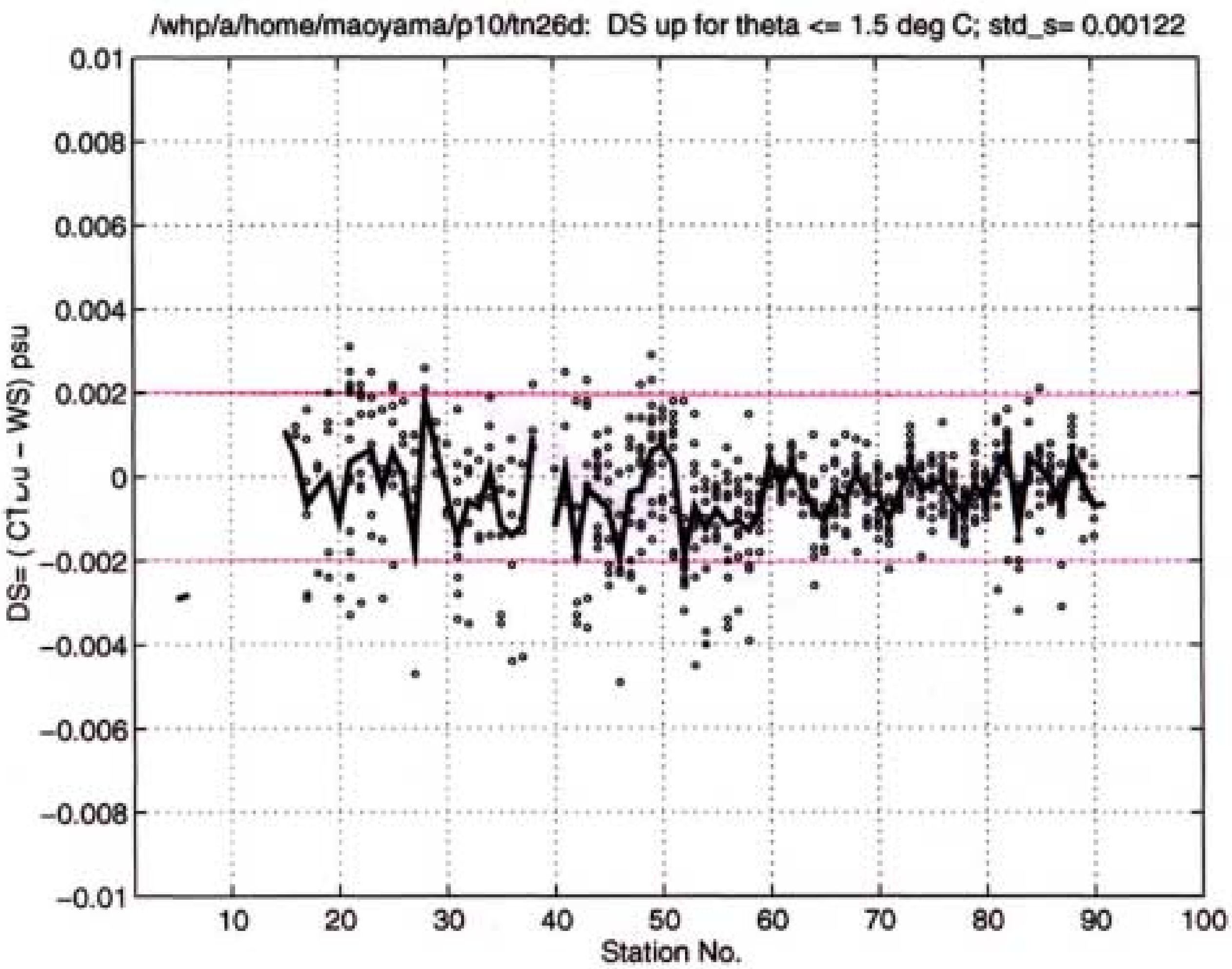
20/1/13 at 1595 dbar: Nitrite concentration is 0.11 mol/kg . This high concentration might originate from contamination during handling/analysis. Suggest flag "4".

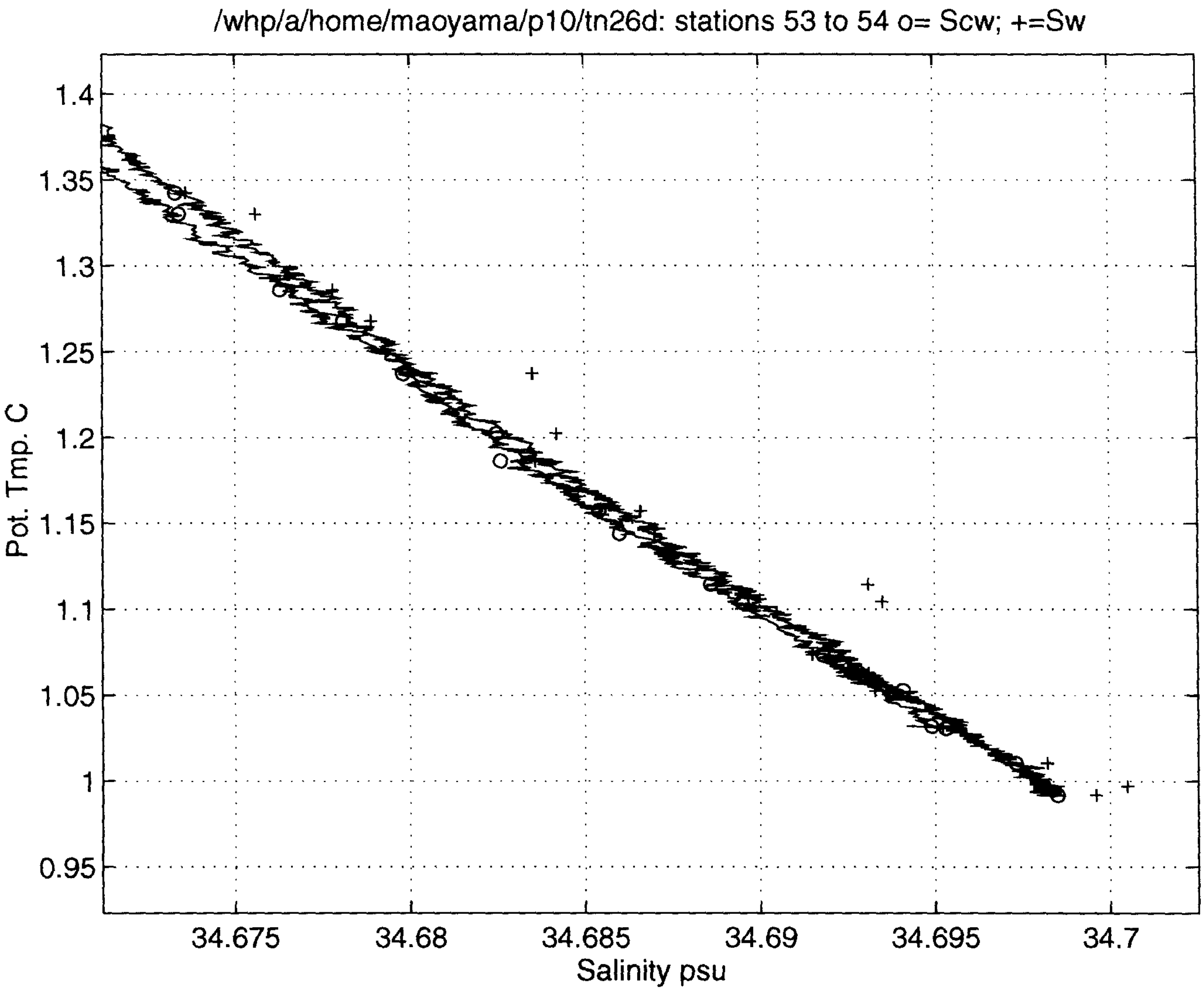
35/1/18 at 699 dbar: Bottle salinity looks like higher. Suggest flag "3".

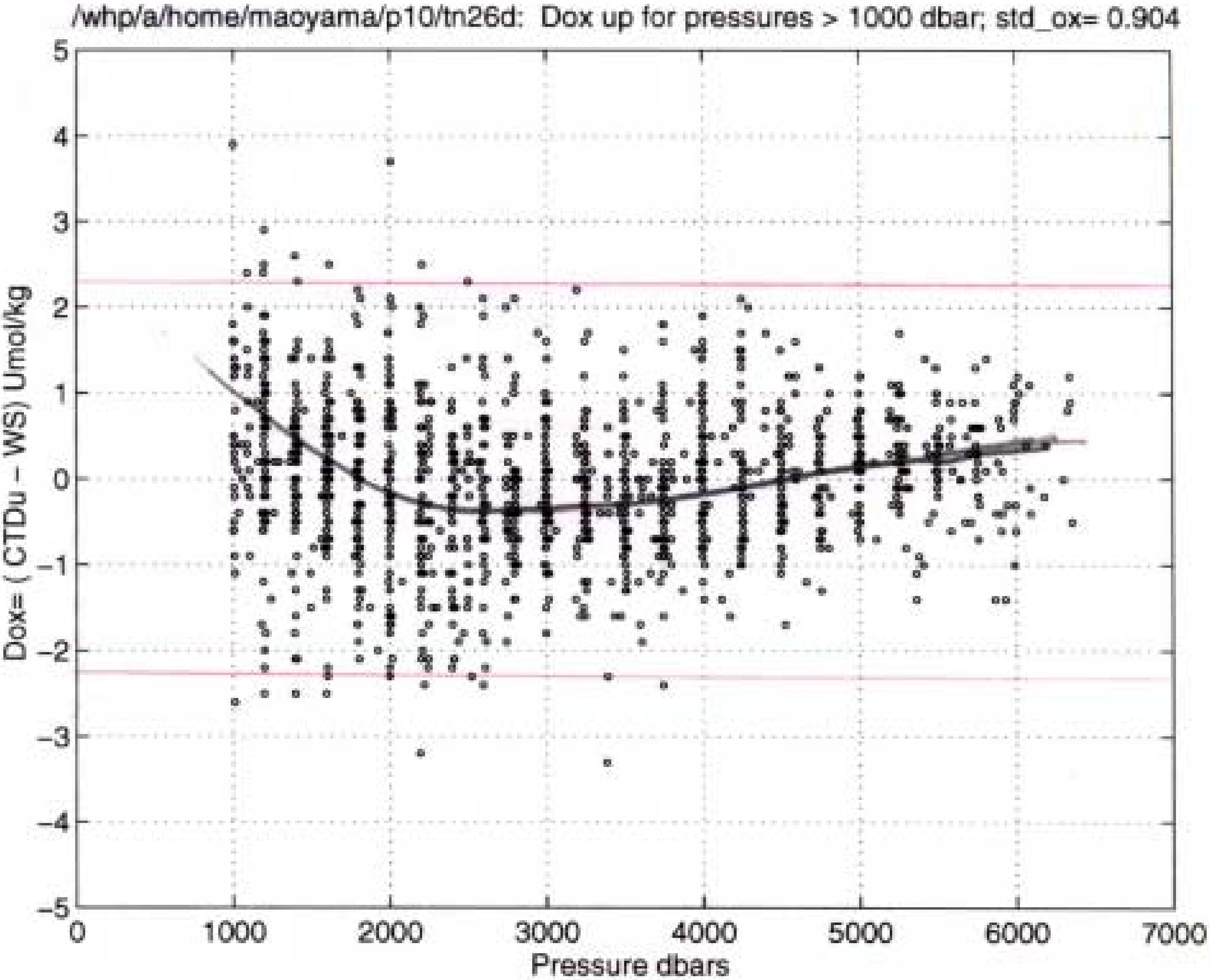
79/1/25 36 at 893dbar - 6.5 dbar: Phosphate concentration gap is observed between 2198dbar (2.96 mol/kg) and 2398dbar(2.72 mol/kg). The phosphate data between 2198dbar and 1193dbar were flagged "3" by PI. DQE observed that the phosphate data shallower than 893 dbar show higher concentration, especially at 893dbar and 798dbar. DQE guess that something might occurred during analyses. If so, suggest flag "3" to the phosphate data shallower than 893 dbar.

81/1/34 at 99dbar: Bottle oxygen looks higher. Suggest change flag to "3"..

83/1/4 at 5004 dbar: Bottle salinity looks like slightly higher. Suggest flag"3".




/whp/a/home/maoyama/p10/tn26d: stations 53 to 54 o= Scw; +=Sw
Pot. Tmp. C
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
34.675
34.68
34.685
34.69
34.695
34.7
Salinity psu



A note about the Quality 2 flags for P10, hydrographic data.
(George Anderson)

The DQE has been done for the discrete bottle data for salinity, oxygen, and the nutrients. However, the Quality 2 flags might suggest that this work has not been done. Almost all of the Q-2 flags have been set to 1. There are a few that are not 1, but in every case but one, the Q-1 flag has been set or reset to the number in the Q-2 field. The one case where the Q-1 flag is not identical to the Q-2 flag is for station 20, bottle 13, at 1595.3 db. The Q-2 flag is a 4, the Q-1 flag is a 2. The "4" was recommended by the DQ evaluator, and I would agree with his comment and conclusion.

My recommendation:

1. copy the Q1 flags to the Q2 field.
2. for the one station mentioned above, change the nitrite Q-2 flag to a 4. this is flag 8.
3. replace the present file on the WEB site with this new file.
4. add a note to the documentation file indicating that this has been done.

Sarilee has a program which copies the Q-1 flags to the Q-2 field. I'm sure she could update the file as I've indicated above and dump the corrected file into the WHPO folder for you or Danie to move to the WEB site.

With this done, one more DQE loose end will have been eliminated.

George

1. Error weighted mean reported with data set
2. Larger of the standard deviation and the error weighted standard deviation of the mean.

1999.11.30

The enclosed file: "p10hy.all.params.no3.dqe" has been modified as follows:

1. The Q1 flags have been copied to the Q2 field.
2. The date in the heading has been changed to June 7, 1999
3. The initials at the end of this field have been changed to GCA.

Background
It would appear that when the original DQE work was performed on the bottle data, specifically: salinity, oxygen and nutrients, all Q2 flags had been set to 1. When the DQ evaluator completed his work, only the 1's in the Q2 field that disagreed with his determinations were set to something other than 1. As a result, most all the Q2 flags remained as 1's with a few flags being changed to something other than 1.

I reviewed all the differences between the Q2 and Q1 flags. In all cases but one, the Q1 flags had been changed to reflect the determinations of the DQ evaluator. The only discrepancy that remained was for station 20, bottle 13 at 1595.3 db. The DQ evaluator showed the Q2 flag for nitrite as a 4, the Q1 flag remained a 2. (I happen to agree with the DQ evaluator; a nitrite value of 0.11 at ~1600 db is unlikely.) So when copying the Q1 flags to the Q2 field, this difference was carried forward.

Much of this data is public, but according to Danie's notes made during some recent data merging, some of the data are not public. When moving this file to the WEB site for Cruise P10, please keep this in mind.

I believe all the data merged into the P10 file by Danie is contained in this file.

George Anderson

Final CFC Data Quality Evaluation (DQE) Comments on P10.
(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 (mwarner@ocean.washington.edu) 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.

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P10
Final Report
for AMS ^{14}C Samples

Robert M. Key
April 24, 1998

1.0 General Information

WOCE cruise P10 was carried out aboard the R/V Thomas G. Thompson in the southwestern Pacific Ocean. The WHPO designation for this cruise was 3250TN026/1. Melinda Hall and Terry Joyce were the co-chief scientists. The cruise departed Suva, Fiji on October 5, 1993 and ended on November 10, 1993 at Yokohama, Japan. The ship deadheaded from Fiji to just north of Papua, New Guinea at 4°S-145°E where the first station was occupied. From there the track was nominally northward along 149°E, generally staying east of the Philippine Sea. A total of 94 stations were occupied. The reader is referred to cruise documentation provided by the chief scientists as the primary source for cruise information. This report covers details of the small volume radiocarbon samples. The AMS station locations are summarized in Table 1 and shown in Figure 1. A total of 588 AMS $\Delta^{14}C$ samples were collected at 38 stations. In addition to the AMS samples, large volume Gerard samples were also collected on this cruise. The large volume measurements are expected to be completed later this year and will be described in a separate report.

2.0 Personnel

^{14}C sampling for this cruise was carried out by R. Key from the Ocean Tracer Lab at Princeton University. Sample extraction, $\delta^{13}C$ analyses and ^{14}C analyses were performed by NOSAMS (National Ocean Sciences AMS Facility at Woods Hole Oceanographic Institution). Salinity and oxygen were analyzed by the WHOI CTD group (G. Tupper, G. Knapp and T. Turner) and nutrients by Oregon State University (J. Jennings and C. Carbonell-Moore for L. Gordon). R. Key collected the data from the originators, merged the files, assigned quality control flags to the ^{14}C results and submitted the data files to the WOCE office (4/98). R. Key is the PI for the ^{14}C data.

3.0 Results

This ^{14}C data set and any changes or additions supersedes any prior release. The $\Delta^{14}C$ results reported here are, under WOCE guidelines, considered proprietary for two years after publication of the preliminary data report (March, 2000) or until publication, whichever comes first.

3.1 Hydrography

Hydrography from this leg has been submitted to the WOCE office by the chief scientist

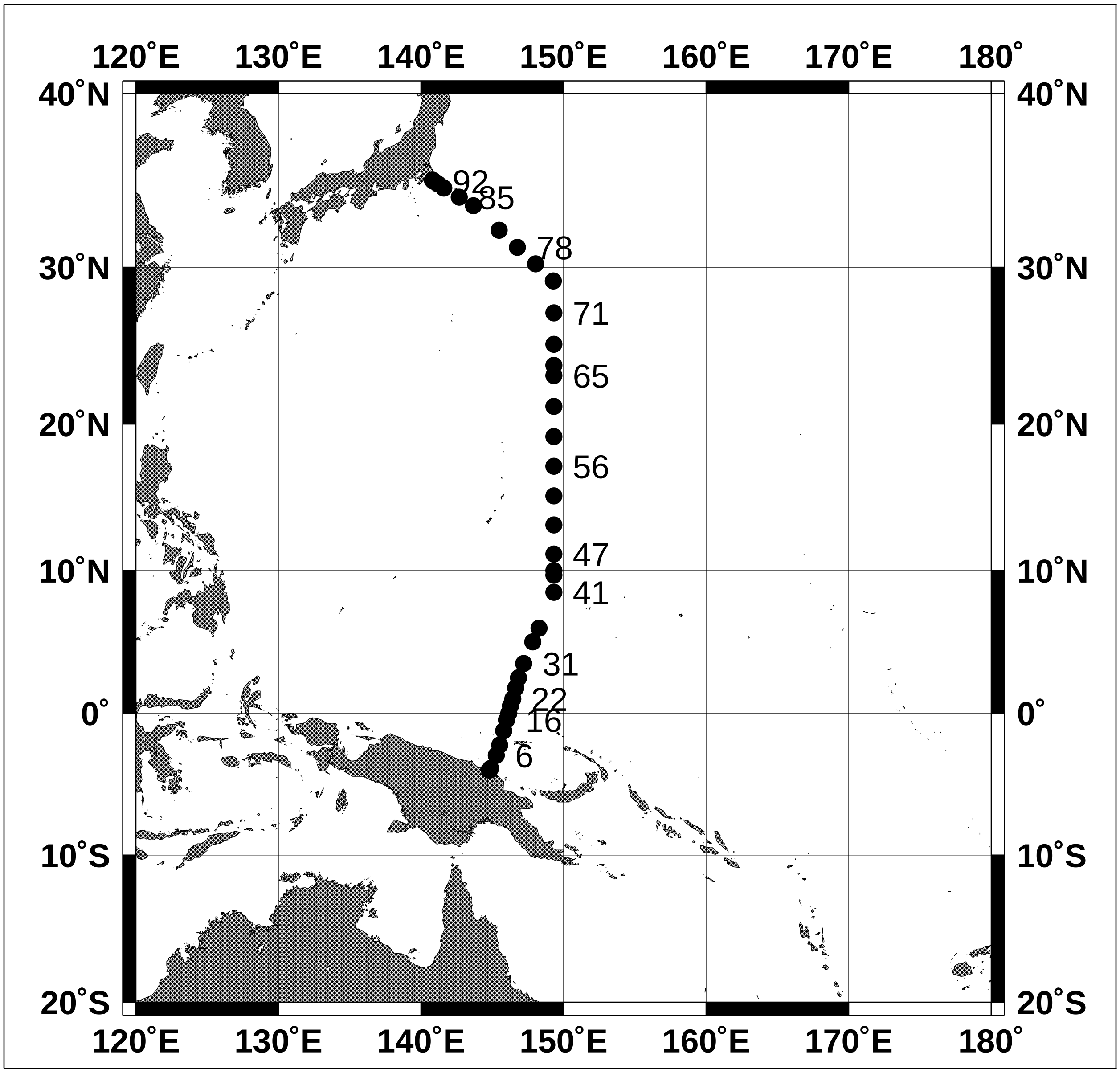

Figure 1: AMS ^{14}C station locations for WOCE P10 (map by GMT, Wessel and Smith, 1991,1995).

TABLE 1. AMS Stations on WOCE Section P10

Station	Date	Latitude	Longitude	Bottom Depth (m)	Max. Sample Pressure
1	10/12/93	-4.015	144.811	212	200
3	10/12/93	-3.892	144.892	1399	1382
6	10/13/93	-3.145	144.286	2080	2077
9	10/13/93	-2.250	145.500	1005	998
13	10/14/93	-1.250	145.786	2299	2297
16	10/15/93	-0.475	146.008	3523	3562
18	10/15/93	0.000	146.142	2477	3503
20	10/16/93	0.500	146.283	4134	4182

TABLE 1. AMS Stations on WOCE Section P10

Station	Date	Latitude	Longitude	Bottom Depth (m)	Max. Sample Pressure
22	10/16/93	1.000	146.428	4521	4573
25	10/17/93	1.750	146.642	4446	4498
28	10/18/93	2.500	146.858	4437	4496
31	10/19/93	3.503	147.214	4586	4656
34	10/20/93	5.000	147.850	4193	4243
36	10/20/93	6.000	148.272	4095	4141
41	10/21/93	8.500	149.333	3617	3665
44	10/22/93	9.697	149.333	5333	5428
45	10/22/93	10.000	149.333	5548	5643
47	10/23/93	11.158	149.331	5809	5912
50	10/25/93	13.167	149.333	5959	6068
53	10/26/93	15.167	149.333	5677	5777
56	10/27/93	17.167	149.333	5391	5482
59	10/28/93	19.167	149.333	5550	5647
62	10/29/93	21.167	149.333	5389	5481
65	10/30/93	23.181	149.339	5797	5904
66	10/31/93	23.833	149.333	5835	5943
68	11/1/93	25.167	149.333	5903	6014
71	11/2/93	27.167	149.333	5885	5996
74	11/3/93	29.158	149.286	5972	6087
76	11/4/93	30.189	148.047	6181	6304
78	11/5/93	31.208	146.761	6059	6179
80	11/5/93	32.230	145.475	5875	5989
83	11/6/93	33.667	143.667	5608	5713
85	11/7/93	34.169	142.692	5595	5699
88	11/8/93	34.725	141.611	5285	5380
90	11/8/93	34.928	141.211	3304	3345
92	11/9/93	35.092	140.892	1174	1156
93	11/9/93	35.125	140.831	484	472
94	11/9/93	35.167	140.781	216	208

and described in the hydrographic report which is available *via* the web address (http://whpo.ucsd.edu/data/onetime/pacific/p10/index.htm).

3.2 ^{14}C

The Δ^{14}C values reported here were originally published in a NOSAMS data report (NOSAMS, March 13, 1998). That report included results which had not been through the WOCE quality control procedures.

All of the AMS samples from this cruise have been measured. Replicate measurements were made on 21 water samples. These replicate analyses are tabulated in Table 2. The table

Table 2: Summary of Replicate Analyses

Sta-Cast-Bottle	$\Delta^{14}C$	Err	E.W.Mean[a]	Uncertainty[b]
6-1-3	-209.4	2.8	-211.0	2.3
	-212.6	2.8		
6-1-5	-187.3	2.7	-189.2	4.4
	-193.5	4.2		
31-1-29	90.8	6.0	89.4	3.4
	88.7	4.2		
34-3-18	-159.8	6.9	-155.2	5.1
	-152.6	5.3		
34-3-25	-52.8	4.5	-55.3	2.6
	-56.5	3.1		
34-3-27	70.2	5.3	71.5	3.4
	72.4	4.5		
36-1-24	-80.0	3.5	-79.8	2.8
	-79.4	4.9		
65-3-33	135.0	4.1	134.6	2.5
	134.4	3.1		
65-3-35	118.0	3.4	118.6	2.6
	119.5	4.0		
68-1-30	117.2	4.6	117.0	3.1
	116.7	4.1		
71-1-25	-126.5	3.1	-129.1	4.1
	-132.3	3.4		
71-1-30	109.8	4.1	107.4	3.6
	104.6	4.5		
74-3-15	-235.1	2.7	-234.1	3.6
	-229.9	5.6		
76-1-28	53.7	3.5	50.3	5.0
	46.6	3.6		
78-1-31	128.4	4.1	123.0	6.8
	118.8	3.6		
83-1-34	121.0	4.1	120.2	2.7
	119.6	3.6		
85-1-24	-110.6	4.0	-115.2	5.8
	-118.8	3.5		
85-1-27	34.9	5.3	30.6	4.9
	28.0	4.0		
90-1-4	-232.2	2.7	-230.4	3.6
	-227.1	3.7		
90-1-17	-76.5	3.6	-71.9	6.5
	-67.4	3.6		
90-1-20	2.9	3.1	1.6	4.3
	-3.2	5.8		

a. Error weighted mean reported with data set

b. Larger of the standard deviation and the error weighted standard deviation of the mean.

shows the error weighted mean and uncertainty for each set of replicates. Uncertainty is defined here as the larger of the standard deviation and the error weighted standard deviation of the mean. For these replicates, the simple average of the tabulated uncertainties for the replicates is 4.0‰ (equal weighting for each replicate set). This precision is typical for the time frame over which these samples were measured (Feb. - Oct., 1997). Note that the errors given for individual measurements in the final data report (with the exception of the replicates) include only counting errors, and errors due to blanks and backgrounds. The uncertainty obtained for replicate analyses is an estimate of the true error which includes errors due to sample collection, sample degassing, *etc*. For a detailed discussion of this see Key (1996a). Once the large volume measurements are completed, comparison between the AMS and LV results will be possible.

4.0 Quality Control Flag Assignment

Quality flag values were assigned to all $\Delta^{14}C$ measurements using the code defined in Table 0.2 of WHP Office Report WHPO 91-1 Rev. 2 section 4.5.2. (Joyce, *et al.*, 1994). Measurement flags values of 2, 3, 4, 5 and 6 have been assigned. The choice between values 2 (good), 3 (questionable) or 4 (bad) involves some interpretation.

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 (~4.0‰). No measured values have been removed from this data set, therefore a flag value of 5 implies that the sample was totally lost somewhere between collection and analysis. Table 3 summarizes the quality control flags assigned to this data set. For a detailed description of the flagging procedure see Key, *et al*. (1996).

Table 3: Summary of Assigned Quality Control Flags

Flag	Number
2	551
3	1
4	3
5	12
6	21

5.0 Data Summary

Figures 2-6 summarize the $\Delta^{14}C$ data collected on this leg. Only $\Delta^{14}C$ measurements with a quality flag value of 2 (“good”) or 6 (“replicate”) are included in each figure. Figure 2 shows the $\Delta^{14}C$ values with 2σ error bars plotted as a function of pressure. The mid depth $\Delta^{14}C$ minimum occurs around 2000 to 2400 meters, but is weak in this data set relative to the eastern North

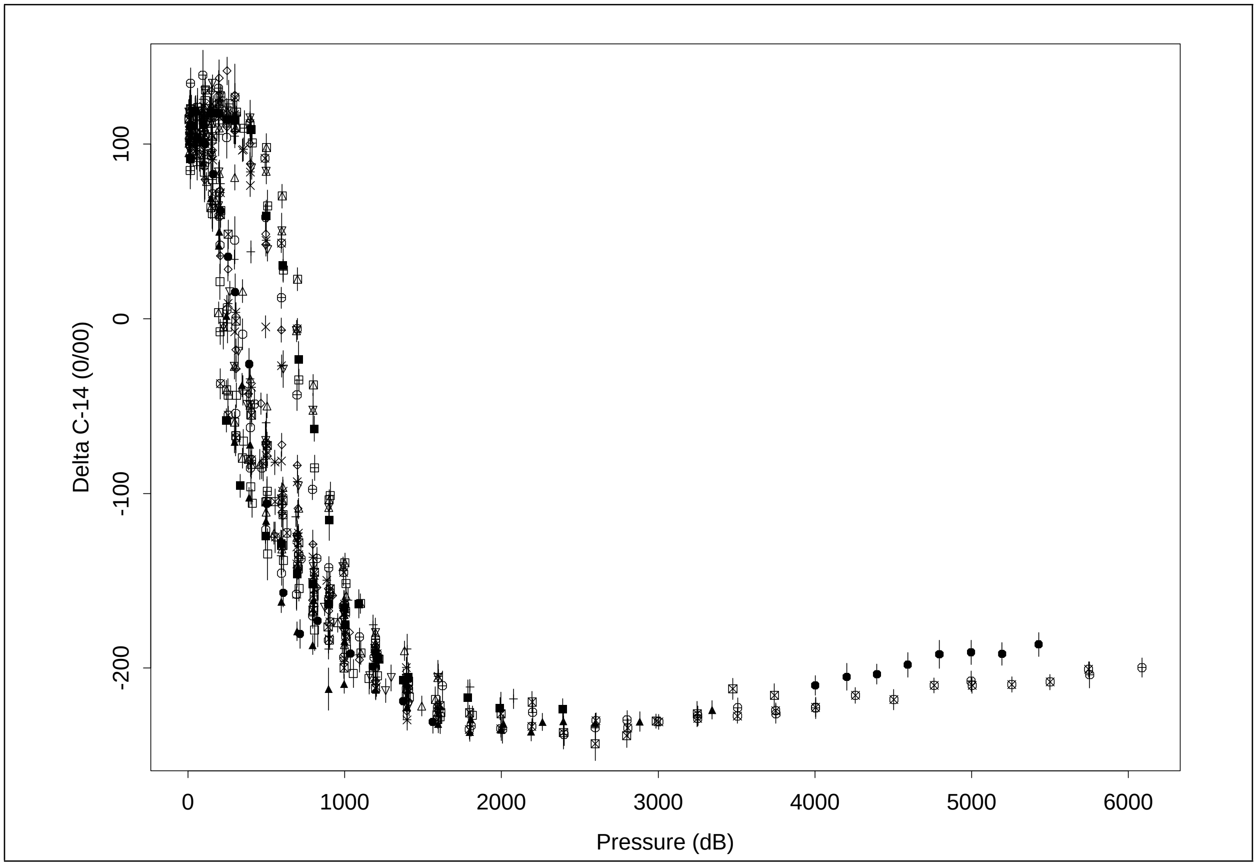

Figure 2: $\Delta^{14}C$ results for P10 stations shown with 2σ error bars.Only those measurements having a quality control flag value of 2 or 6 are plotted.

Pacific. Measurements in the thermocline region fall into two distinct groups with the higher values being from the southern end of the section and the extreme northern end while the lower grouping is from the central portion (see Figure 3 and Figure 4).

Figure 3 shows the $\Delta^{14}C$ values plotted against silicate.The straight line shown in the figure is the least squares 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, however, they note that the interpretation can be problematic at high latitudes. Samples collected from shallower depths at these stations show an upward trend with decreasing silicate values reflecting the addition of bomb produced ^{14}C. As in Figure 2, two distinct trends are apparent. Here the upper grouping is from the northern end of the section and the lower from the southern end.

Another way to visualize the ^{14}C - silicate correlation is as a section. Figure 4 shows $\Delta^{14}C$ as contour lines in silicate - latitude space for samples having a potential density greater than 26.9 which corresponds to ~500m. In this space, shallow waters are toward the bottom of the figure. The density cutoff was selected to eliminate those samples having a very large bomb produced ^{14}C component.   For this data set, Broecker's hypothesis does not work very well. The $\Delta^{14}C$ isolines trend upward to the north and the spacing between the isolines, for contours which fall below the depth of bomb-radiocarbon contamination, decreases northward. The upward curvature

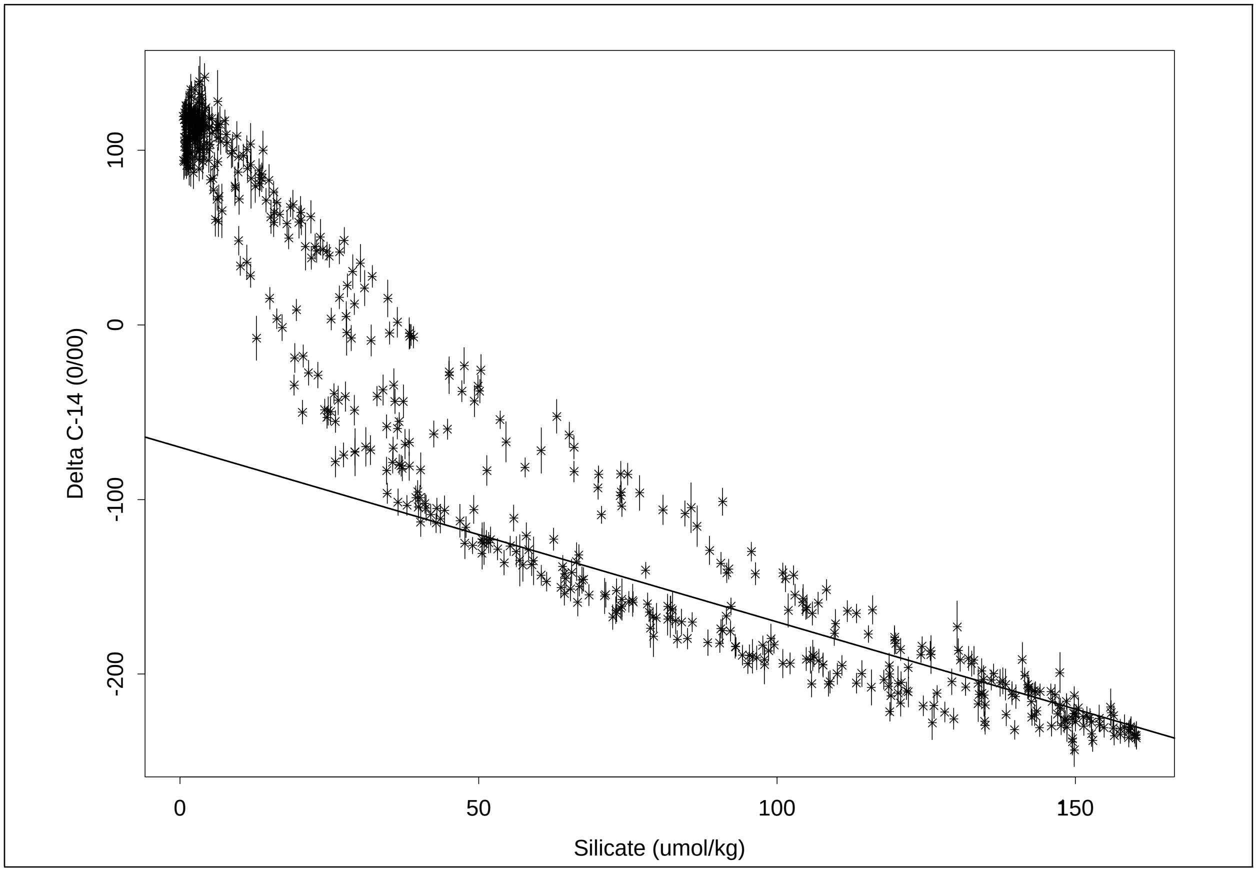

Figure 3: $\Delta^{14}C$ as a function of silicate for P10 AMS samples. The straight line shows the relationship proposed by Broecker, *et al.*, 1995 ($\Delta^{14}C$ = -70 - Si with radiocarbon in ‰ and silicate in µmol/kg).

of the isolines at the northern end of the section is due to the addition of bomb-produced radiocarbon *via* ventilation or due to an "anomalous" silicate signal (Talley and Joyce, 1992).

Figures 5-6 show $\Delta^{14}C$ contoured along the section. Figure 5 is a normal section in latitude-depth space while Figure 6 shows the same data set in potential density-latitude space. The depth section was gridded using LeTraon's (1990)objective technique and the density section was gridded using the "loess" methods described in Chambers *et al.* (1983), Chambers and Hastie (1991), Cleveland (1979) and Cleveland and Devlin (1988).

In Figure 5 the primary structure of the isopleths is due to the presence of the Pacific North Equatorial Current which flows westward across the southern end of the section and the Japan current which flows northeastward across the far northern end of the section. Upwelling near the equator is not particularly evident in Figure 5, but is the source of most of the structure seen in the isopleths in Figure 6 in the low latitude zone. The deep and bottom water AMS results are too sparce to contour. These data will be merged with the large volume results and once that data is available in order to prepare a deep section.

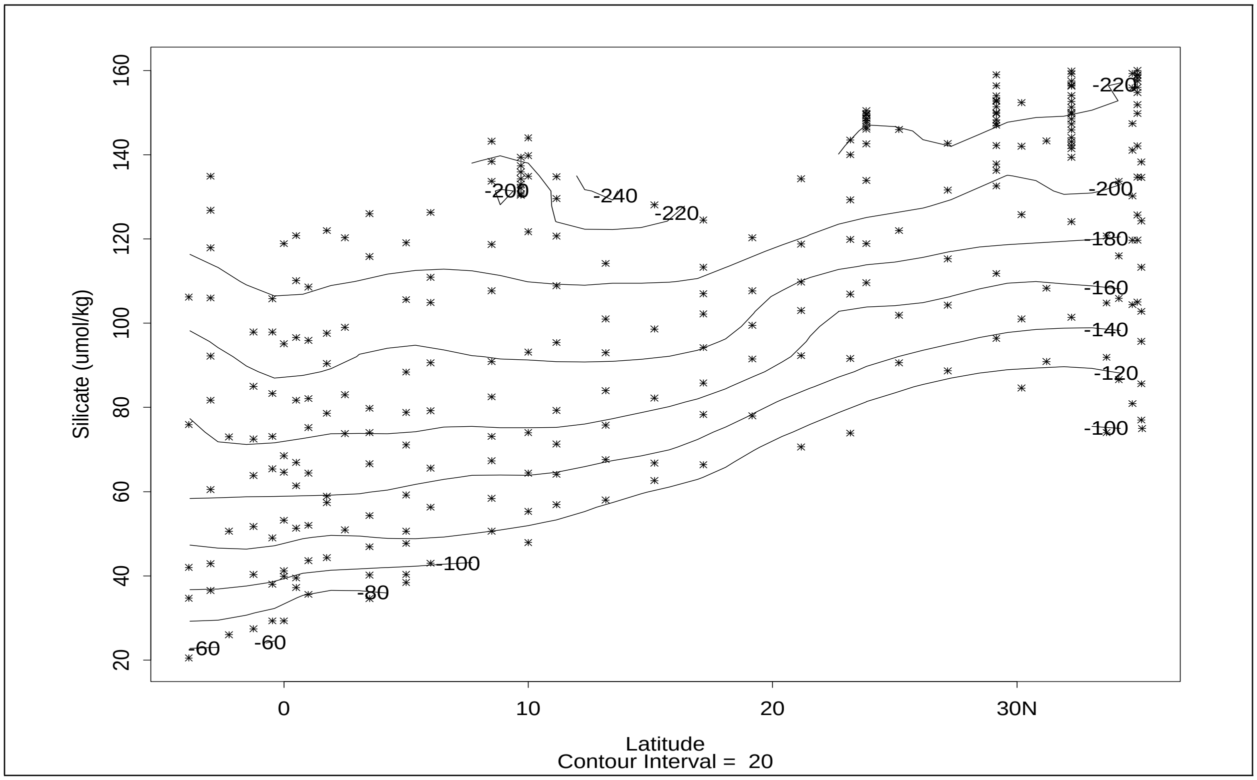

Figure 4: Section of ^{14}C contours along latitude in silicate space for the 500-2500m depth range. Note that for this section, “shallow” is toward the bottom.

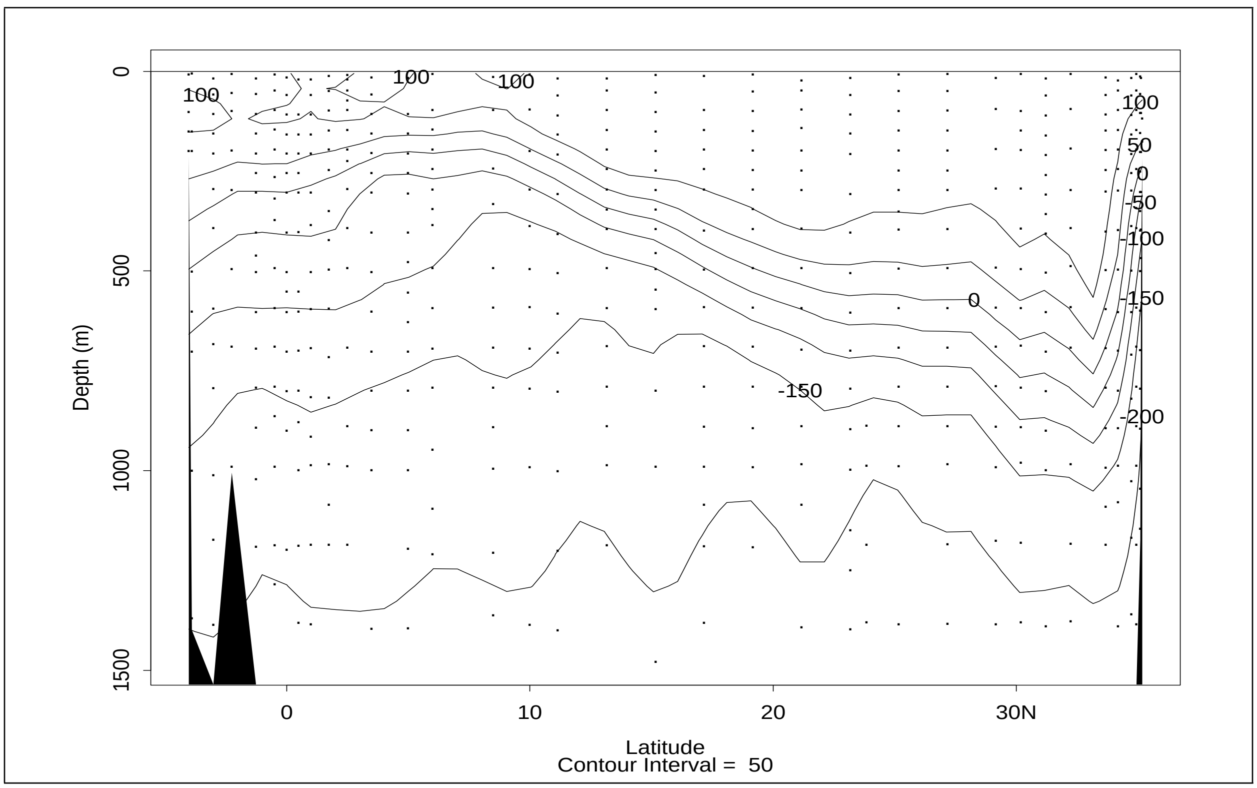

Figure 5: $\Delta^{14}C$ along WOCE section P10. Most of the deep and bottom waters along this section were sampled with the large volume technique. The few AMS samples collected below 1500m were omitted from this section.

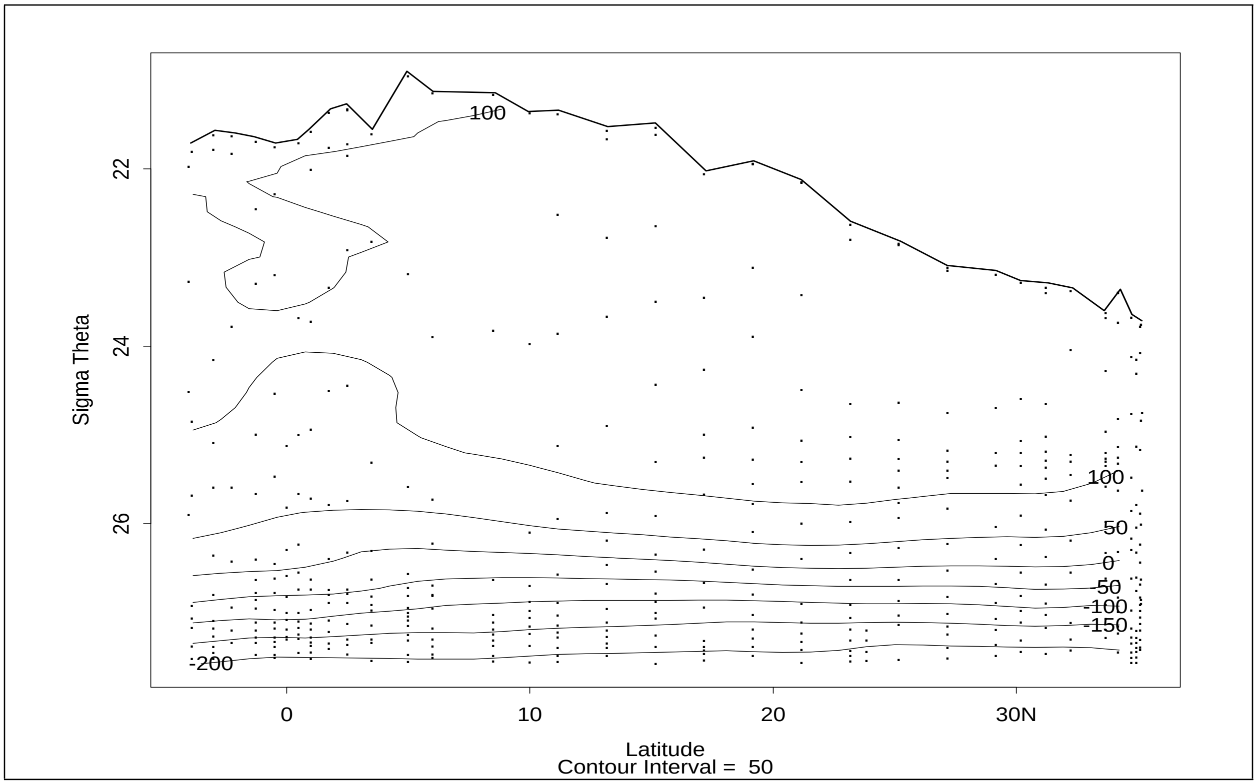

Figure 6: Same data as Figure 5 contoured in potential density space.

6.0 References

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P10
Final Report
for Large Volume Samples
and $\Delta^{14}C$ Measurements

Robert M. Key
April 10, 1998

1.0 General Information

WOCE cruise P10 was carried out aboard the R/V Thomas G. Thompson in the western Pacific Ocean. The WHPO designation for this leg was 3250TN026/1. Melinda Hall of Woods Hole Oceanographic Institute was chief scientist for this cruise. This report covers details of data collection and analysis for the large volume Gerard samples. The reader is referred to the Hall's Final Report for general information. The cruise departed Suva, Fiji on October 5, 1993 and ended at Yokohama, Japan on November 10, 1993. The objective of this cruise was to occupy a hydrographic section nominally along 149°E from Papua, New Guinea to the shelf of Japan near Yokohama as part of the onetime WHP survey of the Pacific Ocean.

Seven large volume (LV) stations were occupied on this leg. The planned sampling density was 1 station every 5° of latitude (~300nmi). Each station (except station 74 which had only one cast) included one deep cast (2500db to the bottom), and an intermediate (1000db to 2500db) cast. All LV casts were done using the starboard-aft winch and coring cable. 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. Table 1 summarizes the LV sampling and Figure 1 shows the station positions for leg P10.

TABLE 1. Station/Cast Summary

Station	Cast	Latitude	Longitude	#Samples
16	1	-0.473	146.015	9
	3	-0.465	146.000	9
25	1	1.750	146.643	9
	3	1.771	146.640	9
34	1	4.997	147.882	9
	3	5.000	147.860	9

TABLE 1. Station/Cast Summary

Station	Cast	Latitude	Longitude	#Samples
47	1	11.169	149.329	9
	3	11.166	149.325	9
56	1	17.163	149.302	9
	3	17.187	149.328	9
65	1	23.170	149.335	9
	3	23.197	149.328	2
74	1	29.163	149.327	5
7	13	TOTALS		106

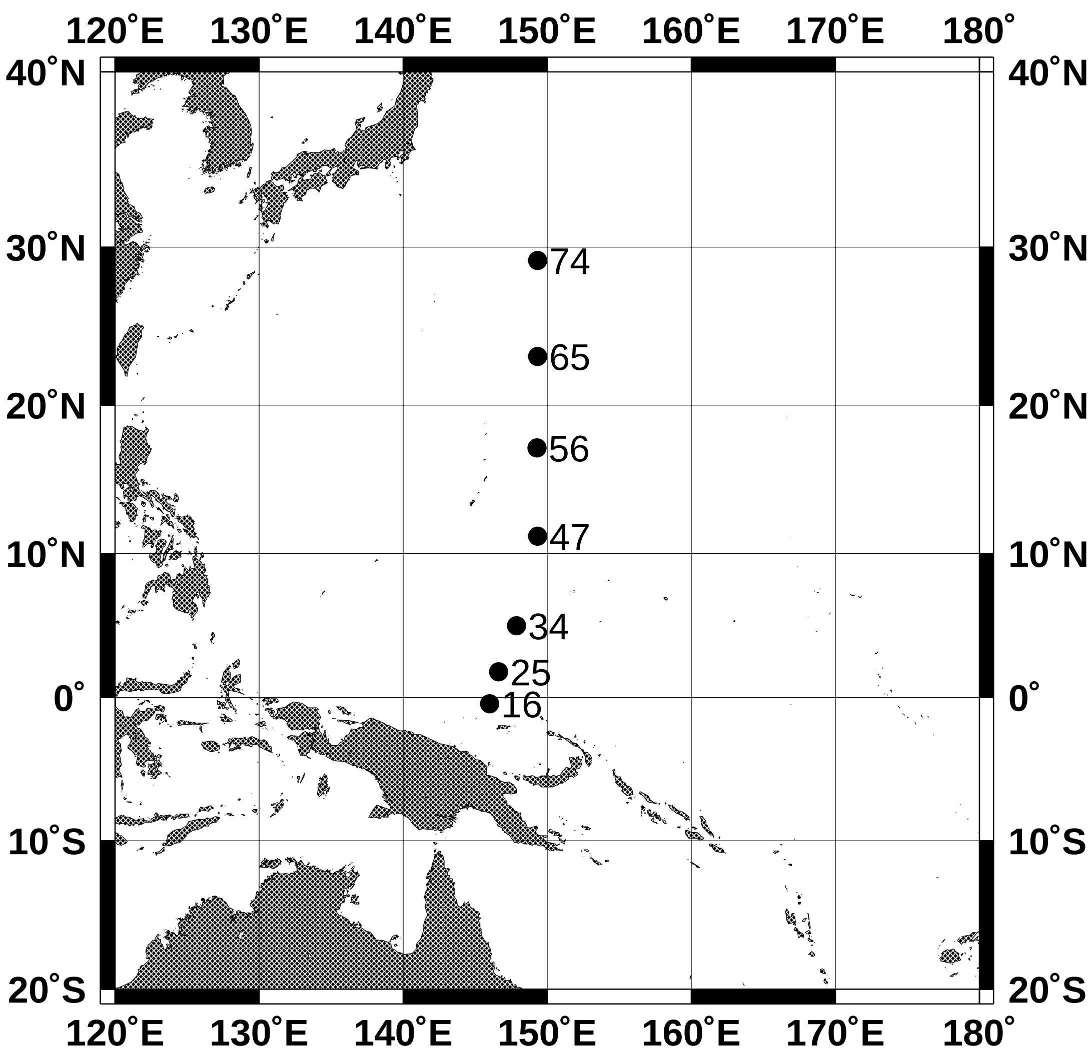

Figure 1: Large volume station locations for WOCE cruise P10 (map by GMT).

Each Gerard barrel was equipped with a piggyback 5 liter Niskin bottle which, in turn, had a full set of high precision reversing thermometers to determine sampling pressure and temperature. Both Gerard and Niskin were sampled for salinity and nutrients. Additionally, each Gerard was sampled for 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. As samples were collected, information was recorded on a sample log sheet. 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. Data checking procedures included verification that the sample was assigned to the correct depth. The salinity and nutrient data were compared with those 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.

During retrieval of station 65 cast 3, seven of the nine Gerard barrels, along with all accompanying equipment, were lost when the winch operator failed to stop when signaled. A few hours were spent trying to drag for the equipment, but this was a long shot at best and complicated by the fact that the remaining coring cable was just long enough to reach bottom. For the remainder of the cruise, the deep water was sampled using AMS samples. Fortunately, this was the last WOCE cruise for which large volume sampling was planned.

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 Key. Deck work was done by the WHOI CTD group under the direction of J. Wells from SIO-ODF. Wells and Key were responsible for reading thermometers. Salinities and nutrients were analyzed by WHOI (George Tupper, George Knapp and Teresa Turner) and Oregon State Univ. (Joe Jennings), respectively. ^{14}C and ^{13}C analyses were performed by Minze Stuiver, Univ. Washington. Key collected the data from the originators, merged the files, assigned quality control flags to all of the large volume hydrographic data and radiocarbon results and submitted the data files to the WOCE office.

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 41-53 while Gerard barrels are in the range 81-94.

3.1 Pressure and Temperature

Pressure and temperature for the 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. The temperatures are based on 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. Figure 2 shows potential temperature *vs.* pressure for the LV casts.

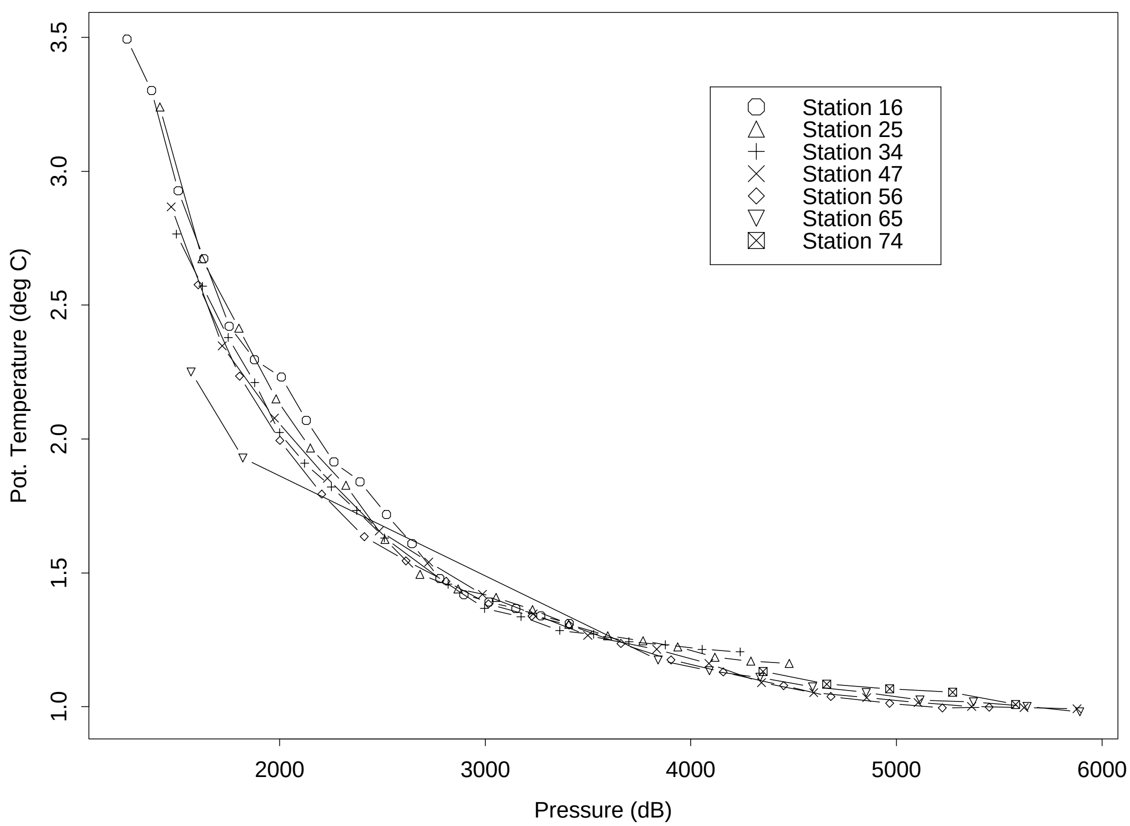

Figure 2: Potential temperature from DSRT on LV casts *vs.* pressure.

3.2 Salinity

Salinity samples were 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. In terms of accuracy, the large volume salinity values for this cruise are actually *better* than those from the Rosette at the same station. The problem with the Rosette salinity values was discovered to be inadequate rinsing (which is never a problem with the LV 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.

Salinity samples were drawn into 200 ml Kimax high alumina borosilicate bottles after 3-5 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 air-tight 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 large volume 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. 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. The quality of the temperature and salinity is demonstrated by Figure 3 which shows data from all of the large volume samples. Each Gerard-Niskin pair is assigned the same temperature which allows direct comparison of many of the paired salinity values on the figure.

The following is taken directly from the chief scientist’s report for this cruise. Note that the correction mentioned (and applied) for the Rosette samples *has not been applied* to the large volume cast results.

> IAPSO Standard Water Batch P-114 was used through station 12. Commencing with station 13, batch P-120 was used for the remainder of the cruise. At the time it was noted that the standby number of the Autosal shifted by +.0015 equivalent salinity

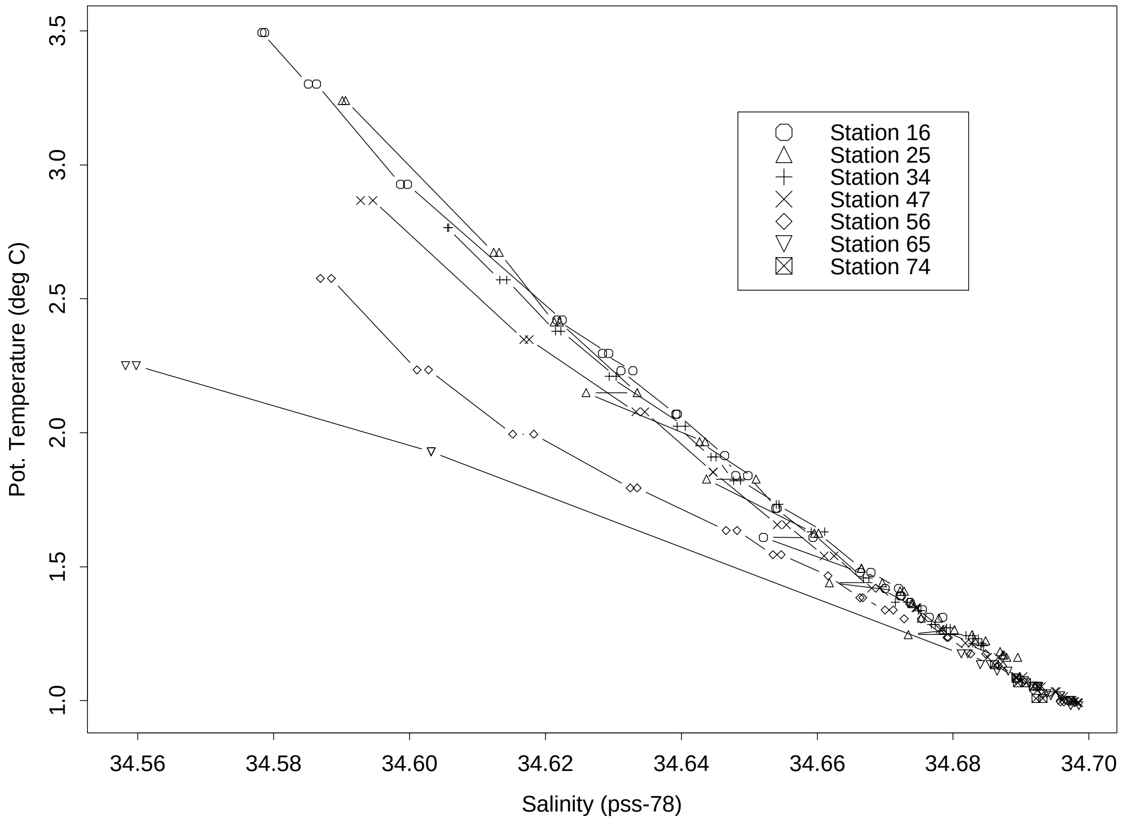

Figure 3: Theta-salinity for all of the large volume cast data with a QC flag of 2 for both temperature and salinity.

units. Post-cruise comparisons of the salinities measured during this cruise with historical measurements suggest that the measured salinities from the later stations were erroneously high. Comparisons of batch P-120 with batches P-118, P-123 and P-124, made during the summer of 1995 confirm that P-120 is approximately 0.0015 fresher than stated on its label. Thus, it was decided to subtract 0.0015 from all salinity measurements commencing with station 13, effectively referencing all salinities to Batch P-114. Because of the multiple problems with salinity during the first 55 stations, estimated accuracy is 0.005. Subsequent salinity data has an estimated accuracy of 0.002.

3.3 Nutrients

Nutrient samples were collected from both Gerard barrels and piggyback Niskin bottles. LV nutrients were measured along with Rosette nutrients so the analytical precision should be the same as Rosette samples. Nutrients collected from LV casts are sometimes 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. See the chief scientist's report for details of nutrient analysis.

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. The overall quality of the nutrient data for this cruise is demonstrated in Figure 4 which shows both Gerard and piggyback values as a function of potential temperature. Overlain on the plot (lines) are the Rosette measurements for the same stations and depth ranges. The Rosette phosphate data are omitted since, at this scale, only confusion results if added.

3.4 ^{14}C

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 Stuiver's lab in Seattle. Both ^{13}C and ^{14}C measurements are performed on the same CO_2 gas extracted from the large volume samples. 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). ^{14}C has been measured on all LV samples collected. This exceeds the rate funded for this work (80%). Prior to this cruise, no ^{14}C data existed for this entire region of the ocean, except for 3 thermocline stations reported by Masao Ishii (personal communication) and a GEOSECS station east of Japan.

4.0 Data Summary

Figures 5 & 6 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 5 shows the $\Delta^{14}C$ values plotted as a function of pressure . One sigma error bars (±4‰) are shown with each datum. The mid-depth minimum which is characteristic of Pacific profiles is present in some of these profiles, however, it is interesting that the minimum is more pronounced at the southern end of the section than at the northern end. Figure 6 shows the $\Delta^{14}C$ values plotted against measured Gerard barrel silicate values. The angled heavy line is the relationship suggested by Broecker *et al.* (1995) to be representative of the mean global pre-bomb $\Delta^{14}C$ - silicate correlation. The relationship does not appear to hold for these waters.

Figure 7 is a section of the radiocarbon data from P10 large volume samples. The northward flowing Antarctic water is evident near the bottom of the section. Lying above is the older water (^{14}C minimum) North Pacific deep water. The minimum values in this section are not at low as those found in the eastern north Pacific.

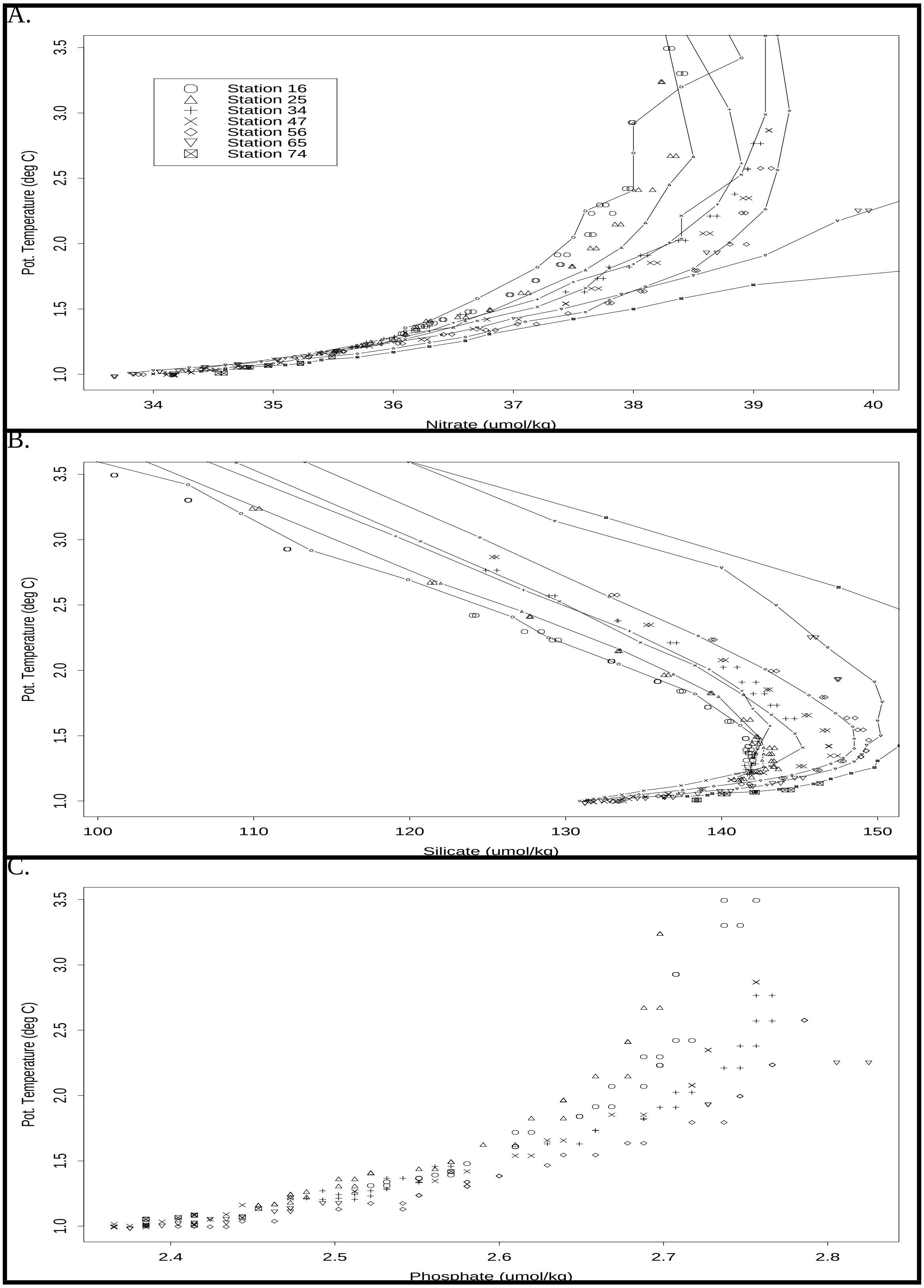

Figure 4: Plot includes nutrient data from both Gerard and piggyback Niskin samples. Rosette/CTD data from the same stations and depth ranges are overlain as lines except for phosphate where the added lines would be too confused to be helpful for comparison. Rosette samples use the same symbols as large volume data from the same station, but are only one-half size.

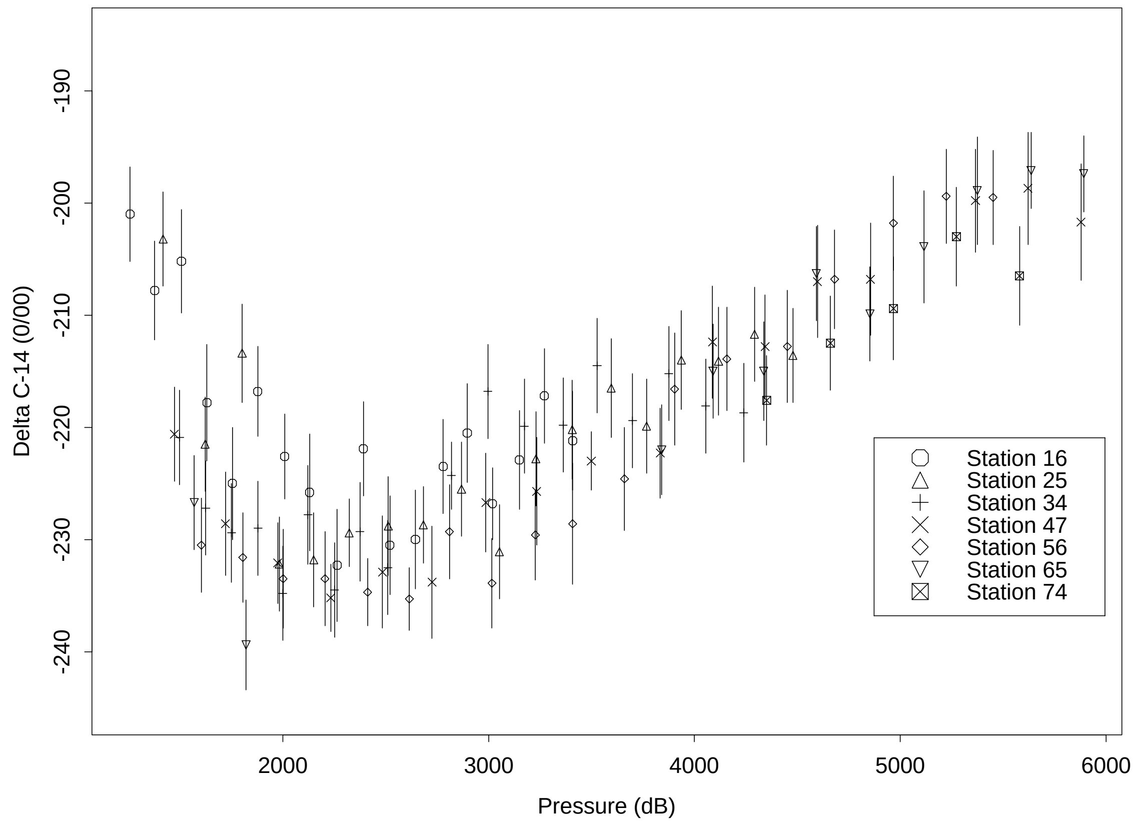

Figure 5: All LV $\Delta^{14}C$ values as a function of pressure. Vertical bars indicate two sigma errors.

5.0 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”. Once the nutrient and salt data had been flagged, these results were considered in flagging the ^{14}C data. There is no overlap between this data set and any existing ^{14}C data, so that type of comparison was impractical. The lack of other data for comparison led to a more lenient grading on the ^{14}C data. 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

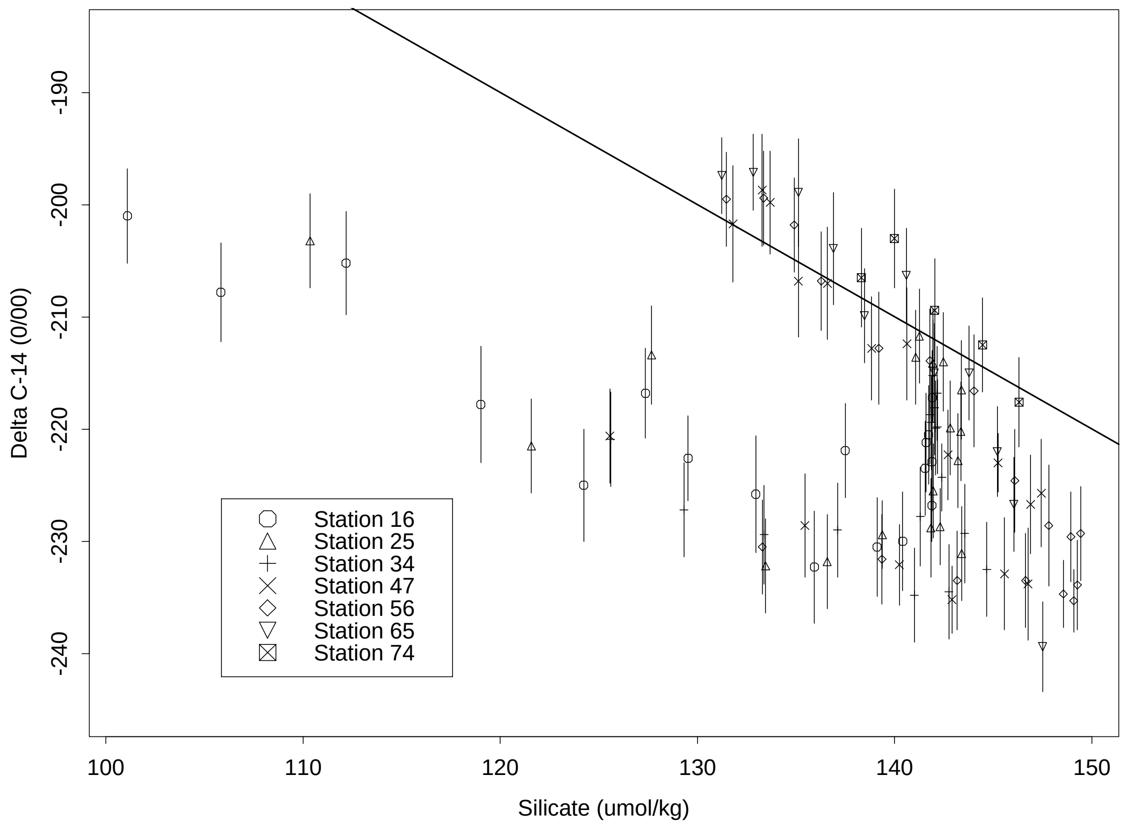

Figure 6: All LV $\Delta^{14}C$ measurements having a quality control flag value of 2 or 6 are plotted. Vertical bars are one sigma errors. The heavy line is that suggested by Broecker, *et al.* (1995) to be representative of the global relationship between pre-bomb ^{14}C and silicate.

more than the measurement precision of ~2‰.

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

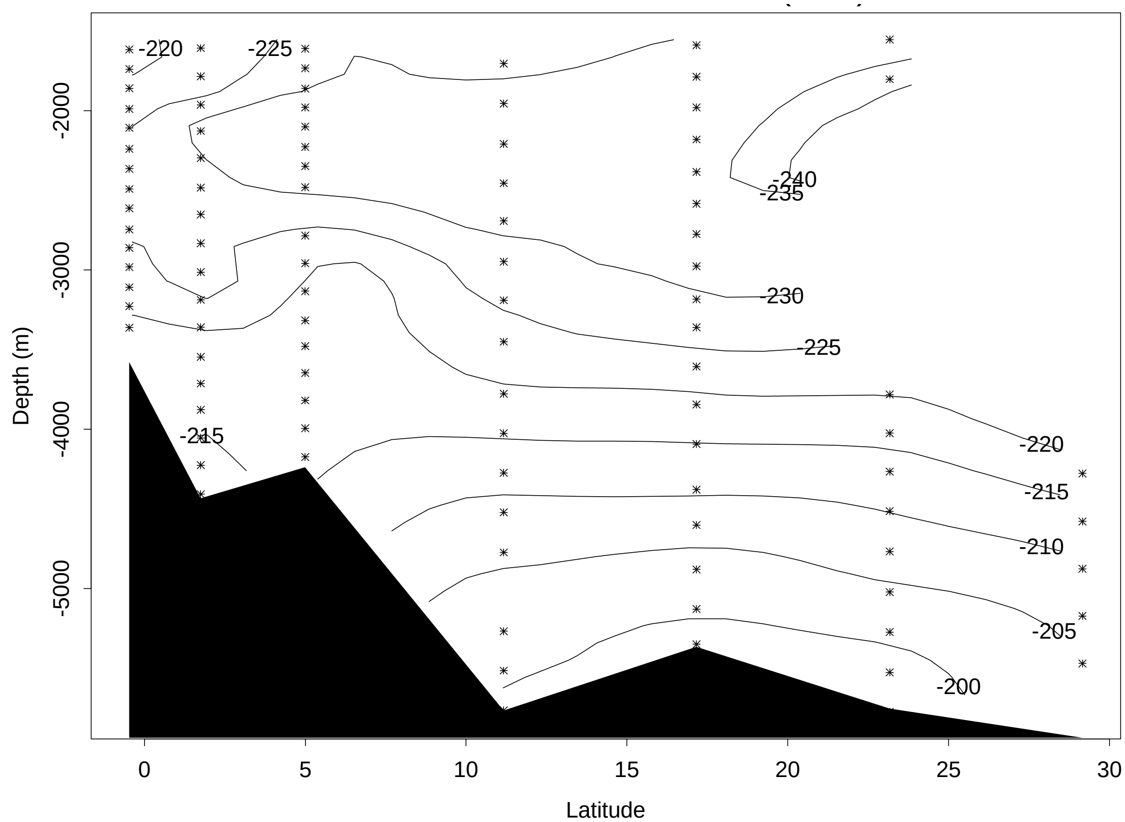

Figure 7: Radiocarbon section for deep and bottom waters.Evident in the figure are northward flowing waters of Antarctic origin along the bottom and the older presumably southward flowing deep water around 2500dB.

inTable 2.

TABLE 2. Quality Code Summary

		WHP Quality Codes								
	Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
BTLNBR	226	0	209	0	17	0	0	0	0	0
SALNTY	226	0	203	1	5	0	0	0	0	14
SILCAT	226	0	205	0	5	0	0	0	0	16
REVTMP	226	0	206	0	0	0	0	0	0	14
DELC14[a]	105	0	105	0	0	0	0	0	0	0

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

6.0 References and Supporting Documentation

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Broecker, W.S., S. Sutherland, W. Smethie, T.-H. Peng and G. Östlund, Oceanic radiocarbon: Separation of the natural and bomb components, *Global Biogeochemical Cycles, 9(2),* 263-288, 1995.

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

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D. Acknowledgments

Funding for this research cruise was primarily from variousgrants from the National Science Foundation (NSF), OCE93-06689(M. Hall). We also wish to thank Captain and crew of the R/V Thomas Thompson for a successful cruise.

E. References

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Oceansoft MKIII/SCTD Acquisition Software Manual. 1990. P/N Manual 10239.EG&G Marine Instruments.

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Toole, John, G. Bond, R. Millard. 1993. Implementation of a titanium straingauge pressure transducer for CTD applications. Deep Sea Research. vol40, no 5. 1009-1021.

Toole, John. 1994. personal communication.

WHPO Data Processing History:				
Date	**Contact**	**Data Type**	**Data Status**	**Summary**
3/14/96	Aoyama	CTD	DQE Report rcvd @ WHPO	
3/20/96	Aoyama	NUTs	DQE Report rcvd @ WHPO	
3/21/96	Aoyama	BTL	DQE Report rcvd @ WHPO	
8/15/97	Uribe	DOC	Submitted	See Note:
	2000.12.11 KJU: File contained here is a CRUISE SUMMARY and NOT sumfile. Documentation is online. 2000.10.11 KJU: Files were found in incoming directory under whp_reports. This directory was zipped, files were separated and placed under proper cruise. All of them are sum files. Received 1997 August 15th.			
4/22/98	Key	DELC14	DQE Report rcvd @ WHPO	
	distribute to WOCE PIs only, included LV sampling. Today I uploaded the P10 small volume data and final report to your anon ftp site. I send the final report in three formats: P10.ps (postscript version with figures), P10.txt (ascii with no figs), P10.rtf (rich text format). proprietary till March, 2000.			
4/27/98	Kozyr	ALKALI/TCARBN	Final Data Rcvd @ WHPO	
	I have put the final CO2-related data file for the Pacific Ocean WOCE Section P10 to the WHPO ftp INCOMING area.			
11/19/98	Key	ALK/C02	Final Data Rcvd @ WHPO	
	As data originators of the TCO2 and alkalinity data for P10, we consider it to be public. It only becomes "officially" public after CDIAC has issued its final report For now, P10 C14 is still proprietary except to WOCE PIs.			
12/3/98	Jenkins	He/Tr	Submitted	Preliminary
	Attached is a listing of the preliminary data (we have a proposal into NSF to do a synthesis to finalize the data). S.Diggs noted problems merging this data w/ BTL file.			
1/25/99	Bartolacci	CTD/BTL/TRA	Data Update	
	Public except for tracers			
1/26/99	Warner	CFCs	Data are Public	
	Yes they can be public. -Mark			
1/26/99	Talley	He/Tr	Tracers merged into HYD file	
2/1/99	Jenkins	HELIUM/Tr	Data are NonPublic for 6 months	
2/9/99	Talley	SUM	Data Update	see note:
	I just found an error in the p10su.txt file, on line 231, where cast 4 (LVS) was mislabeled as station 66, and should have been 65. I corrected it and put the corrected file in my ftp site on whpo.ucsd.edu.			
3/26/99	Ross	NO2+NO3	Data Update	see note:
	In regard to the "P10 - Nitrate" note Lou sent to you the other day - the data listed under the "NITRATE" column is in fact the total of "Nitrate AND Nitrite" or N+N. You are correct in stating that to obtain NITRATE only, you must subtract out the corresponding NITRITE value. Again, the units of mol/Kg are correct for all nutrients. To clarify, I obtained the P10 data (p10hy.txt) from the WOCE website that your PACIFIC data listing website linked - >http://whpo.ucsd.edu/data/onetime/pacific/p10/index.htm.			
4/21/99	Kozyr	DOC	Requested full doc file	

4/23/99	Bartolacci	DOC	Website Updated: complete doc OnLine (ascii)
	I've updated the p10 doc file, and changed the table accordingly. -- Danie		
4/28/99	Kappa	DOC	Cruise Rpt Rcvd @ WHPO
	Sent complete doc file to Kozyr		
4/29/99	Quay	DELC13	Data and/or Status info Requested by dmb
5/6/99	Bartolacci	He/Tr	Update Needed; Following note sent to Jenkins:
	I would like to thank you for the submission of helium and tritium data for p10, and ask you a few questions about the data. The data sent had no WOCE quality flags associated with them. Upon merging, data are designated a flags solely on the basis of being present or missing from the data set (i.e. if a value was present, it was considered an acceptable measurement and designated a flag of 2, if a missing value was present [-99.00] it was understood that no sample was drawn from the bottle and was designated a flag of 9). However, if you wish to send flags that further describe the quality of the data they would be most welcome! Definitions of the WOCE quality flags can be found in the WOCE Operations Manual, which is also on line at http://whpo.ucsd.edu/ under WHP Manuals (chapter 4). Along with Tritium was a parameter named Sigma Tritium which was defined as the uncertainty in the Tritium measurement. Can we assume this parameter to be equivalent to the WOCE parameter Tritium Error? If the quality flags we designated are acceptable, please notify us and we will continue with the merging process. Thank you for your time! According to email sent by Lynne Talley, the incorrect units on HELIUM were changed from PMOL/KG to NMOL/KG. See email below. B. Jenkins was notified via email and phone regarding these data discrepancies. No word from the PI on a course of action. See email below.		
5/10/99	Bartolacci	He/Tr	Update Needed; Following note sent to Jenkins:
	In regards to my previous email on the questions surrounding helium and tritium data for p10 I'd like to add another. Further inspection of the data with Steve Diggs revealed some values that may be questionable. Steve suggested I ask you about these as well. The tritium and sigma tritium data use -99.00 as missing values, however the same does not appear to be true for the helium and delta helium3 values. There is a value of -9.90 that appears in the delta helium3 column which corresponds to a helium value of -4.417 consistently. To my (very limited) knowledge the range of helium values is somewhere between 1-3 nmol/kg. Is -4.417 a valid value for helium or is this an artifact of a calculation? Could you briefly explain what parameters comprise the ratio of delta helium3? Also, there are some values in the helium column that have a different precision. For example, is 1.7 appears as a helium value in the same station as 1.860. Is 1.7 actually 1.700? The WOCE format standards for helium are 8.4 which means precision will be 'added' to these values. If you have carried out measurements to this precision, do you wish to resend values for helium? The WOCE formats will also force the tritium (and sigma tritium) values to a precision of 8.2. These values will be rounded. Thanks very much for your time concerning this data! A sample station (that has values in question) follows below.		

Sincerely, Danie Bartolacci

90	15	34.93	141.21	8	11	93		
224	49	20.336	34.511	216.	-99.00	-99.00	0.48	1.7
223	98	17.474	34.642	187.	1.441	0.010	4.28	1.757
221	197	12.735	34.476	168.	1.558	0.011	9.48	1.797
220	246	10.899	34.391	156.	1.238	0.009	11.42	1.803
218	345	8.834	34.305	139.	1.199	0.010	13.59	1.810
217	396	7.652	34.271	127.	1.053	0.009	14.34	1.817
216	496	5.459	34.247	91.	0.607	0.007	15.82	1.839
215	597	4.411	34.320	73.	0.349	0.005	16.51	1.849
214	697	3.684	34.328	55.	0.218	0.004	16.35	1.860
213	796	3.433	34.367	55.	-99.00	-99.00	16.85	1.9
212	897	3.112	34.395	54.	0.117	0.003	-9.90	-4.417

11/17/99	Key	DELC14	LVS DQE Report rcvd @ WHPO	
11/18/99	Key	DELC14	LVS Final Data Rcvd @ WHPO	
11/30/99	Bartolacci	He/Tr/C14/C02	Data Update	
	I have replaced both the public (he/tr, Tcarb, Alk, and DelC14 masked out of the file) and nonpublic (encrypted) bottle files with the newly formatted version from George Anderson. The new files have correct Q2 bytes in the QUALT2 column now. Old version had all 1's in the Q2 word. I have updated the table to reflect the date of the update.			
12/17/99	Anderson	LVS	Data Update	See note:

Converted the file from Bob Key to the WHP .lvs format. Parameters that were in the original file but were not retained in the .lvs file because they are not in the .lvs record format description:

latitude	QUALT1 flags for:
longitude	temperature
depth (m)	nitrate
nitrate	nitrite
nitrite	phosphate
phosphate	silicate
silicate	aou
AOU	
sigma 0	
sigma 1	
sigma 2	
sigma 3	
sigma 4	

The Key file had station numbers 1-13, but the .sum file indicated that the LVS stations were 16, 25, 34, 47, 56, 65, and 74. In addition the the cast numbers in the Key file were always 1 and 3, which did not agree with the .sum file. After comparing the maximum pressure in the .sum file with the maximum pressure in the Key file for each cast, I was able to determine which station and cast numbers to use. There is a 0 flag for some of the parameters, in fact all of the oxygens except where there was no sample which is flagged 9. This is not a valid number for the quality flags. I left them as 0 since I have no way of knowing what they should be.

Sarilee Anderson -- 17 Dec. 1999

<table>
<tr><td>1/12/00</td><td>Key</td><td>LVS</td><td>Data Update</td><td>See Note:</td></tr>
<tr><td></td><td colspan="4">
I understand the problem. Some days I’m not sure what ocean I’m working on. P10LV files are attached, including the Final Report (pdf). A few additional notes regarding this data set follow. Some of these comments are generic to my LV file procedure (i.e. treatment of missing bottom depth in SUM file), but most are specific to p10

cast numbers. Some confusion existed here because after the cruise Terry and staff changed cast numbers on stations which had a Ra-228 surface soak. This messed up shore based measurements since the sample collection deck logs no longer matched the SUM file. The attached file P10LVSUM.ASC is a copy of the SUM file produced by WHOI whenever. The file p10lvsta is my reduction of that file with corrections to what I think things should be.
In p10lvsta, I have filled in any missing bottom depths.
The locations (BE,BO,EN) are better taken from P10LVSUM.ASC than from p10lvsta since I only keep one location (almost always BO).
The data file has a flag (tf) for the reversing temperature values
Some values in the data file have a flag value of "0" intentionally, by agreement between Jim Swift and me. This indicates that the value was somehow approximated. Oxygen was never measured for the LV casts. Here I interpolated oxygen based on the measured rosette values at the same station. Missing temperature and salinity values were interpolated from surrounding LV cast samples on the same station.
I provided all QC flags. QC values are burst into individual flag values with names that are easily recognized (i.e. sif=silicate flag, sf=salt flag). Marking is according to WOCE convention. QC performed relative to this cruise only (i.e. no comparison to other cruises). Gerard barrel QC on nutrients not as strict as Rosette samples. Note however that the salts values (especially deep) for the first half of this cruise are better than the measured Rosette salt values due to "lazy" collection technique by a graduate student on the Rosette salts (should be a comment in the Chi. Sci. Rpt. about this, but I wouldn’t bet on it - Mandy was in way over her head on this one).
Depths estimated from latitude and pressure using the algorithm published anon. in the 1970 Bulletin Geodesique.
Number of decimal places. There should be the required number or more for all variables, however, my software truncates trailing "0’s" on print.
Nutrient data received in mol/l; converted with lab temperature of 25C and measured salinity.
AOU values calculated using the Weiss algorithm rather than the Garcia algorithm. I now prefer the latter, but you should probably just dump these and recalculate using your programs to be sure of consistency. Ditto on theta and sigmaX.

This is probably more than you wanted to know. Rather than me sending you a giant data dump, I suggest that we deal with the LV cruises one at a time so that the exceptions get properly noted for the final archive.
I have all LV data that exists from U.S. WOCE Pacific.
</td></tr>
<tr><td>2/4/00</td><td>Kozyr</td><td>ALK/TCARBN</td><td colspan="2">Final Data Rcvd @ WHPO</td></tr>
</table>

<table>
<tr><td rowspan="2">2/9/00</td><td>Bartolacci</td><td>CO2</td><td colspan="2">Data Merged/OnLine</td></tr>
<tr><td colspan="4">TCARBN merged new values into existing column. Changed missing data value from -999.9 in latest co2 data set to -9.0 in current bottle file.

ALKALI merged new values into existing column. Changed missing data value from -999.9 in latest co2 data set to -9.0 in current bottle file.

C14ERR added new column for these values into existing column. Changed missing data value in latest co2 data set from -999.9 to -9.0 in current bottle file.

Ran maskhyd to add name/date stamp. Ran wocecvt to check format. Both programs ran with no errors detected in routine formatting.

New file has been placed in p10 directory, and table has been updated to reflect the change.

This information has been added as a readme file to the original p10 directory.

DMB 2000.02.09</td></tr>
<tr><td rowspan="2">2/25/00</td><td>Warner</td><td>CFCs</td><td>Data Update</td><td>See note:</td></tr>
<tr><td colspan="4">Since John Bullister has asked us all to check our data, I have resubmitted the WOCE P10 CFC data to the ftp site. I have changed it to the SIO1993 calibration scale, and flagged one or two questionable points.</td></tr>
<tr><td rowspan="2">3/8/00</td><td>Bartolacci</td><td>CFCs</td><td colspan="2">Data Merged/OnLine</td></tr>
<tr><td colspan="4">• Merged CFC11/12 values from Mark Warner (email below). Used "driver.pl" and "warner.pl" to reformat data in order to merge.
• Used D. Newton’s "mrgsea" for merging both values into existing P10 bottle file obtained from WHPO website.
• Ran wocecvt on merged bottle file. No errors. Ran maskhyd to include date/name stamp. Also made a public version with he/tr and C14 masked out of file (named p10hy.txt).
• Renamed merged bottle file p10hy_all_params encrypted it and moved old file to ’original’ subdirectory with replacement date in filename.</td></tr>
<tr><td>3/28/00</td><td>Talley</td><td>HELIUM</td><td colspan="2">Update Needed; Units should be Nanomoles/kg.</td></tr>
<tr><td rowspan="2">3/28/00</td><td>Bartolacci</td><td>He/Tr</td><td colspan="2">Update Needed, Following note sent to Jenkins:</td></tr>
<tr><td colspan="4">It was discovered by L. Talley that the current version of p10 bottle file on line, has incorrect helium and tritium data merged into it. Therefore the original helium/tritium data sent by Jenkins, was re-merged into the current bottle file. Please see file README.p10 regarding first merging of these data and documentation.

NOTES on merging:

• Used DMN code mrgsea to merge TRITUM, HELIUM, DELHE3, SIGTRI (which possibly should be TRITER)
• changed missing data value for TRITUM from -99.00 to -9.0
• changed missing data value for SIGTRI from -99.00 to -9.0
• changed missing data value for DELHE3 from -9.90 to -999.00
• added missing data value for HELIUM -9.0.
• changed HELIUM units from PMOL/KG to NMOL/KG. ran wocecvt with no bottle file errors.
• ran read_hyd. Code did not recognize SIGTRI as WOCE accepted parameter. no other errors detected.</td></tr>
</table>

<table>
<tr><td></td><td colspan="4">

• ran maskhyd to add date/name stamp. Code stopped after not recognizing SIGTRI as WOCE parameter.
• added date/name stamp by hand edit.
• ran movehyd to put parameter columns in WOCE order.
• Final file is called p10_complete_20000328.txt

PROBLEMS:

• Erroneous HELIUM values -4.417 correspond to DELHE3 values of -9.90 and may be the intended missing data value. These values are out of the accepted range for HELIUM in the WOCE Operations Manual 90-1. These values were merged and left as-is until further word from PI.
• Precision for HELIUM varied from f8.1 to f8.3. WOCE Operations Manual 90-1 states precision for HELIUM should be f8.4. Therefore precision was "added" to these values when merged into the current bottle file.
• SIGTRI is not a recognized WOCE parameter and possibly should be TRITER but no course of action had been given by PI. Parameter was merged as is until further word from PI.
• See email below. This was the second contact for this PI regarding these data problems.

Hello Dr. Jenkins,

Lynne Talley recently caught an error in the helium/tritium data that was merged into the P10 bottle file, which caused me to delve back into the original data you sent a year or so ago. The error Lynne caught was a result of the merging process, however I cannot seem to find a response from you on the following problems/questions we had regarding the data.

Can you please look through the original emails (attached) and reply with a course of action to be taken on these data. Also at this time, may we make the helium and tritium data public?
</td></tr>
<tr><td rowspan="2">4/13/00</td><td>Bartolacci</td><td>He/Tr</td><td>Data Update</td><td>See note:</td></tr>
<tr><td colspan="4">I have re-merged the helium and tritium values sent by Jenkins into the p10 bottle file. The file now contains: TRITUM, HELIUM, DELHE3, and SIGTRI (which I think should be TRITER but is left as is until word from the PI). There were some questions regarding missing data values for HELIUM, and the PI was notified, however no response has come yet. Data were merged AS-IS.

On line bottle file has been replaced and the table has been edited to reflect this change.</td></tr>
<tr><td rowspan="2">4/14/00</td><td>Key</td><td>DELC14</td><td colspan="2">Data are Public</td></tr>
<tr><td colspan="4">As of 3/2000 the 2 year clock expired on the last of the Pacific Ocean C14 data (P10). All Pacific Ocean WOCE C-14 data should be made public.</td></tr>
<tr><td rowspan="2">4/19/00</td><td>Bartolacci</td><td>TRITUM</td><td>Data Update</td><td>Header error, See note:</td></tr>
<tr><td colspan="4">SMALL ERROR I know there is a non-WOCE header for P10 TR data, but I haven't yet heard anything from Jenkins on changing it. I cc'd you on a correspondence regarding that problem (and others) since they should be in the information about P10 that is available to users.</td></tr>
</table>

4/19/00	Jenkins	He/Tr	See following reply to Bartolocci's notes:	
	My apologies for the silence, but I have been rather busy as of late with administrative duties, and have been unable to work with or access the WOCE data with in any convenient format. Based on the information you gave me, I offer the following comments: I regret that the format I sent you was not entirely consistent with the WOCE convention, but my understanding at the time was that this was not a formal submission, but rather a quick response to a personal request by Lynne to look at the data. I have not had the time to work through the data into the final format, as this was to be part of the currently active WOCE-AIMS data mop-up program for tritium-helium. I had hoped that prior to official/final transmission, we could have an opportunity to complete inter-lab comparisons and final data quality control. For the tritium data, -99.00 means no sample, or that the sample analysis failed (e.g., sometimes storage flasks leaked, invalidating the measurement). For helium data, -9.90in the del-3He column means a null value (it's actually -99.00 per mil, but expressed in percent). The corresponding helium concentration value (which for some reason is a negative, but irrelevant number) will be invalid. The reason why the number appears like this is a minor bug in the reporting programme, and should be ignored. No flags were reported for the data at present for the reasons described above. hope this helps, bill PS: I'm hoping to put together the Pacific tritium-helium data submission sometime in the next few months, once we get through this year's graduate admissions process and a couple of other deadlines.			
9/26/00	Buck	LVS	Website Updated; Data added to website	
	Added Large Volume Samples file to website.			
10/17/00	Jenkins	TRITUM	Submitted	Preliminary
	WOCE Indian Ocean = WITrit.dat Contains all legs WOCE Pacific P10 = WP10Trit.dat WOCE Pacific P13 = WP13Trit.dat WOCE Pacific P14c = WP14cTrit.dat WOCE Pacific P18 = WP18Trit.dat WOCE Pacific P19 = WP19Trit.dat WOCE Pacific P21 = WP21Trit.dat SAVE South Atlnt = SAVETrit.dat • Column Layout as follows: Station, Cast, Bottle, Pressure, Tritium, ErrTritium • Units as follows: Tritium and ErrTritium in T.U. All data are unfortunately still preliminary until we have completed the laboratory intercomparision and intercalibration that is still underway.			
10/17/00	Jenkins	He/He3/Neon	Submitted	Preliminary
	WOCE Indian Ocean = WIHe.dat Contains all legs WOCE Pacific P10 = WP10He.dat WOCE Pacific P18 = WP18He.dat WOCE Pacific P19 = WP19He.dat WOCE Pacific P21 = WP21He.dat			

	• Column Layout as follows: Station, Cast, Bottle, Pressure, Delta3He, ErrDelta3He, ConcHelium, ErrConcHelium, ConcNeon, ErrConcNeon • Units as follows: Delta3He and ErrDelta3He in % • ConcHelium, ErrConcHelium, ConcNeon, and ErrConcNeon in nmol/kg • Null values (for ConcNeon and ErrConcNeon only) = -9.000 • All data are unfortunately still preliminary until we have completed the laboratory intercomparision and intercalibration that is still underway.			
11/1/00	Jenkins	He/Tr/Ne	Final Data Rcvd @ WHPO	
	The following data were received from Bill Jenkins 2000/11/01 and were reformatted by Sarilee Anderson: • P10: tr/he/ne • P13: tr • P14C:tr • P18: tr/he/ne • P19: tr/he/ne • P21: tr/he/ne SAVE: S. Atlantic tritium data from SAVE program			
11/8/00	Anderson	HE/NEON	Reformatted by WHPO	
	I have put the Jenkins helium and neon in WOCE format. There were no quality codes so I set the HELIUM, DELHE3, and NEON to 2.			
11/13/00	Anderson	TRITUM	Reformatted by WHPO	
	I have put the Jenkins tritium data into WOCE format. There were no quality codes so I set the TRITUM to 2.			
1/11/01	Kappa	DOC	txt version created	
	includes cfc report, nutrients report, ctd & hyd dqe reports and large- and small-volume c14 reports.			
1/17/01	Huynh	DOC	Website Updated, txt version online	
1/30/01	Stuart	DELC13	Submitted	See Note:
	Enclosed are three text files (and data) for the Pacific. The headers are: • Lab ID • WHPID • Station • Cast • Niskin • Del-C13 • C13 flag The files are for P10, P14C, P17E, and P17E/P19S			
6/22/01	Uribe	CTD/BTL	Website Updated; CSV File Added	
	CTD and Bottle files in exchange format have been put online.			

<table>
<tr><td rowspan="2">8/9/01</td><td>Kappa</td><td>DOC</td><td>new pdf, txt versions online</td></tr>
<tr><td colspan="3">Files put online by K. Uribe. p10_3250TN026_1.txt (replaces the txt file currently online), p10_3250TN026_1.pdf.bin</td></tr>
<tr><td rowspan="2">8/21/01</td><td>Muus</td><td>CFCs</td><td>Data into BTL file</td></tr>
<tr><td colspan="3">Notes on P10 CFC merging Aug 21, 2001. D. Muus

1. New CFC-11 and CFC-12 from:
/usr/export/html-public/data/onetime/pacific/p10/original/20010709_CFC_WISEGARVER_P10/20010709.172120_WISEGARVER_P10_p10_CFC_DQE.dat

merged into plain text web SEA file as of Aug 20, 2001 (20000414WHPOSIODMB) and into encrypted web SEA file as of Aug 20, 2001 (20000328WHPOSIODMB)

2. Changed header "SIGTRI" to "TRITER". Header in Jenkins tritium data file was "ErrTritium".

3. Exchange file made for the plain test version and checked using Java Ocean Atlas.</td></tr>
<tr><td rowspan="2">8/24/01</td><td>Bartolacci</td><td>BTL/CFCs</td><td>Update Needed</td></tr>
<tr><td colspan="3">Updates CFC's will not be online until HE/TR are merged. Although Dave Muus has merged updated CFC's into the current P10 bottle file there was a small flag missmatch in the public version of the data. Because helium and tritium still need merging into this file, this will be done and the final merged bottle file (also with corrected flags) will then be put online.

So for now no updated CFC's will be online until the helium and tritium is merged.</td></tr>
<tr><td rowspan="2">8/27/01</td><td>Swift</td><td>He/Tr</td><td>Status changed to Public</td></tr>
<tr><td colspan="3">Steve - Please make the following changes from non-public to public. All Jenkins Pacific/Indian data are public according to an email he sent 2/26/2001, hence P10 3250TN026_1. The He/Tr data are not in the public data file. Please make them public and available.</td></tr>
<tr><td rowspan="2">8/30/01</td><td>Bartolacci</td><td>BTL</td><td>Website Updated; BTL file replaced</td></tr>
<tr><td colspan="3">Status changed to public. I have replaced the current P10 bottle file with a file containing updated CFC 11 and 12 values as well as merged helium, delhe3, tritium, and neon data. Data merged by D. Muus. According to Jenkins (by way of J. Swift) all tracer data may be made public, and therefore the entire bottle file has been made publicly available in WOCE and Exchange format. Old files have been moved to original subdirectory and have been renamed to reflect replacement. All tables and references have been updated to reflect this change.</td></tr>
</table>

<table>
<tr><td rowspan="2">8/28/01</td><td>D. Muus</td><td>He/Tr/Ne/CFC</td><td>Notes on merging</td></tr>
<tr><td colspan="3">1. New CFC-11 and CFC-12 from:
/usr/export/html-public/data/onetime/pacific/p10/original/20010709_CFC _WISEGARVER_P10/20010709.172120_WISEGARVER_P10_p10_CFC_DQE.dat

merged into plain text web SEA file as of Aug 20, 2001 (20000414WHPOSIODMB)

2. New HELIUM, DELHE3, NEON, and TRITUM from:
/usr/export/html-public/data/onetime/pacific/p10/original/2000.11.13_TRIT_HE _REFORMAT_P10_SA

merged into plain-text SEA file after CFCs merged (Item 1 above). Encrypted web Sea file (20000328WHPOSIODMB) has 60 more bottles with helium data than the new helium file and a net of 7 more tritium levels than the new tritium file.

a. New files have no SAMPNO but BTLNBR appears to be same as SAMPNO in original SEA file while BTLNBR in original SEA file differs from new helium, tritium, neon files BTLNBR (e.g. Sta 1, Cast 1, 8.4db: "WG009" in Sea file, "9" in new file). Matched SAMPNO in SEA file with BTLNBR in new files for this merge. Used original SEA file SAMPNOs and BTLNBRs. No quality codes from data originator so used "2"s used for both QUALT1 and QUALT2.

b. New files have Cast 2 for Stations 16, 56, 74 and 90. SUMMARY file and web SEA file have Station 16 Cast 3(ROS) (Cast 2 is BUC)
56 3(ROS) (No tritium, Cast 2 is LVS)
74 3(ROS) (No tritium, Cast 2 is BUC)
90 1(ROS) (No Cast 2)
Changed new files to match SUMMARY and SEA file data for ROS.

3. Exchange files made for both the Public and Non-Public versions and checked using Java Ocean Atlas.</td></tr>
<tr><td rowspan="2">10/25/01</td><td>Kappa</td><td>Doc</td><td>Cruise Report updates</td></tr>
<tr><td colspan="3">Added CFC DQE reports & CFC merging notes; updated Data Processing Notes</td></tr>
</table>